

**SOME ECOLOGICAL ASPECTS OF THE HELMINTHIC FAUNA OF
THE RED FOX (*Vulpes vulpes* L.) OF THE PALAEARCTIC ZONE.
II - VULPINE IBERIAN POPULATIONS**

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RESUMO

Com base na acentuada discrepância na criação de subespécies da raposa-vermelha (*Vulpes vulpes* L.) da Zona Paleártica, os autores comparam os elementos disponíveis inerentes à helmintofauna da população vulpina da Península Ibérica, França e alguns países do Norte de África. Pretendem, assim, complementar as opiniões dos zoólogos e zoogeógrafos, de modo a confirmar uma definição taxonómica mais correcta, de acordo com as propostas formuladas na primeira parte do nosso trabalho (CARVALHO-VARELA *et al.*, 1985).

ABSTRACT

Based on the marked discrepancy in the establishment of sub-species of the red fox (*Vulpes vulpes* L.) of the Palaearctic Zone, the authors compare the available elements concerning the helminthic fauna of the vulpine population of the Iberian Peninsula, France and some north african countries. Therefore we wish to complement the opinions of zoologists and zoogeographers in order to validate a more correct taxonomic definition, according to the proposals formulated in the first part of our paper (CARVALHO-VARELA *et al.*, 1985).

INTRODUCTION

According to VALVERDE (1967), three main factors determine the faunistic riches of the Iberian Peninsula:

1. Its geographic separation from Europe by the Pyrenees and from Africa by the strait of Gibraltar.
2. Its position in a transitional area between the atlantic and mediterranean climates is the main reason for the existence of two main biomes - *The Temperate deciduous*

forest and the *Mediterranean (Chaparral)* - both of them rich in a great variety of biotopes.

3. The geographic relief characteristics and orographic variation.

The ecological interactions of these three factors created the basic conditions for the development of species or "speciation".

ALMAÇA (1971) also states that "(...) the isolation established by these geographic barriers, formed during the Tertiary Period, certainly played a very important role in the evolution of a fauna presenting such particular characteristics. The comparison of the distribution of present day land's vertebrates shows the isolative efficiency of the pyrenaic and mediterranean barriers, but it is necessary, of course, to consider other elements, such as paleontological findings, the species dispersion, etc., for a more objective evaluation".

Concerning the red fox, MILLER in 1907 already considered the sub-species *Vulpes vulpes silacea* as autochthone in the Iberian Peninsula, a statement confirmed by other Authors who studied this problem (MILLER, 1912; SEABRA, 1924; THEMIDO, 1931; GAMA, 1957; ALMAÇA, 1968).

When we proceeded to a bibliographic revision of the helminthic fauna in the red fox of the Palaearctic Zone (CARVALHO-VARELA *et al.*, 1985), we proposed, as a first approach, to stress the aspects referring to the geographic distribution of the helminthic species in its four zoogeographic sub-regions and their use as biological tags, in order to confirm or develop our knowledge about the feeding habits of the fox.

In this second part of our work and using the same methodology, we proceed to an exhaustive revision of the helminthic fauna of the Iberian fox and compare it with the data available from France and the Northern African countries, in order to offer an up to date information retrieval to all biologists interested in this field.

RESULTS AND DISCUSSION

In order to discriminate the helminthic fauna in the red fox from these three groups of countries, we elaborated tables where we show the helminthic species, the possible

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contamination sources (infective larvae - their common intermediate and accidental hosts) and the Authors who studied them.

From the findings shown in Table I, concerning the Iberian helminthic species, we can infer a greater variability from those obtained in France (Table II), concerning mainly the Classes *TREMATODA* and *NEMATODA*.

While four species of trematodes are referred to in the Iberian Peninsula (the first of which, *Alaria alata*, is transmitted by the ingestion of tadpoles of frogs and the remaining three by different fishes) in France, only the first species is signalled.

Regarding the nematodes, not only a greater number of species is registered in the Iberian Peninsula (25) than in France (10), but also a larger number of heteroxenous nematodes, in contrast to the situation in France, where almost all the species are monoxenous, exception made for *Trichinella spiralis* and *Diriofilaria immitis*. However, the latter is not transmitted by ingestion, but by vector inoculation.

Within the Class *CESTODA*, there is not a significant numerical difference in species. Some cases of *Diphyllobothrium latum* were registered in the Iberian Peninsula, whose transmission is made through fishes.

Thus the facts hereby presented imply a larger feeding variability available to the fox in the Iberian Peninsula, which confirms the faunistic variety of this region, stressed by VALVERDE (1967) and ALMAÇA (1971).

Another point worth referring is the contribution of the study of the fox's helminthic fauna to the elucidation of its feeding habits in the Iberian Peninsula, since it was reported that in food scarcity areas or periods, this animal has frequent recourse to fish. This feeding was for the first time reported by CARVALHO-VARELA (1984).

Since the data shown on Table III concerns only two countries of Northern Africa (Lybia and Egipt) and a small number of foxes (only six), it is irrelevant to the present study.

On the other hand, the ubiquitous and euryxenic behaviour of the helminths registered in the three regions does not allow a valid contribution to the taxonomic position of the red fox at the subspeciation level.

The frequent occurrence of accidental parasitism in this host is another difficulty for a correct taxonomic status.

CONCLUSIONS

The following conclusions are drawn from the available data:

1- The existence of a wider variation of the parasitic helminthic species in the Iberian Peninsula red fox, mainly in relation to the situation observed in France;

2- It was evidenced in the Class *NEMATODA*, that there is a larger percentage of heteroxenous species in the Iberian Peninsula (4,4%) than in France, where it rea-

ches only 2,0%;

3- The occurrence of helminths, whose intermediate hosts are fishes, in the foxes of the Iberian Peninsula, clearly contrasting with what has been seen in the other regions, can be related to adverse climatic conditions and to food scarcity certain seasons;

4- The fact that most of the helminths registered in the Iberian Peninsula foxes result from the ingestion of their intermediate hosts, points to a larger alimentary variability in the peninsular foxes, as compared with France;

5- The ubiquity and euryxenicism of the helminths registered don't allow us to confirm or invalidate the subspeciation of the Iberian fox.

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TABLE I

HELMINTHS OF THE IBERIAN PENINSULA RED FOX

HELMINTHIC SPECIES	POSSIBLE CONTAMINATION SOURCES (Infective larvae - Their usual and accidental intermediate hosts)	AUTHORS
TREMATODA (4)		
<i>Alaria alata</i>	Metacercaria larvae - Frog tadpoles	CARVALHO-VARELA e C. DURÃO (1977); SANCHEZ ACEDO <i>et al.</i> (1979); SIMON VICENTE (1975); MENDONÇA <i>et al.</i> (1982); AFONSO-ROQUE <i>et al.</i> (1983); NAVARRETE <i>et al.</i> (1985); CARVALHO-VARELA <i>et al.</i> (Em vias de publicação).
<i>Cryptocotyle lingua</i>	Metacercaria larvae - Several fishes	
<i>Opisthorchis tenuicollis</i>	Metacercaria larvae - Several fishes	
<i>Pseudamphistomum truncatum</i>	Metacercaria larvae - Freshwater fishes	
CESTODA (13)		
<i>Diphyllobothrium latum</i>	Plerocercoid larvae - Several fishes	LOPEZ-NEYRA (1947); MARTINEZ <i>et al.</i> (1978); SANCHEZ ACEDO <i>et al.</i> (1979); ROMÉRO GONZALEZ & SALAZAR FERNANDEZ (1979); SIMON VICENTE (1975); CORDERO y Colab. (1980); MENDONÇA <i>et al.</i> (1982); AFONSO-ROQUE <i>et al.</i> (1983); NAVARRETE <i>et al.</i> (1984); NAVARRETE <i>et al.</i> (1985); CARVALHO-VARELA <i>et al.</i> (Em vias de publicação).
<i>Dipylidium sp.</i>	Cysticercoid larvae - Arthropods (haematophagous insects. Pulicid fleas and mallophagans)	
<i>Joyeuxiella echinorhynchoides</i>	Cysticercoid larvae type <i>Monocercus</i> - Several reptiles	
<i>J. pasqualei</i>	Cysticercoid larvae type <i>Polycercus</i> - Annelids, arthropods and molluscs	
<i>Mesoscestoides lineatus</i>	Larvae <i>Tetrathyridium bailleti</i> - Reptiles, birds and micromammals	
<i>M. litteratus</i>	Larvae <i>Tetrathyridium variable</i> - Birds	
<i>Multiceps multiceps</i> (= <i>T. multiceps</i>)	Larvae <i>Coenurus cerebralis</i> - Herbivorous and omnivorous	
<i>M. serialis</i> (= <i>T. serialis</i>)	Larvae <i>Coenurus serialis</i> - Herbivorous and omnivorous	
<i>Taenia sp.</i>		
<i>T. crassiceps</i>	Larvae <i>Cysticercus longicollis</i> - Microtids and rodents	
<i>T. hydatigena</i>	Larvae <i>Cysticercus tenuicollis</i> - Herbivorous and omnivorous	
<i>T. pisiformis</i>	Larvae <i>Cysticercus pisiformis</i> - Domestic and wild rabbits	
<i>T. polyacantha</i>	Larvae <i>Tetrathyridium sp.</i> - Rodents	
NEMATODA (25)		
<i>Ancylostoma caninum</i>	Third stage larvae (L3) - (Monoxenous)	TARAZONA (1974); MARTINEZ <i>et al.</i> (1978); SANCHEZ ACEDO <i>et al.</i> (1979); ROMÉRO GONZALEZ & SALAZAR FERNANDEZ (1979); SIMON VICENTE (1975); CORDERO y Colab. (1980); MENDONÇA <i>et al.</i> (1982); AFONSO-ROQUE <i>et al.</i> (1983); NAVARRETE <i>et al.</i> (1985); CARVALHO-VARELA <i>et al.</i> (Em vias de publicação).
<i>Angiostrongylus vasorum</i>	First stage larvae (L1) - (Monoxenous)	
<i>Ascarops sp.</i>	Third stage larvae (L3) - Coprophagus coleoptera	
<i>Aspicularis sp.</i>	Rhabditiform larvae - (Monoxenous) (Rodents common parasites)	

TABLE I (Cont.)

HELMINTHIC SPECIES	POSSIBLE CONTAMINATION SOURCES (Infective larvae - Their usual and accidental intermediate hosts)	AUTHORS
<i>Capillaria aerophila</i>	Egg with infective larvae - (Monoxenous). (Earth worms. Facultative intermediate hosts)	SIMON VICENTE (1975); CORDERO y Colab. (1980); MENDONÇA <i>et al.</i> (1982); AFONSO-ROQUE <i>et al.</i> (1983)
<i>Crenosoma vulpis</i>	Third stage larvae (L3) - Molluscs	
<i>Dirofilaria immitis</i>	Third stage larvae (L3) - Arthropods (haematophagous insects)	
<i>Filaroides martis</i>	Unknown - Gastropode molluscs	
<i>Graphidium strigosum</i>	Third stage larvae (L3) - (Monoxenous) Common leporide parasites)	
<i>Mastophorus muris</i>	Unknown	
<i>Ollulanus sp.</i>	Unknown - (Monoxenous)	
<i>Oxyema crassispiculum</i>	Unknown	
<i>Physaloptera sp.</i>		
<i>P. praeputialis</i>	Third stage larvae (L3) - Coprophagus coleoptera	
<i>Rictularia sp.</i>	Unknown - Unidentified reptiles	
<i>R. affinis</i>	Unknown - Unidentified reptiles	
<i>R. proni</i> (accidental)	Unknown - Unidentified reptiles	
<i>Spirocerca lupi</i>	Third stage larvae (L3) - Amphibians, reptiles, birds and small mammals	
<i>Strongyloides stercoralis</i>	Filariform larvae (L3) - (Monoxenous)	
<i>Syphacia sp.</i>	Unknown. (Rodents common parasites)	
<i>Toxascaris leonina</i>	Second stage larvae (L2) - (Monoxenous)	
<i>Toxocara canis</i>	Second stage larvae (L2) - (Monoxenous)	
<i>Trichinella spiralis</i> (adults and larvae)	First stage larvae (L1) - Microtids and other rodents	
<i>Trichuris vulpis</i>	First stage larvae (L1) - Microtids and other rodents	
<i>Uncinaria stenocephala</i>	Third stage larvae (L3) - (Monoxenous)	
ACANTHOCEPHALA (1)		
<i>Macracanthorhynchus catulinum</i>	<i>Cystacanth</i> larvae (?) - Coprophagus coleoptera (?) Microrodents(?)	

TABLE II
HELMINTHS OF THE RED FOX IN FRANCE

POSSIBLE CONTAMINATION SOURCES		
HELMINTHIC SPECIES	(Infective larvae - Their usual and accidental intermediate hosts)	AUTHORS
TREMATODA (1)		
<i>Alaria alata</i>	Metacercaria larvae - Frog tadpoles	COUDERT <i>et al.</i> (1970)
CESTODA (11)		
<i>Amoebotaenia paradoxa</i>	Cysticercoid larvae - Eart worms	COUDERT <i>et al.</i> (1970); PETAVY & DEBLOCK (198); HOUIN & LIANCE (1984); PETAVY <i>et al.</i> (1984).
<i>Dipilidium caninum</i>	Cysticercoid larvae - Arthropods (haematophagous insects: Pulicid fleas and mallophagans)	
<i>Echinococcus multilocularis</i>	Larvae of <i>E. multilocularis</i> - Microtids and other microrodents	
<i>Mesocestoides litteratus</i>	Larvae <i>Tetrathyridium variable</i> - Birds	
<i>Taenia crassiceps</i>	Larvae <i>Cysticercus longicollis</i> - Microtids and other microrodents	
<i>T. hydatigena</i>	Larvae <i>Cysticercus tenuicollis</i> - Herbivorous and omnivorous	
<i>T. multiceps</i> (= <i>M. multiceps</i>)	Larvae <i>Coenurus cerebralis</i> - Herbivorous and omnivorous	
<i>T. ovis</i>	Larvae <i>Cysticercus ovis</i> - Small ruminants	
<i>T. polyacantha</i>	Larvae <i>Tetrathyridium</i> - Rodents	
<i>T. serialis</i> (= <i>M. serialis</i>)	Larvae <i>Coenurus serialis</i> - Herbivorous and omnivorous	
<i>T. taeniaeformis</i>	Larvae <i>Cysticercus fasciolaris</i> - Voles and mus telids	
NEMATODA (10)		
<i>Ancylostoma caninum</i>	Third stage larvae (L3) - (Monoxenous)	COUDERT <i>et al.</i> (1970); ARTOIS (1978); PETAVY <i>et al.</i> (1984).
<i>Dirofilaria immitis</i>	Third stage larvae (L3) - Haematophagous arthropods	
<i>Molineus patents</i>	Unknown	
<i>Oxyuridae</i> sp.	Eggs with E3 - (Monoxenous)	
<i>Toxascaris leonina</i>	Second stage larvae (L2) - (Monoxenous)	
<i>Toxocara canis</i>	Second stage larvae (L2) - (Monoxenous)	
<i>Toxocara cati</i>	Second stage larvae (L2) - (Monoxenous) - Paratenic hosts: birds and ruminants	
<i>Trichinella spiralis</i>	First stage larvae (L1) - Microtids and other rodents	
<i>Trichuris vulpis</i>	Eggs with E1 - (Monoxenous)	
<i>Uncinaria stenocephala</i>	Third stage larvae (L3) - (Monoxenous)	

TABLE III
HELMINTHS OF THE RED FOX IN NORTHERN AFRICAN COUNTRIES

POSSIBLE CONTAMINATION SOURCES		
HELMINTHIC SPECIES	(Infective larvae - Their usual and accidental intermediate hosts)	AUTHORS
CESTODA (2)		
<i>Echinococcus granulosus</i>	Larvae <i>E. polymorphus</i> - Domestic and wild herbivorous and omnivorous	BERNARD (1968); AHMED & FAYEK (1985)
<i>Joyeuxiella echinorhynchoides</i>	Cysticercoid type <i>Monocercus</i> - Reptiles	
NEMATODA (7)		
<i>Oxynema crassispiculum</i>	Unknown	BERNARD (1968).
<i>Rictularia affinis</i> (= <i>R. cahirensis</i> = = <i>R. splendida</i>)	Unknown - Unidentified reptiles	
<i>Spirocerca lupi</i>	Third stage larvae (L3) - Amphibians, reptiles, micromammals and birds	
<i>Spirura rytupleurites</i>	Fourth stage larvae (L4) - Orthopterans and coleoptera	
<i>Spiruridae</i> sp.	First stage larvae (L1) - (Monoxenous)	
<i>Trichuris cyrenaica</i>	Unknown	
<i>Vigisospirura grimaldiae</i>	Unknown	
ACANTOCEPHALA (1)		
<i>Oncicola</i> sp.	Unknown	BERNARD (1968).