Trichuriasis in Deer

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Trichuris spp. are endoparasites found in a wide range of mammalian species. Some of these host species include humans, non-human primates, dogs, cats, pigs, wild ruminants and domesticated ruminants.

Trichuris | Neo-Tropics | Europe | Deer | Canada

1. *Trichuris* in Deer Located in the Neo-Tropics

Knight et al. [1] analysed the morphometry of adult (male and female) *Trichuris* found in the caecum of the white-tailed deer. Based on the morphometry of this helminth, he proposed a new species called *Trichuris odocoileus*. Prior to this, endoparasites in white-tailed deer was studied and several authors identified *Trichuris ovis* in the caecum of deer (based on morphometry) [2][3][4]. *Trichuris ovis* and *T skrjabini* has also been reported in sheep that share similar pastures to deer [5]. The prevalence of *Trichuris ovis* in white-tailed deer is relatively low and it seems to have little clinical effect on the animal. The prevalence was reported as 3.3% [4], 15% [5], and 3.4% [3]. Similar prevalence values have been reported in cattle: 3.8% [6], 1.26% [7], 7.3% and 13.2% [8]. Large ruminants such as the bison were found to have a low rate of infection, as low as 1% [9]. In contrast, small ruminants (sheep and goats) had a wide range of prevalence for *Trichuris* [10][11]. Using faecal flotation, sheep and goats had a prevalence of 40.46% and 50.51% [11], 4.9% and 4.1% [10]. Using morphological techniques, the prevalence in sheep and goat was 8.9% and 6.7% [10]. Further research on sheep reported a variable prevalence of 6.25% (using faecal flotation) and 27.42% (using morphology of adults) [12]. Recently, Yevstafieva et al. [13] reported 65% of sheep were infected with *Trichuris* spp. using morphological techniques. Knight and Tuff [14] identified *Trichuris skrjabini* in Sika deer (*Cervus Nippon*) based on morphological analysis but the animals showed no overt signs of disease. Cook et al. [15] noted that whipworms in the white-tailed deer had a prevalence of 4.76% (4/84) but failed to identify the species of the parasite. It must also be noted that one study failed to identify *Trichuris* spp. in white-tailed deer but found it in the Sambar deer living in the same population [15]. Interestingly, there were few studies that investigated the causes of morbidity and mortality of farmed white-tailed deer. In this review, based on morphological data, only one (1/347) case of *Trichuris* spp. infestation was identified as a cause of death in farmed white-tailed deer [16].

In recent times, archaeological studies have identified *Trichuris* spp. in deer that inhabited the neo-tropics [17][18]. These samples were found in Brazil and Argentina and shed some light on parasitism by *Trichuris* in wild deer species before colonisation. It also shows that these parasites were present in these animals before the arrival of domesticated livestock. Disease surveys have been conducted on free-ranging grey brocket deer in Bolivia and Brazil [19][20]. The authors noted that these animals were in good body condition before samples were taken. The

prevalence was very low, which was similar to other reports in neo-tropical deer species with 9.09% (1/11) in Bolivia [19]. Lux Hoppe [20] was unable to detect *Trichuris* in deer samples that were collected. However, it must be noted that Lux Hoppe [20] did not analyse caecal or colonic contents which are the predilection sites for this parasite. Some work was done on the causes of mortality in Key deer (*Odocoileus virginianus clavium*) in Florida [21]. The authors identified several causes of morbidity and mortality in these animals such as haemonchosis, highway mortality and chronic purulent infection [21]. However, the effect of endoparasites on mortality was overlooked as well as the effect of individual parasites such as species of *Trichuris*. *Trichuris* spp. was identified in the gastrointestinal tracts of white-tailed deer and pampas deer in Mexico and Uruguay [22][23]. Thus, in these neo-tropical regions more work has to be done to investigate the prevalence of this parasite and its effect on wild populations. There were numerous investigations on gastrointestinal parasites found in deer in the neo-tropics. Most of these reports did not identify *Trichuris* spp. in the gastrointestinal tracts of white-tailed deer and fallow deer [24][25][26][27][28][29][30]. Interestingly, the studies mentioned above used morphological techniques as the method of parasite identification. This shows that the use of this technique as the sole means of identification of parasites can be inaccurate. In summary, the prevalence of this parasite found in deer within the neo-tropics is generally low.

2. *Trichuris* in Deer Located in Europe

Research was done in Czechoslovakia on endoparasites in roe deer. Two species of whipworm were identified as *Trichocephalus* (syn. *Trichuris*) *capreoli* and *T. globulosa*, which had a prevalence of 8.9% and 21.4%, respectively [31]. In Ireland, *Trichuris* spp. was found in red deer (*Cervus elaphus*) and fallow deer (*Dama dama*). *Trichuris* spp. occupied the large intestines of young or sick deer but never occurred in healthy deer. *Trichuris ovis* was found in red deer and an unidentified species of *Trichuris* was found in a fallow deer fawn. In the unidentified species, no males were recovered, which made identification based on morphology impossible [32]. In France, the relationship between helminth infestation and body condition in roe deer was investigated. Roe deer were hunted and the gastrointestinal tract and content were observed for adult helminths and eggs. *Trichuris capreoli* was found in the caecum and young animals had a higher infestation of helminths [33]. In a follow-up study done in roe deer, *Trichuris capreoli* infected males more often than females for each age and class category [34].

In Slovenia, wild fallow deer were hunted and gastrointestinal contents were analysed for helminths. These animals were clinically healthy when they were hunted with low number of parasites found in single animals [35]. Surprisingly, there were no gross pathological lesions attributed to the presence of nematodes in any of the infested digestive tracts. Three species of *Trichuris* were identified based on morphological analysis. They were *T. globulosa*, *T. capreoli* and *T. ovis*. Only a few deer were infected, 7% were infested with *T. globulosa*, 2% with *T. capreoli* and 2% with *T. ovis* [35]. Recently, a survey that lasted twenty months was done to investigate Cervidae kept in zoos in Belgium. The Cervidae under investigation included fallow deer (*Dama dama*), Dybowski's deer (*Cervus nippon dybiwski*), puda (*Puda puda*) and reindeer (*Rangifer tarandus tarandus*) [36]. Adult helminths were collected from the carcasses of the animals and it was noted that the *Trichuris* spp. was present in one of the two zoos surveyed. The reindeer at the zoo were found to have a prevalence of 25% (n = 4). All other cervid species were negative for *Trichuris* spp. based on morphological identification of the adult worms [36].

Helminth fauna in cervids in Belarus was investigated and *Trichuris ovis* was identified in moose (*Alces alces)*, roe deer (*Capreolus capreolus*) and red deer (*Cervus elaphus*). The intensity was low in the animals sampled and the prevalence of parasites in deer species were 33.3%, 37.5% and 37.5%, respectively [37]. In northern Poland, the prevalence in red deer and fallow deer was 1.9% and 3.64% respectively. However, *Trichuris* spp. was not detected in roe deer using morphological techniques. The maximum faecal egg load was 30 eggs per gram (EPG) [38]. Similar work was conducted in various countries and the prevalence in Turkey was 13.3% [39], 2.4% for Croatia [40] and 14.7% in Austria [41]. In the Iberian Peninsula, wild roe deer was found with *T. capreoli* and *T. ovis* in 53.1% and 10.4%, respectively, of the animals sampled. It was also noted that the prevalence of *Trichuris* was higher in males (59.4%) in comparison to females (22.6%) [42]. Free-ranging red deer was found to contain several endoparasites, one of which was *Trichuris ovis*. The authors showed that a low level of endoparasites caused reduction in the body condition of the animals [43].

In Norway, several studies have been done investigating the effect of endoparasites on body condition in moose (*A. alces*) [44] as well as the effect that supplemental feeding has on nematode infection [45]. The prevalence of *Trichuris* spp. was 2.2% [46] and 33.3% [45] with the level of endoparasites having an inverse relationship to body condition [46]. In addition, supplemental feeding had no impact on the level of endoparasites in the sampled animals [45]. Researchers also investigated the parasites in Norwegian red deer in an isolated reserve and found *Trichuris globulosa* in 30.8% of the samples, but the mean helminth count was relatively low [44].

In most of the investigations previously recorded, deer were usually hunted or reared semi-intensively with limited information on the health of the animal. In contrast, a study was done in Sweden investigating gastrointestinal parasitic infection in dead or debilitated moose (*A. alces*) [47]. *Trichuris* eggs were found in 38% of faecal samples but worms were found in 10% of caecum and 2% in the ascending colon [47]. Jokelainen et al. [48] reviewed gastrointestinal parasites in reindeer located in Fennoscandia (Finland, Sweden, Norway and Russia). It was stated that historically, the *Trichuris* spp. was not commonly found in reindeer or moose from Europe but recent evidence has shown that they can be found in these species. Recently, *T. globulosa* was found in 38.9% of roe deer that were sampled in Russia [49]. In summary, the prevalence of this parasite in European deer was quite variable. In some regions, the prevalence was high (>75%) whilst it was low (<2%) in others. Variability in the prevalence may be due to several reasons, such as the method of identification, geographical location and environmental factors such as season.

3. *Trichuris* in Deer Located in Canada

In Canada, the gastrointestinal tracts of wild moose (*Alces alces*) and elk (*Cervus elaphus*) were examined for endoparasites. These endoparasites were identified using morphological characteristics. *Trichuris* spp. were identified in the caecum of both the moose (n = 140) and the wapiti (n = 186) in 34% and 20% of the respective samples. Only female worms were identified and worms had characteristics similar to the vulva and uteri of *T. ovis* [50]. In eastern Ontario (Canada), two species of *Trichuris* were identified in wild moose (*Alces alces*) [51]. *T. ovis* and *T. discolor* were identified using morphological analysis and it was the first time the latter species had been identified in moose. The prevalence of *T. ovis* and *T. discolor* was 13% and 25%, respectively. The intensity of

these parasites was not considered large enough to have affected the health of the animals. The two species of *Trichuris* identified have also been found in domestic ruminants and it should be mentioned that moose that were captured were present in a forest reserve in close proximity to agricultural areas [51]. Farmed and wild woodland caribou (*Rangifer tarandus*) in north-western Ontario (Canada) were found to have *Trichuris* spp. eggs in their faeces. Adult *Trichuris ovis* were discovered in the gastrointestinal tract of farmed woodland caribou [52]. The Atlantic-Gaspesie caribou (*Rangifer tarandus caribou*) is a small isolated population of an endangered species. Faecal samples were taken to assess the level of parasitism present in these animals. *Trichuris* eggs were found in 6% of the animals sampled with a low level of infection detected [53]. In summary, the prevalence of this parasite in Canadian deer was at an intermediate level.

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