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Meningeal Worm in Free-Ranging Deer in Nebraska

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ABSTRACT: The meningeal worm (*Parelaphostrongylus tenuis*) was found in 22 (7%) of 300 white-tailed deer (*Odocoileus virginianus*) (257 adults, 43 fawns) examined from Nebraska (USA) during November 1996. None of 53 mule deer (*Odocoileus hemionus*) (47 adults and 6 fawns) examined were infected. Twenty-two white-tailed deer from 18 counties in eastern Nebraska were infected with *Parelaphostrongylus tenuis*. This is the first record of *P. tenuis* in white-tailed deer from this state.

Key words: Meningeal worm, mule deer, *Odocoileus hemionus*, *Odocoileus virginianus*, *Parelaphostrongylus tenuis*, survey, white-tailed deer.

The meningeal worm (*Parelaphostrongylus tenuis*), is a common and widely distributed parasite of the white-tailed deer (*Odocoileus virginianus*) in the eastern USA (Anderson and Prestwood, 1981; Comer et al., 1991). The white-tailed deer is the normal definitive host for this parasite and large numbers of *P. tenuis* have been reported from deer exhibiting no clinical signs (Samuel et al., 1992). Other wild ungulates such as caribou (*Rangifer tarandus*), moose (*Alces alces*), elk (*Cervus canadensis*), and mule deer (*Odocoileus hemionus*) may develop severe neurological disorders leading to death, from very low numbers of migrating *P. tenuis* (Anderson and Strelive, 1968; Anderson, 1972; Trainer, 1973; Samuel et al., 1992). The intermediate hosts for *P. tenuis* include several genera of terrestrial gastropods (snails and slugs); wild ungulates become infected while feeding when they accidentally ingest these infected gastropods (Anderson and Prestwood, 1981).

Populations of white-tailed deer and terrestrial gastropods suitable as intermediate hosts, exist in areas throughout North America (Lankester and Anderson, 1968). The reason that *P. tenuis* has not been established in the western North America is unclear as no physical barriers exist. It has been suggested that an ecological barrier associated with a prairie habitat (Samuel and Holmes, 1974) may affect survival of first stage larvae (Shostak and Samuel, 1984).

With the increased translocation of wild ungulates to replenish animals in historic ranges and reduce populations of ungulates in national parks and urban areas (Lothian, 1981; Bryant and Maser, 1982; Jones and Witham, 1990), there is growing concern among wildlife biologists regarding the translocation of infected animals and the establishment of *P. tenuis* in the western states of the USA and provinces of Canada. In addition, with the increase of private game farms the danger of inadvertently transmitting the parasite to new areas has increased dramatically (Samuel, 1987; Samuel et al., 1992).

The Nebraska Game and Parks Commission (Lincoln, Nebraska, USA) became concerned about allowing the translocation of wild and domestic ungulates into the state. The presence of *P. tenuis* in bordering states and states west of the Missouri river (Table 1) has been documented and deer populations in Nebraska are at risk. This study was undertaken to determine if *P. tenuis* is present in deer in Nebraska. The authors conducted a preliminary survey with the cooperation of South Dakota Game, Fish, and Parks Department (Pierre, South Dakota, USA) to determine if *P. tenuis* existed in that state.

Twenty-eight locker plants (Fig. 1) east of Grand Island (Nebraska) contacted by the Nebraska Game and Parks Commission (Lincoln, Nebraska) agreed to save heads of deer brought to them for processing by hunters during the 1996 rifle deer season. The deer were tagged for

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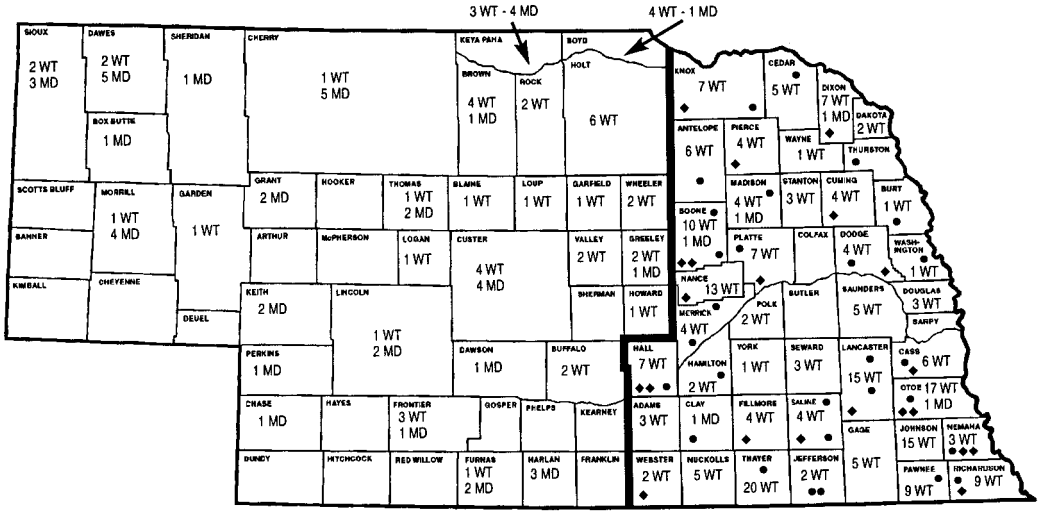


FIGURE 1. White-tailed and mule deer examined for meningeal worm in Nebraska. Legends include white-tailed deer (WT), mule deer (MD), locker plant location (●), and white-tailed deer with *P. tenuis* (◆). The heavy vertical line denotes the western boundary of meningeal worm in Nebraska.

identification at the time of harvest by check station personnel. The county of origin of the deer could be traced by correlating the number on the tag to information collected at the check stations. Hunters that killed deer infected with *P. tenuis* were contacted and asked for precise harvest locations. The heads were usually placed outside and became frozen due to ambient temperatures prior to retrieval. Heads were held in a walk in cooler until the time of examination, then transported to the Veterinary Science Department (University of Nebraska, Lincoln, Nebraska) where they were examined for *P. tenuis*.

Heads were prepared using a butcher's band-saw to cut off approximately 9 cm of the nose (remove incisors) and then to make a sagittal cut dividing the skull into left and right halves. Each brain half was removed carefully using necropsy tools or fingers to lift the brain away from the skull. The surface, and the ventricles of the brain, were examined closely for the presences of adult *P. tenuis*. The interior surface of the skull was checked for adults embedded in the dura mater.

Adult *P. tenuis* on the surface of the brain were gently removed using a dissecting probe. Parasites found embedded in the dura mater were delicately teased from the surrounding tissue using a dissecting probe taking precautions not to damage the parasites. Some of the specimens of *P. tenuis* were placed in 10% buffered formalin for fixation and later transferred to a solution of 70% ethyl alcohol and 3% glycerine for identification and permanent storage. Others were stored in 95% ethyl alcohol or placed in an ultra cold freezer for future DNA sequencing and molecular work. Most specimens were entered in the parasite collection housed in the Harold W. Manter Laboratory of Parasitology (University of Nebraska, Lincoln, Nebraska, USA; assession numbers HWML 39293–HWML 39313).

Three hundred fifty three deer heads including 300 white-tailed deer (257 adults, 43 fawns) and 53 mule deer (47 adults, 6 fawns) from 72 of 93 counties in Nebraska were examined for adult *P. tenuis*. Meningeal worms were found in 22 white-tailed deer originating in 18 counties of eastern Nebraska (Fig. 1). A prevalence of 7% was found in Nebraska white-tailed deer and none of the mule deer were in-

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TABLE 1. Prevalence of *Parelaphostrongylus tenuis* infection in deer from the central USA.

State	Prevalence (%)	Positive/examined	References
Iowa	45	19/42[a]	(Jarvinen and Hedberg, 1993)
Missouri	15	13/85[a]	(Garrison et al., 1986)
North Dakota	8	40/519[a]	(Wasel, 1995)
Oklahoma	52	40/79[a]	(Carpenter et al., 1972)
	39	75/190[a]	(Kocan et al., 1982)
Nebraska	0	0/53[b]	Present study
	7	22/300[a]	
South Dakota	0	0/21[b]	Present study
	7	10/142[a]	

[a] White-tailed deer.
[b] Mule deer.

fected (Table 1). In conjunction with this study the authors conducted a preliminary examination of deer from the adjoining state of South Dakota. One hundred sixty three deer were examined (142 white-tailed deer, 21 mule deer). Only 10 of 142 (7%) white-tailed deer were infected with *P. tenuis*. No mule deer were infected.

The number of adult *P. tenuis* found in brain cavity ranged from one to four, but most infections consisted of only one nematode; several had two nematodes and only one had four individuals. Most adult nematodes were embedded in the dura mater of the parietal regions of the brain. The ages of infected deer ranged from a fawn to a 3.5-yr-old doe. Of the 22 infected deer, 12 were males and 10 were females. Abnormal coloration and thickening of the dura mater as well as exudate was noticed in several deer infected with *P. tenuis*.

Our results indicate that the meningeal worm is well established in eastern Nebraska. Most infected deer were located along major waterways or their tributaries. Deer collected in six of the 13 counties along the Missouri River were infected with *P. tenuis*. Four deer with *P. tenuis* were collected in 12 counties east of Grand Island along the Platte River. In addition, six deer in six counties adjacent to the Blue, Loup, Nemaha, and Elkhorn Rivers were infected. This accounts for 16 of the 18 counties with infected deer and 19 of 22 deer infected. Three deer from two counties were not adjacent to major waterways. This distribution suggests that infected deer occur most frequently along major river systems.

The intermediate hosts (land snails and slugs) and the final host (white-tailed deer) for *P. tenuis* are found throughout the state. All the deer examined in this study from the western two thirds of the state (40) were not infected with *P. tenuis* suggesting that at this time, *P. tenuis* may be confined to the eastern one-third of Nebraska. There was limited sampling of deer in the western part of the state and further studies are needed to better define the extent of the westward range of this parasite.

The presence of *P. tenuis* in Nebraska warrants closer monitoring of the mule deer population in areas where mule deer and white-tailed deer coexist. Any translocation of wild ungulates within or outside the state of Nebraska, private or otherwise, should be regulated to reduce the risk of infected animals from eastern North America and eastern Nebraska spreading the parasite to the west.

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