Documenting Indigenous Knowledge to Identify and Understand the Stressors of Muskoxen in Nunavut

Kugluktuk Angoniatit Association

A **collaborative initiative** among the Kutz research group, the Kugluktuk Angoniatit Association, the Government of Nunavut, and muskox harvesters from Kugluktuk, done as a component of Juliette Di Francesco's PhD thesis

UNIVERSITY OF CALGARY

Kutz Research

Background

- Muskoxen extremely well **adapted** to Arctic environment, but **low genetic diversity** → **vulnerable** to new, complex, and increasing environmental **stressors**
- Importance of **identifying these stressors** and understanding their **impacts** on muskoxen

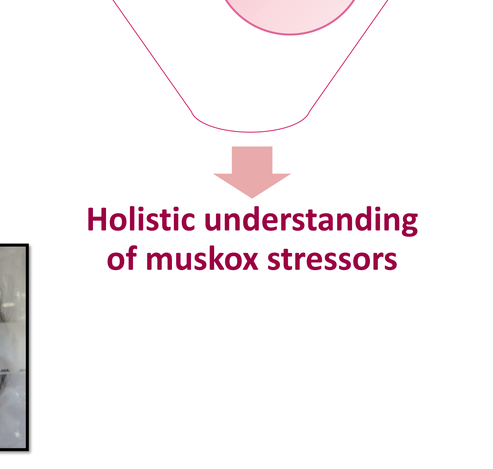
Study Objectives

- Discuss the **positive** and **negative factors** affecting muskoxen, their impacts, changes over time, and timing of occurrence
- Discuss factors potentially contributing to the **sex differences**, and **seasonal** and **yearly variations** in **muskox stress levels**

Methods

Hunter-based sampling program

- **150 muskox hair samples** analyzed between 2013 and 2016
- Measurement of hair stress (cortisol) levels
- Assessment of **sex, seasonal, and yearly differences**



Holistic understanding of muskox stressors

Documenting traditional Inuit knowledge

- **Seven small group interviews** with muskox harvesters – 2-3 participants/group
- Transcription and determination of **themes**
- Clarification and confirmation of results through **validation sessions**

Results

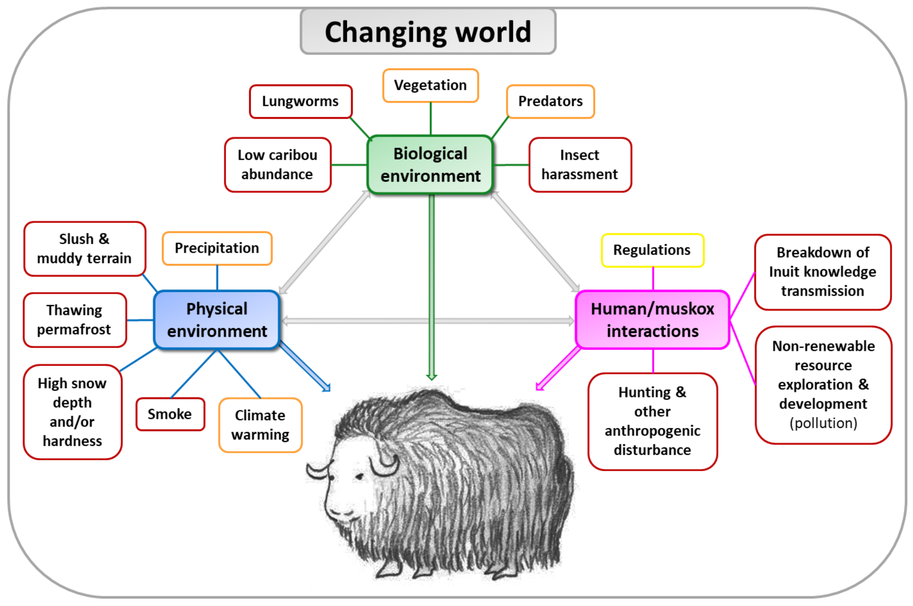


Figure 1: Factors affecting muskoxen negatively (red), positively (yellow) or both negatively and positively (orange) (muskox drawing by Jayninn Yue; Di Francesco *et al*. (2021)).

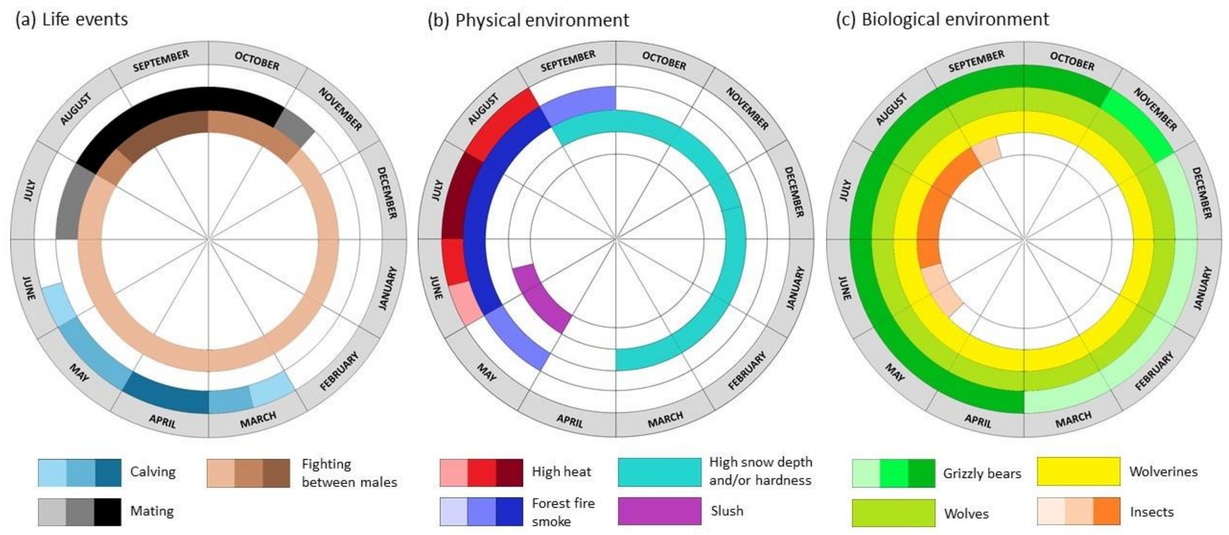


Figure 2: Yearly calendars summarizing interviews and validation sessions showing the timing of key life events (a) and of factors that negatively affect muskoxen within their physical (b) and biological (c) environments (Di Francesco *et al*. (2021)). The darker the color, the more groups indicated the month of occurrence during the interviews. If all groups indicated the same information, only one color was used.

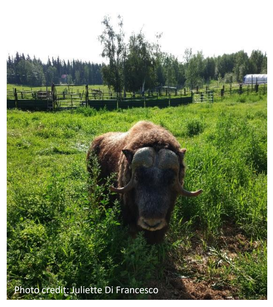
Insect harassment

Changes over time

- Climate warming & air/sea traffic → **increase in diversity of species** since 1980s-1990s
- **Abundance** – strong annual variations, increase?
- **Longer period of activity**

Effects on muskoxen – only one study in 1982

Muskoxen increase proportion of time spent walking and standing, and decrease proportion of time spent feeding during high insect harassment



Negative Impact

- Thick skin & long hair → **muskoxen less harassed & sensitive** than caribou
- Avoid harassment by staying next to water sources
- **Affected on their legs & face (shorter hair)** → moderate restlessness, increased movements, less time spent eating

→ **Limited but non-negligible effect**

Figure 3: Impacts of insect harassment on muskoxen – findings from scientific knowledge and traditional Inuit knowledge.

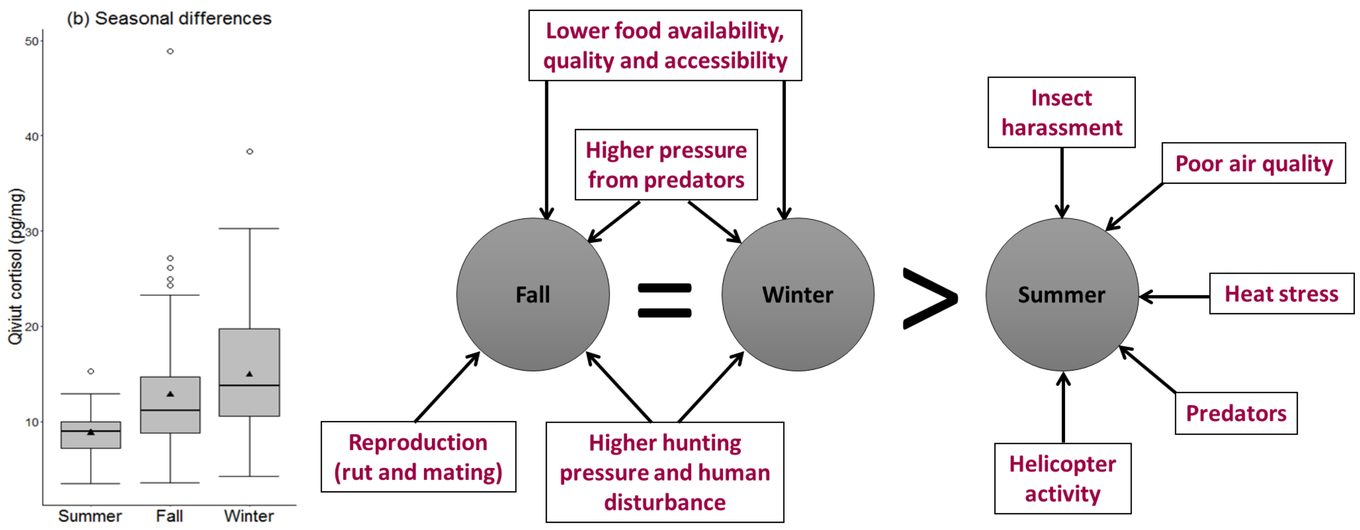


Figure 4: Seasonal variations in muskox hair stress (qiviut cortisol) levels and factors potentially contributing to the differences (Di Francesco *et al.* (2017, 2021)).

Implications & Conclusions

- **Invaluable insights** on factors possibly affecting muskoxen
- Findings applicable to the **participants' area of observation** (Kugluktuk, Victoria Island, and Kent Peninsula), and not generalizable to the rest of the muskox range

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Hair Stress Levels: A Reliable Tool to Monitor Muskox Health?

Kugluktuk Angoniatit Association

Ekaluktutiak Hunters and Trappers Organization

Olokhaktomiut Hunters and Trappers Committee

A **collaborative initiative** among the Kutz research group, the Kugluktuk Angoniatit Association, the Olokhaktomiut Hunters and Trappers Committee, the Ekaluktutiak Hunters and Trappers Organization, the Government of Nunavut, and the Government of the NWT, done as a component of Juliette Di Francesco's PhD thesis

Government of Northwest Territories

Kutz Research

Background

- Muskoxen **increasingly exposed to stressors** in the **rapidly changing Arctic**
- **Increased stress** over **long periods of time** may cause **negative effects**, such as **reduced health, reproductive success**, and **survival**
- Stress levels measured in hair represent the **stress experienced** by the animal **during the time of the hair's growth**
- Measuring stress levels in hair allows us to **identify factors that may be causing stress**

Study Objectives

- Determine if hair stress levels are related to other **measures of the health of individual animals**
- Determine if hair stress levels vary across **sexes**, **age classes**, **seasons, years,** and **geographical locations**

Methods

- Sample kits were collected from **211** harvested muskoxen **between 2015 and 2019** through the monitoring program

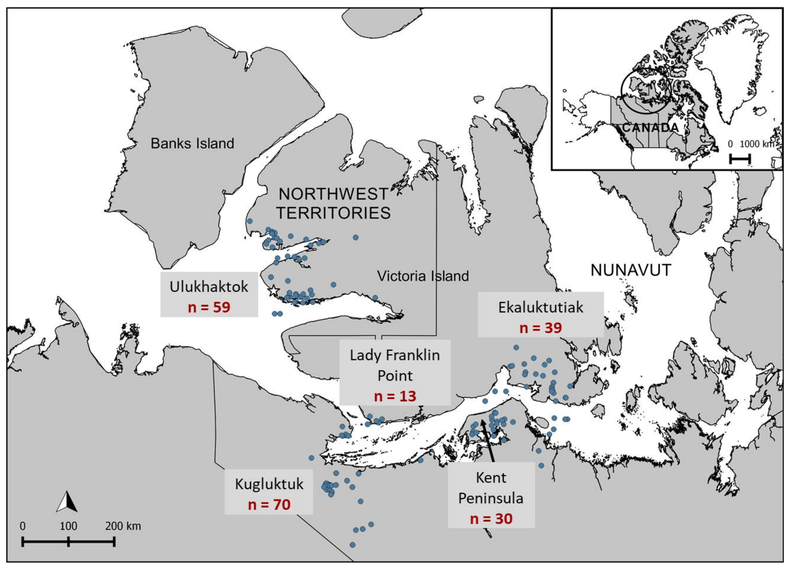

Figure 1: Sampling location of the 211 muskoxen.

Figure 2: Samples collected using the standardized kits and analyses carried out.

- We analyzed the data to look at the relationship between hair stress (qiviut cortisol) levels and sex, age, season, hair growth year, geographical location, body condition (back fat, hunter assessment, and marrow fat), incisor breakage, lungworms, gastro-intestinal parasites, and bacterial exposure

Results

Sex, Seasonal, and Yearly Variations

- **Males** had **higher stress levels** in their hair than **females**
- **Males** in **late fall-early winter** had **higher stress levels** in their hair than **males** in **mid-late winter**, which is likely due to the stress experienced during **rut and mating**
- Stress levels in hair were **higher in 2015 and 2018**, and **lower in 2016 and 2017**

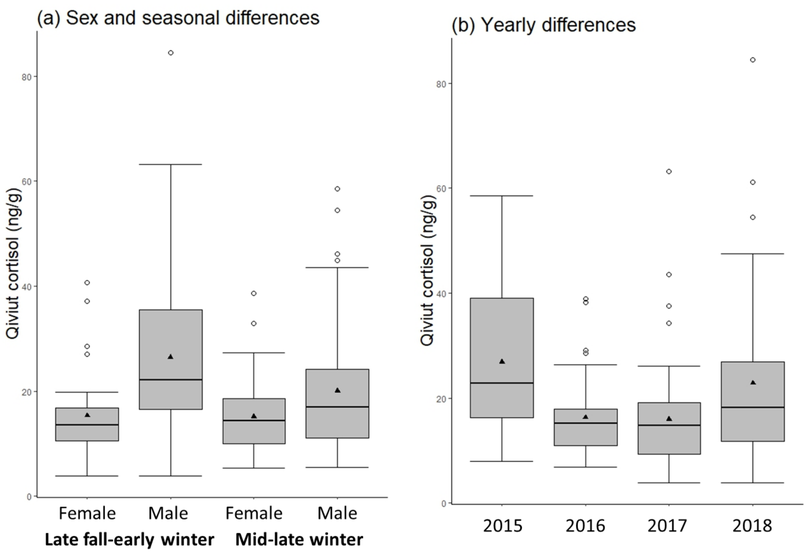

Figure 3: Sex, seasonal (a), and yearly (b) differences in muskox hair stress (qiviut cortisol) levels.

Age and Geographical Variations

- No difference in hair stress levels between age classes
- Hair stress levels were **higher on Victoria Island** than in Kugluktuk, and **even higher on the Kent Peninsula**
- Results **were consistent with muskox population trends – lower hair stress levels in Kugluktuk** matched where the muskox population is **stable to increasing**, and **higher levels on Victoria Island** matched where the population is **declining**

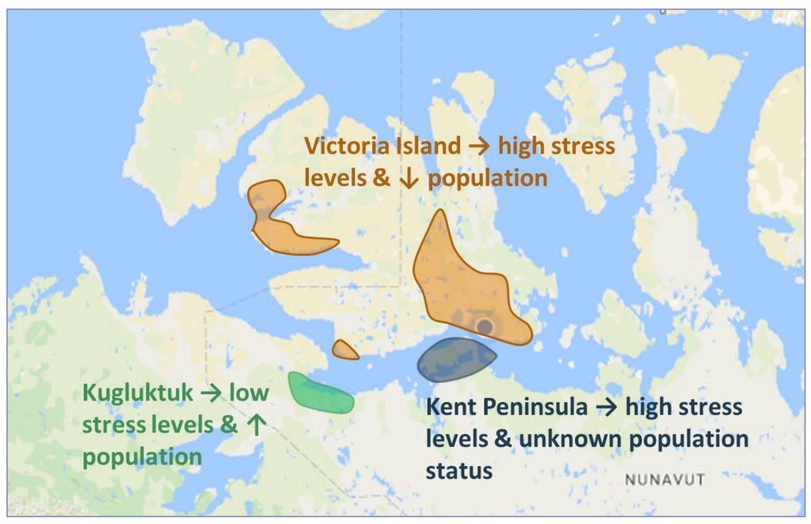

Figure 4: Geographical differences in muskox hair stress (qiviut cortisol) levels.

Relationship with Health Metrics

- **Increased hair stress levels** were associated with **decreased marrow fat** (body condition)
- The relationship between hair stress levels and levels of the lungworm *Umingmakstrongylus pallikuukensis* (*Up*) depended on the geographical location:
  - **Kugluktuk**: Hair stress levels increased as *Up* decreased – reflects **long-term parasite-muskox relationship** with almost 100% muskoxen infected and high levels of *Up*
  - **Victoria Island**: No relationship – reflects minimal parasite negative effects at low levels
- No relationship between hair stress levels and incisor breakage or exposure to the bacteria *Brucella suis* and *Erysipelothrix rhusiopathiae*
- No relationship between hair stress levels and gastro-intestinal parasites, which is likely due to low parasite levels and the ability of muskoxen to limit the negative impacts of the parasites

Implications & Conclusions

- Need to gather long-term data from additional muskox populations for which population trends are known to **confirm the relationship between population trajectory and hair stress levels** – if consistent, hair stress levels could be used as a **tool to monitor muskox population health**
- If increases in hair stress levels precede population declines or mortality events, they could be used as a **tool to predict population health**

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