

# Moose Health and Climate Change in Minnesota

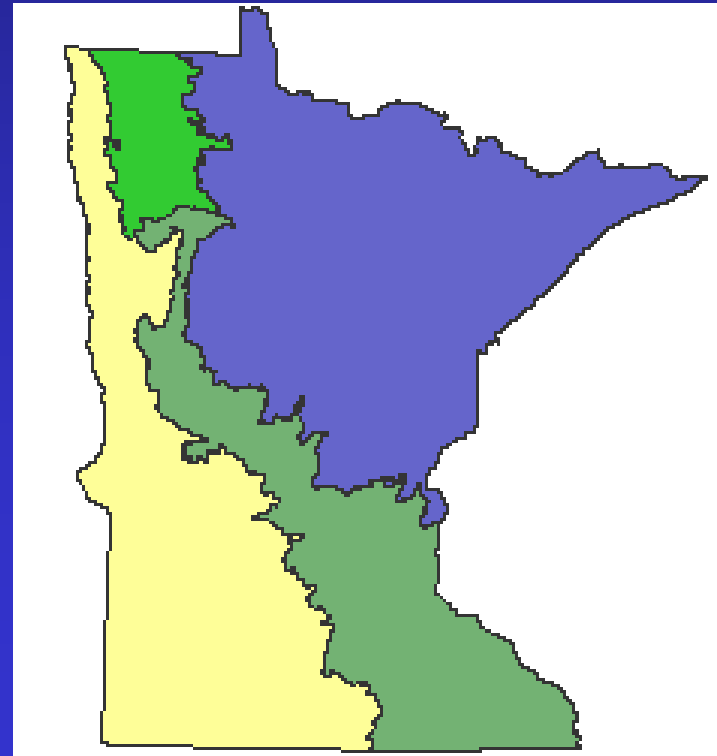


# Minnesota Climate Projections

- **Winter temps increase 4-8F**
- **Summer temps increase 7-16F**
- **Annual precipitation unchanged but drier overall due to increased evaporation**
- **Increase in extreme weather events**
- **Growing season lengthened by 3-6 weeks.**

# At risk

- **Northern forests at the southern edge of their range in Minnesota**
- **Northern wildlife species at the southern edge of their range in Minnesota**

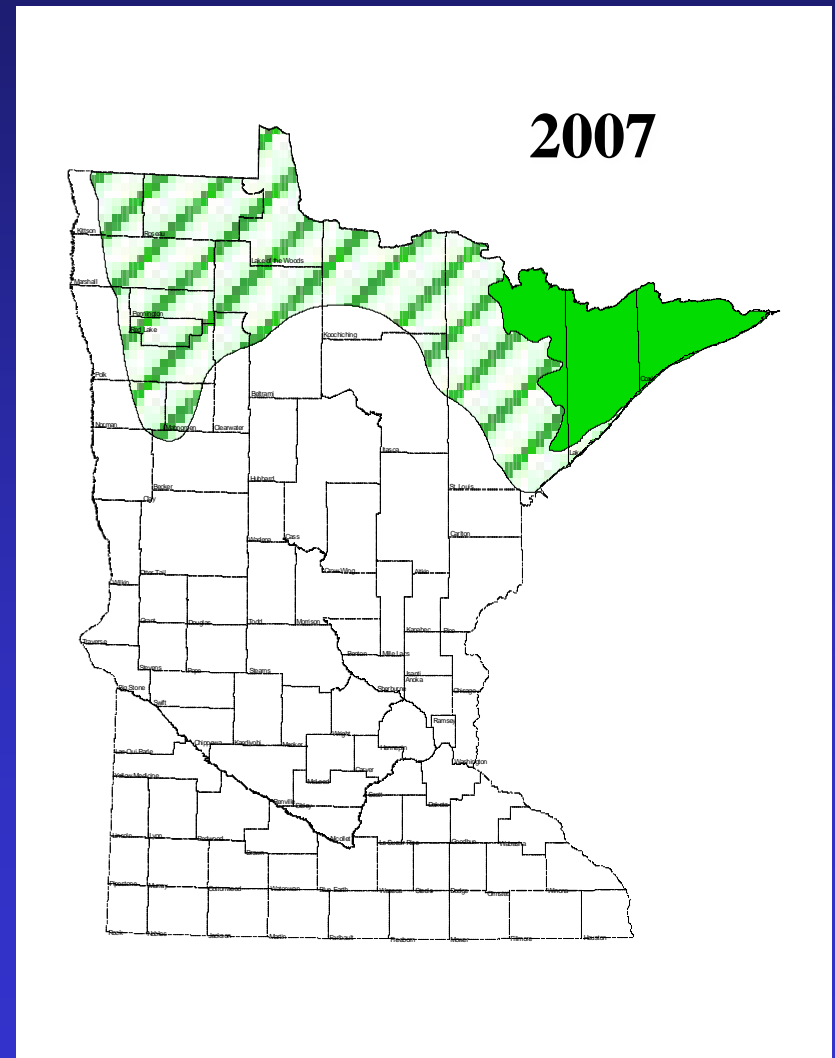
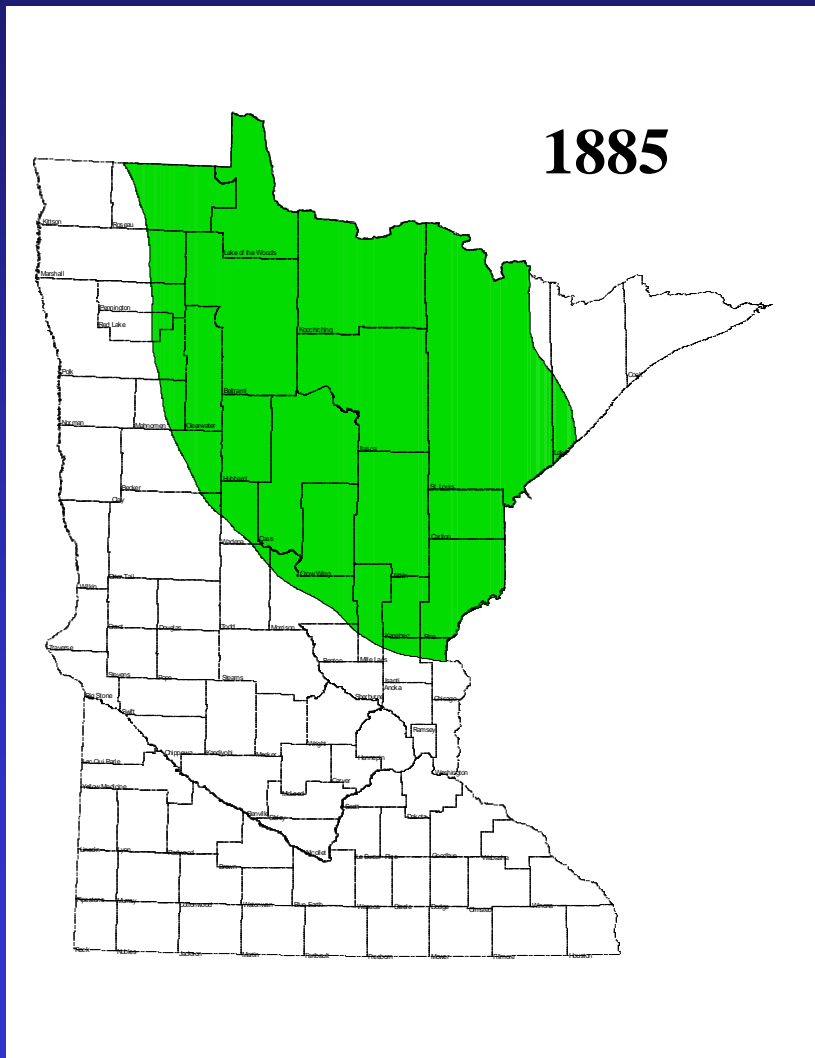






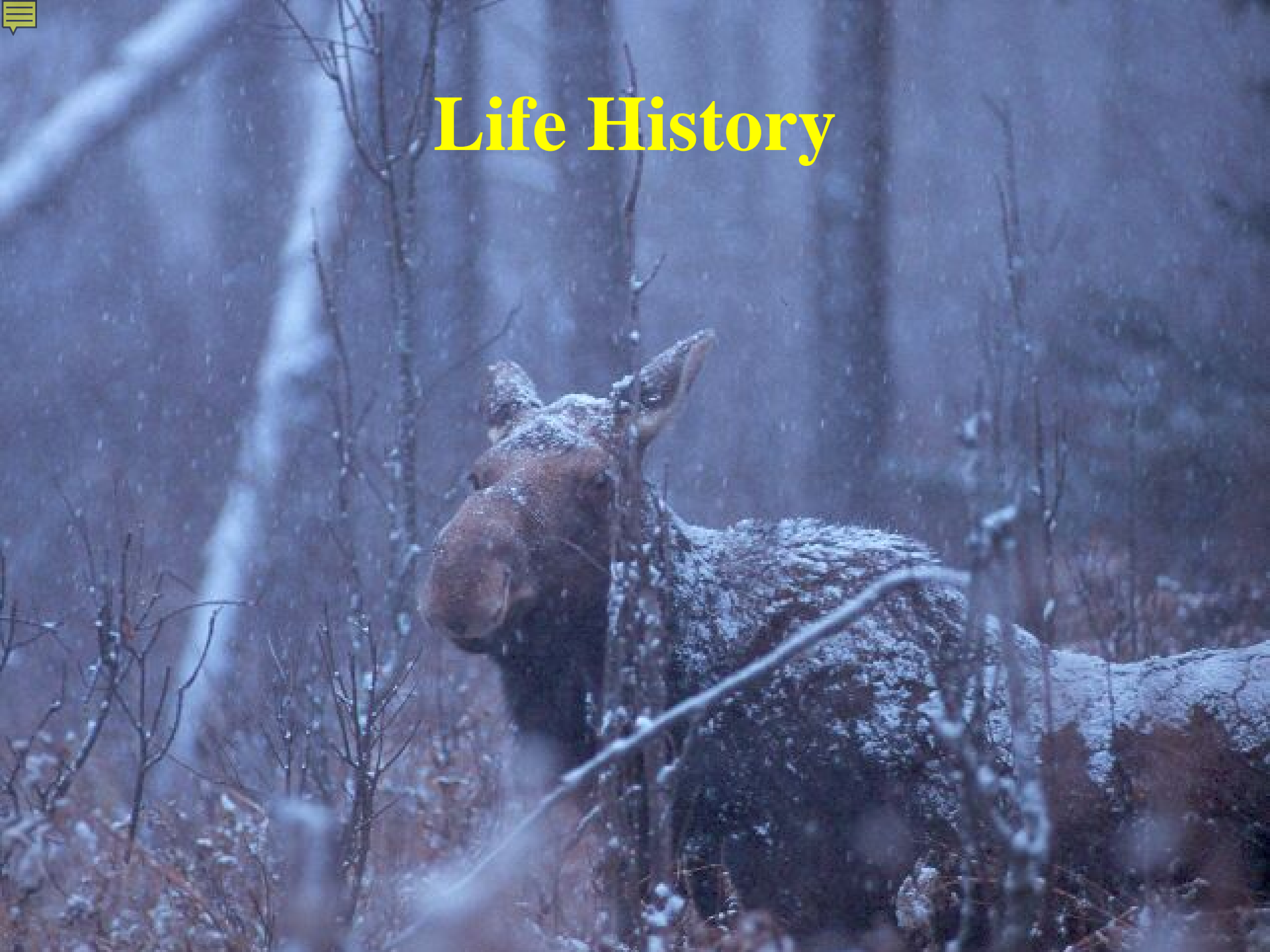
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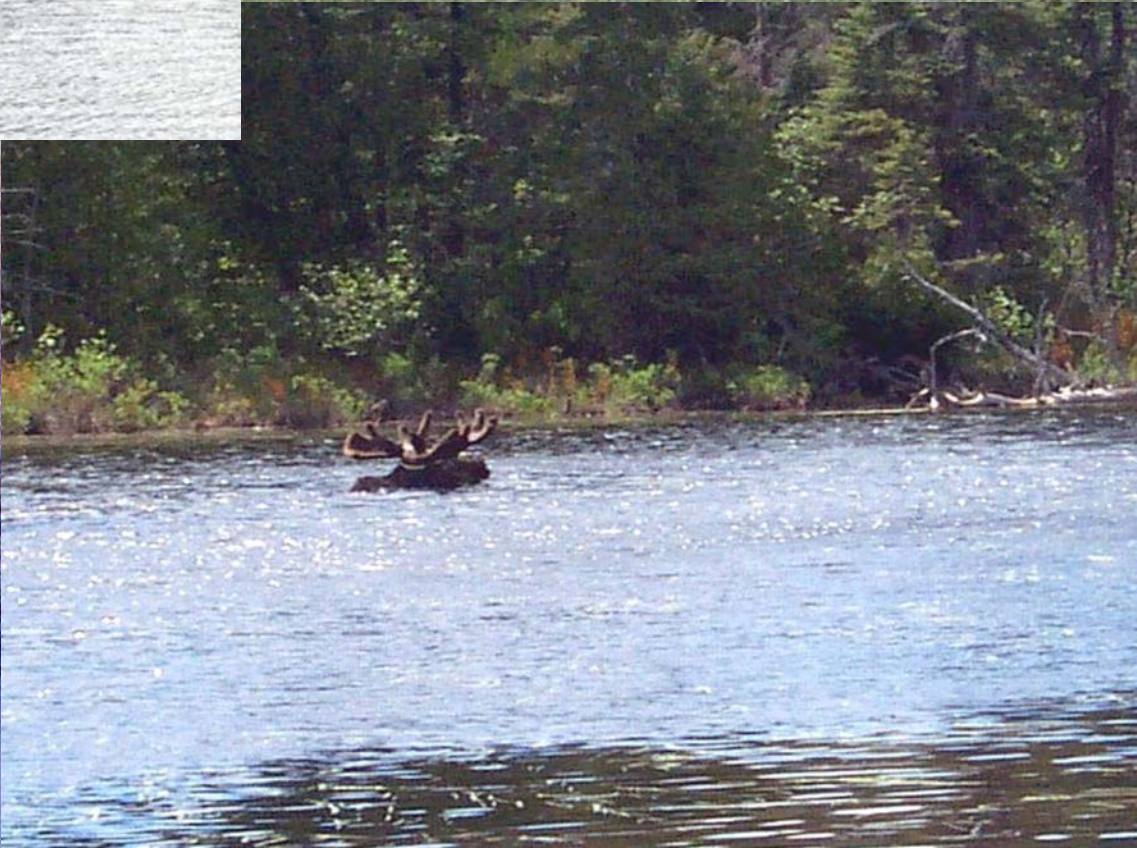
# Historic and Current Range



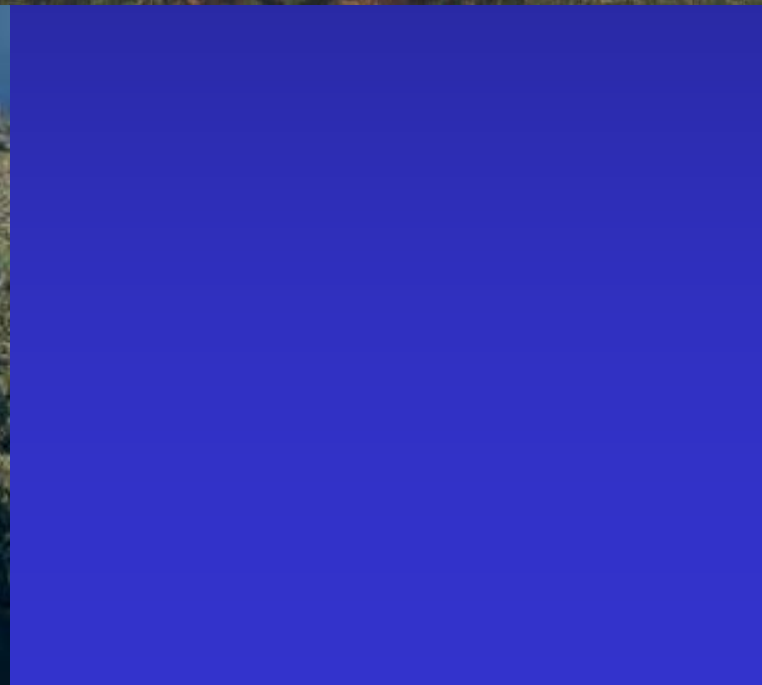


# Life History

















Jefferson Davis et al. Wildlife Center

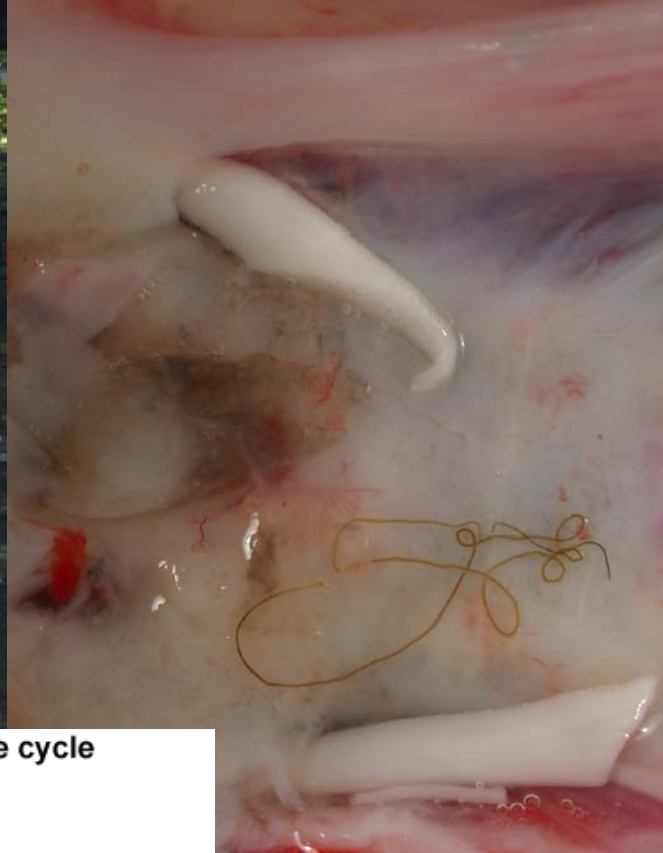


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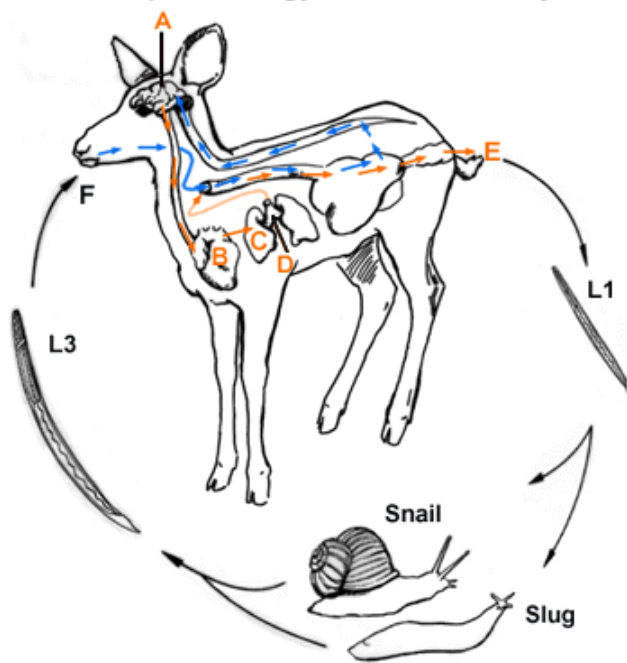


# Disease and Parasites





*Parelaphostrongylus tenuis* life cycle

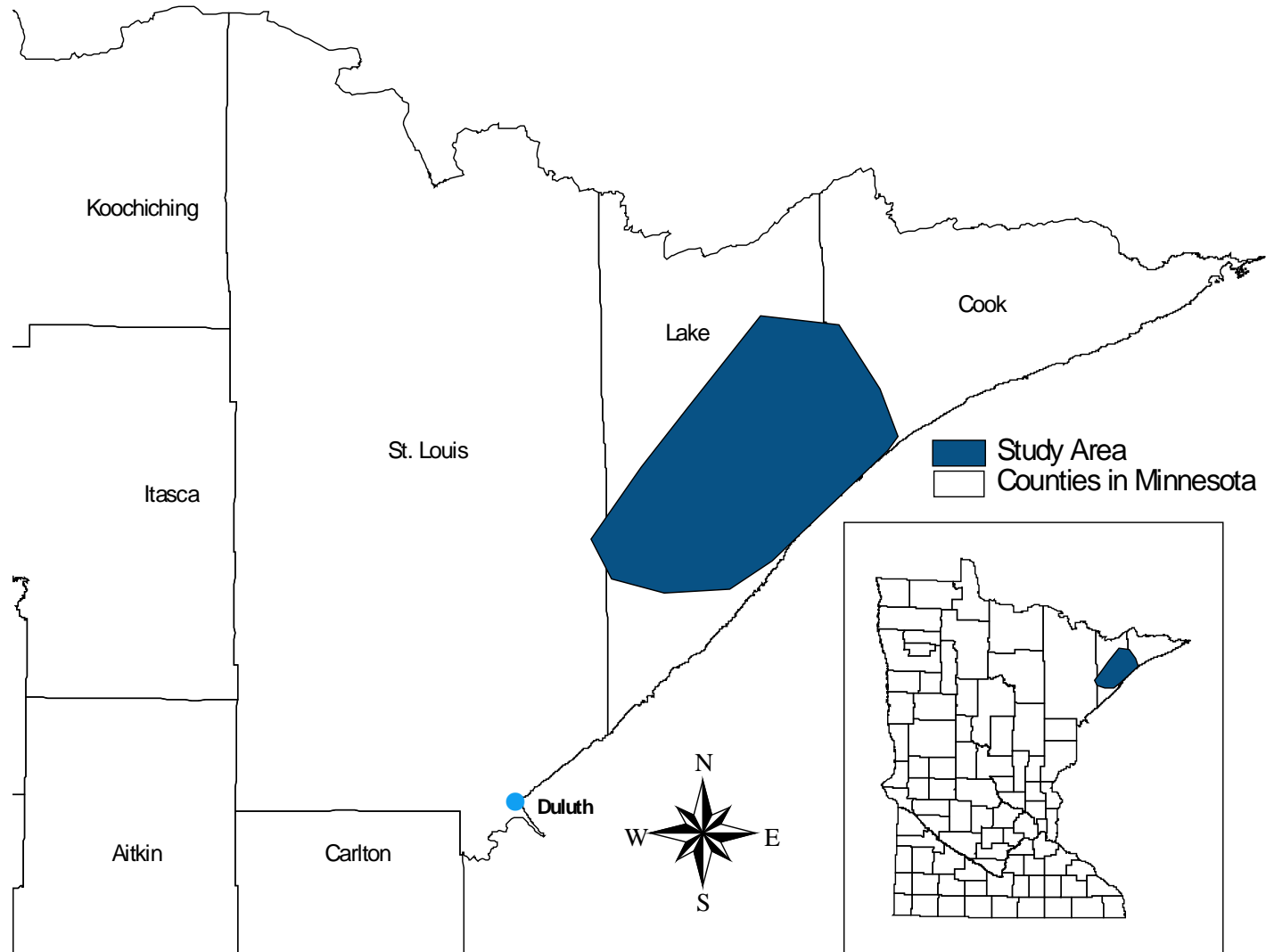








# Northeastern Minnesota Study Area



# Objectives

- **Improve aerial survey of moose numbers**
- **Movements and home range**
- **Determine survival of calf and adult moose**
- **Determine causes and rates of adult mortality**



# Partners

- Minnesota Department of Natural Resources
- 1854 Treaty Authority
- U.S. Geological Survey
- Fond du Lac Band of Lake Superior Chippewa















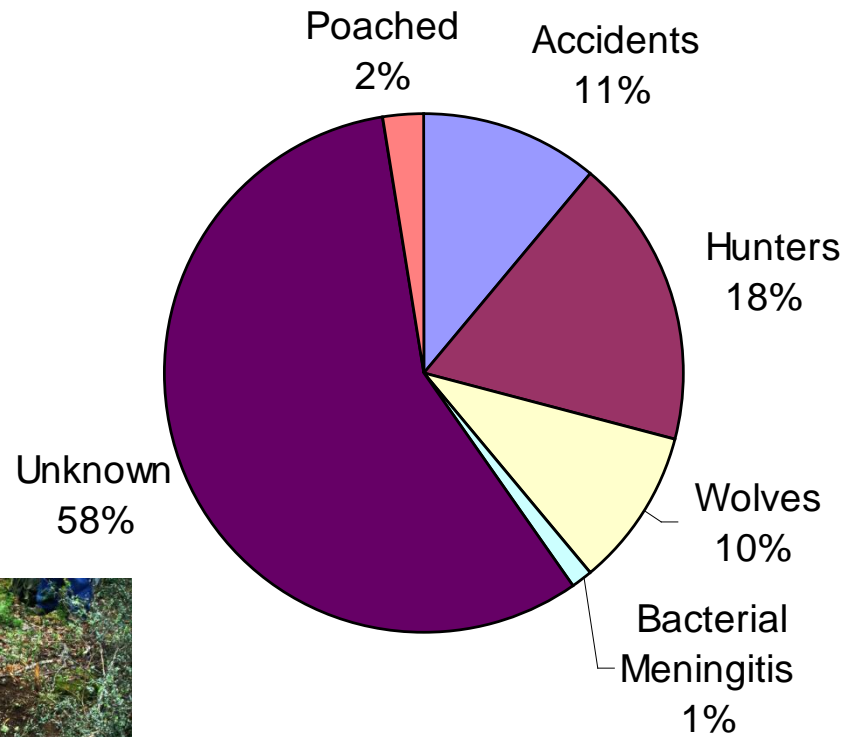
# Results

- **Poor adult survival**
- **Calf survival of 35%**
- **Pregnancy rate of 83% and twinning rate of 30%**
- **58% of mortality described as unknown but likely health related**
- **Correlation between a Heat Severity Index and subsequent mortality**

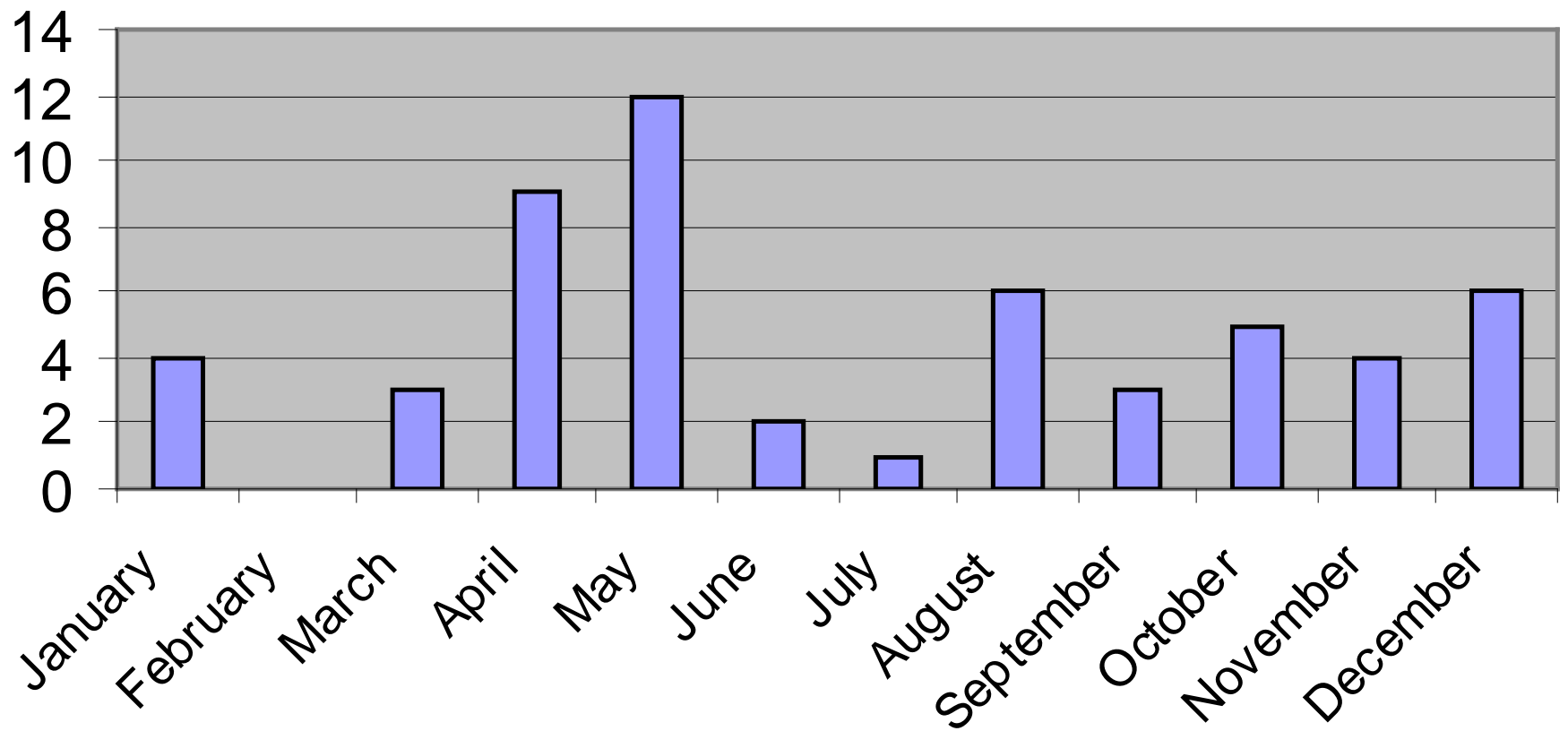
# Adult Non-Hunting Mortality

	Average Adult Non-Hunting Mortality
Alaska & Canada	8 – 12%
Northwestern Minnesota	21% (16–26%)
Northeastern Minnesota	21% (5–35%)

# Causes of NE MN Mortality



# Timing of Non-anthropogenic Mortality





11/20/2002





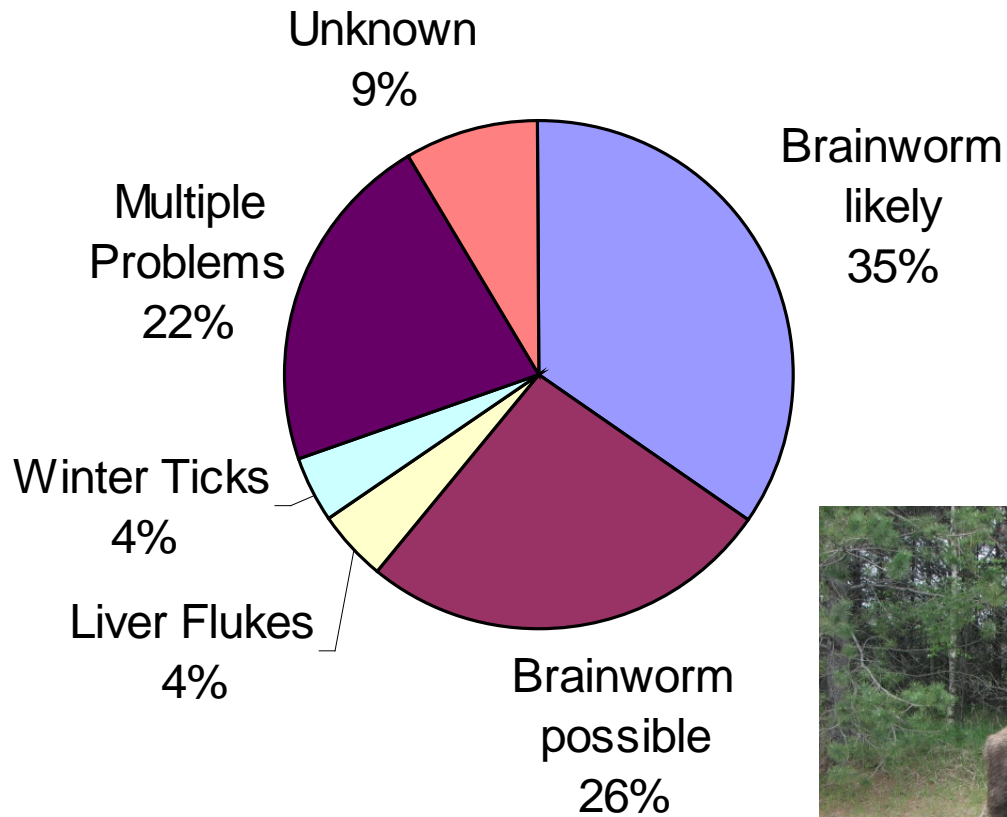






8/4/2004 09:50

# NE Anecdotal Mortality



# Moose Health Screening



# 2007 Results

- **38.5% of samples positive for WNV some strong reactions**
- **35.1% positive for Lyme's Disease some strong reactions**
- **6.8% positive for MCF**
- **4.3 % positive for EEE all strong reactions**
- **1.7% positive for BVD both strong reactions**
- **0.9% positive for Anaplasmosis**

Positives only indicate exposure and strength of reaction. It does not mean the individual developed the disease.

# Negative Results

- **Fecal Sedimentation (discontinuing)**
- **Mycoplasma**
- **Mycobacterium paratuberculosis**
- **Brucellosis**
- **Bovine herpes virus**
- **Blue tongue virus**
- **Epizootic hemorrhagic disease**
- **Neospora**
- **CWD**
- **Bovine TB**



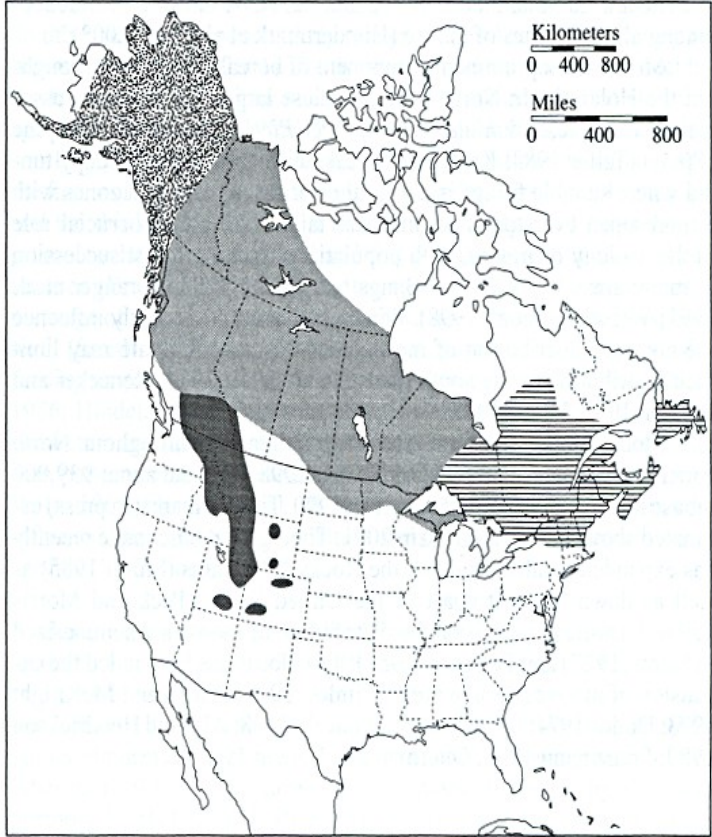






# Pending Results

- **Serum test for brainworm exposure**
- **Analysis of liver for trace elements**
- **Analysis of other data sets of moose samples**



# Heat Stress



-  *A.a. americana*
-  *A.a. andersoni*
-  *A.a. gigas*
-  *A.a. shirasi*



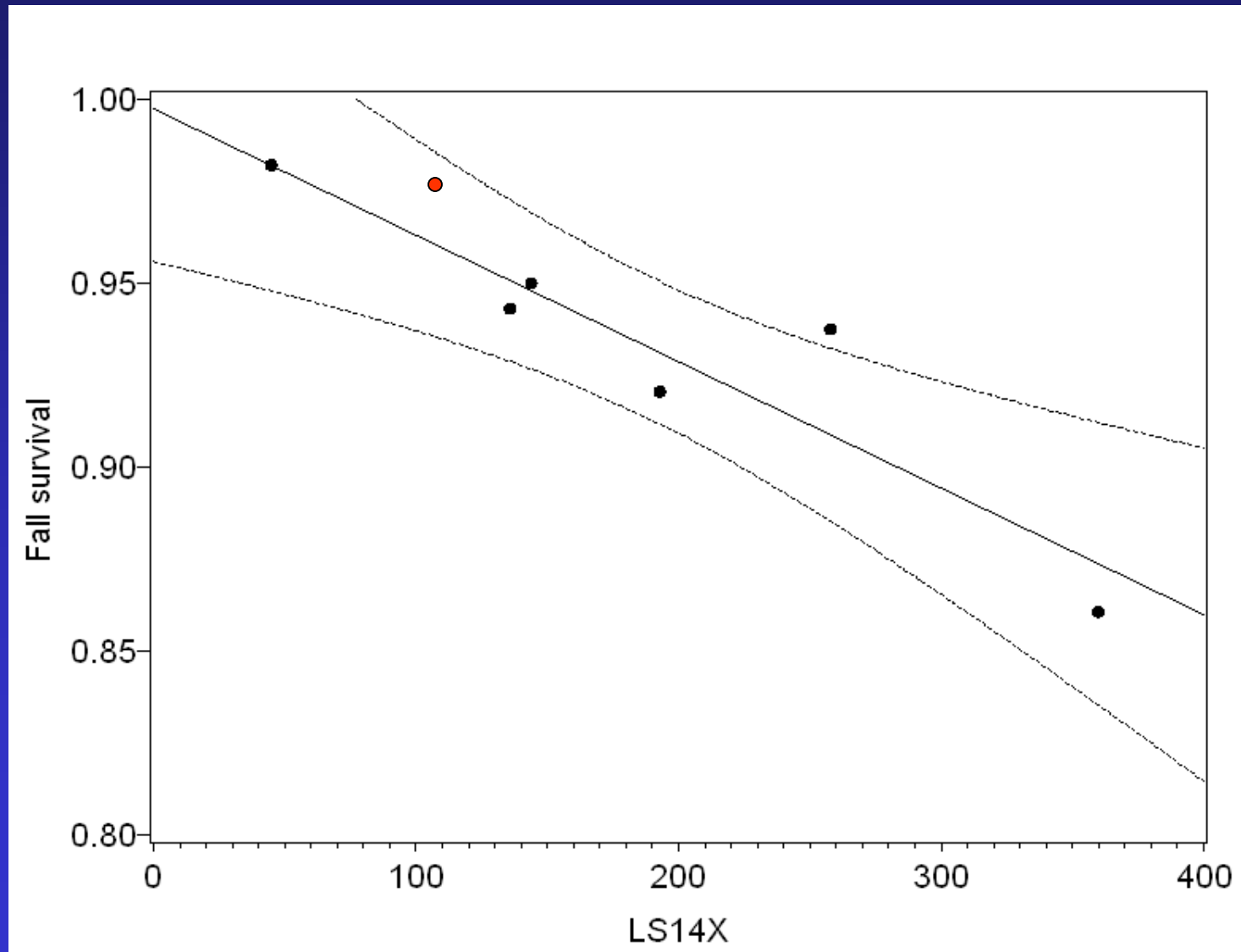


# **In domestic cattle heat stress causes:**

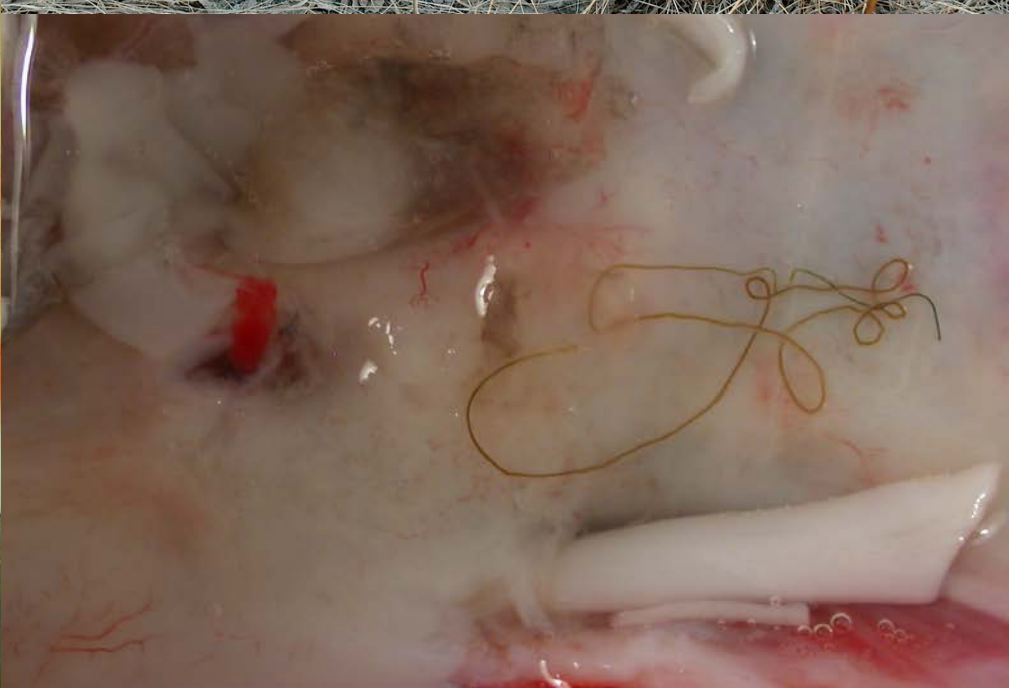
- **Decreased food intake**
- **Reduced weight gain**
- **Decreased milk production**
- **Impaired immune system**

**Reasonable<sup>R</sup> to infer similar effects in moose<sub>e</sub>**

# Temperature and Mortality Relationships in NE Minnesota

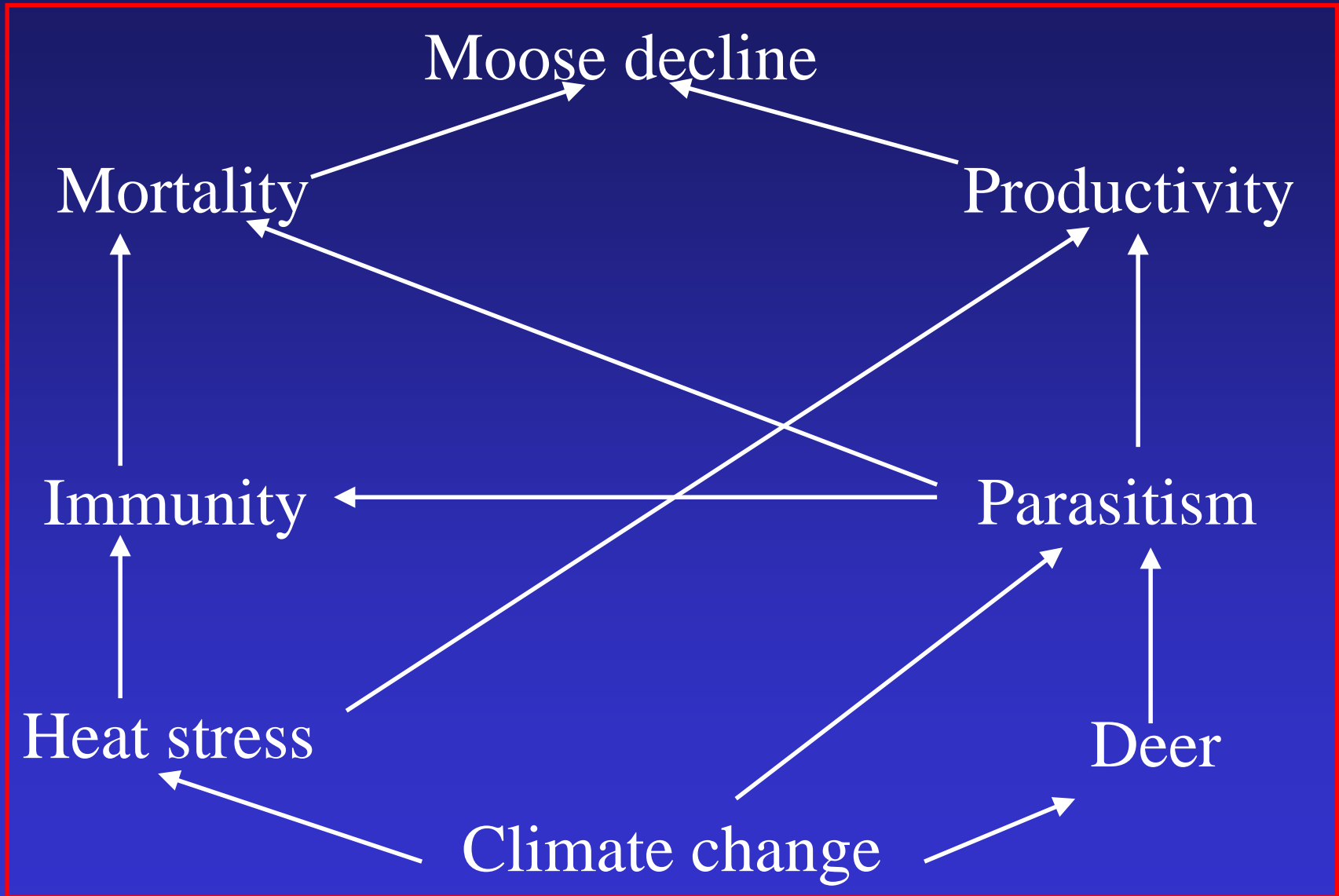






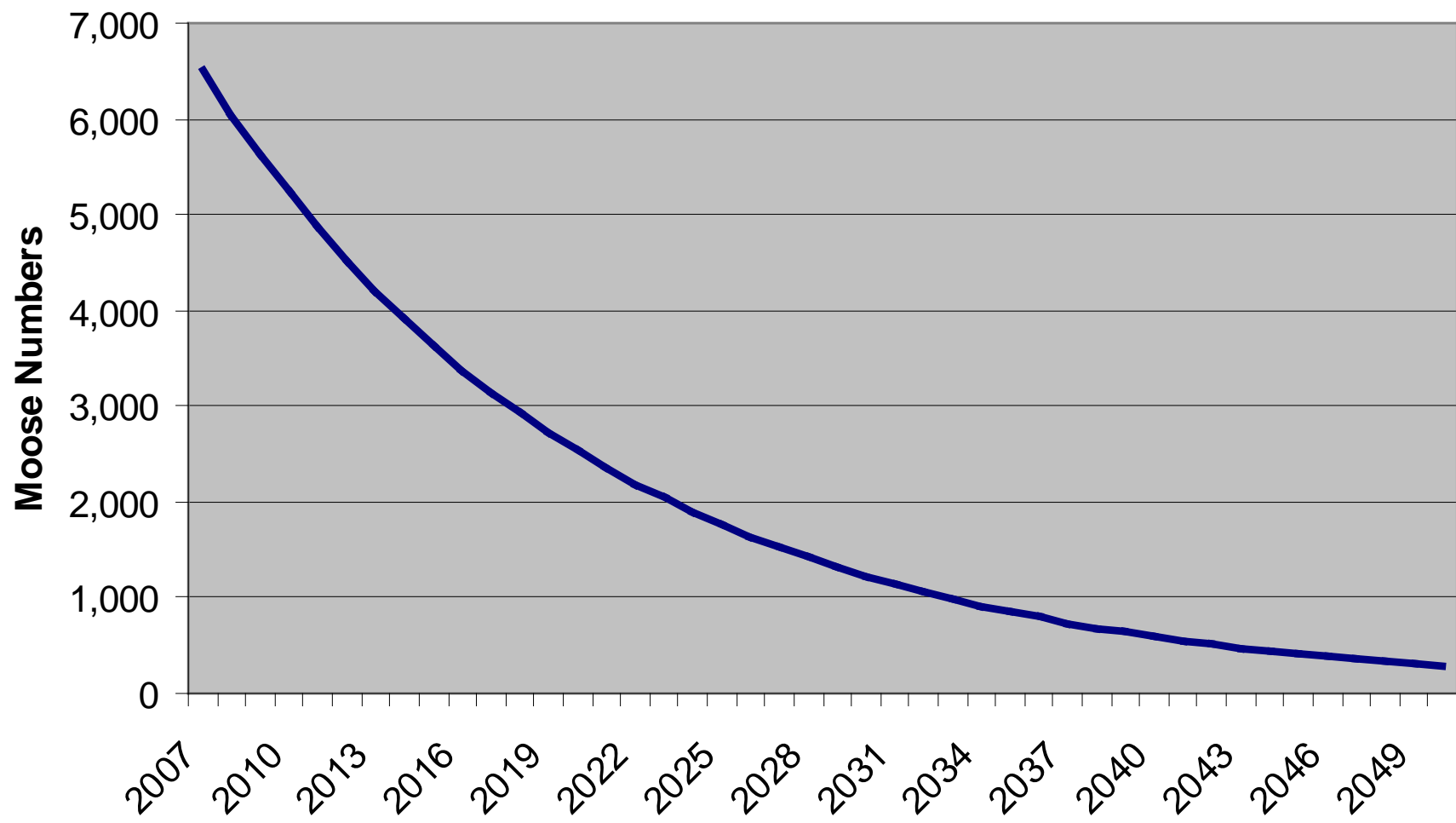


# Conceptual model of moose population decline





# Northeastern Moose Population



# Conclusions

- **Climate change is driving current decline of moose in MN.**
- **Unclear if the primary pathway is heat stress or deer and parasite related.**
- **Projected temperature increases will increase heat stress on moose.**
- **Climate change will create conditions where disease/parasite hosts are more numerous (deer).**
- **Create conditions where disease/parasite hosts are active for a longer season (gastropods, ticks, mosquitoes).**
- **Create conditions suitable for new diseases and parasites to get established.**



