

Rangifer Health and the Pathogen Landscape

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What is Health?

Contextual!

	Characteristics	Values
Biologist	Survival and reproductive rates	Population persistence
Veterinarian	Disease/toxin syndromes, body condition, immunity/physiology	Individuals and populations, food safety, trade, welfare
Reindeer herders	Weight gain, meat quality, calf production, revenue	Livelihood, economics, welfare
Subsistence hunters	Meat and hide quality, availability, behaviour	Food safety/security, culture, animals/ecosystems
Sport hunters	Size, antlers, availability	Quality animal, experience

- Health Does not equal just the absence of disease!!
- Populations and individuals
 - Healthy populations can have unhealthy individuals and vice versa
- Do we need a shared definition of *Rangifer* health?





MacBeth and Kutz. 2018.





Histogram of hair cortisol for wild muskoxen (DiFrancesco et al., 2017)



Hair cortisol predicted mortality of BC boreal caribou by the subsequent winter



Bondo, MacBeth, Kutz, Schwantje

How do Pathogens Affect Health?



Direct Energetic costs: All the energy required for a warble life-cyle is derived solely from the caribou





Consumption, immunity, inflammation, pain, behaviour





Endemic pathogens: Direct Reproductive costs

 Caribou seronegative to Neospora caninum were more likely to be pregnant than those that were seropositive (OR = 11.0; P = 0.016)



- Other pathogens of caribou with <u>direct</u> reproductive effects:
 - Toxoplasma, Besnoitia
 - Brucella, Chlamydophila
 - Cervid Herpes virus, Pestivirus (unidentified species)
- DU caribou in 2015 & 2016 Neospora (22%), Toxoplasma (7%), Brucella (15%), Herpes (85%)

What is the impact of one disease-associated pregnancy loss over a lifetime?

Other Direct, Indirect, and Interactive effects



P. odocoiliei, 'muscleworm' in thinhorn sheep



Changing Landscape of Pathogens

• Exposure:

- Climate driven increase/expansion of endemic pathogens
- Invasion of new pathogens and hosts (known and unknown)
- Behavioural changes e.g., migration/concentration
- Susceptibility:
 - Links back to the determinants of health

Changing Exposure: Climate Change and Parasites



Climate change amplifies endemic parasites, shifts the population to the right



Emerging (but predictable) diseasesWinter Tick in BC boreal caribou

MILD

BC BCHRP BC BCHRP British Columbia Boreal Califou Health Research Program

79% of 164 captures with hair loss '*not an issue 10 years ago*'





Moose density? Shifting host communities





Behavioral change – loss of migratory escape from parasites increases exposure





Development and availability of the free-living stages of Ostertagia gruehneri, an abomasal parasite of barrenground caribou (Rangifer tarandus groenlandicus), on the Canadian tundra



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DU caribou migration

Changing Susceptibility

- Susceptibility:
 - Links back to the determinants of health
 - Severe weather crash
 - Nutrition trace elements
 - Poly-pathogens co-infections
 - Disturbance stress



MacBeth and Kutz. 2018. In Reindeer and Caribou Health and Diseases

Severe weather events – increased susceptibility to existing parasites



e.g., Soay Sheep and gi parasites

Erysipelothrix rhusiopathiae: a Cumulative Effects Opportunist?

- <u>Opportunistic, generalist</u> bacterium historically common in domestic pigs and poultry, major production losses
- Discovered as cause of mass acute mortality in muskoxen 2010-2014
- New, or increased susceptibility?



(Kutz et al., 2015)

- BC boreal caribou high mortality 2013
- 14% seroprevalence winter 2012-2013, 42% in 2013-2014
- Several 'deads', including those previously attributed to predation, cultured positive



Trace Minerals - BC Boreal caribou



BC boreal caribou have low/deficient copper and selenium levels



BC BCHRI

White muscle disease – Selenium and Vitamin E deficiency. Weak calves, cardiac failure, capture myopathy



Monitoring and Mitigating Health Risks: Using Scientific and Local Knowledge

> Cortisol Parasitome Virome

Size, jaws, dental enamel, condition, pregnancy, antlers

SAA/ Haptoglobin Microbiome

Local and Traditional Knowledge for Caribou Health Monitoring

Biological Conservation 217 (2018) 337-348



Local knowledge to enhance wildlife population health surveillance: Conserving muskoxen and caribou in the Canadian Arctic

Matilde Tomaselli^{a,*}, Susan Kutz^{a,b}, Craig Gerlach^c, Sylvia Checkley^{a,d}

Drawing exercises and **Proportional piling** with beans used to generate numbers and quantify people's perceptions



1. Pile of beans



2. Work collaboratively



3. Measuring & generating proportions

Drawing Exercise, Population Trends, Life time observations on the Dolphin and Union Caribou herd





Composition and body condition



Young = yearling + calves



Observed abnormalities list, relative proportion (%), and trend

ALREADY NOTICED PRIOR THE DECLINE





Increasing trend - noticed since mid-2000s *few cases reported in 2014

NEWLY OBSERVED (after mid-2000s)

- < 1% Bleeding scabs on the nose area orf like lesions
- < 1% Pale meat and yellow color of subcutaneous tissue (especially in animals with poor body condition status)
- < 1% Liquid lung cysts
- < 1% Lung infection pneumonia

Local Knowledge for Mortality Detection



Muskox Health Research Program

(Slide from M. Tomaselli)

Mitigation

- Understand the system and threats
 - Health assessment across ALL research and monitoring programs, including increasing efforts on determining cause of death
- Use multiple sources of knowledge for early detection and effective response
- 'DEW-line for caribou health'
 - Systematic collection of Local Knowledge <u>what will it</u> take to act on this information????



