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Meningeal Worm in Deer from Western Nebraska

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ABSTRACT: One hundred seventy-eight white-tailed deer (*Odocoileus virginianus*) and 275 mule deer (*Odocoileus hemionus*) collected from locker plants in the western 2/3 of Nebraska (USA) in November 1997 were examined for the meningeal worm (*Parelaphostrongylus tenuis*). *Parelaphostrongylus tenuis* was identified in 17 (10%) of 168 white-tailed deer and in one (<1%) of 273 mule deer. This is the first naturally occurring infection of *P. tenuis* recorded in a mule deer.

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

The meningeal worm (*Parelaphostrongylus tenuis*) is a common parasite of white-tailed deer (*Odocoileus virginianus*) in the eastern United States (Anderson and Prestwood, 1981). Very rarely does this parasite cause death in white-tailed deer, even when large numbers of this parasite have been recovered from the central nervous system (Pybus et al., 1990). *Parelaphostrongylus tenuis* has been responsible for the death of other common wild or reintroduced ungulates (Anderson and Strelive, 1968; Anderson, 1972; Trainer, 1973; Samuel et al., 1992; D. J. Steffen, pers. comm.) such as caribou (*Rangifer tarandus*), reindeer (*Rangifer tarandus tarandus*), moose (*Alces alces*), wapiti (*Cervus elaphus*), pronghorn antelope (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*). Complete elimination of entire reintroduced populations have been attributed to the presence of meningeal worm (Anderson, 1972; Bergerud and Mercer, 1989).

The known range of *P. tenuis* extended westward in the United States with the finding of infected deer in North Dakota (Wasel, 1995), Nebraska and South Dakota (Oates et al., 1999). The previous western boundary was a north-south line extending through the United States along the western boundary of Iowa (Anderson and Prestwood, 1981; Comer et al., 1991; Wasel, 1995). With the discovery of meningeal worm in Nebraska and South Dakota (Oates et al., 1999), the western boundary expanded to include the eastern portions of these states.

In 1996, a preliminary study by the Nebraska Game and Parks Commission (Lincoln, Nebraska, USA) found *P. tenuis* present in the eastern 1/3 of the state (Oates et al., 1999). This study was undertaken to determine if *P. tenuis* was present in the western 2/3 of Nebraska.

Twenty-four locker plants from the western 2/3 of Nebraska that process whole deer were contacted by the Nebraska Game and Parks Commission; agreed to save the heads of deer brought to them by hunters. The techniques and procedures utilized were described in Oates et al. (1999). *Parelaphostrongylus tenuis* collected were entered into the parasite collection housed in the Harold W. Manter Laboratory of Parasitology (University of Nebraska, Lincoln, Nebraska, USA) and assigned the following sequence of numbers HWML 39958 to HWML 39976.

In November 1997, 453 (Fig. 1) heads were collected from locker plants in the western 2/3's of the state and examined for adult *P. tenuis*. Sample analysis at the University of Nebraska Veterinary Diagnostic Laboratory (Lincoln, Nebraska, USA) found that 20 deer possessed meningeal worms in 12 western counties and two eastern counties. From the western 2/3's of the state, 168 white-tailed deer (126 adults and 42 fawns) examined, 17 adults (10%) had meningeal worm. Of the 273 mule deer (218 adults and 55 fawns) ex-

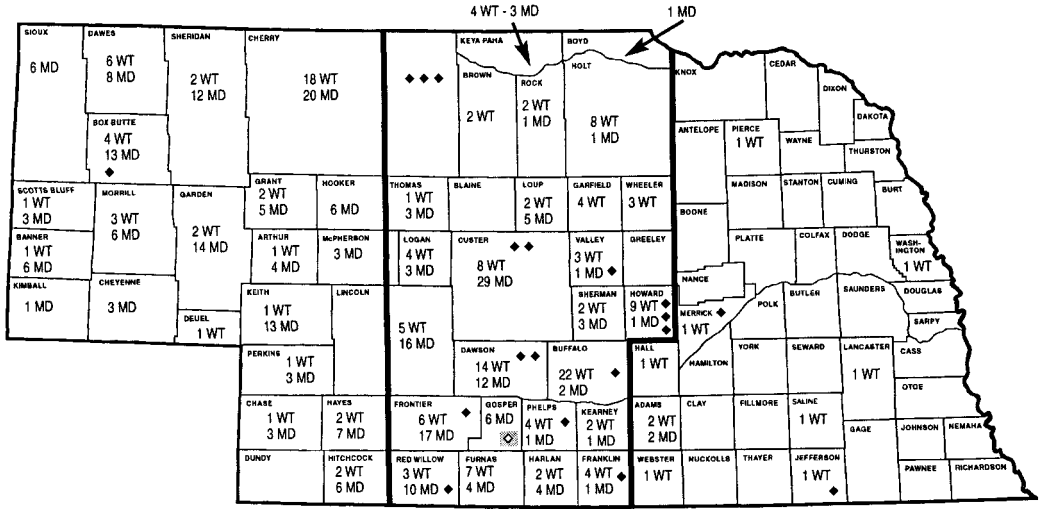

FIGURE 1. White-tailed and mule deer examined for Meningeal worm in Nebraska. Legends include white-tailed deer (WT), mule deer (MD), white-tailed deer with *Paraelaphostrongylus tenuis* (◆), and mule deer with *P. tenuis* (◇). The eastern line represents the portion of the state found to have meningeal worm in 1996. The western line represents the possible boundary from 1997 data.

amined, only one mule deer (<1%) had *P. tenuis.*

The only infected mule deer was a doe, reportedly emaciated, from Gosper County in south-central Nebraska (Fig. 1). Laboratory examination of the brain of that mule deer showed a yellowish material between the dura mater and the brain and the presence of four meningeal worms. The mule deer was aged at ≥4.5 yr.

In 1996, no meningeal worms were found in a sample of 49 white-tailed and 46 mule deer collected from the western 2/3 of the state. However, 17 of 168 white-tailed deer collected in 1997 from the same area contained meningeal worms. This suggests a westward spread of *P. tenuis* between sampling periods.

In the last 2 yr, 806 heads were examined from deer in Nebraska (478-white-tailed and 328 mule deer). The overall percentage for meningeal worms was 41/478 (9%) for white-tailed deer, and 1/328 (<1%) for mule deer. Of the 42 infected deer, 22 were males (21 1.5-yr to 2.5-yr-old) and 20 were females (fawn to ≥6-yr-old). The majority of males collected were 1.5-yr-old. The racks of older bucks were retained by the hunter and the heads could not be utilized in this study. Most of the adult worms were embedded in the dura mater of the parietal regions of the brain. Abnormal yellowish coloration and thickening of the dura mater, as well as exudate, was noticed in several deer found positive for *P. tenuis.* The yellow exudate was not examined in this study, but other studies reported that the exudate contained eggs and viable larvae of *P. tenuis* (Jarvinen and Hedberg, 1993). Only the surface of the brain and the floor of the cranium were examined for adult worms. Due to the fact that the venous sinuses and spinal cord were not examined, the percent of infected deer was probably higher than what was recorded. The majority of infections for the 2 yr period, consisted of only one adult nematode (32), several had two (6), three (2), and a maximum of four (2) nematodes. The significance of single worm infections was unclear. In past studies, it was reported that deer with only a single worm were passing viable larvae and in some cases no adult was found upon necropsy (Slomke et al., 1995).

Several closely related parasites to *P. tenuis* have larvae that are indistinguish-

able from *P. tenuis* larvae (Pybus and Shave, 1984; Gray et al., 1985). To state that *P. tenuis* is present based on the presence of larvae with a cuticular spine on the posterior dorsal surface alone, without finding the adults in the brain, is unreliable. To date, there are no reports of adult *P. tenuis* in deer west of Nebraska in the United States or Manitoba in Canada.

The reason the natural invasion of *P. tenuis* into the western states has not taken place is unclear. Though there is no physical barrier, it was suggested that an ecological barrier associated with prairie habitat (Samuel and Holmes, 1974) may affect the survival of the first stage larvae (Shostak and Samuel, 1984). Historically, the tall grass prairie would approximately cover the eastern 1/3 of the state, the mixed grass prairie would roughly cover to the panhandle and short grass prairie would cover part of the panhandle. Our results indicate that, in fact, prairie habitat did not act as a natural barrier and larvae can survive the prairie environment perhaps around rivers, streams, wet meadows, and lakes in sufficient numbers to infect deer.

The finding of an infected white-tailed deer in western Nebraska is reason for concern. As white-tailed deer expand their range and move into areas formally only occupied by mule deer, the potential for transmitting the parasite to mule deer increases greatly. As white-tailed deer move into habitats occupied by elk, moose, and pronghorn antelope (D. J. Steffen, pers. comm.), abnormal behavior or reduction in their populations could also occur.

With the spread of *P. tenuis* appearing to move westward, western states should continue to monitor for meningeal worm, especially in areas where the range of other ungulates overlap with that of the white-tailed deer.

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