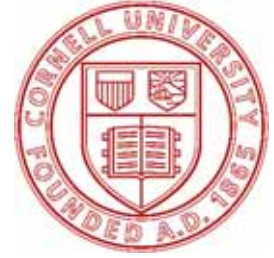


# Deer Worm Factsheet

## Prepared for sheep and goat producers



Courtesy of Cornell Sheep & Goat Program  
and Cornell Ambulatory Veterinary Services

*Funding provided by the Beakman Fund and the Hatch & Smith-Lever Federal Capacity Fund Grant "Application of New Concepts for Control of Internal parasites in Sheep and Goats".*

**What is deer worm?** *Parelaphostrongylus tenuis* (abbreviated *P. tenuis*), also called deer worm or meningeal worm, is a parasitic worm of ruminants. It is very common in white-tailed deer in the Northeast United States (up to 90% of deer harvested during hunting season have been shown to be infected), but does not cause disease in this species. The worm has an indirect life cycle, requiring land snails or slugs as intermediate hosts before being able to infect a ruminant.

**What animals are affected by the deer worm?** Although meningeal worm is best suited to white-tailed deer, many other animals that share grazing land with the deer, including sheep and goats, can be infected. In all species except the white-tailed deer infection with meningeal worm can cause serious neurologic disease.

**What is the life cycle of *P. tenuis*/How do sheep and goats become infected?** Immature deer worm larvae are shed in the feces of white-tailed deer and are either ingested by or burrow into a passing intermediate host (land snail or slug); over 2-3 months, they develop into a more mature, infective larval form. They will either remain in the snail or slug or can be left behind in its mucus trail. Sheep and goats that eat forage contaminated with the snail/slug or their mucus trail can become infected.

Once ingested, the mature larvae migrate out of the true stomach into the abdomen and follow nerves in the body wall until they reach the spinal cord. In the definitive host (white-tailed deer), the larvae then follow an orderly pattern of maturation in the grey matter of the spinal cord before migrating up to the head where they live, reproduce, and lay eggs in the tissues surrounding the brain. However, in small ruminants (because they are not the definitive host) the larvae are unable to 'orient' themselves and follow an unpredictable and erratic course around the spinal cord and nearby nerves. This, in conjunction with the body's inflammatory response, causes damage to the central nervous system and leads to the external signs of disease discussed below.

**What are the signs of infection with deer worm?** There are two common types of signs that an infected sheep or goat may show. Many affected animals will have trouble moving around; early signs of deer worm infection include mild stumbling, knuckling and/or dragging the toes of one or both hind limbs, and general weakness of the hind limbs. In more advanced cases the sheep/goat may suffer total paralysis of the hind limbs, leaving it sitting in a dog-sitting posture or down and unable to get up. The front limbs are less commonly affected, but can have the same problems as the hind limbs. Even in a case of total limb paralysis, animals may still recover fully given proper treatment and/or time (see below). Another common sign associated with deer worm infection is excessive itching and rubbing of one area on the side of the body. Migrating larvae can irritate an individual nerve where it merges with the spinal cord, making the animal rub and/or bite incessantly at the area where the nerve runs. This can lead to hair loss and occasionally a wound in the skin. Less commonly, infected animals will show signs of brain disease such as a head tilt, walking in circles, rapid eye flickering, and difficulty

chewing. Appetite and body temperature typically remain normal in animals affected with the deer worm, which is not often the case with other common diseases of the brain in sheep and goats. It is important to note that not all affected animals will show all these signs. There can be a wide range of manifestations of deer worm infection, so it is important to be vigilant in watching for any problems with your animals.

**How do we know that one of our animals is infected with deer worm?** To make the diagnosis of deer worm, we rely heavily upon the grazing history of the animal as well as the signs of disease it is showing. The fluid that surrounds the brain and spine (cerebrospinal fluid) will also often have characteristic changes to it when viewed microscopically. An absolute diagnosis is made by examining the spinal cord of an affected animal after a necropsy has been performed.

**How do we treat?** There exist many different approaches to treatment of *P. tenuis*, largely because no studies have previously been conducted to demonstrate what is most effective. Many have used ivermectin to treat migrating larvae, but this is thought to only be effective when the larvae are traveling in the stomach or abdominal cavity and not once they have reached the spinal cord. Fenbendazole is often used because it can penetrate into the central nervous system, killing larvae already in the spinal cord or brain. To help reduce inflammation and further damage to the nervous tissue, steroids such as dexamethasone, or NSAIDs such as flunixin meglumine (Banamine), are also commonly utilized in treating infected animals. Some animals will recover without any treatment, and not all treated animals will inevitably recover. It is important to note, however, that animals treated earlier in the course of the disease tend to have a higher chance for full recovery compared with those treated after the disease has progressed to a more severe state.

**What is Cornell's involvement with deer worm research?** Ongoing research by the Cornell Sheep & Goat Program and Cornell Ambulatory Veterinary Services is investigating the effectiveness of two different treatment protocols of naturally infected sheep and goats. Both protocols include fenbendazole and an anti-inflammatory drug; however, one includes ivermectin while the other does not. Because ivermectin cannot cross the blood-brain barrier into the cerebrospinal fluid (and thus may not have any effect on larvae already in the CNS), it may have little utility in animals already showing signs of disease. This research will help producers and veterinarians develop better-informed treatment plans while maximizing effectiveness, reducing cost, and minimizing unnecessary drug withdrawals.

**Can infection be prevented?** The most effective way of preventing infection is to reduce exposure of sheep and goats to infected snails and slugs and to limit deer access to grazing pastures. Pastures bordering woodlands are more likely to be frequented by deer and low, moist areas provide a more conducive environment for deer worm larval development. Avoiding these conditions especially in wet seasons or after the leaves have fallen in the fall will help reduce the deer worm load of an area, and may decrease the chances of deer worm infection in your animals. Daily patrolling by guardian dogs during the winter and grazing season and other deterrents such as human activity and/or deer-proof fencing, to discourage deer from bedding down in pastures, will also reduce the incidence of disease. Fields the first year after forest clearing are especially high risk. Regular, frequent dosing of antiparasitic drugs to prophylactically treat for deer worm is costly and time-demanding; perhaps more importantly, it is likely to select for deer worm larvae that are resistant to the drug, rendering future treatments with that drug ineffective.

***Thank you to the Beakman Fund for Research in Meat Goat Health for funding to prepare this factsheet.***