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Research Note

First report of *Elaphostrongylus cervi* in Spanish red deer *Cervus elaphus hispanicus*

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Abstract

Elaphostrongylus cervi Cameron, 1931 was identified in six *Cervus elaphus hispanicus* sampled in Cuenca, central Spain. A total of 23 adult worms were found in the central nervous system with a mean of 3.8. Although *E. cervi* is reported to be widespread in cervids, this is the first time it has been recorded in Spanish red deer.

Several species of the genus *Elaphostrongylus* (Nematoda: Metastrongyloidea: Protostrongylidae) have been found in different Cervidae: *Elaphostrongylus cervi* (in red deer, roe deer, fallow deer, caribou and wapiti deer), *E. rangiferi* (in reindeer) and *E. panticola* (in maral and sika deer). Adult nematodes are usually localized in the intermuscular connective tissue (Demiaszkiewicz, 1987; Eriksen *et al*., 1989, Handeland *et al*., 2000a) producing a subclinical parasitosis. Recent studies have shown the pathogenesis and migratory life cycle of *Elaphostrongylus* in domestic ruminants (Handeland *et al*., 1993; Handeland & Slettbakk, 1995; Demiaszkiewicz, 1987; Demiaszkiewicz *et al*., 2000; Handeland *et al*., 2000b). During larval migration or developing of immature adult worms, these nematodes cause serious damage in the abomasal wall, liver, lungs, myocardium, kidneys and central nervous system (Handeland, 1994; Handeland *et al*., 2000a,b) and even death (Handeland & Norberg, 1992).

During a survey of the parasite fauna of *Cervus elaphus hispanicus* in Cuenca, central Spain, supported by an INIA project (no. SC97-034), several specimens of *E. cervi* were found in the central nervous system. Animals were shot during the hunting season and sampled by personnel of the Servicio de Investigación y Tecnología Agraria (Laboratorio de Parasitología animal) with the authorization and coordination of the Servicio de Espacios Protegidos y Vida Silvestre, Direction of the Parque Cinegético Experimental El Hosquillo of the Consejería de Agricultura y Medio Ambiente de la Junta de Comunidades de Castilla-La Mancha.

Nineteen heads of *Cervus elaphus* shot by game wardens in February–March 2000 were longitudinally opened and the cranial cavities examined for parasites. The nematode specimens recovered from subarachnoid spaces were washed in physiological saline, fixed in 70% alcohol and cleared in lactophenol for microscopic examination. Six male and 16 female specimens were used for measurements and nematode identification was made according to Kutzer & Prosl (1975), Demiaszkiewicz (1987), Steen *et al.* (1989) and Gibbons *et al.* (1991).

A total of 23 immature adult *E. cervi* nematodes were found in central nervous system of six of 19 red deer examined. Measurements of the worms are given in tables 1 and 2. The number of worms ranged from one to seven per brain with a mean of 3.8. The majority (73%) were female worms.

Most of the red deer were less than one year old (68%) and 58% were females (table 3). In this small sample of red deer, no clear differences were observed in the prevalence of infection relative to host age or sex. In addition no neurological signs or macroscopic lesions were observed in the central nervous system of the red deer.

Although several species of *Elaphostrongylus*, i.e. *E. alces*, *E. cervi*, *E. panticola* and *E. rangiferi* have

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Table 1. Body dimensions (μm) of male *Elaphostrongylus cervi*.

	Mean	Min	Max
Length (mm)	37	29	41
Width at oesophagus end	230	210	240
Maximum width	233	210	250
Width in front of copulatory bursa	109	100	120
Length of oesophagus	746	700	820
Maximum width of oesophagus	118	110	130
Distance of excretory pore from anterior end	135	120	150
Distance of nerve ring from anterior end	103	100	105
Length of left spicule	228	200	260
Length of right spicule	233	225	260
Width of proximal end of spicules	17	10	25
Length of gubernaculum	78	65	90
Maximum width of gubernaculum	11	10	15

been recorded from different Cervidae, most of these nematode species have been identified from morphological features of a small number of specimens and several authors have raised doubts about the identification. Thus, infections in the cervids could be produced by the same species *E. cervi* (Boev, 1957; Kotrlá & Kotrlý, 1969; Kutzer & Prosl, 1975) or the subspecies, *E. cervi rangiferi* (Pryadko & Boev, 1971).

Demiaszkiewicz (1987), who compared the morphology and measurements of *E. panticola* from the brain of maral in Kazakhastan and *E. cervi* from red deer in Poland, made no distinction between those nematodes recovered from intermuscular connective tissue or brain and concluded that both species must be considered as *E. cervi*.

Worm measurements, which are clearly important for diagnosis, must be combined with other criteria to assess the correct identification of species of *Elaphostrongylus*. It seems that *E. rangiferi* and *E. alces* are different from *E. cervi* on the basis of morphological and biological criteria (Steen *et al.*, 1989; Halvorsen *et al.*, 1989; Gibbons *et al.*, 1991). On the other hand, *E. cervi* and *E. rangiferi* cause cerebrospinal disease in wild ruminants (Borg, 1979; Lankester & Fong, 1998) and can affect domestic ruminants (Mickevich, 1958; Bakken *et al.*, 1975; Demiaszkiewicz *et al.*, 2000) but *E. alces* does not infect domestic sheep and goats (Stuve & Skorping, 1990). Consequently, there appears to be at least three valid species of *Elaphostrongylus*, i.e. *E. alces*, *E. rangiferi* and *E. cervi*.

Table 2. Body dimensions (μm) of female *Elaphostrongylus cervi*.

	Mean	Min	Max
Length (mm)	48	33	58
Width at oesophagus end	237	200	280
Maximum width	253	220	280
Width at vulva level	147	125	165
Length of oesophagus	738	630	850
Maximum width of oesophagus	128	100	150
Distance of excretory pore from anterior end	122	110	130
Distance of nerve ring from anterior end	100	100	100
Distance of vulva from posterior end	217	200	270
Length of tail	61	50	75

Table 3. The prevalence (%) of infection of *Elaphostrongylus cervi* in red deer *Cervus elaphus*, from central Spain.

Cervus elaphus	Number examined	Number infected	Prevalence (%)
<1 year	13	4	30.8
1–2 year	6	2	33.3
Males	8	2	25.0
Females	11	4	36.4
Total	19	6	31.6

In the present study, 32% of the brains of red deer were infected with nematodes with a mean worm burden of 3.8, which is higher than that observed by Demiaszkiewicz (1987) and Eriksen *et al.* (1989) who recovered one and two worms, respectively.

Specimens from the brain are smaller than those in intermuscular connective tissue (Eriksen *et al.*, 1989). The present specimens were similar in length to *E. panticola* recovered from the brain by Demiaszkiewicz (1987); if we had recovered specimens from connective tissue, their measurements might have been longer and then similar to those reported for *E. cervi* by Demiaszkiewicz (1987). This is feasible as worms in the brain are still in the process of developing while those in muscles have already matured (Lankester, 1977; Handeland, 1994; Handeland *et al.*, 2000a). Unfortunately we could not investigate the presence of nematodes in connective tissue and thus no comparisons could be made. Despite that, the dimensions included in the ranges reported by Demiaszkiewicz (1987), together with identical morphological features, and the absence of neurological signs or lesions in the central nervous system suggests that specimens belong to *E. cervi*.

Although the genus *Elaphostrongylus* has been described throughout Europe, North America and New Zealand, this is the first report of the presence of adults of *Elaphostrongylus cervi* in Spain, thus adding to the great diversity of parasite fauna in red deer (Valcárcel & García Romero, 2000; Valcárcel *et al.*, 2000) and other wild or domestic ungulates (Cordero del Campillo *et al.*, 1994). However, because of the small sample of hosts examined, further studies are needed to determine the epidemiology and potential importance of *E. cervi* in Spanish red deer.

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