

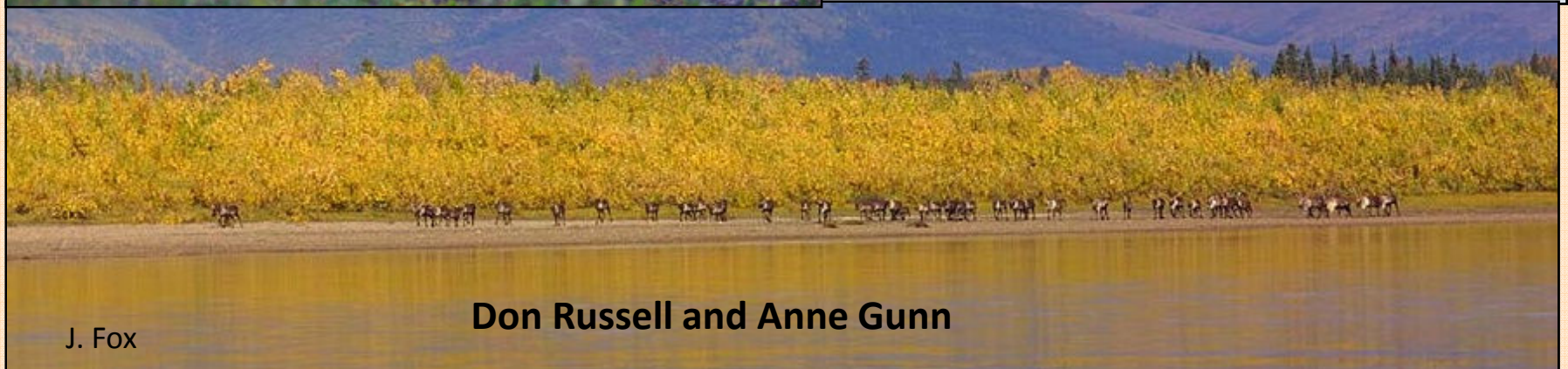


L. Witter



Changing Landscapes: Climate

S. Thorisson



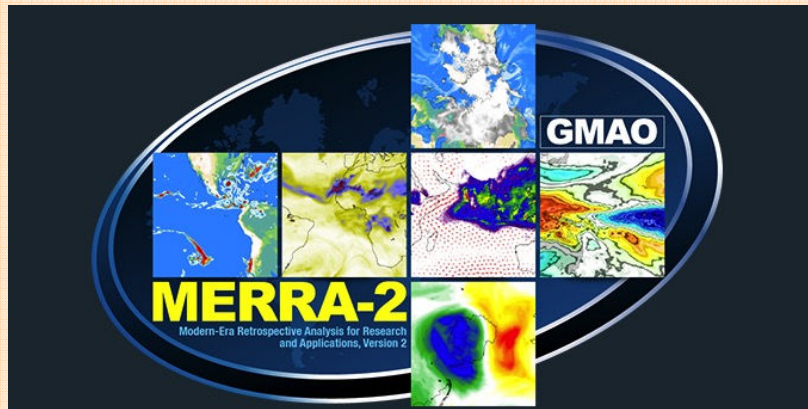
J. Fox

Don Russell and Anne Gunn

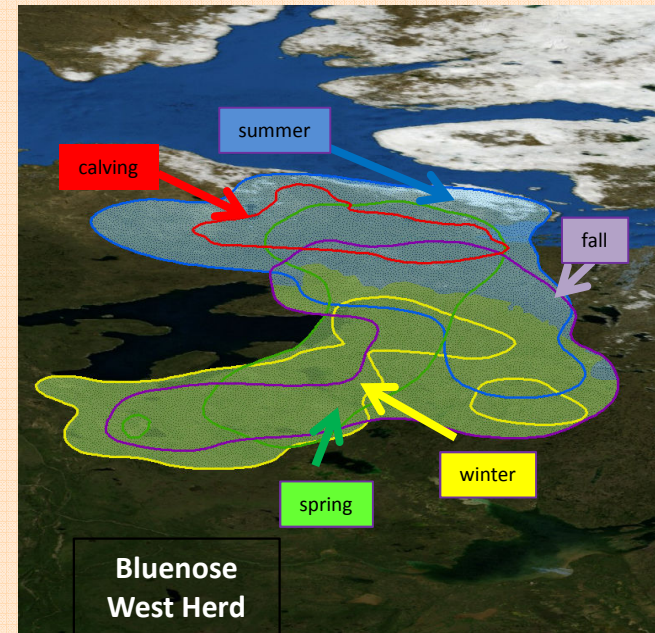
Why a CARMA climate database

- CARMA's mission: monitor and assess
- Cross-herd comparisons
- Climate role in herd productivity
- Need standardization





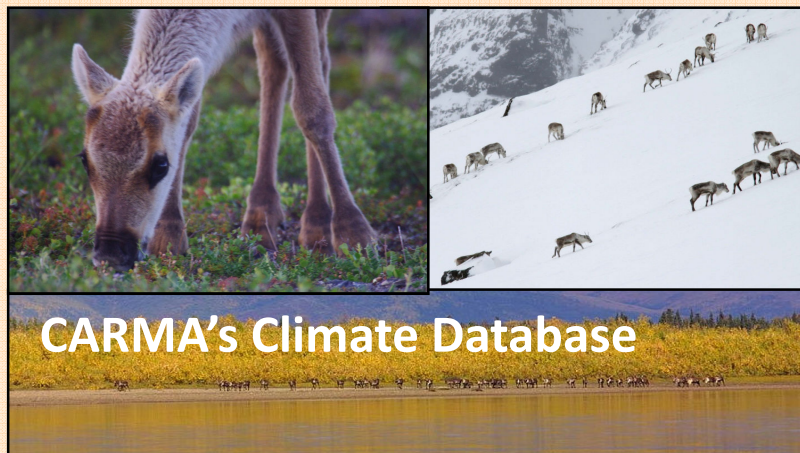
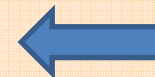
Download



Extract season herd data



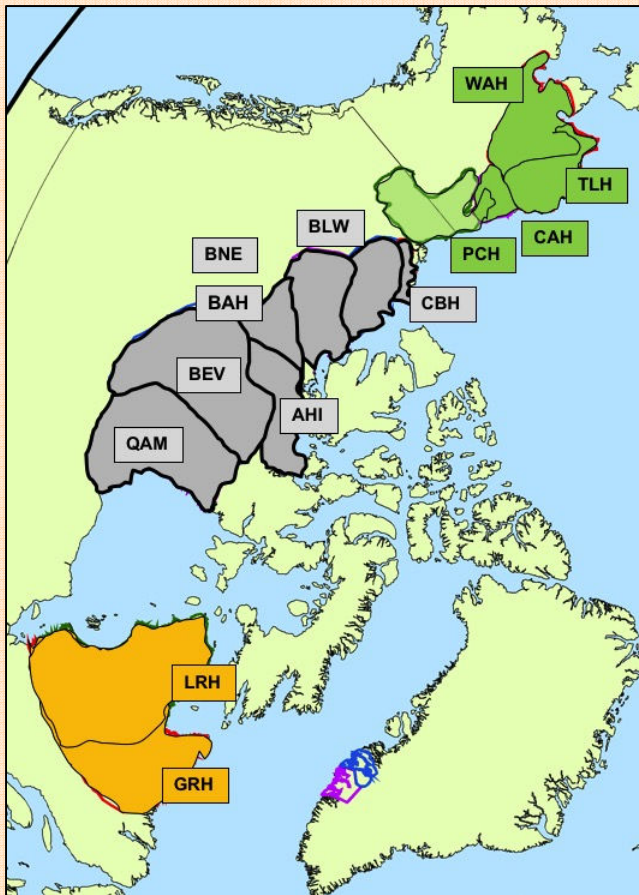
Create daily caribou relevant data



Update annually

North American climate and trends

Herds

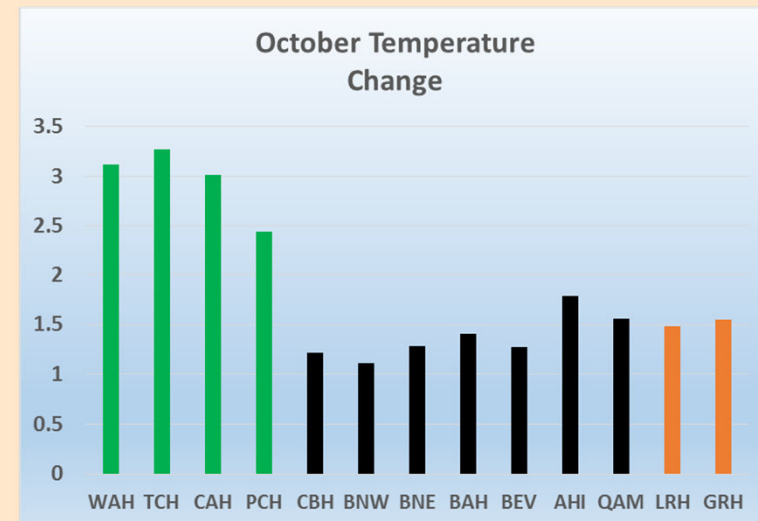
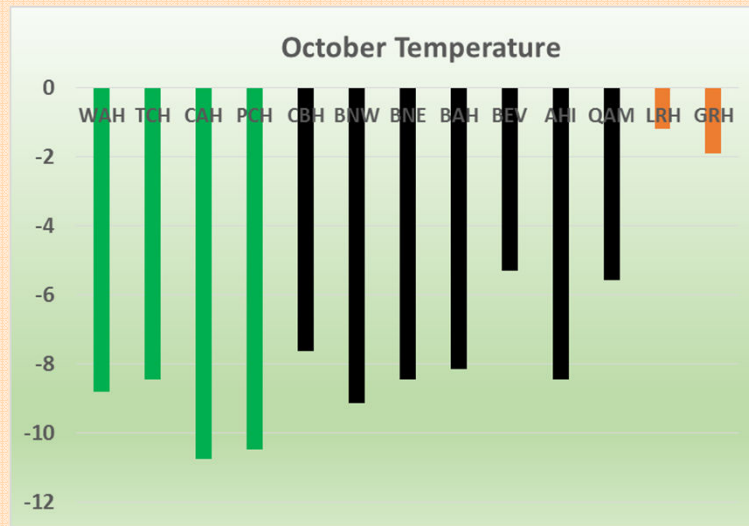


Average climate value
1979 - 2016

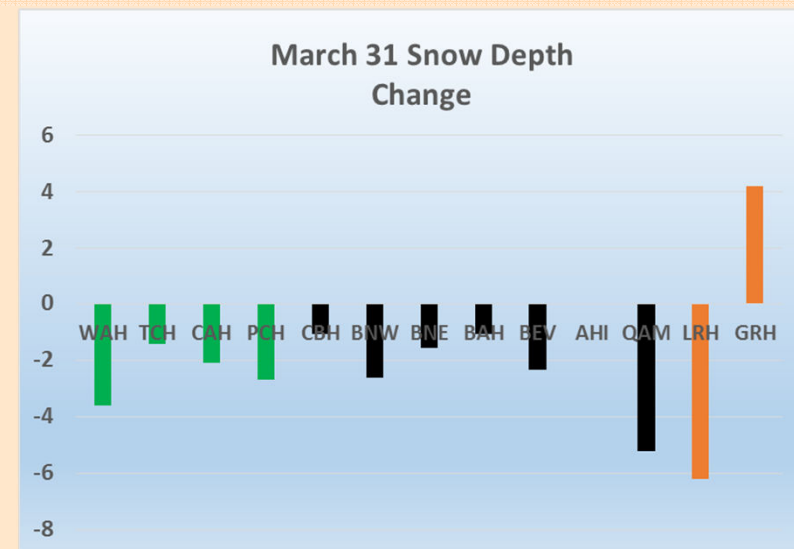
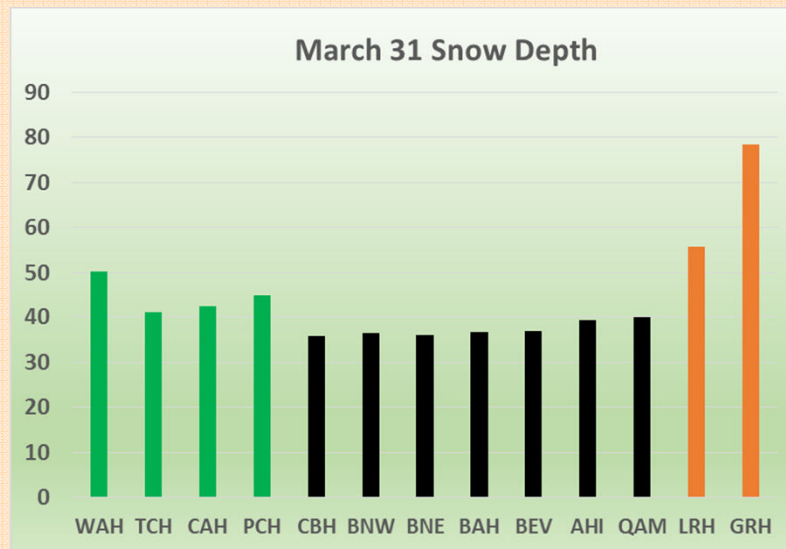
WAH TCH CAH PCH CBH BNW BNE BAH BEV AHI QAM LRH GRH

Change in average climate value
from 1979-1997
to 1998-2016

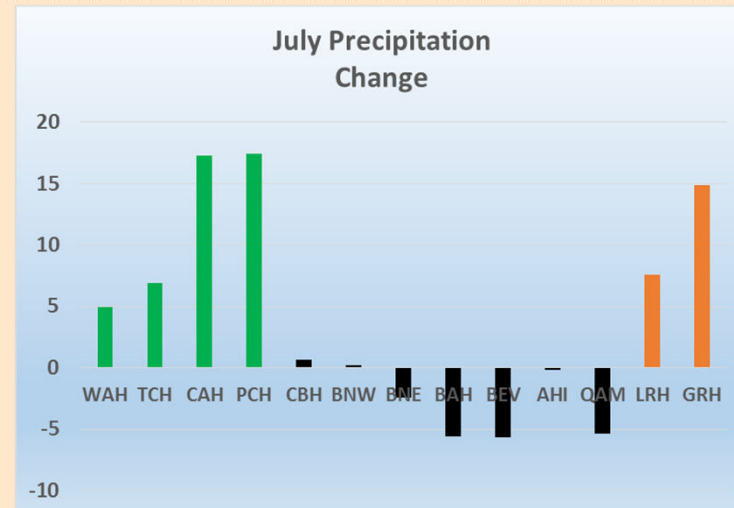
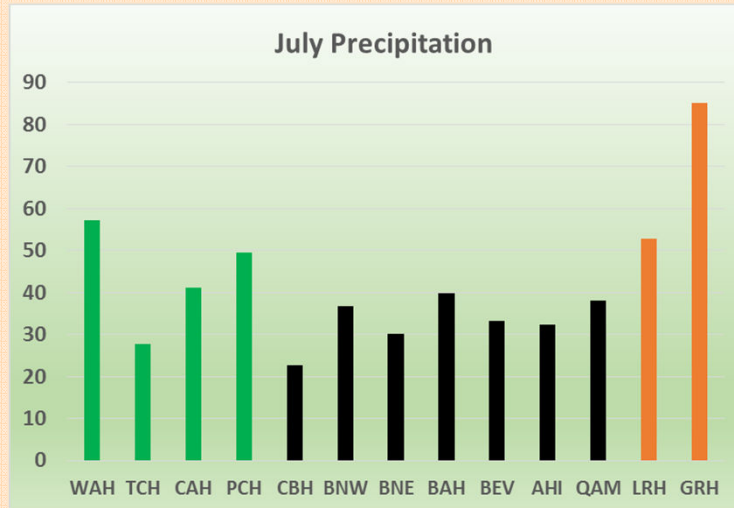
WAH TCH CAH PCH CBH BNW BNE BAH BEV AHI QAM LRH GRH



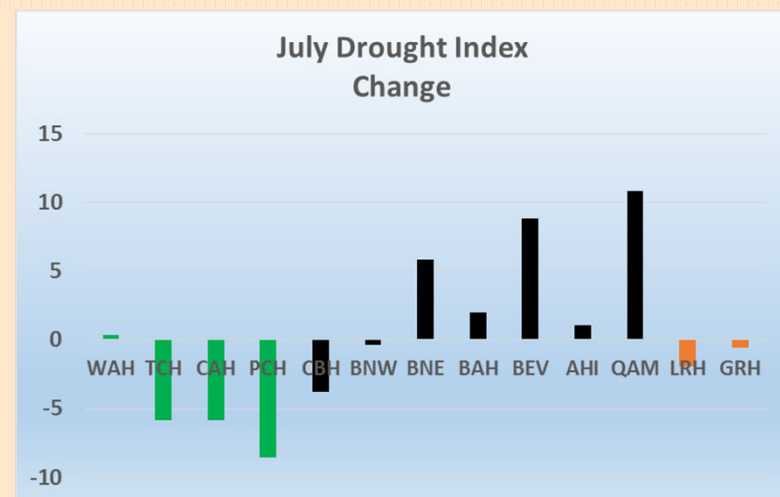
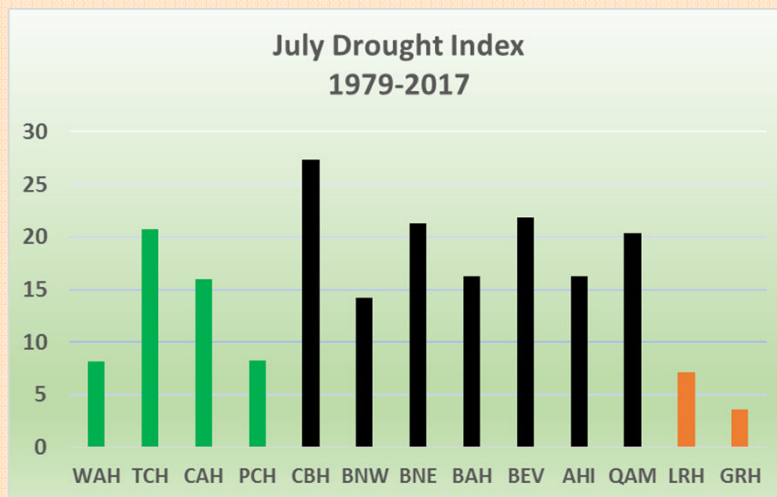
Although regional patterns appear, fall is getting warmer across NA



In general March 31 snow depth is decreasing across NA, **except GRH**



Precipitation lower on average in NWT and Nunavut, and trend getting lower



Reflected in lower summer drought trend in east and west and higher in NWT and Nunavut



Climate trends of North American migratory tundra herds

Don Russell and Anne Gunn, CARMA

Conclusions

- Warmer October temperature is the most significant trend across North America.
- Mean values between 1979-1997 and 1998-2016 show strong regional trends for climate indicators.
- A herd-specific vulnerability analysis would integrate the climate indices with other landscape attributes to support projections for how landscape change may influence herd recovery.

NOTE:

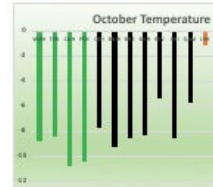
- Standardized data allows for easy comparative analysis of climate data
- NASA's MERRA data is also downloaded for Canadian Arctic Islands, Greenland, Iceland, Scandinavia (including Svalbard), and Eurasia up to 2016.
- Need to update herd-specific database for herds within these regions

Data available through CARMA Network

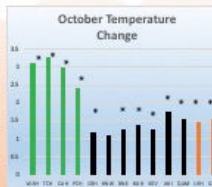


Snow conditions through the eyes of a Norwegian wild reindeer.
(GPS collar camera; thanks to Norwegian institute for Nature Research)

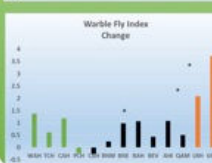
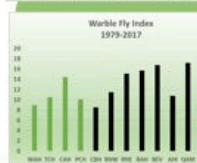
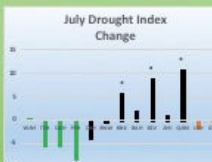
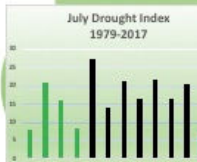
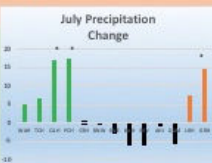
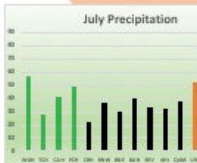
Average value 1979 - 2016



Change in average value from 1979-1997 to 1998-2016



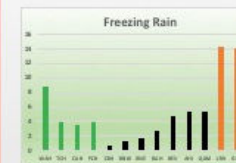
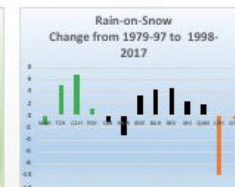
FALL



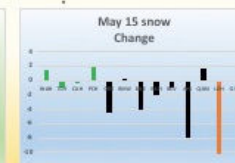
SUMMER



CALVING



WINTER

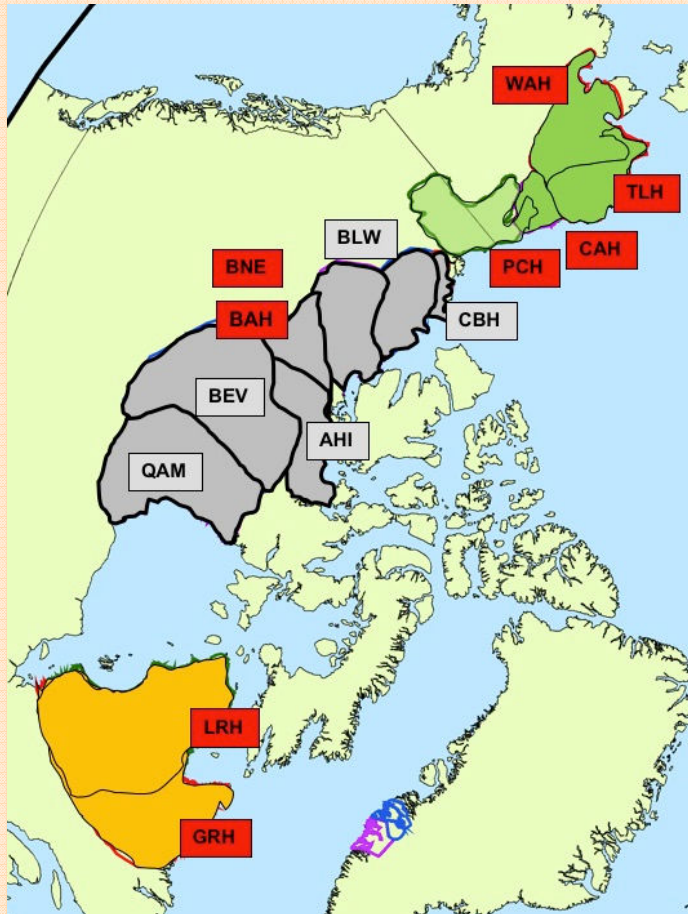


SPRING

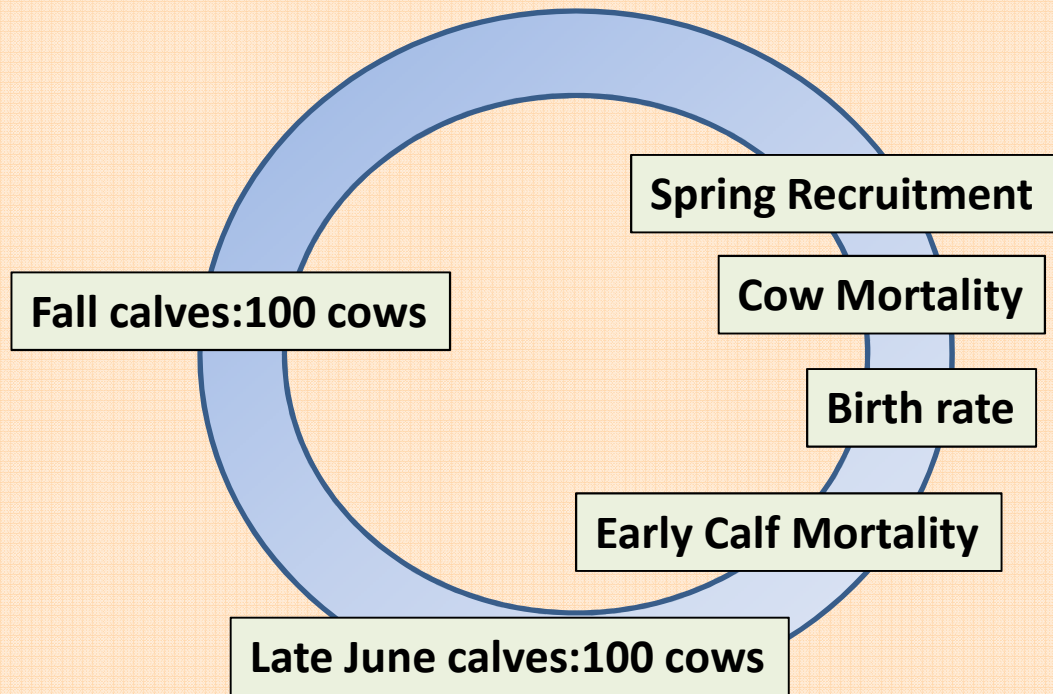
More indicators at our poster

How does climate effect caribou herd productivity?

Herds with available data



Available vital rate data



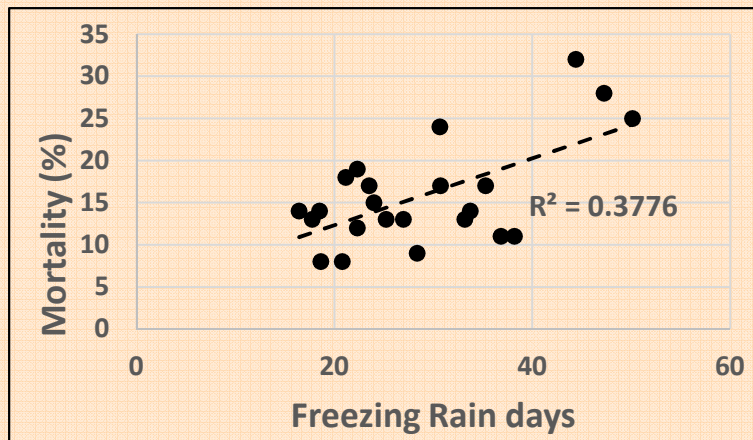
Analysis

- Which two climate variables explained the most variability
- "De-trended" data

	Western Arctic	Teshekpuk Lake	Central Arctic	Porcupine	Bluenose East	Bathurst	Leaf River	George River
Cow Mortality								
Birth Rate								
June calf survival								
Late June calf:cow								
Fall calves: 100 cows								
Spring Recruitment								

Some results....

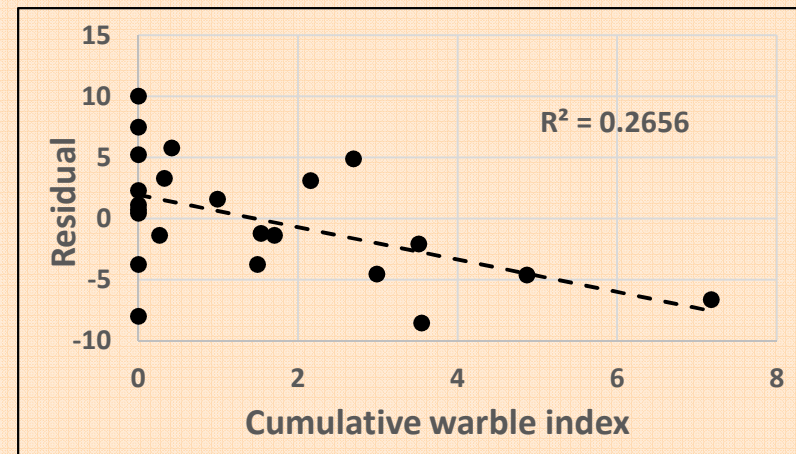
Teshekpuk herd adult cow mortality



- the higher the number of freezing rain days, the higher the adult cow mortality

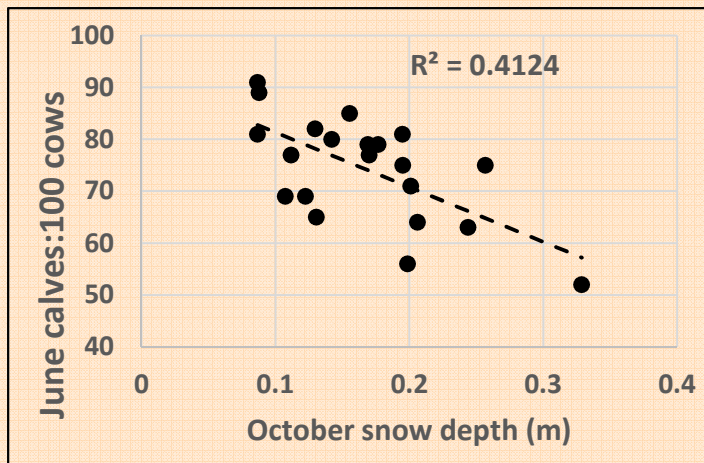
- Together they accounted for **58%** of the variability.

Residual = actual - predicted

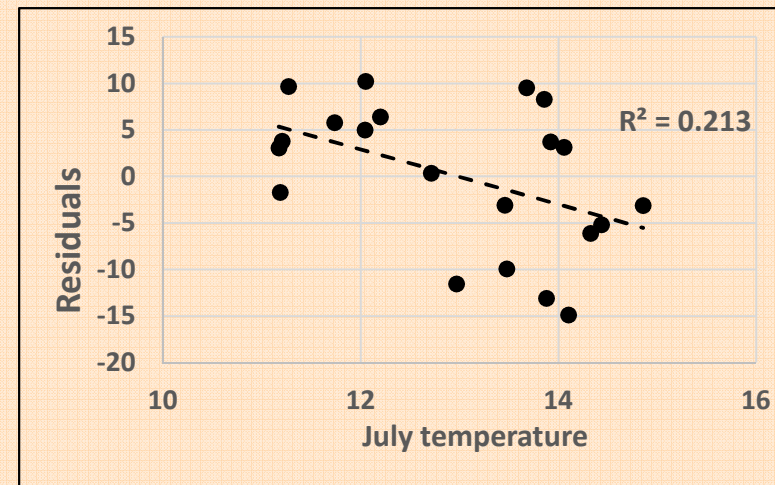


- If freezing rain regression over-estimated actual mortality, it was because warble flies were bad.

Central Arctic Herd late June calves: 100 cows



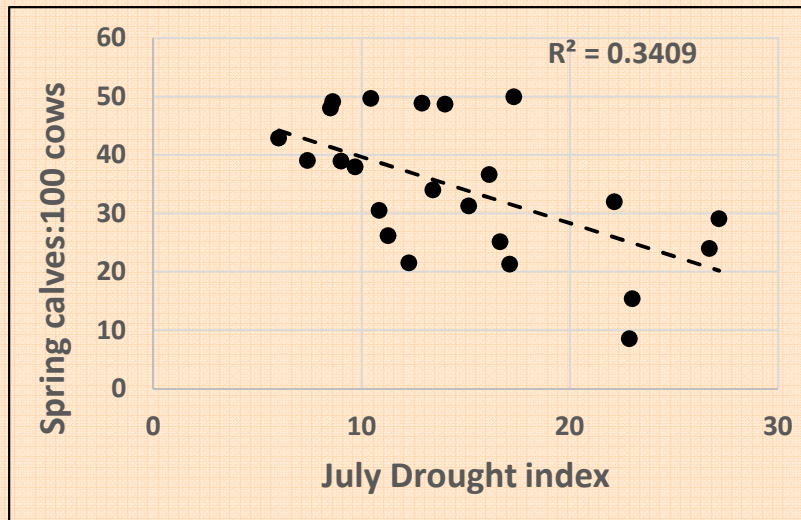
..the deeper October snow the lower June calves:100 cows the following spring



.. if October snow regression over-estimated actual calves:100 cows, it was because of warmer July conditions

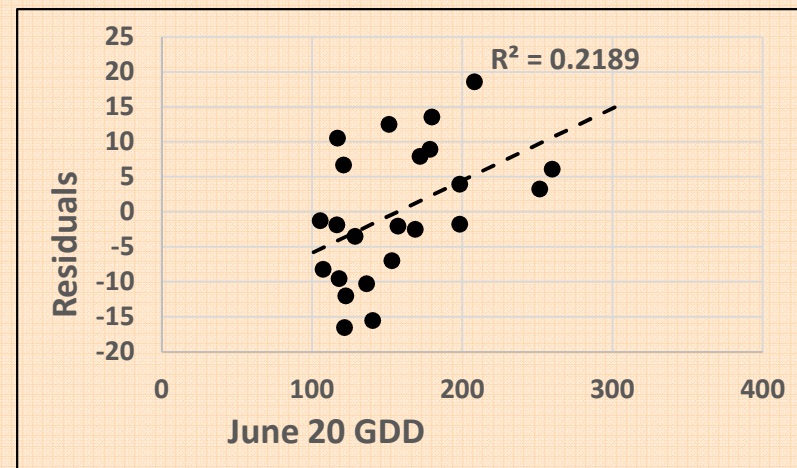
- Together October snow and July temperature accounted for **55%** of the variability.

Bathurst herd spring recruitment



..the more severe the July drought the lower the spring recruitment of calves

- Together July drought and June 20 GDD accounted for **54%** of the variability in spring recruitment.

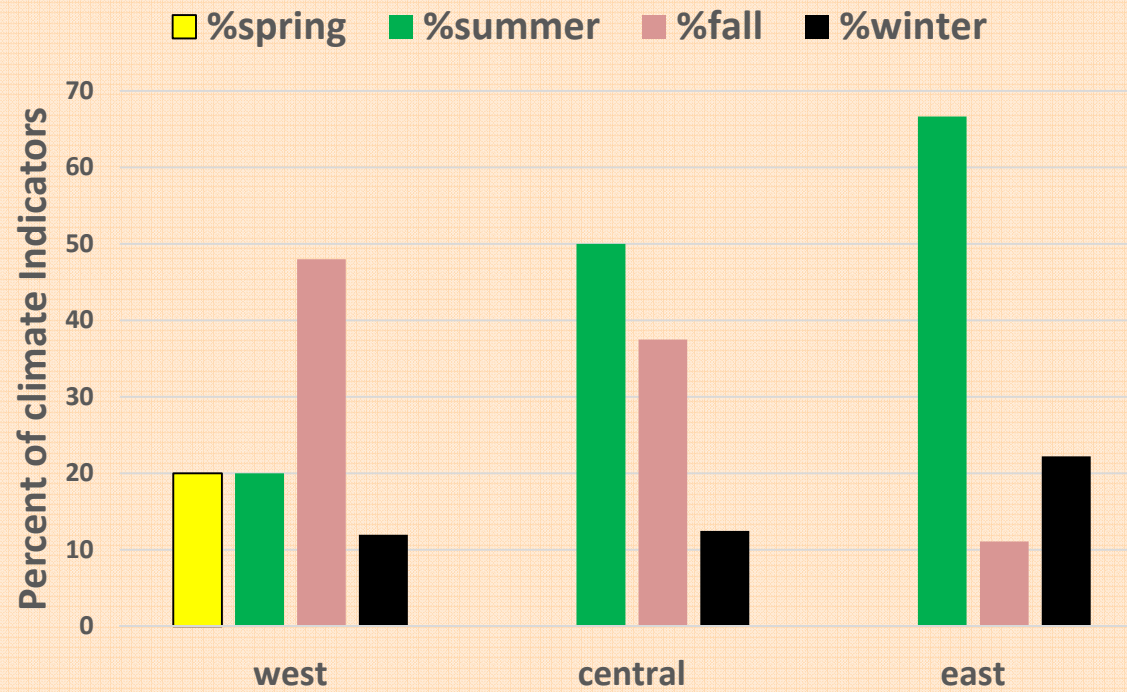


.. If July drought regression over-estimated actual spring recruitment, it was because of cooler June temperatures

	Western Arctic	Teshkepuk Lake	Central Arctic	Porcupine	Bluenose East	Bathurst	Leaf River	George River
Cow Mortality								
Birth Rate								
June calf survival								
Late June calf:cow								
Fall calves: 100 cows								
Spring Recruitment								

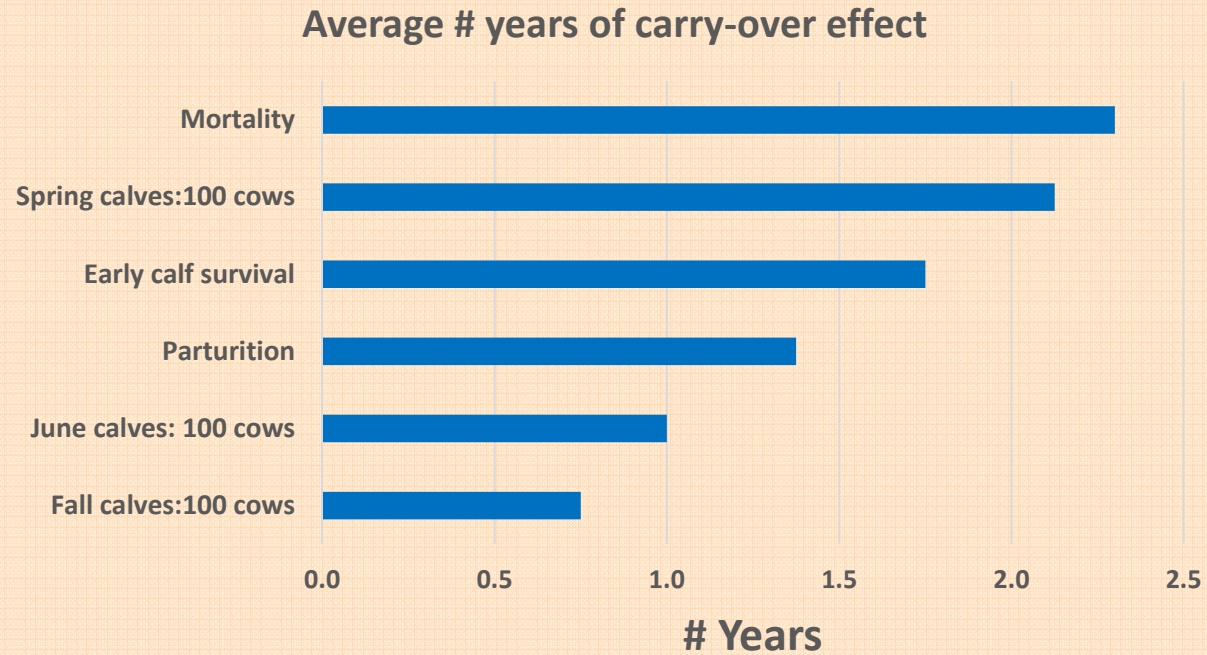
	Western Arctic	Teshekpuk Lake	Central Arctic	Porcupine	Bluenose East	Bathurst	Leaf River	George River
Cow Mortality	40	53	59			68		
Birth Rate	0	76	48	63				
June calf survival			56	57				
Late June calf:cow			55	46				
Fall calves: 100 cows	79					76	62	28
Spring Recruitment	19	32			81	54		

The percent of climate indicators by region

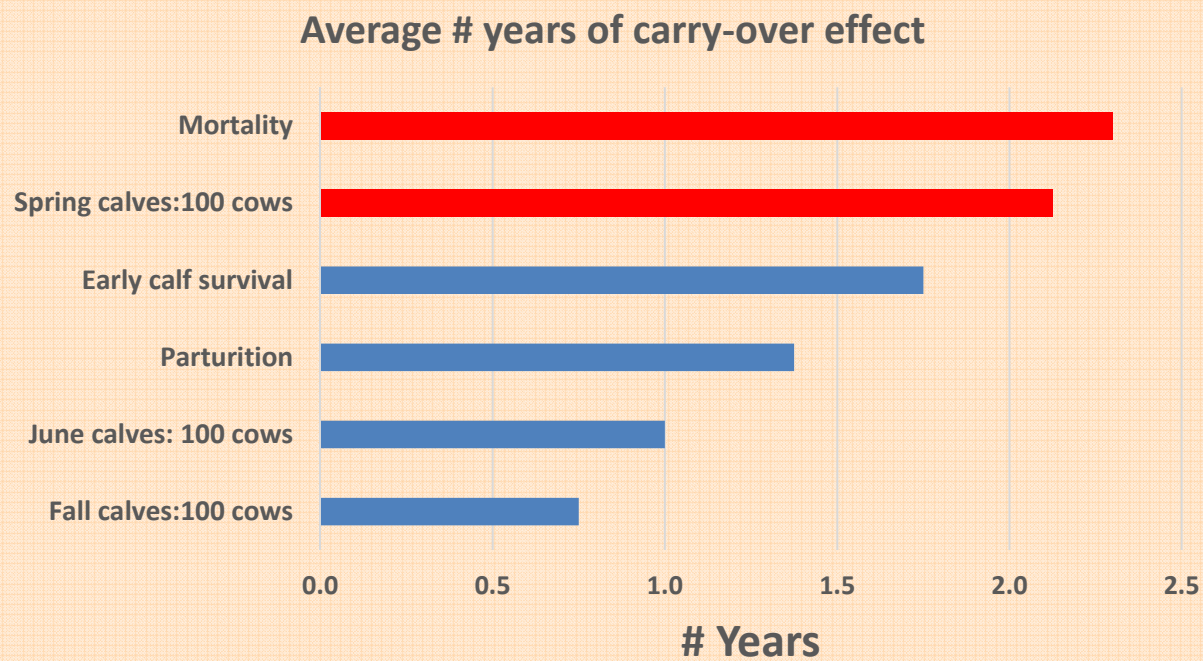


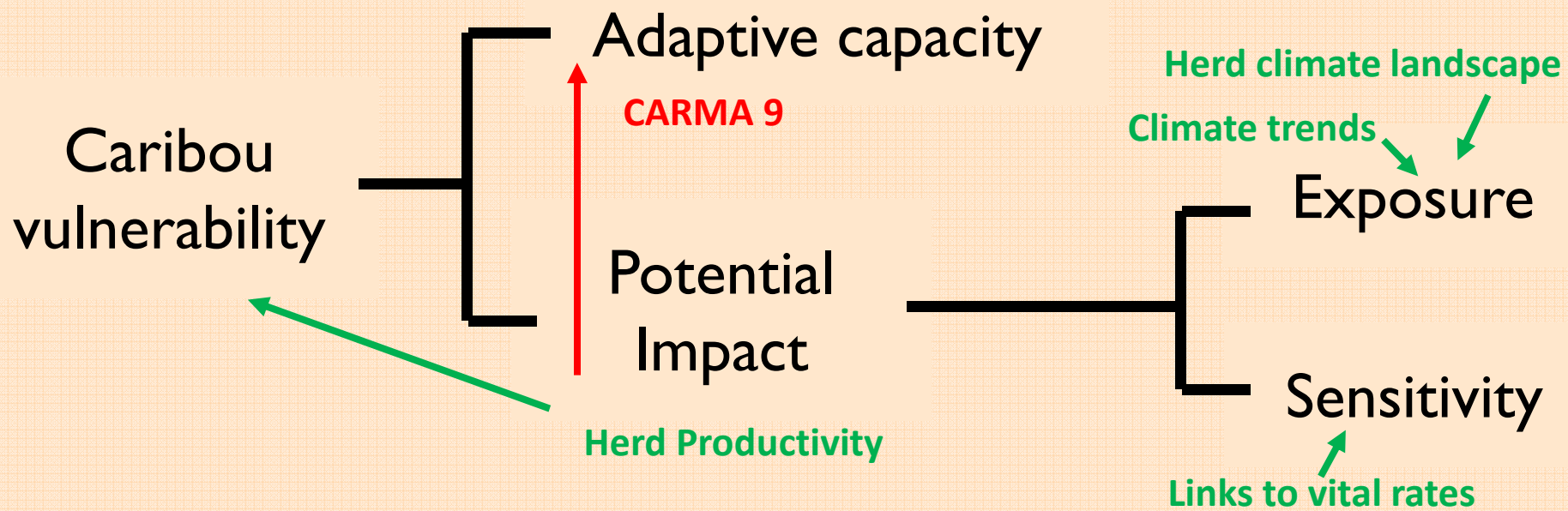
NOTE: Winter snow depth never entered any of the correlations

Carry-over effect – climate conditions in past influence productivity in subsequent years



Carry-over effect – climate conditions in past influence productivity in subsequent years





So we are not going to stop climate change...but

- Links between climate and herd productivity
 - Access to Climate database
 - Climate trends and herd recovery
 - Incorporate climate into population models

Conclusion

- Climate's impact on caribou is complex
- Herds survive on different climate landscapes