

## Supplementary Materials for

### **Arctic greening from warming promotes declines in caribou populations**

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**table S1. Linear time trends in climate (1979–2014) and NDVI variables (1982–2011).**

Pearson's correlation coefficient are given for each caribou herd range (three letter code) and for all ranges combined (Total).

Herd	May Temp	Jun-Aug Temp	Sea ice conc.	Snow melt	Snow cover	May NDVI	Jun-Aug NDVI
WAH	0.16	0.20	-0.79	-0.45	-0.52	-0.12	0.73
TCH	0.13	0.11	-0.78	-0.48	-0.48	-0.07	0.81
CAH	0.11	-0.15	-0.74	-0.46	-0.33	-0.03	0.87
PCH	0.16	-0.09	-0.71	-0.50	-0.44	0.08	0.89
CBH	0.23	0.10	-0.61	-0.24	-0.40	-0.27	0.76
BLW	0.22	0.12	-0.58	-0.60	-0.26	-0.01	0.83
BAT	0.00	0.23	-0.68	-0.36	0.13	-0.05	0.61
BEV	-0.13	0.28	-0.75	-0.24	0.10	-0.24	0.62
QAM	-0.11	0.36	-0.72	-0.31	-0.10	-0.20	0.55
LRH	0.16	0.52	-0.66	-0.35	-0.54	-0.03	0.50
GRH	0.22	0.56	-0.59	-0.22	-0.50	-0.08	0.49
Total	0.10	0.20	-0.69	-0.38	-0.30	-0.09	0.70

**table S2. Data set of migratory tundra caribou in North America.** References are given as notes to the table.

Herd code	Herd name	Data period	No. censuses	References
WAH	Western Arctic Herd	1970-2013	16	1,2
TCH	Teshekpuk Lake Caribou Herd	1978-2013	11	1,3
CAH	Central Arctic caribou Herd	1978-2010	11	1,3
PCH	Porcupine Caribou Herd	1961-2013	13	1,5
CBH	Cape Bathurst Herd	1986-2012	8	6
BLW	Bluenose-West herd	1986-2012	8	6
BAT	Bathurst Herd	1977-2012	12	7,8,9,10,11
BEV	Beverly Herd	1967-2011	8	12
QAM	Qamanirjuaq Herd	1968-2008	9	13
LRH	Leaf River Herd	1975-2014	7	14,15
GRH	George River Herd	1954-2014	11	14,16,17,18,19,20

1. Harper P (editor) et al. (2013) Caribou management report of survey-inventory activities 1 July 2010–30 June 2012. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2013-3, Juneau.
2. WACHWG (2011) Western Arctic Caribou Herd Cooperative Management Plan - Revised December 2011. Western Arctic Caribou Herd Working Group. Nome, Alaska.
3. CARMA 2016. CircumArctic Rangifer Monitoring and Assessment Network. <http://carma.caff.is/>.
4. ADFG (2014) Four North Slope Caribou Herds Counted. Behind the Numbers: How Are the Caribou? Alaska Fish & Wildlife News August 2014. Alaska Department of Fish & Game. [http://www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.view\\_article&articles\\_id=678](http://www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.view_article&articles_id=678)
5. PCTC (2014) Porcupine Caribou Annual Summary Report 2014. Prepared for the Porcupine Caribou Management Board. Porcupine Caribou Technical Committee.
6. GNWT 2014. Technical Report on the Cape Bathurst, Bluenose-West, and Bluenose-East Barren-Ground Caribou Herds. Companion Report to Taking Care of Caribou: The Cape Bathurst, Bluenose-West, and Bluenose-East Barren-Ground Caribou Herds Management Plan. Government of Northwest Territories.
7. Case R, Buckland L, Williams L. 1996. The status and trend of the Bathurst caribou herd, Northwest Territories, Canada. Department of Renewable Resources, Government of Northwest Territories, Yellowknife NWT. File Report No. 116.
8. Gunn A, Dragon J, Nishi J. 1997. Bathurst Calving Ground Survey 1996. Department of Wildlife and Economic Development, Government of Northwest Territories, Yellowknife NWT. File Report No. 119.
9. Gunn A, Nishi J, Boulanger J, Williams J. 2005. An estimate of breeding females in the Bathurst herd of barren-ground caribou, June 2003. Department of Environment and Natural Resources Government of the Northwest Territories. Manuscript Report No. 164.
10. Adamczewski J, Boulanger J, Croft B, Cluff D, Elkin B, Nishi J, Kelly A, D'Hont A, Nicolson C. 2009. Decline in the Bathurst caribou herd 2006-2009: a technical evaluation of field data and modeling. Department of Environment and Natural Resources, Government of the Northwest Territories. Yellowknife, NT. Draft (17 December, 2009).
11. Boulanger J, Croft B, Adamczewski J. 2014. An estimate of breeding females and analyses of demographics for the Bathurst herd of barren-ground caribou: 2012 calving ground photographic survey. Environment and Natural Resources, Government of Northwest Territories. File Report No. 142.
12. Campbell M, Boulanger J, Lee DS, Dumond M, McPherson J. 2012. Calving ground abundance estimates of the Beverly and Ahiak subpopulations of barren-ground caribou (*Rangifer tarandus groenlandicus*) – June 2011. Government of Nunavut, Department of Environment. Technical Report Series No. 03-2012.
13. Campbell M, Nishi J, Boulanger J. 2010. A calving ground photo survey of the Qamanirjuaq migratory barren-ground caribou (*Rangifer tarandus groenlandicus*) population – June 2008. Government of Nunavut, Department of Environment. Technical Report Series 2010 No. 1-10.

14. Couturier S, Jean D, Otto R, Rivard S. 2004. Demography of the migratory tundra caribou (*Rangifer tarandus*) of the Nord-du-Québec region and Labrador. Ministère des Ressources naturelles, de la Faune et des Parcs, Direction de l'aménagement de la faune du Nord-du-Québec and Direction de la recherche sur la faune. Québec, QC.
15. GQ 2015. Migratory caribou hunting in Northern Québec - Hunting measures for the 2015-2016 season. Press Release, Ministère des Forêts, de la Faune et des Parcs, Gouvernement du Québec, 2015. <http://www.fil-information.gouv.qc.ca/Pages/Article.aspx?aiguillage=ajd&type=1&lang=en&idArticle=2302064405>
16. Messier F, Huot J, Henaff DL, Luttich S. 1988. Demography of the George River Caribou Herd: evidence of population regulation by forage exploitation and range expansion. *Arctic* 41:279-287.
17. Couturier S, Brunelle J, Vandal D, St-Martin G. 1990. Changes in the population dynamics of the George River Caribou Herd, 1976-87. *Arctic* 43:9-20.
18. Couturier S, Courtois R, Crépeau H, Rivest LP, Luttich S. 1996. Calving photocensus of the Rivière George Caribou Herd and comparison with an independent census. *Rangifer Special Issue* 9:283-296.
19. Gunn A, Russell D, Eamer J. 2011. Northern caribou population trends in Canada. *Canadian Biodiversity: Ecosystem Status and Trends 2010*, Technical Thematic Report No. 10. Canadian Councils of Resource Ministers. Ottawa, ON.
20. GNL 2014. Provincial Government Provides Update on George River Caribou Herd. News release Government of Newfoundland and Labrador, Department of Environment and Conservation, August 14, 2014. <http://www.releases.gov.nl.ca/releases/2014/env/0814n04.aspx>.

**table S3. Correlation matrices of variables used in SE models of caribou, climate, and NDVI.**

	Population growth	Population size	May NDVI	June-August NDVI	May Temperature	June-August Temperature	Sea ice concentration	Annual snow cover	Date of snowmelt
Time lag = 0, N = 81									
Population growth	1								
Population size	-0.18	1							
May NDVI	-0.05	0.32	1						
Jun-Aug NDVI	-0.50	0.10	0.09	1					
May Temp	-0.15	0.06	0.30	0.16	1				
Jun-Aug Temp	-0.20	0.19	0.11	0.21	0.31	1			
Sea ice concentration	0.48	-0.07	0.21	-0.77	-0.31	-0.43	1		
Snow cover	-0.04	-0.07	0.20	-0.26	-0.46	-0.46	0.55	1	
Date of snowmelt	0.04	-0.12	0.19	-0.37	-0.19	-0.34	0.55	0.70	1
Time lag = 1, N = 78									
Population growth	1								
Population size	-0.08	1							
May NDVI	0.07	0.27	1						
Jun-Aug NDVI	-0.48	0.01	0.13	1					
May Temp	0.07	0.07	0.31	-0.01	1				
Jun-Aug Temp	-0.34	0.02	0.05	0.32	0.15	1			
Sea ice concentration	0.37	-0.04	0.25	-0.73	-0.20	-0.41	1		
Snow cover	-0.09	-0.05	0.09	-0.27	-0.46	-0.24	0.52	1	
Date of snowmelt	0.00	-0.02	0.07	-0.36	-0.27	-0.26	0.56	0.71	1
Time lag = 2, N = 74									
Population growth	1								
Population size	0.00	1							
May NDVI	-0.03	0.24	1						
Jun-Aug NDVI	-0.46	-0.08	0.15	1					
May Temp	-0.09	0.13	0.44	0.02	1				
Jun-Aug Temp	-0.28	0.09	0.09	0.19	0.41	1			
Sea ice concentration	0.30	0.06	0.23	-0.69	-0.13	-0.41	1		
Snow cover	-0.03	-0.14	0.05	-0.10	-0.47	-0.36	0.37	1	
Date of snowmelt	0.06	0.02	-0.07	-0.21	-0.30	-0.31	0.39	0.69	1
Time lag = 3, N = 72									
Population growth	1								
Population size	0.02	1							
May NDVI	-0.03	0.11	1						
Jun-Aug NDVI	-0.39	-0.21	0.22	1					
May Temp	-0.12	-0.01	0.38	0.17	1				
Jun-Aug Temp	-0.18	0.11	0.10	0.15	0.18	1			
Sea ice concentration	0.30	0.07	0.03	-0.74	-0.34	-0.37	1		
Snow cover	-0.04	-0.14	0.10	-0.07	-0.44	-0.34	0.42	1	
Date of snowmelt	0.05	-0.05	-0.09	-0.19	-0.28	-0.24	0.40	0.53	1