USING MOVEMENT ECOLOGY TO INVESTIGATE MENINGEAL WORM RISK IN MOOSE[1]

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ABSTRACT

Anthropogenic habitat change and moderating climatic conditions have enabled the northward geographic range expansion of white-tailed deer (*Odocoileus virginianus*) and the parasitic nematode (meningeal worm) it carries, *Parelaphostrongylus tenuis*. This expansion can have consequences in dead-end host species for other ungulates because meningeal worm reduces health, causes morbidity or direct mortality, and has been attributed to population declines. In northeastern Minnesota, which marks the southern extent of the bioclimatic range for moose (*Alces alces*), the population has declined more than 50% in the last decade, with studies detecting *P. tenuis* in 25 to 45% of necropsied animals. We took a novel, top-down approach for assessing the factors that are most associated with meningeal worm infection by linking moose movement ecology with known *P. tenuis* infection status from necropsy. Moose were outfitted with GPS-collars to assess their space use and cause-specific mortality. Upon death, a necropsy was performed to determine cause of death and document meningeal worm infection. We then created statistical models to assess the relationship between meningeal worm infection and exposure to hypothesized factors of infection risk based on the space-use of each moose by season. Predictors included landcover types, deer space use and density, environmental conditions, and demographics of individual moose (age and sex). Moose had a greater risk of infection when their home ranges contained higher proportions of wetter environments and their fall home ranges included more upland shrub/conifer. In contrast, the strongest relationships showed that higher proportions of mixed and conifer forest within spring home ranges resulted in lower risk of infection. Relationships between exposure and infection were strongest in the spring models, potentially due to moose foraging on ground vegetation during spring. By incorporating the movement of moose into disease ecology, we were able to test hypothesized components of infection risk with actual spatial and temporal exposure of individual necropsied moose. The probability of infection for moose in northeastern Minnesota was not influenced by deer density, although deer densities did not vary greatly within the study area (2 – 4 deer/km^2), highlighting the importance of both moose space use and environmental conditions in understanding infection risk. We suggest management strategies that use a combination of deer and land management prescriptions designed to limit contact rates in susceptible populations.

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