Meningeal worm (*P. tenuis*)

November 2025

Significance

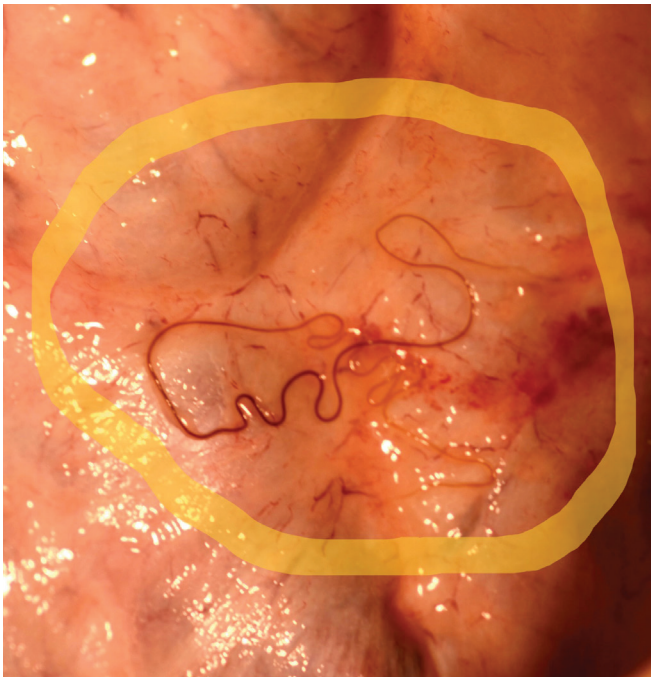
Meningeal worm, *Parelaphostrongylus tenuis*, is a nematode (roundworm) common throughout eastern and central Canada and USA. It lives in tissue spaces adjacent to the brain and spinal cord in white-tailed deer without causing serious damage. However, infection often is fatal and can be a serious risk to mule deer, moose, elk, and caribou populations. Bighorn sheep and mountain goats also are at risk if this nematode arrives in mountain habitats. Fatal infections also can occur in pronghorn and domestic sheep, goats, llamas, and alpacas.

What? Where? How?

Whole book chapters are written about meningeal worm and careers have been spent unravelling its secrets. The story is as complex and intriguing as any spy novel. The interactions between meningeal worms and cervids include elements of stealth and natural biological warfare, with the potential to wreak havoc on unsuspecting populations. And all this from a tiny nematode that is about the size and shape of a human hair. Yet this little animal can bring a towering moose to its knees and to its death.

Meningeal worm is a native North American species that evolved on this continent. The optimal place for adult *P. tenuis* to live is in blood vessels associated with the thin coverings around the brain (called the meninges) of white-tailed deer. In whitetails, the worms are able to get in and out of this sensitive site without causing serious harm to the deer (see below).

However, other ungulate species are not so well adapted and during their migration the worms often cause serious or fatal damage to critical tissues of the central nervous system (CNS). Depending on what part of the brain or spinal cord is damaged, the clinical signs may include weakness in legs or foot joints, uncoordinated movement (ataxia), partial or complete paralysis, blindness, head tilt, twisted neck, circling, loss of fear, reluctance to move, and death.



Transmission cycle

Adult females in or near the blood vessels around the brain release their eggs into the blood stream. These are swept along in the blood until they are filtered out in tiny capillaries in the lungs. The high oxygen content provides excellent conditions for the eggs to hatch in the lung tissues. Microscopic larvae, each with a tiny spine on the dorsal side of the tail (dorsal-spined larvae), burrow out of the blood vessels and into the pulmonary air spaces. From here they are carried or coughed up the windpipe and into the mouth. Rather than going out the mouth, larvae take a different route to leave the deer. They are swallowed, pass unharmed through the stomachs and intestines, and finally reach the ground in the mucous coating on deer faecal pellets.

Common land snails and slugs are attracted to mucous (slime) and use the partially digested plant material in deer pellets as a food source. Larvae on the pellets burrow into the foot of the snail or slug. Some larvae may be washed off the pellet by rain and melting snow but they can survive for quite some time in the leaf litter, providing additional opportunities to burrow into and infect passing snails and slugs.

The saga continues. Once in the snail or slug tissues, larvae have access to lots of food (protein soup), moisture (internal tissues are always wet) and shelter (away from the external environment) so they are well protected. The larvae moult twice and then wait for the snail or slug to be eaten by a deer. In some cases, larvae can survive in overwintering snails or slugs. During the summer or next spring, snails and slugs may be eaten as deer forage on contaminated vegetation. In addition, infected snails can occur deep within the gills of native mushrooms and apparently, deer love mushrooms! Nothing in this life cycle happens by chance.

Once inside the deer, the infective larvae start a truly marvelous journey. Larvae digested out of the snail tissues burrow through the stomach wall and out into the deer's abdominal cavity. The larvae detect nerves in the body wall, travel along them towards the backbone, and in about 10 days arrive at the spinal cord. Larvae burrow into the spinal cord tissues and moult twice more. About ~40 days after being swallowed they become adult male or female *P. tenuis*.

Adult worms move out of the spinal tissue and into the fluid-filled space around the spinal cord. They then migrate in the [subdural] space towards the head of the deer. When they reach the brain, the worms coil up beside or burrow into the major blood vessels in the meninges. From here females can release eggs into the blood stream and start the process all over again. A truly fantastic journey in a variety of inner spaces!!

This life cycle works wonderfully well in white-tailed deer. Both *P. tenuis* and whitetails maintain ongoing populations. Unfortunately, in other species the complicated migration often damages the delicate CNS tissues. Sometimes the larvae burrow too deeply into the spinal cord and nerve damage interferes with movement and control of the legs (i.e. lack of coordination, weakness in legs and feet). If the damage is extensive, the animal may become paralyzed—particularly the rear legs. In other individuals, larvae stay in the spinal cord tissue as they start moving towards the brain. Relatively large pre-adult worms tunnelling through the spinal cord cause significant damage. In other individuals, the worms successfully migrate to the head but then burrow deep into the brain tissue. Such animals usually tilt their head and turn aimlessly in circles. Some are blind. Some have an obvious kink in their neck. Some repeatedly trip and fall. And others walk into trees and barns and anything else that happens to be in the way. These individuals eventually die or are easy prey for predators (and vehicles!).

Different cervid species show differing risks of fatal infection. Mule deer are highly susceptible to meningeal worm and die with only a few worms present. Like mule deer, caribou are highly susceptible and infection often is fatal. Moose generally die, but some individuals survive if they eat only a few larvae in infected snails and if the larvae successfully find their way to the meninges without damaging the spinal cord or brain along the way. Infections can be fatal in elk. But experimental results and evidence from eastern provinces and states shows that meningeal worm can successfully reach the meninges and produce dorsal-spined larvae that occur in elk faecal pellets.

Distribution in Canada and Alberta

Meningeal worm is widely distributed in eastern Canada and the United States, extending as far west as the eastern edge of the central Great Plains. In Canada, the natural distribution of *P. tenuis* seems to fade out at the Saskatchewan/ Manitoba border, probably due to significant differences in the soils, vegetation, climate, and distribution of deer, snails, and slugs in the prairie region. However, since ~ 2010, Saskatchewan recorded increasing occurrence of meningeal worm in eastern and central SK, as well as in the Meadow Lake area near the AB/SK border.

Alberta

In June 2024, a caribou displaying neurologic clinical signs was detected as part of ongoing caribou monitoring in northeast Alberta on the Cold Lake Air Weapons Range. Over the next few months, five similar situations involving 4 caribou and one moose were investigated in the same general area. Following an extensive series of tests, infection with meningeal worm was confirmed in all 6 animals.

It is apparent that *P. tenuis* is present in northeast Alberta in the vicinity of Cold Lake and extending north-westerly toward Fort McMurray. Enhanced surveillance is underway to better define the occurrence of meningeal worm in the area. It is anticipated that once established, this species will expand its distribution in whitetails within Alberta. Significant numbers of mule deer, moose, elk, and caribou are likely to pay the price of overlapping with infected WTD.

Importance for wildlife management

Meningeal worm creates three primary areas of concern or interest for wildlife managers: effects in free-ranging populations, translocation of live wildlife, and movements of game farm cervids.

The precise effect of *P. tenuis* on free-ranging populations is difficult to document. However, in areas where it occurs in white-tailed deer, local moose, caribou, and elk populations decline and are lower than would be expected if the worm was not present. On a broad time scale, meningeal worm is considered the primary factor in the disappearance of caribou, elk, and mule deer from large areas of eastern Canada and northern US. As early settlers moved north and west from the Atlantic coast, suitable habitats for white-tailed deer (and meningeal worm) also expanded. Large tracts of land were cleared to make way for farms, roads, and houses. Remnant populations of caribou and elk exist in the east today only in local areas where infected whitetails generally do not go. On the contrary, mule deer are particularly susceptible to fatal infections and the species cannot persist in areas where meningeal worm is established.

Meningeal worm must be considered in any translocation of live wild cervids into or out of eastern Canada. Attempts to re-establish caribou in parts of eastern Canada and northeastern US failed because of the presence and effects of *P. tenuis*. Programs aimed at re-introducing elk to these same areas are marginally successful, largely due to mortality associated with meningeal worm infections.

The possibility of moving meningeal worm out of eastern areas and into Alberta has been an ongoing concern for decades. Since the early 1960s, when

Dr. Roy Anderson (University of Guelph) identified the life cycle and implications of meningeal worm, there has been common policy shared by western wildlife management agencies: Live free-ranging white-tailed deer must not be moved from east to west across the Central Plains. Any transfer of *P. tenuis* into Alberta would put mule deer, moose, elk, caribou and antelope at risk of fatal infection.

Meningeal worm does not recognise whether the deer or elk is wild or captive. Thus, Alberta's import restrictions applied to movement of game-farm cervids into the province include strict mitigations to prevent inadvertent transfer of *P. tenuis* into the province. Despite the finding of meningeal worm in a limited area of northeast Alberta, the province remains diligent in limiting any human-caused spread to this deadly parasite into or within the province.

Public significance

Meningeal worm does not infect humans.

It can cause fatal infections in a wide range of domestic species, including sheep, goats, llamas, alpacas and, rarely, cattle. Fatal infections in exotic cervid and bovid species occur in zoos in eastern North America.

Prevention/control

There is no practical way to control meningeal worm in wild populations. This native species co-evolved in North America along with white-tailed deer. Natural conditions appear to limit its distribution to the area east of the prairies and Central Plains region. Control programs aimed at keeping meningeal worm out of western regions of North America include the prohibition on moving elk or deer without strict measures to prevent also moving *P. tenuis*. For many years Alberta has applied strict import restrictions on translocating live cervids into the province.

Alberta

There are no effective means of treating infections; however, mitigations can be applied to farmed ungulates. Infection may be prevented with rigorous protocols that kill incoming larvae when infected snails are consumed. Ongoing monthly injections of an avermectin product may prevent infections in livestock but must be diligently adhered to within enzootic areas.

Summary

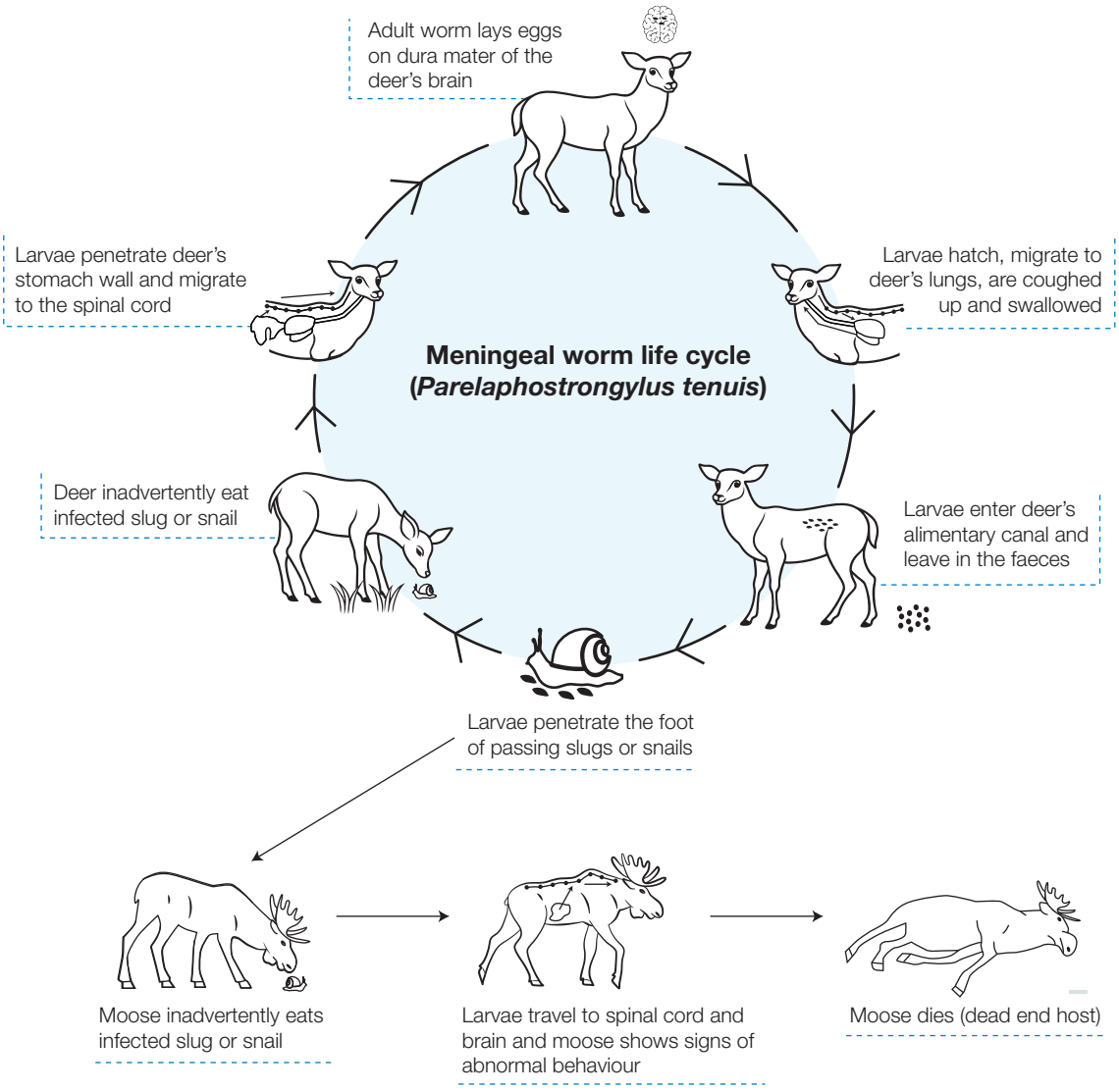
Meningeal worm poses a significant threat to the health and survival of cervids other than white-tailed deer, whether free-ranging or farmed. Similarly, once established in wild whitetails, *P. tenuis* is an ongoing risk to various livestock species.

Additional information

Lankester, M.W. 2001. Chapter 9 – Extrapulmonary Lungworms of Cervids. In Parasitic Diseases of Wild Mammals, Second Edition. Edited by William M. Samuel, Margo J. Pybus and A. Alan Kocan.

Wasel, S.M., Samuel, W.M. and Crichton, V., 2003. Distribution and ecology of meningeal worm, Parelaphostrongylus tenuis (Nematoda), in northcentral North America. Journal of Wildlife Diseases 39: 338-346.

Lankester, M.W., 2010. Understanding the impact of meningeal worm, Parelaphostrongylus tenuis, on moose populations. Alces 46: 53-70.



alberta.ca/wildlife-diseases-in-alberta