UNIVERSITY OF CALGARY
FACULTY OF VETERINARY MEDICINE

Muskox and Caribou Health Research: Activity Update March 2017

Prepared by Fabien Mavrot and Susan Kutz March 2017

The Muskox Health Research Program is a collaborative program among universities, communities, industry, and territorial and federal government agencies. The program was initiated in 2008 in response to the apparently changing health status of muskoxen. The muskox lungworm, *Umingmakstrongylus pallikuukensis,* was detected in muskox samples submitted from a community hunt on southwest Victoria Island at that time. Historically this lungworm had been restricted to the mainland and this finding indicated an important range expansion, presumably linked to climate change. Subsequent monitoring found the recently discovered lungworm of caribou and muskoxen, *Varestrongylus eleguneniensis,* in muskoxen from the Cambridge Bay commercial harvest in 2010, and subsequently *U. pallikuukensis* was detected in 2012. Also, during this time there were several reports of dead muskoxen near Ulukhaktok in 2009, near Cambridge Bay in 2010, Lady Franklin Point in 2011, and Banks Island 2012-2013. Deaths of all sampled animals were attributed to the bacterium *Erysipelothrix rhusiopathiae.*

In response to these health changes we launched a collaborative, multifaceted research program with the aim of understanding the general health of muskoxen in this region. The program has grown and evolved over the years and strives to use traditional, local, and scientific knowledge together to better understand the health of muskoxen. Recently, we secured additional funding to support expanding this work to the Dolphin and Union caribou herd, and we are initiating this program in 2017.

The research that we've done to date has only been possible because of the amazing collaboration among communities, governments, universities and the qiviut and sport hunting industries. We thank all the individuals and organizations that have contributed to this work and look forward to working with you further. In the following pages, you will see a brief overview of the various projects that are currently underway as well as contact information for the students involved in the research.

Please feel free to contact me about the overall project and with any questions or concerns.

Best,

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Erysipelothrix in Arctic Wildlife

What's the Issue?

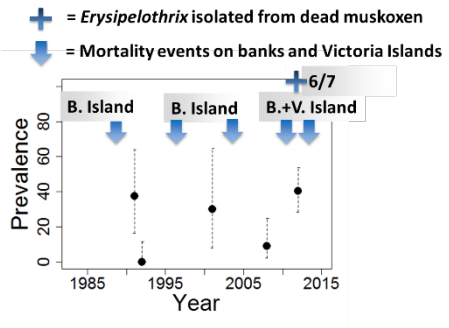
Erysipelothrix rhusiopathiae is a bacterium, primarily known for its role causing disease outbreaks in pig and poultry. This bacterium was isolated for the first time in muskoxen during several unusual mortality events on Banks and Victoria Islands between 2010-2013. We are now investigating if it is present in other wildlife species, such as caribou, geese and lemmings, and if it is new to the Arctic.

Is it new to the Arctic?

No, it's very likely that the bacterium has been around in muskox populations for a long time. We have tested over 600 archived serum samples that from muskoxen collected between 1976 and 2015. Seropositive animals, meaning that they've been exposed to *Erysipelothrix,* were found in muskoxen from all investigated regions in Alaska and Canada, beginning as early as the 1980s. However, there is a lot of variation in the proportion of positive animals from year to year and there is considerable variation in occurrence among populations.

We have also tested over 3'000 caribou serum samples from Labrador to Alaska and have found evidence of this bacteria in all herds tested. We are currently culturing cloacal samples from lesser snow geese collected on Banks Island and also plan to test archived rodent samples from Victoria Island and the adjacent mainland in the near future. So far none of 162 snow geese samples tested cultured positive for *Erysipelothrix*.

Proportion of muskoxen positive for exposure to Erysipelothrix on Banks Island between 1990 and 2012



Why is it important?

We have cultured *Erysipelothrix* from multiple tissues of muskoxen sampled during mortality events and believe it is an important factor in the death of these animals. Exposure to the bacteria is also higher in some declining muskox populations in Alaska, suggesting that it may play a role in population declines. Mortality events are likely multifactorial though, with stress, environment, climate, etc., also involved.

What's next?

We are currently analyzing data on exposure to *Erysipelothrix* in caribou relative to population trends to assess if there is evidence of it playing a role in recent caribou declines. Through community-based monitoring in Ulukhaktok and the Kitikmeot, together with disease investigations and opportunistic sampling, we will continue monitoring muskoxen and caribou for exposure to *Erysipelothrix* during 2017 and analyze samples from other populations (Greenland, Quebec). We also hope to collect Traditional Knowledge in Ulukhaktok to help identify risk factors for infection with the bacterium.

Research conducted by Fabien Mavrot, Michele Anholt

Teeth abnormalities

What's the issue?

Beginning in 2015, we noticed that almost all of the muskoxen sampled in our community-based sampling program on Victoria Island had multiple broken incisors (front teeth). The occurrence of this tooth breakage is much lower in the muskoxen that we've examined from the adjacent mainland. Comparing our findings today with data from 30 years ago, it seems that there is a large increase in the occurrence of "bad teeth" cases on Victoria Island.

Why is it important?

Animals with broken teeth are not uncommon in the wild. In particular, old individuals are likely to have broken and worn out incisors. However, our investigation showed that many muskoxen, including young animals, had almost all their incisors broken.

In such extreme cases, the animals are probably not able to feed themselves correctly and might either starve or be weakened and more susceptible to disease or predation.

What are the causes?

We don't know yet why there is such a high occurrence of incisor breakage. Possible causes are

- vitamin/mineral deficiencies or imbalances
- mechanical breakage: if vegetation has changed/is harder (especially during the winter – if there is less snow in winter to insulate the plants, they might be frozen particularly hard resulting in damage to the incisors.)
- genetic: e.g., increased occurrence of animals with misaligned teeth (which are more likely to break)

What's next?

Our results so far are based on a small number of animals. We will collect more jaws both on Victoria Island and on the mainland to better assess the situation. We will conduct specific analysis on the collected jaws in order to better understand the causes of the problem.

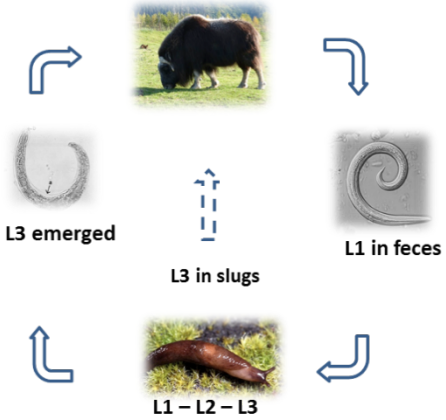
Research conducted by Fabien Mavrot

Muskox lungworm

What's this?

Umingmakstrongylus pallikuukensis is a parasite that lives in the lungs of muskoxen and can cause bleeding in the lungs and through the nose after animals run. The parasite grows in nodules of 1-4cm in diameter in the lungs. Worms than lay eggs, which hatch into first stage larvae (L1) in the lungs and then are coughed up, swallowed and passed in the muskox feces. There, they enter slugs that feed on muskox feces (intermediate hosts) and grow to the third stage (L3) in the slug. This development depends on outside temperature, occurring more rapidly when it is warm. The L3 reaches muskox stomach while grazing (emerged L3), or when the slugs get eaten by muskoxen (by accident with grass). They then migrate to the lungs, and a new infection cycle begins.

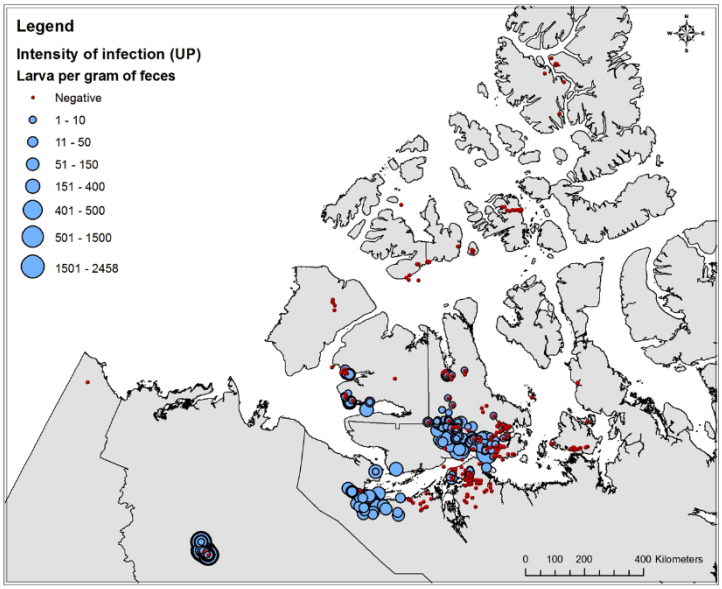
Lungworm infection cycle.



What have we found so far?

We are monitoring the *Umingmakstrongylus* and documenting its spread in the Canadian Arctic. We have tested over 1200 muskox and caribou feces since 2013. Our results show that, although the parasite was absent from Victoria Island 20 years ago, it has now colonized the southern and central part of the island. It is very likely that the **warmer arctic climate** is responsible for this range expansion.

Lungworm infection in muskoxen sampled between 2013 and 206.



Why is it important?

Parasites are common in wild animals and lungworms alone are not going to kill muskoxen. However, they contribute to a general bad health of the infected animals and can act together with other stress factors to make the animals weaker. We need to further investigate the impact of lungworms on muskoxen of Victoria Island.

What's next?

We continue to track the range expansion of lungworm by expanding our muskox sampling to Ulukhaktok and the surrounding areas, and doing further sampling to determine the distribution of slugs. We are also using lab experiments and mathematical modeling to understand the environmental factors driving and limiting the range expansion of this parasite in the Arctic.

Research conducted by Pratap Kafle (University of Calgary) and Alex Nascou (University of Toronto)

Monitoring muskoxen using local/traditional knowledge

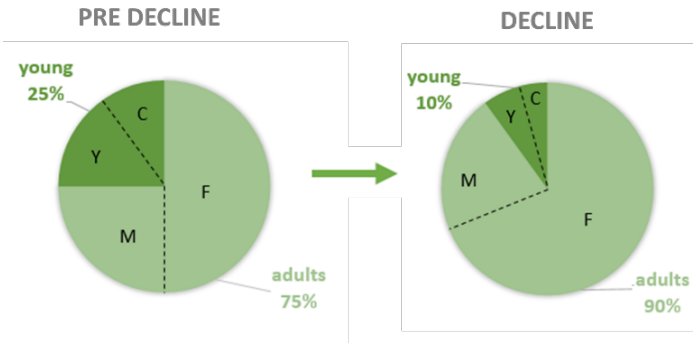
What's that?

The Arctic is a remote and harsh environment that makes it difficult for scientists to observe and sample muskoxen continuously over long time periods. However, Inuit hunters and community members live in close contact with the muskoxen and have an extensive knowledge of the species. We believe that integrating this local/traditional knowledge with our current scientific monitoring of muskoxen will improve our understanding of the species' ecology and health.

What have we found so far?

In a project conducted in Cambridge Bay, PhD student Matilde Tomaselli conducted interviews of local inhabitants and summarized their observations on muskoxen. Important findings were:

- Muskox numbers around Cambridge Bay have decreased dramatically since the mid 2000's (these observations are consistent with recent estimates done through aerial survey).
- Muskox groups tend to be smaller now than in the past and with fewer young animals.
- More dead, skinny or sick muskoxen have been observed in recent year.
- Muskoxen with scabs on their nose and bleeding from the nose are recently observed. This was never seen before. The bleeding is consistent with lungworm infection and the scabs are consistent with disease caused by "orf" virus, first described in muskoxen on Victoria Island in 2016.



Why is it important?

Participatory action research that gathers local and traditional knowledge on muskoxen provides important information for wildlife management. Scientific sampling is robust, but is only conducted at periodic intervals. In contrast, hunters on the land are able to provide considerable information over time, over seasons, and over a vast geographic area when all combined. Observations gathered through interviews demonstrated similar findings as the population surveys, however, they provided additional information. For example, the observations of smaller groups, fewer young, increased mortality and thinner animals all provide new insights into possible factors causing population declines.

What's next?

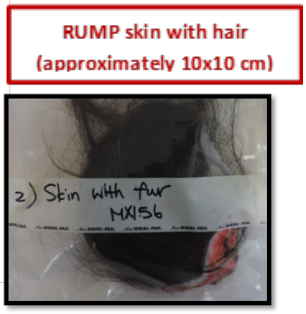
We are currently expanding this approach to two new communities in the Canadian Arctic: Ulukhaktok and Kugluktuk and to the Dolphin and Union caribou. We will compare the results obtained in these communities with those from Cambridge Bay.

Research by Matilde Tomaselli. New researchers: Juliette Di Francesco, Fabien Mavrot, Andrea Hanke

Measuring stress in muskoxen

How do we measure stress?

When an animal is stressed, it releases hormones that are incorporated into the fur. These hormones can be measured in qiviut and guard hairs. For this reason, we ask hunters to collect a small sample of skin with hair as part of the overall sample collection on hunted muskoxen.



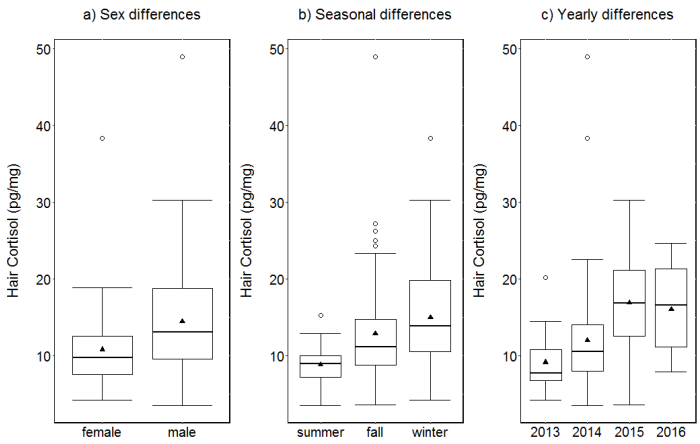
Why is it important?

Stressed animals are more likely to get sick and may have a reduced reproductive success. Measuring the stress level of muskoxen can tell us a lot about the general health status of the animals or the populations. Our preliminary results on **150 hair samples** collected in the communities of Cambridge Bay, Sachs Harbor, Kugluktuk, Ulukhaktok and Paulatuk shows a wide range of stress levels in muskoxen. The sex of the animals, along with the season and year the samples were collected, all have an effect on qiviut cortisol levels, which shows the importance of recording this information for each animal sampled. Additionally, stress levels tend to be higher in the declining island populations compared to mainland populations.

What's next?

We will expand sampling in 2017 to Ulukhaktok and Kugluktuk and begin to evaluate how qiviut cortisol is related to the health of individual animals. We will also further study the hormonal response to stress in an experimental trial on captive muskoxen in collaboration with the University of Fairbanks, Alaska. The ultimate goal of this project is to determine if qiviut cortisol levels can be used as an indicator of individual and/or population health.

Differences in muskox stress level between by sex, season and year



Research conducted by Juliette Di Francesco

Orf virus in muskoxen

What's that?

Orf is a virus commonly found in sheep. It causes bleeding lesions, later covered with crust (scabs), on the nose, around the mouth and on the feet of the animals. It is also known as sore mouth or contagious ecthyma and can be transmitted to humans. However human infections are generally harmless and heal by themselves in a few weeks.

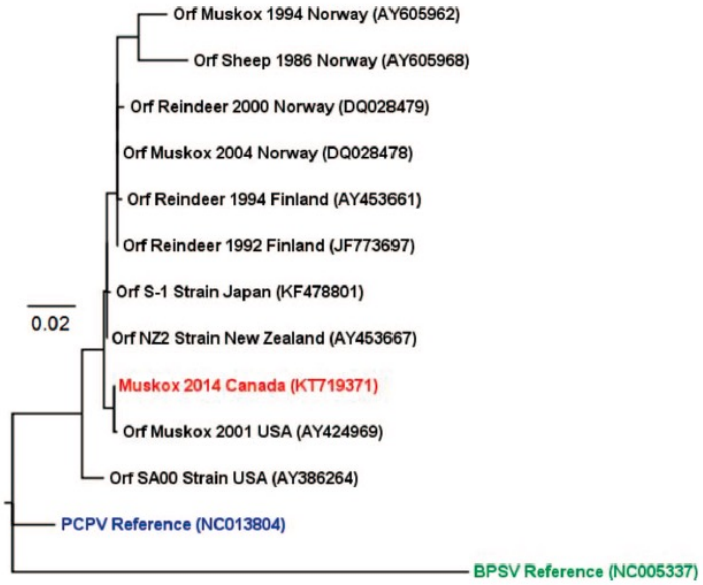
In 2014, scabs that are characteristic of the disease were detected on a muskox from Victoria Island during our monitoring effort. After additional laboratory analyses, we confirmed that the animal was infected with an "orf" virus.

Since then, the virus has been detected in several other muskoxen on Victoria Island. All the animals had lesions on their nose or their feet that were likely caused by the "orf" virus

Why is it important?

Orf is typically a problem for young or weak animals which have a reduced capacity to defend themselves against microbes. In some cases with sheep, the sores on the mouth of the lambs, or sores on the udders of the ewes, results in the lambs starving to death. The wounds caused by orf may also let other bacteria invade the skin. The fact that we have detected orf lesions in adult animals may be a sign of other underlying problems/stressors in those animals.

Genetic closeness between different "orf" viruses found in muskoxen and other species.



What's next?

We will perform more in depth genetic analyses to better understand the origin of the virus found in the muskoxen of Victoria Island. We also look for the virus in other species such as caribou.

Research conducted by Chimone Dalton

Muskox Health and Ecology Symposium

Our group organized the first International Muskox Health and Ecology Symposium that was held at the University of Calgary from the 7 to 10th November, 2016. More than 70 delegates from all the main "muskox regions" and representing different groups such as co-management boards, industry, government, Hunters and Trappers organizations, and academia, gathered for this three-day event. During the sessions of oral presentations and break-out groups, speakers and attendees discussed themes as diverse as the value of muskoxen, the current population status and trends across the Arctic, the existing monitoring tools available and the gaps in knowledge regarding the species.

This Symposium was a unique opportunity to have muskox experts from different fields and interest groups debating together the challenges of managing the species in a changing Arctic. We plan to publish the summary of those presentations and discussions in a special issue of Arctic in June 2017.

Educational activities in Arctic communities

During recent consultations on research needs to address alarming declines in muskox health and numbers in Ulukhaktok, the Olokhaktok Hunters and Trappers Committee emphasized the critical importance of implementing a youth educational program concurrent with scientific research in order to directly engage this next generation in science and, ultimately, inspire them to go further to develop the knowledge and tools and for monitoring and management of the wildlife populations in their rapidly changing environment. Similar sentiments were expressed by the Kugluktuk Hunters and Trappers Organization during consultations in spring 2016.

This inspired us to apply for a NSERC: Promoscience grant to deliver educational activities to the youth of Ulukhaktok and Kugluktuk. Those activities will be organized in parallel to our field work and in collaboration with the local schools. We will deliver presentation on different topics related to wildlife health monitoring but also on ecology and careers opportunities in science. We will also organize workshops and "on-the-land" activities where students will get in touch with more practical aspects of our work.