



COMMUNITY-BASED MUSKOX AND CARIBOU HEALTH MONITORING

ACTIVITY UPDATE – NOVEMBER 2023



INVESTIGATION OF MUSKOX MORTALITIES IN ASSOCIATION WITH *ERYSIPELOTHRIX RHUSIOPATHIAE* ON ELLESMERE AND AXEL HEIBERG ISLANDS

PARTNERS



Kugluktuk Angoniatit Association



Olokhtomiut Hunters and Trappers Committee



Ekaluktutiak Hunters and Trappers Organization



WHAT ARE WE DOING?

In the summer of 2021, we were alerted by a documentary film crew of an abnormal number of recently deceased muskoxen seen on the Fosheim Peninsula of Ellesmere Island, Nunavut. The deaths of a selection of these animals were ultimately found to be associated with a clone of the bacterium *Erysipelothrix rhusiopathiae* that has previously been implicated in mass mortality events on Victoria and Banks Islands between 2010 and 2014, and Prince Patrick Island in 2017.

In partnership with the Government of Nunavut (GN), we have sampled (and re-sampled) muskox mortality sites over the past three summer seasons in this region of Ellesmere Island to assess the outbreak and gather additional information relating to this pathogen to better understand why it is affecting High Arctic muskox populations so severely. In 2022 and 2023, GN wildlife biologists did aerial reconnaissance on the Ellesmere and Axel Heiberg to assess the scale of the disease outbreak more broadly.

Additionally, we have been attempting to evaluate the role of sympatric species (foxes, wolves, lemmings, insects, birds, etc.) and the environment in this disease system by sampling feces, regurgitated materials (predatory bird “pellets”), soil, vegetation, and water we have encountered on the landscape while assessing deceased muskoxen.

Using traditional bacterial culture methods in addition to more modern molecular techniques like polymerase chain reaction (PCR) and next-generation DNA sequencing, we are beginning to build a better picture of the epidemiological story in this host-pathogen-environment system.

WHAT ARE WE FINDING?

Over the past three field seasons, 132 muskox carcass sites have been documented across Ellesmere and Axel Heiberg Islands with 114 (86%) of those being sampled in some way (typically a bone for marrow analysis, at minimum), and 25 of those 114 (22% of sampled carcasses) with known dates or date ranges of death. Laboratory analyses are strongly supportive of an active outbreak of disease and mortality secondary to *Erysipelothrix rhusiopathiae* in both 2021 and 2022. Extended sample analyses in 2022 have shown these bacteria to be resilient to the harsh conditions of the Arctic, with live bacteria being isolated a year following the known time of death in both bone marrow and soil in select cases.

Furthermore, phylogenetic analyses of bacterial isolates we have recovered thus far have inferred a timeline



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Remains of a muskox bull encountered on Ellesmere Island in August 2023. A herd of muskoxen grazes in the background.

and direction of disease spread – **Victoria Island** to **Banks Island**, **Banks Island** to **Prince Patrick Island**, and **Victoria Island** to **Ellesmere** and **Axel Heiberg Islands**. The mechanism of spread is not yet fully understood.

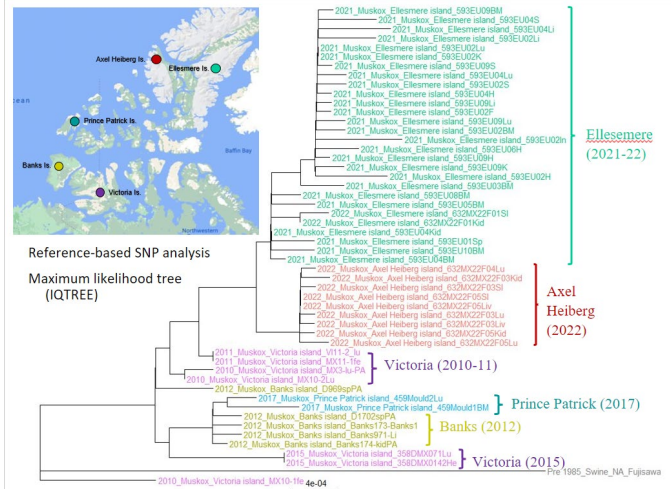
We have also begun to investigate whether other co-infectious agents may be contributing to the emergence of clinical disease in association with *E. rhusiopathiae*. Preliminary data from metagenomic analyses of tissues from freshly dead animals collected in 2022 have pointed toward the presence of both *Babesia* sp. and *Plasmodium* sp. The validity of these findings, in addition to the potential role of hemoparasitic agents in the observed disease outbreak, are still under investigation. We will also be evaluating tissues for the presence of orfvirus, which has previously been implicated as a possible co-infection that may facilitate infection of muskoxen by *E. rhusiopathiae*.

Analyses of the wide breadth of samples collected this season will continue to expand our knowledge of how this agent is persisting in the Arctic environment and how it may be spreading.

In 2023, we observed some muskox calves and only identified two adult animals that had recently died. While these findings bring hope that the deaths from *E. rhusiopathiae* may be slowing in this region, the full effects of this disease on the muskox population are not yet known. We are actively investigating how these bacteria may be being maintained and disseminated in this environment.

WHY DOES THIS WORK MATTER?

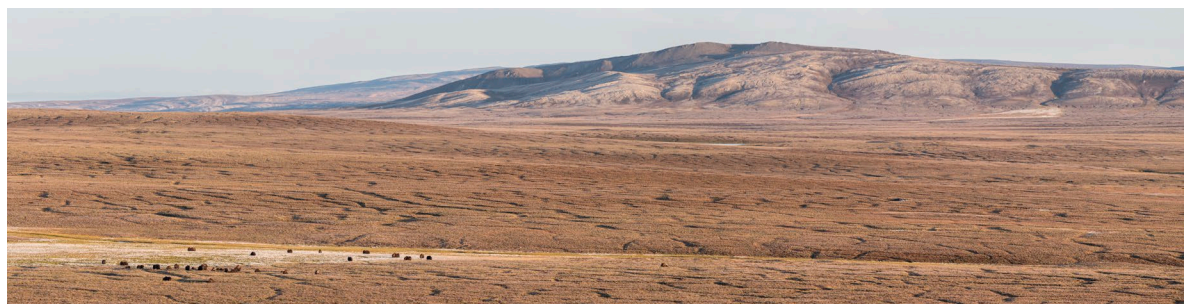
This collaborative investigation is generating useful information on muskox health on Ellesmere and Axel Heiberg Islands and more broadly. We hope that what we are finding will aid in understanding disease threats to muskoxen in a rapidly changing Arctic ecosystem. The development of management strategies that will ensure the continued health of these muskox herds is a top priority for the scientists, organizations, and communities involved.



Maximum-likelihood tree from a reference-based single nucleotide polymorphism (SNP) analysis of selected *E. rhusiopathiae* isolates recovered from deceased muskoxen in the Canadian High Arctic illustrating the timeline and direction of bacterial evolution over the past 10+ years. (Developed by Sreejith Radhakrishnan, Postdoctoral Associate, University of Glasgow)



Arctic wolves encountered on Ellesmere Island in August 2023.



In lam sunlight, a herd of muskoxen graze in a cottongrass meadow on Ellesmere Island in August 2023.

