Co-infection of Anaplasma bacteria and winter ticks decreases moose calf survival in Maine

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Introduction

- Moose (Alces alces) populations in the northeastern United States are declining, with winter ticks (Dermacentor albipictus) as the primary driver1,2,6
- Recently, an uncharacterized species of Anaplasma has been found to infect moose in Maine3
- Anaplasma is a genus of bacteria that are intracellular blood parasites known to infect canids, livestock, and humans4
- Anaplasma infections in cattle are known to cause anemia, abortion, and even death5

Objectives

1. Evaluate temporal trends in Anaplasma prevalence in moose
2. Determine if co-infection of Anaplasma and winter ticks significantly reduce moose calf survival

Methods

Step 1
Moose calves collared in January in Wildlife Management Districts (WMDs) 2, 4 & 8 in Maine. Whole blood taken, along with winter tick counts. Calves were tracked through the winter.

Step 2
Nested PCR assay to determine Anaplasma presence/absence

Step 3
Kaplan-Meier analyses performed using “survival” and “survminer” packages in RStudio6, to examine parasite effects on moose calf survival (to May 18th)7

Results

- Over five years, the estimated overwintering mortality rate in calves was 66.29%
- Anaplasma infection prevalence increased over time, peaking in 2022 (Fig. 1)
- Anaplasma infection significantly reduced moose calf survival probability (p < 0.0001)
- Moose with heavy tick loads (≥46) and Anaplasma co-infection had the lowest survival probability (Fig. 2); and co-infection in moose with both moderate (10-45) and heavy tick loads reduced survival (Fig. 3)
- In moose with light tick loads (≤9), there was not a significant difference in survival based on Anaplasma infection status (p > 0.5)

Discussion and Future Directions

- These results highlight the importance of considering how multiple parasites interact to impact moose survival
- Anaplasma and winter ticks are just two parasites that could be working to destabilize moose populations; other parasites to consider are Dictyocaulus spp., P. tenuis, and Echinococcus granulosus2,6,8
- Further work is needed to determine the vector of the cervid-specific Anaplasma strain, which remains unknown9, to better understand pathogen transmission

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Citations


Figure 1: Overwintering mortality rates and Anaplasma infection prevalence in Maine moose (n = 350) from 2017 to 2022. Mortality and Anaplasma prevalence estimates from WMDs 2 and 8 are shown in black, while those from WMD 4 are in red. Blood samples for Anaplasma were not collected in 2020.

Figure 2: Effects of winter ticks and Anaplasma infection on overwintering survival of moose calves. Kaplan-Meier non-parametric survival curves shown for calves with both Anaplasma infection and light (n = 28), moderate (n = 211), or heavy (n = 211) winter tick infestations.

Figure 3: Effects of moderate (A) and heavy (B) winter tick loads and Anaplasma infection on overwintering survival of moose calves. Kaplan-Meier non-parametric survival curves shown for moose calves experiencing Anaplasma infection and moderate (A; n = 211), or heavy (B; n = 211) winter tick infestations. Shading represents the 95% confidence interval.