Parasites of the red fox (*Vulpes vulpes* Linnaeus, 1758) in Murcia, southeast Spain

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**SUMMARY**

Fifty five red foxes were captured in Murcia province (Southeast Spain) and necropsied to evaluate parasitic infections. Fifteen helminth species were found, including five cestodes (*Mesocestoides lineatus*, *Mesocestoides litteratus*, *Joyeuxiella pasqualei*, *Taenia pisiformis* and *Dipylidium caninum*), nine nematodes (*Pterygodermatites affinis*, *Toxocara canis*, *Trichuris vulpis*, *Toxascaris leonina*, *Oxynema crassispiculum*, *Eucoleus* (Capillaria) *aerophilus*, *Toxocara cati*, *Uncinaria stenocephala* and *Angiostrongylus vasorum*), and one acanthocephalan (*Macracanthorhynchus catulinus*). Coprological method revealed the presence of, *Isopora* spp. oocysts. Also, fleas and ticks were recovered from the carcasses, corresponding to *Pulex irritans*, *Spilopsyllus cuniculi*, *Ctenocephalides felis felis*, *Rhipicephalus sanguineus*, *Ixodes ricinus*, and *Ixodes tick*. Both *S. cuniculi* and *C. felis felis* are first records in foxes in the Iberian Peninsula.

Keywords : Red fox, *Vulpes vulpes*, Spain, protozoa, helminths, acanthocephalans, ectoparasites.

**Introduction**

The presence of red foxes (*Vulpes vulpes* Linnaeus, 1758) in Murcia (Southeast Spain) is well known, being the most abundant wild carnivore. This wild canid is an opportunistic predator and scavenger perfectly adapted to periurban environments in Spain and other European countries [6]. In these locations, fox population densities can be much higher than in rural habitats due to the abundant availability of anthropogenic food sources. Red fox may harbour a wide range of parasites, some of which can be infectious to man and domestic animals [29, 32]. Therefore, the presence of red foxes has important implications for the control and prevention of these pathogens in rural and periurban areas. Many studies have investigated the prevalence of several parasites of zoonotic and veterinary importance from red fox in Europe [14, 11, 20, 17, 1, 22, 31, 19, 12, 8, 30, 27, 26, 5, 10, 24]. The absence of information concerning parasites from red fox in southeast Spain aimed the present study.

**Material and Methods**

A total of 55 foxes (19 females and 36 males) were hunted from 2001 to 2004 in Altiplano region (North of Murcia, Spain, from 38° 30’ to 38° 45’ N and from 1° 00’ to 1° 30’ E). The climate of the study area is semiarid with an average annual precipitation of less than 300 mm. Animals were hunted during the breeding seasons (February to June) as a part of a population control program. Intact fresh carcasses were submitted to the Laboratory of Parasitic Diseases (Faculty of Veterinary, Murcia, Spain) and all of them were frozen at -20°C until necropsy.

At necropsy, foxes were visually aged by general size, and were classified as juveniles (less than 12 months age) or adult (more than 12 months). Also, animals were examined visually and by palpation for external injuries or wounds. Pelage was brushed and thoroughly inspected for the presence of ectoparasites, which were collected and stored in alcohol 70% until their identification.

Faeces, viscera, digestive tract, and thoracic and abdominal cavities from all foxes were examined and processed in order to collect and identify parasites. Faeces (5 g) were examined by Sheather’s sugar floatation method to detect helminth eggs, protozoan cysts and coccidian oocysts. The gastrointestinal tract was removed and processed separately (stomach, small and large intestine). Each part of digestive tract was cut open longitudinally, mucosae was scraped and carefully examined for parasites. The content was washed and sieved through a
series of mesh screens, the final one of which had apertures 0.3 mm in size. Parasites were separated by taxa and stored in 70% ethanol (nematodes and acanthocephalans) or 5% formalin (cestodes). Cestodes were stained with Semichon’s carmine and mounted in Canada balsam for their identification. Moreover, samples from diaphragm pillars were taken for larvae of *Trichinella* spp. evaluation; small pieces were compressed between glass plates and microscopically examined. For the same purpose, a 10 g sample of each diaphragm was minced and digested by using a solution of pepsine 2% and HCl 2% at 37°C during 3 h. The fluid was examined under 40x magnification. Finally, trachea, bronchi and lungs were examined macroscopically, and subsequently 25 g of lung parenchyma were evaluated using the Baermann’s method.

## Results

The general condition of all foxes was rated as good. No external detectable injuries were observed.

All of the animals were infected with parasites: 23.6% had *Isospora* oocysts, 76.7% cestodes, 86.1% nematodes, 27.9% acanthocephalans, and 95.4% ectoparasites. Results of faecal flotations are summarized in table I, while parasites found at necropsy and their frequencies are shown in table II.

<table>
<thead>
<tr>
<th>Parasites</th>
<th>Number of positive foxes (frequency %)</th>
<th>Mean intensity in parasitized foxes (±SD)</th>
<th>Parasite burden range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Juvenile (n = 26)</td>
<td>Adult (n = 29)</td>
<td>Total (n = 55)</td>
</tr>
<tr>
<td><em>Isospora</em> spp. oocysts</td>
<td>9 (34.6)</td>
<td>4 (13.8)</td>
<td>13 (23.6)</td>
</tr>
<tr>
<td><em>Toxocara canis</em> eggs</td>
<td>4 (15.4)</td>
<td>3 (10.3)</td>
<td>7 (12.7)</td>
</tr>
<tr>
<td><em>Trichurus vulpis</em> eggs</td>
<td>1 (3.9)</td>
<td>0</td>
<td>1 (1.8)</td>
</tr>
</tbody>
</table>

**Table 1: Parasites recovered from faecal flotation of red foxes**

<table>
<thead>
<tr>
<th>Parasites</th>
<th>Number of positive foxes (frequency %)</th>
<th>Mean intensity in parasitized foxes (±SD)</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Juvenile (n = 26)</td>
<td>Adult (n = 29)</td>
<td>Total (n = 55)</td>
</tr>
<tr>
<td><strong>Cestodes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>M. lineatus</em></td>
<td>15 (57.7)</td>
<td>16 (55.2)</td>
<td>31 (56.4)</td>
</tr>
<tr>
<td><em>M. litteratus</em></td>
<td>1 (3.9)</td>
<td>2 (6.9)</td>
<td>3 (5.4)</td>
</tr>
<tr>
<td><em>J. pasqualei</em></td>
<td>3 (11.5)</td>
<td>16 (55.2)</td>
<td>19 (34.6)</td>
</tr>
<tr>
<td><em>T. pisiformis</em></td>
<td>2 (7.7)</td>
<td>2 (6.9)</td>
<td>4 (7.3)</td>
</tr>
<tr>
<td><em>D. caninum</em></td>
<td>0</td>
<td>1 (3.4)</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td><strong>Nematodes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. affinis</em></td>
<td>12 (46.2)</td>
<td>18 (62.1)</td>
<td>30 (54.5)</td>
</tr>
<tr>
<td><em>T. canis</em></td>
<td>15 (57.7)</td>
<td>10 (34.5)</td>
<td>25 (45.5)</td>
</tr>
<tr>
<td><em>T. cati</em></td>
<td>1 (3.9)</td>
<td>0</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td><em>T. leonina</em></td>
<td>1 (3.9)</td>
<td>2 (6.9)</td>
<td>3 (5.4)</td>
</tr>
<tr>
<td><em>O. crassispicuum</em></td>
<td>0</td>
<td>3 (10.3)</td>
<td>3 (5.4)</td>
</tr>
<tr>
<td><em>U. stenocephala</em></td>
<td>1 (3.9)</td>
<td>0</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td><em>T. vulpis</em></td>
<td>1 (3.9)</td>
<td>4 (13.8)</td>
<td>5 (9.1)</td>
</tr>
<tr>
<td><em>A. vasorum</em></td>
<td>0</td>
<td>1 (3.4)</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td><em>E. (C.) aerophilus</em></td>
<td>0</td>
<td>3 (10.3)</td>
<td>3 (5.4)</td>
</tr>
<tr>
<td><strong>Acanthocephalans</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>M. catulinus</em></td>
<td>7 (26.9)</td>
<td>8 (27.6)</td>
<td>15 (27.3)</td>
</tr>
<tr>
<td><strong>Arthropods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. irritans</em></td>
<td>24 (92.3)</td>
<td>26 (89.7)</td>
<td>50 (90.1)</td>
</tr>
<tr>
<td><em>S. cuniculi</em></td>
<td>2 (7.7)</td>
<td>0</td>
<td>2 (3.6)</td>
</tr>
<tr>
<td><em>C. felis felis</em></td>
<td>2 (7.7)</td>
<td>3 (10.3)</td>
<td>5 (9.1)</td>
</tr>
<tr>
<td><em>R. sanguineus</em></td>
<td>14 (53.9)</td>
<td>16 (55.2)</td>
<td>30 (54.5)</td>
</tr>
<tr>
<td><em>I. ventraloidi</em></td>
<td>6 (23.0)</td>
<td>5 (17.2)</td>
<td>11 (20.0)</td>
</tr>
<tr>
<td><em>I. ricinus</em></td>
<td>1 (3.9)</td>
<td>0</td>
<td>1 (1.8)</td>
</tr>
</tbody>
</table>

ND: not determined - SD: standard deviation

**Table 2: Parasites recovered from red foxes**

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Sixteen species of helminths (*Mesocestoides lineatus*, *Me-
 socestoides litteratus*, *Joyeuxiella pasquei*, *Taenia pisiformis*, *Dipylidium caninum*, *Ptirygoderma affinis*, *Toxocara canis*, *Toxocara cati*, *Toxascaris leonina*, *Trichuris vulpis*, *Oxyema crassipiculum*, *Uncinaria stenocephala*, *E uc oleus (Capillaria) aerophilus*, *Gongylonema spp.* *Angiostrongylus vasorum* and *Macracanthorhynchus catulinus*), and six ar-
thropod species (*Pulex irritans*, *Spilopsyllus cuniculi*, *Cieno-
cephalides felis felis*, *Rhipicephalus sanguineus*, *Ixodes ventalloi*, and *Ixodes ricinus*) were identified. Larvae of *G-
gylonema spp.* in the third stage of development were col-
lected from the stomach of two foxes. Also, two larvae of *Angiostrongylus vasorum* were recovered by Baermann’s 
technique using the lungs of the fox parasitized by this 
nematode species. Procedures for detecting *Trichinella spp.* 
were always negative, and trematodes were not found in this 
survey.

**Discussion**

Although foxes are considered as hosts for parasites of po-
tential zoonotic and veterinary significance, few data are avai-
larable relating to parasites of this wild canid in southeast Spain 
and about their role in the natural nidality and propagation of 
these pathogens, knowledge that is necessary to develop pre-
vention strategies.

In the present study, frequency of *Isospora* spp. oocysts was 
much higher than in previous records [31, 8]. This could be 
attributable to several factors, including differences in tech-
niques used for diagnosis, bioclimatic or seasonal conditions 
of each area of study, or even to the high number of juvenile 
foxes in our work (47.3%).

Our results suggest that the helminth fauna of the fox in 
Murcia is similar to that in the Iberian Peninsula as a whole 
[16, 21, 1, 12, 8, 26]. However, it is remarkable the absence of 
trematodes. This group of parasites is usually associated to 
humid habitats since they use aquatic animals as intermediate 
hosts. This reason could explain the lack of trematodes in 
Murcia, since this is a semiarid region in which lakes, ponds 
or marshes are scarce.

Cestodes are highly frequent in foxes from Murcia (76.7%). Most of the foxes harboured *M. lineatus* (56.4%), followed by *J. pasquei* (34.6%). Frequencies of other cestodes (*T. pisiformis*, *M. litteratus*, and *D. caninum*) were always low. In agreement with the results obtained by other authors [12, 26], the genus *Mesocestoides* is the most common finding in our study, usually associated to semiarid areas, and this suggests that diet of foxes probably includes reptiles, birds and rodents. The absence of *T. crassiceps*, which has been described as the most common taeniid species in foxes in other European 
countries [14, 11, 20, 27] endorsed that foxes in southeast 
Spain are less depart on rodents for their requirements than 
foxes from other areas. In this sense, the lack of *T. hydatigena* 
in our survey showed that fresh sheep, goat and cattle car-
casses constitute a minor food item in the diet of foxes.

As occurred in most studies previously carried out in Spain 
[12, 26], we were unable to find any specimen of *Echinococc-
cus granulosus* nor *E. multilocularis*, despite red fox has been 
demonstrated to be a good host for both cestodes [9, 13]. The 
absence of these cestode species in our study suggests that 
foxes are unlikely to develop a significant role in cystic and 
alveolar echinococcosis in Murcia.

The most prevalent nematode in our study was *P. affinis* 
(54.5%). This parasite has been previously described in foxes 
in Spain [17, 12], although with lower prevalence records (6% 
and 23.4%, respectively). *Ptirygoderma affinis* shows 
higher prevalences in semiarid habitats, probably associated to 
the abundance of suitable paratenic hosts [12]. This should 
explain the frequent occurrence of this nematode in Murcia, 
and indicates a higher frequency of reptiles in the diet of these 
foxes.

Of particular interest, because of its association with human 
toxocariasis, is the presence of *T. canis* in red foxes from Mur-
cia. In agreement with several reports in Spain [16] and other 
countries [31, 19], *T. canis* should be considered the most pre-
valent ascarid in red fox. With a minor presence, *T. cati* and 
*T. leonina* were also collected in our study. All three ascarid 
nematodes were previously cited in Spain [16, 21, 17, 1, 2, 
12, 8]. Thus, the presence of foxes in urban and periurban 
areas could increase the risk of *Toxocara* spp. infection in hu-
mans [18, 23], although the evaluation of this epidemiologic 
role has not yet been ascertained in Spain.

The presence of *O. crassispiculum* in foxes is not a frequent 
finding, although this nematode has been previously described 
in this host in Spain [28].

Our report indicates the absence of *Trichinella spp.* in foxes 
from Murcia. Also negative results were obtained in Andalu-
cia [16], Catalonia [17] and Galicia [1], in contrast with results 
obtained by other authors [12, 8], who found *Trichinella* spp. 
prevalences of 1.2% and 8.9%, respectively, in foxes from 
central and north-eastern Spain.

Only one fox harboured *U. stenocephala*; however, this 
nematode was highly prevalent [12] or even the most frequently 
occuring nematode in other studies [1, 22, 31, 8]. The reason 
explaining these results should be the humidity requirements of 
the nematode, whose parasitic stages need moist soil 
conditions [22]. *Trichuris vulpis*, which is considered habi-
tual in semiarid habitats [12], was also recovered in the 
present survey.

Regarding cardiorespiratory nematodes, *E. (C.) aerophilus* 
was recovered from three foxes (5.4%); this frequency is 
much lower than that one previously described in Catalonia 
[15]. Again, the dryness of the study area could explain these 
results since infection is more probable in moist soils.

In the present study, it should not be surprising the scarce 
preseence of *A. vasorum* and the absence of *Dirofilaria immi-
tis*, given that their obligatory intermediate hosts require moist 
habitats. In what concerns *D. immitis*, our results contrast with 
those obtained in north-eastern Spain [12], with a prevalence 
of 12.7%, but are similar to findings reported in Catalonia (0.4%) [15].

In our study, two larvae in the third stage of development 
of *Gongylonema spp.* were recovered from the stomach of two 
foxes. In our knowledge, this is the first time that this nemat-
ode is recovered from the digestive tract of a red fox. This
result should be attributed to the ingestion of intermediate hosts of this parasite (coprophagic beetles), but certainly these larvae would not be able to reach the adult stage in this host. *Macracanthorhynchus catulinus* is an uncommon acanthocephalan, which has been scarcely recovered from foxes in Spain [12]. Infection should be associated to the inclusion in foxes’ diet of intermediate hosts such as beetles harbouring larvae, or adult acanthocephalans present in definitive hosts such as birds [22].

Ticks and fleas were frequently found in foxes (60.5% and 90.7%, respectively). In most cases (58.5%), these two kinds of arthropods infected simultaneously the animals. It is notable the absence of lice in our study despite the care with which foxes were examined; this result is in agreement with the findings consulted in the literature, where no lice are described in red foxes [16, 4, 25, 30]. Frequency of *P. irritans* in our study is much higher than the one previously cited in foxes in Spain [16] and, except in other European countries: 51.25% in France [3], 43% in Hungary [30], and 2% in England [4]. The predominance of the human flea should be attributed to the contact of foxes with animals living in a synanthropic environment in rural and suburban areas [30]. The finding of *S. cuniculi* and *C. felis felis* constitute the first report of these flea species in foxes in the Iberian Peninsula.

Regarding ticks, *I. ventralloi*, *I. ricinus*, and *R. sanguineus* have been previously found in foxes in Spain [7] and, except for *I. ricinus*, in other European countries [30]. It could be emphasized the absence of *I. canisuga* and *Chaetopsylla globiceps*, considered the fox tick and flea respectively. Presence of *S. cuniculi* and *I. ventralloi* in the studied foxes is probably due to the close contact with rabbits and their burrows; these arthropod species are specific parasites of rabbit, and should not be regarded as parasites of fox, that acts as a simply phoretic host.

In the present study, both necropsy and faecal flotation test have been made to all red fox. This information allows us to confirm that the flotation technique underestimates the level of infection with cestodes and nematodes [31]. The same hypothesis was mentioned by other authors [8], who found much lower prevalence records for these parasites than in other works, concluding that the lacking of necropsies should explain those values. This indicates a need for direct intestinal examination for surveillance of parasites in fox populations.

Our results show that the fox in southeast Spain is a host to a wide range of parasites. Most of them are known to be present in dog, and for this reason, the possibility of foxes serving as a reservoir for all the referred parasites might represent a significant risk for dogs. In addition, the environmental contamination with ascarid eggs constitutes a threat for humans. So, sanitary authorities should take into account this possibility for any attempt to control parasite infection in dogs and zoonosis, and surveys in the fox population should be undertaken periodically.

**References**


