

# Preliminary data about the parasitism caused by Protozoa, Helminths and Ticks in cervids and wild bovids from Salamanca (western Spain).

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**Summary:** A parasitological screening was carried out on faeces and cadavers (n=38) from wild animals shot in the Las Batuecas National Reserve and in some private game reserves of the Salamanca province (Spain). The following parasites were identified: *Babesia/Theileria* spp. Were found in red deer, fallow deer and mouflon. *Sarcocystis* spp. Was found in roe deer, fallow deer, mouflon, red deer and Spanish ibex. *Eimeria* spp. In Spanish ibex, mouflon, roe deer and red deer. *Cryptosporidium* spp. Was found in fallow deer, mouflon and red deer. *Dicrocoelium dendriticum* was found in red deer, fallow deer and mouflon. *Paramphistomum cervi* was found in red deer. *Moniezia* spp. Was present in Spanish ibex, fallow deer, roe deer and red deer and *Echinococcus hydatidosus* was detected in male Spanish ibexes. *Elaphostrongylus cervi* in roe deer and red deer. *Cystocaulus ocreatus* in Spanish ibex and *Protostrongylus/Muellerius* in roe deer, red deer, fallow deer and mouflon. Gastrointestinal nematodes appeared in nearly 100% of the animals: *Ostertagia* spp. In red deer; *Spiculopteragia asymmetrica* in fallow deer; *Teladorsagia davitiani* in roe deer; *T. circumcincta* in mouflon, red deer, Spanish ibex; *Trichostrongylus axei* in mouflon, red deer and roe deer; *T. vitrinus*, *Cooperia oncophora* and *Oesophagostomum venulosum* in mouflon; *Nematodirus filicollis* in roe deer, *N. spathiger* in mouflon and red deer; *Capillaria* sp. In red deer and *Trichuris ovis* in whole host species. Hard ticks were removed from red deer (*Haemophysalis punctata* and *Rhipicephalus bursa*) and fallow deer (*Ixodes ricinus*). In the Salamanca province all these wild ruminants share epidemiological links with domestic ruminants bred in extensive-system farms.

**Key words:** cervids, wild bovids, parasites, Salamanca province (Spain).

**Resumen:** Se estudian heces y 38 cadáveres de animales abatidos en caza en la Reserva Regional de Las Batuecas y cotos privados de Salamanca. La parasitofauna registrada fue la siguiente: Piroplasmas sin determinar (*Babesia/Theileria*) aparecieron en ciervo, gamo y muflón. *Sarcocystis* spp. en corzo, gamo, muflon, ciervo y cabra montés. *Eimeria* spp. en cabra montés, muflón, corzo y ciervo. *Cryptosporidium* spp. en gamo, muflón y ciervo. *Dicrocoelium dendriticum* en ciervo, gamo y muflón, y *Paramphistomum cervi* en ciervo. *Moniezia* spp. en cabra montés, gamo, corzo y ciervo, y *Echinococcus hydatidosus* en macho montés. Protostrongylidae extrapulmonares (*Elaphostrongylus cervi*) en corzo y ciervo. Protostrongylidae pulmonares en cabra montés (*Cystocaulus ocreatus*), corzo, ciervo, gamo y muflón (*Protostrongylus/Muellerius*). Nematodos gastroentéricos en prácticamente el 100% de los animales: *Ostertagia* spp. en ciervo; *Spiculopteragia asimétrica* en gamo; *Teladorsagia davitiani* en corzo; *T. circumcincta* en muflón, ciervo y cabra montés; *Trichostrongylus axei* en muflón, ciervo y corzo; *T. vitrinus*, *Cooperia oncophora* y *Oesophagostomum venulosum* en muflón; *Nematodirus filicollis* en corzo; *N. spathiger* en muflón y ciervo; *Capillaria* sp. en ciervo y *Trichuris ovis* en todas las especies hospedadoras. Garrapatas se localizaron en ciervos (*Haemophysalis punctata* y *Rhipicephalus bursa*) y gamos (*Ixodes ricinus*). En el área salmantina, estos animales comparten vínculos epidemiológicos con los rumiantes domésticos de explotación extensiva.

**Palabras clave:** cérvidos, bóvidos silvestres, parásitos, Salamanca (España).

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## 1. Introduction

The Regional Game Reserve of Las Batuecas, located in the mountains of the Sierra de Francia (Province of Salamanca), currently harbours a noteworthy colony of Spanish ibexes

(*Capra pyrenaica victoriae*) that started to be re-introduced in 1974 by consecutive repopulations with specimens coming from the Sierra de Gredos (Losa, 1989). Together with the Spanish ibexes, here also lives a big population of roe deer (*Capreolus capreolus*), which is currently expanding over the boundaries of the game reserve, from the mount slopes to the adjacent extensive farms (dehesas) devoted to the livestock breeding.

In addition, in the Salamanca province there are registered 22 private game reserves (four of them classified as intensive big game reserves), which are mostly located in the mountains of the so called Sierras of Gata, Francia and Bejar, in places of medium to high altitude and in meadows with abundant oak and holm oak woods. In all these reserves is usual to add the livestock breeding to the hunting activities.

Among these reserves, fourteen of them are exclusively for roe deer, three for red deer (*Cervus elaphus*), one for roe deer and red deer, one for red deer and fallow deer (*Dama dama*) and the last three joint together red deer, fallow deer and mouflon (*Ovis musimon*).

The studies carried out in Spain on the Protozoa, Helminths and Ixodids from wild ruminants have been scarce and partial until the 90's but they have experienced a noteworthy increase in the last decade. Now it can be said that it have been investigated the parasites of every species of cervids and wild bovids present in almost all national, regional, private and communal game reserves throughout the national territory (Hernández *et al.*, 1980; García Fernández *et al.*, 1989; Hueli and Díaz, 1989; Breña *et al.*, 1989; Meana *et al.*, 1996; Lavín *et al.*, 1998; Díez Baños *et al.*, 1999; Hidalgo *et al.*, 2001; Panadero *et al.*, 2001; Vicente and Gortázar, 2001; Santín Durán, 2002; Valcárcel *et al.*, 2002; Pérez *et al.*, 2003; García Romero, 2003; Santín Durán *et al.*, 2004; Ruíz de Ibáñez *et al.*, 2004).

Notwithstanding, the information about all those parasitisms in the populations of wild animals of the province of Salamanca is yet insufficient. Our group has recently carried out a preliminary parasitological study on faeces of roe deers and Spanish ibexes from las Batuecas that has revealed the need of study this topic in more depth (Oleaga *et al.*, 2003).

In this article we offer opening results from a recently initiated study whose aims are to know the parasitological status of the populations of wild ruminants of Salamanca and to analyze the epidemiological relationship between these populations and those of domestic ruminants with which they co-inhabit in the extensive farm systems. These two objectives are in accordance with that is currently asked on this topic in Spain (Sebastián *et al.*, 2005).

## 2. Material and Methods

We examined a total of 38 whole cadavers of diverse adult animals shot in several shooting parties: 11 roe deers (eight males and three females), eight red deers (four males and four females), eight fallow deers (five males and three females), eight mouflons (five males and three females) and three Spanish ibexes (two males and one female). In addition, we examined also 100 samples of faeces from Spanish ibexes of various ages.

The Spanish ibexes and roe deers came from Las Batuecas and the rest from private reserves from the Salamanca province.

In each cadaver a whole parasitological necropsy was performed according to the procedures described by Valcárcel *et al.* (2000) for the collection and analysis of parasites in small ruminants, namely, ectoparasites on hair and skin, and head, thoracic and abdominal contents including the whole respiratory and alimentary tracts, viscera, tight muscles, blood and faeces.

The parasite forms recovered were preserved in 10% formalin or 70% ethanol for later study and identification. The muscle samples were preserved at 4°C and examined in the following 48 hours. Blood extensions were also immediately prepared, fixed and stained with Giemsa. The fecal samples were analyzed by the method of Parfitt (1958) for protozoa oocysts and helminth eggs, Boray (1969) for heavy eggs and Kinyoun for *Cryptosporidium* sp.

The identification of the parasites was essentially based on their descriptions by the following authors: Miodrag and Lewis (1977) and Barnett (1977) for Piroplasms; Kenneth and Ernst (1977) for Coccidia; Arrowood (1997) for *Cryptosporidium*;

Yamaguti (1961) and Euzeby (1981-82) for Helminths; Valcárcel *et al.*, (2000) for Nematoda; Gibbons and Khalil (1982) for trichostrongylids; Jansen and Gibbons (1981) for *Ostertagia* and Hillyard (1996) and Estrada-Peña (2000) for ticks.

There were not carried out comparative statistic analyses on the parasitism in relation to sex and age in each ruminant species because the number of the sampled animals in each species was considered too small.

### 3. Results

All the animals examined were parasitized by at least one parasite species. Table 1 shows the parasites found in the diverse animal hosts, including the parasites' prevalences and anatomic locations.

High prevalences of unidentified piroplasms (*Babesia/Theileria*) were found only in fallow deer, red deer and mouflon from private reserves. The parasitized individuals were 1-6 years old and, in this age

Table 1.- Geometric mean of lungworm larvae per gram of faeces (lpg) in experimental groups and efficacy in moxidectin treated.

Parasites	Hosts and prevalence (%)	Location
<b>PROTOZOA</b>		
Piroplasms ( <i>Babesia</i> / <i>Theileria</i> )	Fallow deer (63%), red deer (50%), mouflon (38%)	blood
<i>Sarcocystis</i> spp.	Roe deer (75%), Spanish ibex (67%)	oesophagus
	Red deer (50%), mouflon (50%), fallow deer (50%)	diaphragm
<i>Cryptosporidium</i> spp.	Mouflon (50%), red deer (13%), fallow deer (13%)	myocardium
<i>Eimeria</i> spp.	Mouflon (50%), Spanish ibex (43%), roe deer (20%), red deer (13%)	intestine
<b>HELMINTHS</b>		
<b>-Trematoda:</b>		
<i>Dicrocoelium dendriticum</i>	Mouflon (63%), red deer (25%), fallow deer (13%)	liver
<i>Paramphistomum cervi</i>	Red deer (50%)	rumen
<b>-Cestoda:</b>		
<i>Echinococcus hydatidosus</i>	Spanish ibex (33%)	liver
<i>Moniezia benedeni</i>	Red deer (38%), roe deer (33%), fallow deer (13%), Spanish ibex (6%)	small intestine
<i>M. expansa</i>	Fallow deer(13%),	small intestine
<b>-Nematoda:</b>		
<i>Elaphostrongylus cervi</i>	Red deer (75%), roe deer (45%)	lung
<i>Cystocaulus ocreatus</i>	Spanish ibex (66%)	lung
<i>Protostrongylus /Muellerius</i>	Fallow deer (13%), mouflon (12%)	lung
<i>Ostertagia</i> spp.	Red deer (63%)	abomasum
<i>Spiculopteria asymmetrica</i>	Fallow deer (78%)	abomasum
<i>Teladorsagia davtiani</i>	Roe deer (63%)	abomasum
<i>T. circumcincta</i>	Mouflon (63%), red deer (50%), Spanish ibex (66%)	abomasum
<i>Trichostrongylus axei</i>	Mouflon (63%), red deer (50%), roe deer (11%)	abomasum
<i>T. vitrinus</i>	Mouflon (38%)	small intestine
<i>Cooperia oncophora</i>	Mouflon (38%)	small intestine
<i>Nematodirus filicollis</i>	Roe deer (13%)	small intestine
<i>N. spathiger</i>	Mouflon (38%), red deer (13%)	small intestine
<i>Oesophagostomum venulosum</i>	Mouflon (12%)	cecum
<i>Capillaria</i> sp.	Red deer (13%)	intestine, colon
<i>Trichuris ovis</i>	Mouflon (50%), roe deer (33%), red deer (13%), fallow deer (25%), Spanish ibex (2%)	cecum
<b>ARTROPHODS</b>		
<b>-Acarina. Ixodidae:</b>		
<i>Ixodes ricinus</i>	Fallow deer (13%)	skin
<i>Haemaphysalis punctata</i>	Red deer (38%)	skin
<i>Rhipicephalus bursa</i>	Red deer (38%)	skin

range, they were all similarly affected. There were no differences in the parasitism intensities, which were always very moderate, as a function of sex. The Ibexes and roe deers were all free of piroplasms.

*Sarcocystis spp.* was found in the five species of ruminants investigated and in all of them prevalences higher than 50% were detected. The most frequent location of the parasites was the oesophagus followed by the diaphragm and, finally, the myocardium. There were no apparent differences between sexes. The age of the infected animals ranged between 1 to 14 years, although the infections were more frequent in animals older than 2-3 years. The intensities of the parasitisms by *Sarcocystis spp.* were always very moderate.

*Cryptosporidium spp.* was detected in faeces from mouflon, deer and fallow deer coming from private reserves dedicated to intensive game. The infected animals were males and females between 2 and four years old. All the infections were subclinic.

*Eimeria spp.* was found in the faeces of a great part of the mouflons and ibexes and, to a lesser extent, in the faeces of roe deers and red deers. Mixed subclinic infections predominated, independently of sex, in mouflons, roe deers and red deers of 1-4 years of age and in ibexes of every age.

Some trematoda were also present, although they were detected only in animals coming from private reserves. *Dicrocoelium dendriticum* was found to be highly prevalent in mouflons (65%) and moderate in red deers and fallow deers. *Paramphistomum cervi* was exclusively found in red deers at a prevalence rate of 50%. In every case, these trematodoses were subclinic, with fluke recovering rates lower than 30 flukes/animal for both parasites. Both infections seemed to be independent of sex and age, although the majority of the cases were recorded in individuals between 1 and 3 years old.

Among the larval cestodoses was noteworthy the intense hepatic parasitism of an old ibex male by *Echinococcus hydatidosus*. Regarding digestive cestodoses, *Moniezia benedeni* was found in all the species of hosts studied but mouflon, showing moderate to low prevalences. *M. expansa* was only found in 13% of fallow deers. The indicated cestodoses

were asymptomatic and affected both sexes equally, but showed preference for individuals 1-2 years old.

Nematodes have been by far the most represented Helminths, especially those that inhabit the pulmonary parenchyma and bronchioles (Protostrongylidae) and those from the alimentary tract.

Larvae I of Protostrongylidae morphometrically compatible with the genera *Elaphostrongylus*, *Muellerius*, *Cystocaulus* and *Protostrongylus* were found in the faeces and/or the lungs of all the host species studied. High prevalences of these larvae were registered in red deers, ibexes and roe deers; in the rest of the host species the larval prevalences were moderate.

*Elaphostrongylus cervi* was present in red deers and roe deers, while *Cystocaulus ocreatus* was present in Spanish ibexes and mixed infections by *Protostrongylus* and *Muellerius* were seen in roe deers, red deers, fallow deers and mouflons. Adult worms were not found in lungs or extra pulmonary locations. These parasitisms were all of very low intensity and were homogeneously distributed between sexes and ages.

Among the Nematodes of the digestive tract are worth mentioning, by their diversity, prevalence and parasitisms' intensity, those belonging to the family Trichostrongylidae, followed by families Trichuridae, Strongylidae and Capillaridae.

Trichostrongylidae of abomasal location were isolated from all the host species. High prevalences of *Ostertagia spp.* in red deers; *Spiculopteragia asymmetrica* in fallow deers; *Teladorsagia circumcincta* in mouflons, ibexes and red deers; *T. davtianii* in roe deers and *Trichostrongylus axei* in mouflons, red deers and roe deers were detected. *S. asymmetrica* was, simultaneously, the most prevalent abomasal parasite in fallow deers (78%) and the less one in roe deers, in which it was found in mixed infections with *T. axei*. By the other hand, the abomasal parasite found in the highest number of host species was *T. circumcincta*.

Trichostrongylidae from small intestine were found mouflons (*T. vitrinus*, *Cooperia oncophora* and *Nematodirus spathiger*), red deers (*N.*

Table 2.- Mean, minimum and maximum parasite burdens (n° of worms/animal) for gastrointestinal nematodes.

Worms	Ibex			Roe deer			Red deer			Mouflon			Fallow deer		
	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
<i>Ostertagia spp.</i>							600	150	1000						
<i>S. asymmetrica</i>													1400	300	4600
<i>T. daviani</i>				850	100	2000									
<i>T. circumcincta</i>	2000	500	3500				666	100	1500	1300	150	2500			
<i>T. axei</i>					200		100	50	200	1300	150	2500			
<i>T. vitrinus</i>											200				
<i>C. oncophora</i>											200				
<i>N. filicollis</i>				187	50	400									
<i>N. spathiger</i>							300			250	200	300		200	
<i>O. venulosum</i>											100				
<i>Capillaria sp.</i>								200							
<i>T. ovis</i>	20	10	30	50	20	60	200	50	250	20	10	30	100	20	130

*spathiger*) and roe deers (*N. filicollis*). All these parasites showed moderate to low prevalences.

Trichuridae (*Trichuris ovis*) were found in the cecum of all host species showing diverse prevalence rates (from 2% in ibexes to 50% in mouflons).

*Oesophagostomum venulosum* was isolated only in mouflons and *Capillaria sp.* only in red deer, and both parasites showed low prevalences.

In the table 2 can be seen the mean, minimum and maximum parasite burdens (as number of worms/animal) recorded for all the gastrointestinal nematodes found.

In every case we found asymptomatic or sub-clinic infections showing very moderate intensities, compatible with a health status of the hosts good enough to be called healthy carriers.

In Trichostrongylidae, the highest parasite burden were observed for *S. asymmetrica* in fallow deers (4.600 worms/animal) and the lowest for *T. axei* and *N. filicollis* in red deers and roe deers, respectively (50 worms/animal).

*Trichuris ovis*, present in all host species, showed the highest burdens in red deers (250 worms/animal) and the lowest in ibexes and mouflons (10 worms/animal). *O. venulosum* and *Capillaria sp.* never surpassed the 100-200 worms/animal in the hosts infected by them.

Regarding the relation between the parasite burden in the alimentary tract with the age and sex

of the hosts, we observed, (i), that in red deer and fallow deer there were not differences between sexes and that the highest burdens were found in young animals (1 year old); (ii), that in Spanish ibexes and roe deers the highest parasite burdens were found in the oldest males (more than seven years old) and (iii), that in mouflons there were no differences among sexes or ages.

In relation to the Ixodidae, we collected: engorged *Ixodes ricinus* female ticks from young male fallow deers that were carriers of piroplasms; male and female *Haemaphysalis punctata* and *Rhipicephalus bursa* from red deers of both sexes and various ages, some of which were carriers of piroplasms. Tick prevalence was low for *I. ricinus* (13%) and moderate (38%) for *H. punctata* and *R. bursa*. Tick infestation intensities were usually low, varying from less than 10 ticks in the majority of the animals to more than 50 in a three years old male red deer.

#### 4. Discussion

Our results show that the aetiology, prevalence and intensity of the parasitic infections in wild ruminants from Salamanca (Spain) are very similar to those recorded for these animals in other parts of the Iberian Peninsula. In addition it is confirmed that these wild animals share a great part of their parasites with the domestic small ruminants in this area of study (Ramajo, 1992; Ramajo *et al.*, 1996).



The simple conventional microscopic examination did not allow us the specific identification of the Piroplasms found. *Babesia* and/or *Theileria* were present in tick-parasitized animals from private reserves but not in tick-free Ibexes and roe deers. *Babesia ovis* has been found in Spanish ibexes and mouflons from other parts of Spain (Ferrer *et al.*, 1998a, 1998b; Marco *et al.*, 2000). Theilerioses by *Theileria sp.* and *T. annulata* have been recently reported in red deer of central Spain (Giménez *et al.*, 2005).

Microscopic examination was also insufficient to identify the species of *Sarcocystis spp.*, which are protozoa with high host specificity and were quite prevalent in all the animals involved in our study. In Spain, it has been reported *Sarcocystis sp.* and *S. cervicanis* in red deer (Hernández *et al.*, 1980; Hernández *et al.*, 1981; Rojo Vázquez *et al.*, 2000; Díez and Hidalgo, 2004), *Sarcocystis sp.* and *S. capreolicanis* in roe deer (Breña *et al.*, 1989; De la Fuente *et al.*, 1995; Reina *et al.*, 1992) y *S. jorriani sp. nov.* and *Sarcocystis sp.* in fallow deer (Hernández *et al.*, 1992; Lavín, 1998). More recently, Díaz *et al.* (2005) have found *Sarcocystis sp.* in 100% of the Spanish ibexes, red deers, mouflons and fallow deers examined in several regions of Spain.

*Cryptosporidium spp.* have been observed by us to be high prevalent in mouflon and low prevalent in en red deer and fallow deer. They have been also found recently in mouflons and fallow deers in parts of Spain where, simultaneously, red deers and Spanish ibexes were *Cryptosporidium*-free (Alonso *et al.*, 2004). Spanish ibexes and roe deers from the province of Salamanca also seemed to be free of *Cryptosporidium*. It is reasonable to think that the species that we have found is *C. parvum*, because it is the species that usually infects the wild ruminants of our study (Fayer *et al.*, 1997) and moreover because it can be found infecting also the domestic ruminants coming from the same area of our study (Oleaga *et al.*, 2003).

*Eimeria spp.* were found in the faeces of all the hosts studied except fallow deer. In Spanish ibexes and roe deers from our study area *Eimeria spp.* have been already detected in earlier works (Oleaga *et al.*, 2003). The presence of *Eimeria spp.* in these animals from all over Spain was largely known (Hernández *et*

*al.*, 1980; Gómez Bautista *et al.*, 1996; Hidalgo *et al.*, 1999; Marco *et al.*, 2000; Hidalgo *et al.*, 2001). The *Eimeria* species that we have found are very diverse and most of them are shared with the domestic small ruminants from that area, namely, sheep and goats.

*Dicrocoelium dendriticum*, present here in mouflons, red deers and fallow deers, is also present in mouflons and red deers from other spanish regions (Lavín *et al.*, 1998; Hidalgo *et al.*, 2001; García Romero, 2003). We have not found *D. dendriticum* in roe deers or Spanish ibexes from Salamanca, although it has been already reported in these same hosts from different parts of Spain (Hidalgo *et al.*, 1999; Marco *et al.*, 2000). *D. dendriticum* is shared by the domestic ruminants from Salamanca. *Paramphistomum cervi* is largely known to be present in roe deer in Spain (Cordero del Campillo *et al.*, 1994), consequently, its high prevalence in red deers from Salamanca (50%) was somewhat expectable. By contrast to that observed elsewhere in Spain, the wild ruminants of Salamanca seemed to be free of *Fasciola hepatica*.

The adult cestoda that we have found, *Moniezia benedeni* and *M. expansa*, have been reported in other provinces of Spain: Cordero del Campillo *et al.* (1994) in Spanish ibexes; Hidalgo *et al.* (1999) in roe deers and Hidalgo *et al.* (2001) and García Romero (2003) in red deer. Both species are also common in domestic ruminants of our area of study. The finding of an old Spanish ibex male with hepatic hydatidosis demonstrates that this life cycle can also be completed in the wild.

The pulmonary nematodes found (*Muellerius*, *Cystocaulus* and *Protostrongylus*) are frequent in wild ruminants from every part of Spain (Cordero del Campillo *et al.*, 1994; Meana *et al.*, 1996; Sangenis *et al.*, 1999; García Romero, 2003). However, in roe deers from the humid northern regions the predominant species is *Varestrongylus capreoli* (Panadero *et al.*, 2001). This species has not been found yet in Salamanca.

The pathogenicity of these infections is very low, as it is also observed in domestic small ruminants; therefore they seem not to be a health risk for the Spanish ibex populations (Acevedo *et al.*, 2005).

Extra pulmonary Protostrongylidae (*Elaphostrongylus cervi*) are frequent in red deers and roe deers from central Spain (Luzón *et al.*, 2000; Vicente and Gortázar, 2001; Hidalgo *et al.*, 2001; Valcárcel and Romero, 2002). Hematic Filarioidea (*Elaeophora elaphi*), found in red deers and fallow deers from other spanish regions (Santín Durán *et al.*, 2000; Luzón *et al.*, 2001; García Romero, 2003) have not been found yet in Salamanca.

The majority of nematodes that we have found in the alimentary tract are frequent in sheep and goat and they are already known in cervids and wild bovids (Cordero del Campillo *et al.*, 1994). Among these, the most prevalent and abundant in all the host species are the Ostertagiinae from the abomasum. A great number of similar infections by these parasite have been described: *Ostertagia spp.* in red deers (Valcárcel *et al.*, 2000; Valcárcel *et al.*, 2002; García Romero, 2003), *Ostertagia spp.* and *Spiculopteragia asymmetrica* in red deers and fallow deers (Santín Durán *et al.*, 2004); *Teladorsagia circumcincta* in mouflons and Spanish ibexes (Meana *et al.*, 1996) and *T. davtianii* in Spanish ibexes (Pérez *et al.*, 2003).

*Trichostrongylus axei* from abomasum and *Trichostrongylus spp.* and *T. vitrinus* from the small intestine have been observed also in red deers and ibexes (Cordero del Campillo *et al.*, 1994; Valcárcel *et al.*, 2000; Valcárcel *et al.*, 2002; García Romero, 2003), mouflons (Meana *et al.*, 1996) and roe deers (Hidalgo *et al.*, 1999).

*Nematodirus spp.* have been isolated mainly from roe deers, red deers and mouflons (Cordero del Campillo *et al.*, 1994; Hidalgo *et al.*, 1999; Valcárcel *et al.*, 2002; García Romero, 2003). *Cooperia oncophora*, which is present in mouflons and domestic ruminants, specially cattle, from Salamanca (Ramajo, 1992), is not limited to the wild ruminants of our area since it has been also detected in other areas, although in such areas *C. pectinata* and *C. punctata* predominate (Valcárcel *et al.*, 2002).

*Oesophagostomum sp.*, *Capillaria sp.* and *Trichuris sp.* are also frequently cited in wild ruminants from other spanish territories (Cordero del Campillo *et al.*, 1994; Valcárcel *et al.*, 2002; García

Romero, 2003). In the present study *T. ovis* was the only helminth present in all the host species analysed.

Regarding the ixodid ticks that we have found, namely, *Ixodes ricinus*, *Haemaphysalis punctata* and *Rhipicephalus bursa*, they are largely known to infect wild and domestic ruminants and their presence in Spain has been already reported (Cordero del Campillo *et al.*, 1994; Encinas Grandes, 1986), therefore, their presence in the animals sampled is not surprising. As expected, *I. ricinus* were removed from animals shot in medium to high lands and *H. punctata* and *R. bursa* from animals coming from more dry and low lands.

## 5. Acknowledgements

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