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Spiculopteragia spiculoptera and *S. asymmetrica* (Nematoda: Trichostrongyloidea) from Red Deer (*Cervus elaphus*) in Texas

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ABSTRACT: Specimens of *Spiculopteragia spiculoptera* and *S. asymmetrica* were recovered from the abomasa of five of ten naturally infected red deer (*Cervus elaphus*) in Texas (USA). Female specimens of *Spiculopteragia* were present in all five animals. Male specimens of *S. spiculoptera* and *S. asymmetrica* were present in one of five and three of five red deer, respectively. *Spiculopteragia spiculoptera* has not previously been recognized in the United States and the present report constitutes the first records of *Spiculopteragia* spp. in red deer from North America. It is likely that species of *Spiculopteragia* have been introduced to North America with the import of exotic cervids on several occasions. Focal populations of these nematodes have been established in North America; however, distribution of the parasites likely coincides with areas of residence of introduced populations of red deer and fallow deer (*Cervus dama*) in the Nearctic.

Key words: Parasites, *Spiculopteragia spiculoptera*, *Spiculopteragia asymmetrica*, *Cervus elaphus*, red deer, Trichostrongyloidea, Nematoda.

Spiculopteragia spiculoptera (=*S. bohmi*) and *Spiculopteragia asymmetrica* are gastrointestinal nematodes frequently found in the abomasa of cervids but less often among some domestic and sylvatic bovids and camelids primarily in the Palearctic and Eurasia (Jansen, 1959; Drozdz, 1966; Suarez and Cabaret, 1991). *Spiculopteragia spiculoptera* has been reported from cervids including red deer (but not wapiti) (*Cervus elaphus*), sika deer (*Cervus nippon*), fallow deer (*Cervus dama*), sambar deer (*Cervus unicolor*), roe deer (*Capreolus capreolus*), caribou/reindeer (*Rangifer tarandus*), moose (*Alces alces*), and white-tailed deer (*Odocoileus virginianus*). Bovid hosts include tahr (*Hemitragus jemiahicus*), chamois (*Rupicapra rupicapra*), mouflon (*Ovis musimon*), domestic sheep (*Ovis aries*), domestic goats (*Capra hircus*), and domestic cattle (*Bos taurus*), while camelid hosts are restricted to a single report from a llama (*Lama glama*) (Jansen, 1959, 1976; Drozdz, 1966; Doster and Friend, 1971; Andrews, 1973; Fruetel and Lankester, 1989; Suarez and Cabaret, 1991). *Spiculopteragia asymmetrica* has a similar host distribution primarily among cervids including red deer, sika deer, fallow deer, roe deer, caribou/reindeer, moose, and white-tailed deer. It is rare in bovids and camelids, having been recorded only from chamois, sheep and a llama (Ware, 1925; Jansen, 1959, 1976; Drozdz, 1966; Doster and Friend, 1971; Andrews, 1973; Fruetel and Lankester, 1989; Suarez and Cabaret, 1991).

The historical geographic range of both species of *Spiculopteragia* considered herein, apparently includes the Palearctic and Eurasia; however, the current geographic range has expanded through translocation of infected hosts. Consequently, *S. spiculoptera* has become established in New Zealand, Australia, and Argentina and *S. asymmetrica* in New Zealand, the United States, and Argentina (Drozdz, 1965, 1966, 1967; Doster and Friend, 1971; Andrews, 1973; McKenzie et al., 1985; Fruetel and Lankester, 1989; Suarez et al., 1991). In this report of *S. spiculoptera* and *S. asymmetrica* from red deer on a game farm in Texas (USA), we present both a new locality record (*S. spiculoptera*) and host record (both species) in North America; these may be linked to introductions of red deer from Europe or New Zealand during the period from 1930 to 1989.

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Specimens of *S. spiculoptera* and *S. asymmetrica* were recovered from the abomasa of weanling red deer during an anthelmintic trial in which we applied Ivomec (MSD-Agvet, Rahway, New Jersey, USA) at 500 μg/kg along the dorsal midline according to the manufacturer's instructions. The animals were born and raised on a commercial game farm near Bellville, Texas (29°57′N; 96°17′W) that was previously a cattle ranch but had been converted to a red deer farm in the late 1980's. The red deer used were offspring of animals that were either imported from New Zealand in 1989 or were from a hunting preserve in Texas. This hunting preserve had been established in the 1930's and contained, in addition to red deer, numerous species of African hoofed stock and European fallow deer. The population of red deer on the game farm was further supplemented by importation of red deer from New Zealand, Canada, and England in 1988 and 1989. The red deer used in the study grazed pastures with a history of use by all the imported red deer as well as those from the hunting preserve.

Prior to initiation of the anthelmintic trial, the weanling red deer had received routine health care but had not received any anthelmintic treatments while on the farm. After weaning, animals were transported from the point of origin to indoor housing facilities at the College of Veterinary Medicine, Texas A&M University, College Station, Texas. Upon arrival, fecal examinations (Foreyt, 1990) were used to confirm that all animals were passing strongyle-type nematode eggs. For purposes of the trial, naturally acquired infections were supplemented by administering third-stage larvae of *Dictyocaulus* spp. (n = 2,000 larvae), *Trichostrongylus axei* (n = 15,000), *Ostertagia* spp. (n = 15,000), *Cooperia oncophora* (n = 7,500), *Cooperia punctata* (n = 7,500), and *Haemonchus contortus* (n = 5,000) to each deer. The larvae for each deer were combined and injected intraruminally into the left side of the animal using a 35 ml syringe and 16 gauge needle. Ten red deer were randomly allocated into two groups (treatment and control) of five animals each. Animals from both groups were euthanized (Cash Stun Gun, Accles & Shelvoke Ltd., Aston, Birmingham, England) and necropsied 14 or 15 days after anthelmintic treatment.

Female specimens of the genus *Spiculopteragia* were recovered from all five of the nontreated, control animals (mean intensity = 88; range = 60 to 140). Identification of females was limited to the generic level because morphological attributes at the species level have not been adequately described (E. P. Hoberg, unpubl. data). Based on identification of male nematodes (Skrjabin et al., 1954), *S. spiculoptera* was found in one of the five (intensity = 40) while *S. asymmetrica* was found in three of the five control animals (mean intensity = 26; range = 20 to 40). Mixed species infections were not observed. Specimens of *Spiculopteragia* were not recovered from animals of the treatment group. Representative specimens have been deposited in the United States National Helminth Collection, Numbers 82742 and 82743.

The history and geographic distribution of *Spiculopteragia* spp. in North America is not completely understood. The first report of *S. spiculoptera* was from white-tailed deer on Anticosti Island, Quebec, Canada; however, the origin of this parasite on the island has not been clarified (Doster and Friend, 1971). It is postulated that nematodes were introduced with white-tailed deer, stocked on the island in the 1890's, or that *S. spiculoptera* was later translocated with elk, moose or bison (*Bison bison*). More recently, Fruetel and Lankester (1989) reported *S. spiculoptera* from captive woodland caribou at the Kakabeka Falls Game Farm in Ontario, Canada. The caribou were known to use common pastures with moose, white-tailed deer, sika deer, fallow deer, cattle and llamas, some of which are considered to be typical hosts of *S. spiculoptera* in the Pa-

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learctic (Drozdz, 1965, 1966). Although this species had been reported from reindeer in Sweden, it had not been known from caribou in North America (Fruetel and Lankester, 1989). Thus the known distribution of *S. spiculoptera* in North America includes foci in eastern Canada and in Texas.

The first report of *S. asymmetrica* in the United States was from fallow deer on Little St. Simons Island, Georgia (USA) (Doster and Friend, 1971). Subsequent records were from fallow deer from Kentucky (USA) (Davidson et al., 1985) and Texas (T. M. Craig, unpubl. data) and captive woodland caribou (the first report from *Rangifer tarandus*) at the Kakabeka Falls Game Farm (Fruetel and Lankester, 1989). However *S. asymmetrica* has not been reported from white-tailed deer or other cervids and bovids sympatric with fallow deer or caribou at these localities. Thus the known geographic distribution of *S. asymmetrica* in North America includes a few specific localities in eastern Canada and the United States. Such a range would be compatible with the contention by Davidson et al. (1985) that this ostertagiine had been introduced to North America with fallow deer of European origin.

The origin of these species of *Spiculopteragia* or when they were introduced onto the ranch in Texas cannot be determined. However, it is likely they were imported with the red deer which originally stocked the farm or those added later to supplement the existing herd. This contention is supported by previous studies of endemic cervids and domestic bovids in Texas (Craig, 1979; Gray et al., 1978; Foreyt and Samuel, 1980; Waid et al., 1985; Stubblefield et al., 1987; Craig et al., 1988) as well as detailed studies of the parasites of both white-tailed and black-tailed deer (*Odocoileus hemionus*) in North America (Walker and Becklund, 1970; Hoberg et al., 1993) in which neither species of *Spiculopteragia* were found.

Although the known distributions of *S. spiculoptera* and *S. asymmetrica* in North America appear to be focal, the actual distribution likely coincides with areas of residence of introduced populations of red deer and fallow deer in the Nearctic. The currently restricted distribution of both ostertagiines in the United States and Canada appear to coincide with a history of importation of definitive cervid hosts from Europe or New Zealand. The significance of transport of infected stock in the dissemination of helminthic parasites is further illustrated by the distribution of *Spiculopteragia* spp. among exotic cervids in New Zealand and Argentina (Andrews, 1973; Suarez et al., 1991). Additionally, the presence of these nematodes in red deer born in Texas indicates the apparent ease with which some parasites, particularly those with direct life cycles, become established in new geographic regions (Suarez and Cabaret, 1991). Thus the current report emphasizes the need for surveillance and control of parasites among exotic cervids and bovids as a means of preventing the introduction, establishment and spread of allocthonous helminths.

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