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Brief Communication

Differences in parasite diversity, prevalence, and intensity assessed through analyses of fecal samples from two West Greenland caribou populations

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Introduction

Many northern communities depend on caribou (*Rangifer tarandus groenlandicus)* as a dietary staple and for their contributions to northern economies and cultures. In *Rangifer* sp., experimental removal of gastrointestinal helminth parasites has been associated with increased fat reserves and pregnancy rates, and it is generally accepted that the effects of these parasites on individuals can influence population dynamics and herd sustainability (Albon *et al.,* 2002; Stien *et al.,* 2002).

Study Area

West Greenland is home to several populations of caribou, with Akia-Maniitsoq (AM = 24, 000) and Kangerlussuaq-Sisimiut (KS = 98, 300) the two largest (Cuyler *et al.,* 2011). The ranges of these two populations extend east-west from the Greenland ice cap to the coast and from 62°N to 68°N, with KS the more northerly. They are isolated from other caribou populations by extensive fjord systems and from each other by the Sukkertoppen icecap, although movement between herds is theoretically possible (Cuyler *et al.,* 2011). While AM and KS are genetically related (Jepsen *et al.,* 2002), have adjacent ranges and lack predators (Melgaard, 1986), they are unique in their exposure to other ungulate species through human-mediated translocations and importations. The KS population shares its range with muskoxen *(Ovibos moschatus wardi)* translocated from east Greenland (Pedersen & Aastrup, 2000), whereas AM has seen transient introductions of cattle, horses, sheep, and goats

(Norlund, 1936; Rose *et al.,* 1984), and the importation of semi-domestic Norwegian reindeer *(R. t. tarandus)* into a neighbouring range (Cuyler, 1999). The presence of introduced ungulates may have influenced parasite diversity in these native caribou populations.

Gastrointestinal parasite diversity is poorly defined for animals in west Greenland, with the two previous studies focusing solely on ungulates from the KS range. Raundrup (2005) sampled muskoxen from this area and reported the presence of 'trichostrongyle' eggs and larvae which she attributes to *Ostertagia (Teladorsagia) circumcincta,* however she provides no morphological or molecular data to support this. Korsholm and Olesen (1993) did a smaller, but more detailed study not only on muskoxen (n = 5), but also caribou (n = 5) from the KS range. In caribou, these authors reported the abomasal nematodes *Teladorsagia circumcincta* and *Marshallagia marshalli,* as well as *Eimeria* oocysts. Along with these parasites, muskoxen were also positive for *Nematodirella longissimespiculata, Nematodirus helvetianus,* and *Moniezia expansa.* To date, no similar work has been done for AM, although warbles *(Hypoderma tarandi)* and nose bots *(Cephenemyia trompe)* have been evaluated in both populations (Cuyler *et al.,* 2012). The purpose of our work was to do a fecal survey of gastrointestinal parasites in the AM and KS caribou populations. We expected that, due to their common ancestry and neighboring ranges, there would be no differences between parasite species present in the two populations.

Methods

Collections for this study took place during International Polar Year as part of an initiative by the CircumArctic *Rangifer* Monitoring and Assessment (CARMA) network (Kutz *et al.,* in press). Adult female caribou (≥ 3 years), subadults (1–2 years) and their calves-at-heel (<1 year) were collected opportunistically through scientific hunts from Mar. 29 – Apr. 13, 2008 (AM) and Mar. 3 – 17, 2009 (KS). Rectal fecal samples were collected, frozen, and transported to the University of Calgary where they were processed using a modified Wisconsin double centrifugation-sugar flotation technique (Hoar *et al.,* 2009). Eggs and oocysts were identified to family or genus based on morphology (Foreyt, 2001). Eggs identified as having typical 'strongyle-egg' morphology can belong to a number of different genera, however in arctic and subarctic environments the abomasal nematodes *Ostertagia gruehneri* and *Teladorsagia boreoarcticus* are the most common in *Rangifer* sp. (Hoberg *et al.,* 2001; Kutz *et al.,* 2012). Also producing 'strongyle-type' eggs, *Teladorsagia circumcincta* has been previously reported in KS by Korsholm & Olesen (1993). This identification should be revisited as it preceded the description of the morphologically similar *T. boreoarcticus* and it is now recognised that most descriptions of *T. circumcincta* in arctic hosts are mistaken (Hoberg *et al.,* 1999; Kutz *et al.,* 2012).

Results

We observed differences between AM and KS in regards to the diversity of parasites present, prevalence (percent of samples positive), and intensity (eggs per gram feces from positive samples) (Table 1). 'Strongyle-type', Nematodirinae and Anoplocephalidae eggs, and *Eimeria* oocysts were found in both populations. *Marshallagia* spp. eggs were common in KS samples, but absent entirely from AM.

Prevalence and intensity of 'strongyle-type' eggs were much higher in AM than KS, which may reflect differences in species diversity, host genetics or health status, timing of sampling, or sampling years (Baker *et al.,* 2001; Baker *et al.,* 1998; Dunn, 1969; Irvine *et al.,* 2001). Nematodirinae eggs, produced by the small intestinal nematodes *Nematodirus* spp. or *Nematodirella* spp., were found in both populations, but with

Table 1. Prevalence [% positive samples] and intensity [EPG/OPG; Median (Min. – Max.)] of gastrointestinal parasite eggs and oocysts of fecal samples from animals of the Akia-Maniitsoq and Kangerlussuaq-Sisimiut caribou populations. Significant differences between herds ($p \leq 0.05$), within an age class, are indicated by *, Fisher's Exact (prevalence) or Wilcoxon (intensity) tests.

		Strongyle-type		*Marshallagia* spp.		Nematodirinae		Anoplocephalidae		*Eimeria* spp.	
Herd	*n*	Prevalence	Intensity	Prevalence	Intensity	Prevalence	Intensity	Prevalence	Intensity	Prevalence	Intensity
Akia-Maniitsoq (2008)	47										
Calves	6	83.3*	5.0 (0.2-11.7)*	0.0*	N/A	33.3	0.5 (0.2-0.8)	33.3	35.3 (18.9-51.6)	0.0	N/A
Subadults	7	71.4*	1.2 (0.2-2.5)	0.0*	N/A	0.0	N/A	28.6	8.4 (1.5-15.4)	0.0	N/A
Adults	34	50.0*	0.8 (0.2-2.8)*	0.0*	N/A	0.0*	N/A	5.9	3.5 (0.3-6.8)	2.9	32.1
Kangerlussuaq-Sisimiut (2009)	48										
Calves	9	22.2*	0.3 (0.3-0.3)*	55.6*	0.5 (0.3-1.0)	44.4	1.8 (0.5-4.4)	22.2	30.5 (13.6-47.4)	0.0	N/A
Subadults	4	0.0*	N/A	75.0*	0.8 (0.3-1.3)	50.0	0.8 (0.5-1.0)	0.0	N/A	0.0	N/A
Adults	35	11.4*	0.3 (0.3-0.5)*	62.9*	0.5 (0.2-1.0)	54.3*	0.3 (0.2-2.2)	11.4	9.5 (2.3-42.0)	2.9	0.3

very different patterns of distribution. In AM, these eggs were only present in samples from calves, as is expected for ruminants, however they were common in all age classes of KS. This suggests that there may be different species of nematodirines present in these two populations, which requires further investigation.

The presence of *Marshallagia* spp. in KS, but not AM, is likely the result of spill-over from introduced muskoxen (Pedersen & Aastrup, 2000), however the effects of climatic conditions cannot be discounted. *Marshallagia* spp. in particular is more commonly found in arid regions (Meradi *et al.,* 2011), and the drier climate of the KS region may be more suitable for this parasite than the AM range (Tamstorf, 2001). At least two varieties of *Eimeria* oocysts were present in each population, possibly *E. hreindyria, E. mayeri,* or *E. rangiferis* as these have all been reported previously in *Rangifer* sp. (Guðmundsdóttir, 2006). Differences in prevalence and intensity of *Eimeria* spp. between the populations were non-significant, which may be a true result, or be due to our small sample size. This may also apply to our Anoplocephalidae results.

Conclusions

Our research has demonstrated that, although the AM and KS caribou populations are closely related genetically (Jepsen *et al.,* 2002) and geographically, there are significant qualitative (species diversity) and quantitative (prevalence, intensity, and distribution across age classes) differences in their parasites. Identification of parasites in this study was limited to morphological examination of eggs and, as such, we are only able to report to genus or family level. Species-level identifications, currently underway, are expected to reveal greater differences in diversity and provide deeper insight into the influence of historical and contemporary factors on the parasite community of these caribou populations.

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