

**2011-mi ukiakkut aamma 2012-mi ukiukkut tuttunniarnissamut
siunnersuinerit**

Kitaa: Naternami, Avannani, Qeqqani, Kujataani aamma Paamiuni nunap
immikkoortui kiisalu nunap immikkoortui allat sisamat:
Inglefield- Prudhoe Land, Kangerluarsussuaq, Nuussuaq, Ivittuut

NAMMINERSORLUTIK OQARTUSSANUT SIUNNERSUINERIT



allattut

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Nunat immikkoortuini tullinnguuttuni makkunani tuttunniarnissanut siunnersuinerit:

Naterna (1), Avannaa (2), Qeqqa(3), Kujataa (4-5), Paamiut (6-7), Inglefield Land (10), Prudhoe Land (10), Kangerluarsussuaq (9), Nuussuaq (8) aamma Ivittuut (11). Kisitsisit ungaluutiniittut nunap immikkoortuisa normuinut innersuussutaapput.

Allakkiaq una Pinngortitaleriffimmit Namminersorlutik Oqartussani Aalisarnermut, Piniarnermut Nunalerinermullu Naalackersuisoqarfimmut Kitaani Avannaatalu kitaani 2011-mi ukiakkut 2012-milu ukiakkut tuttunniarnissanut (*Rangifer tarandus spp.*)siunnersuutitut tunngassuteqarpoq.

Siunnersuinerit

Kitaani tuttunniarnissamat Pinngortitaleriffimmit siunnersuinerit Pinngortitaleriffimmi naliliinernit pitsaanerpaanit aallaaveqarput. Siunnersuinerit 2006-imi siunnersuinerit assigaat (Cuyler & Witting). Allakkiami matumani siunnersuinerit tuttunniarnissamat aggersumut taamaallaat tunngassuteqarput, tassa imaappoq 2011-mi ukiakkut aamma 2012-mi ukiukkut.

Taamatuttaaq siusinnerusukkut siunnersuisarsimanermisut piniartut angutivissanik arnavissanullu amerlaqatigiinnik pisaqartarnissaat siunnersuutigineqarpoq, tassami tuttoqatigiinni angutivissat arnavissallu siunissami nalinginnaasumik amerlaqatigiittuarnissaat anguniagaammat.

Tuttoqatigiikkuutaanut ataasiakkaanut siunnersuinerit Avannaaniit Kujataanut tulleriiaarneqarput.

Nunap immikkoortua 10, Inglefield Land aamma Prudhoe Land – Inglefield Land-imi tutut amerlassusiat

Sumiiffimmut tassunga tunngatillugu nutaanik paasissutissaateqanngilagut; 1999 tutut 2.260-iussagatinneqarput. Pisarineqartussatut siunnersuutivut 2006-imi siunnersuunitsit (Cuyler & Witting 2006)amerlatigipput , tassa imaappoq:

- 1) *Piffissami killilimmi tuttunniarneq, tamanna sumiiffimmi piniartut siunersiorlugit eqqarsaatersuutigineqartariaqarpoq.*
- 2) *Najukkami piniartut siunersiorlugit pisassiissutit aalajangiiffigineqassasut. Siusinnerusukkut Namminersornerullutik Oqartussat Inglefield Land-imi aamma Prudhoe Land-imi 150-inik aamma 50-inik tuttuttassiisoqarnissaa aalajangersarsimavaat.*
- 3) *Inglefield Land-ip kangia´tungaani tuttunniartoqartanngiinnarnissaa siunnersuutigaarput.*

Inglefield Land ukiup annersaani piniartunit tikinneqarsinnaaneq ajorpoq.

Nunap immikkoortua 9, Kangerluarsussuaq – Kangerluarsussuarmi tutut amerlassusiat

Sumiiffimmit tassannga paasissutissanik nutaanik peqarpallaanngilagut. Tuttoqatigiit taakku affarmik nujuitsunit qulingiluaasunillu aamma Kangerluarsussuarmut 1965-imi inissinneqartunit kingoqqisuupput. 2005-mi apriliip qaammataani Namminersornerullutik Oqartussat aalajangerput tuttoqatigiit taakku nungusarneqassasut, kisianni suliassap tamatuma sularineqarnissaanut pilersaarut naliliinerlu suli kommunimit/Namminersorlutik Oqartussanit sularineqanngillat.

Sumiiffimmi tassani tuttunniarnissamut siunnersuinivut 2006-imi siunnersuinititut ippat (Cuyler & Witting 2006), tassa imaappoq *”tuttoqatigiit nungusarneqarusuppata maannakkut 200-nik pisassiissutigineqartartunit amerlanerujussuarnik pisaqartoqartariaqarpoq. Taamaattoqassappat piffissami killeqanngiusartumi killilersugaanngitsumillu tuttunniartoqartariaqarpoq.”*

Nunap immikkoortua 8, Nuussuaq– Nuussuarmi tutut amerlassusiat

Sumiiffimmit tassanga nutaanik paasissutissaateqanngilagut; 2002-mi Nuussuaq ikinnerpaanik 1.164-inik tuttoqassagatinneqarpoq. Sumiiffimmi 2012-mi februaari/marsimi ukiukkut qamuteralaat atorlugit kisitsinissarput pilersaarutigaarput. Tamanna 2002-miilli aatsaat kisitseqqinnerusaaq. Taamaattumik sumiiffimmi ukiukkut tuttunniartoqarnissaa inassutigingilarput. Tamatuma saniatigut sumiiffimmut tunngatillugu siunnersuinerput kingullermik 2006-imi ((Cuyler & Witting 2006) siunnersuinitita assigaa, tassa imaappoq *”ukiakkut piffissami killilimmi pisassiissutit naapertorlugit tuttunniarneq, kisianni najukkami piniartut siunersioriarlugit tamanna allanngortinneqarsinnaavoq.”*

Nunap immikkoortua 1, Naternaq – Naternami tutut amerlassusiat

Sumiiffimmut tassunga tunngasunik paasissutissanik nutaanik peqanngilagut; 1995-imi Naternaq 271-inik tuttoqassagatinneqarpoq. Maannakkut siunnersuinerput kingullermik siunnersuinititut ippat (Cuyler & Witting 2006), tassa imaappoq *”Naternaq ilaani piffissami killiimmi killeqanngitsumik tuttunniartoqaannarsinnaasoq, tassami tamatumuunakkut tuttoqatigiit navianartorsiortinneqarnissaat naatsorsuutigineqanngimmat.”*

Nunap immikkoortua 2, Avannaani nunap immikkoortua, Kangerlussuaq-Sisimiut (KS)-imi tutut amerlassusiat

Sumiiffimmi tassani tuttoqatigiit 2010-mi 98.300-uunissaat missingerneqarput taamaallutillu tuttoqatigiit tamakku nunatsinni amerlanerpaapput. Tuttoqatigiit 67.000-iunissaanik siunnersuutigineqartunit amerlanerupput. Tuttoqatigiit ikittuinnarnik piaqqisarput, timaat taanikinnerupput aamma siornatigumut naleqqiullugu ukiuunerani nerisassaalatsinerupput. 2010-mi tutut ukiuunerani najortakkaminni km² –imut arfineq marluussagatinneqarput, taamaattumillu tutut amerlivallaarsimasorineqarput. Ulloq manna tikillugu tututtarineqartartut tutut ikilissutigisimagunangilaat. Tutut maannakkut sinerissamiinnerunatik nunap timaaniinnerusarput taamaattumillu tikikkuminaannerusuniillutik aammalumi taamaattumik tututtarineqartartut ikinnerullutik.

Ukiami piffissami killilimmi killeqanngitsumik Akia-Maniitsumisut, Ameralik aamma Qeqertarsuatsiaaniset tuttunniartoqarnissaa siunnersuutigaarput, tamatuma saniatigut ukiuunerani tuttunniartoqarnissaa siunnersuutigaarput.

Tuttuttarineqartartut tuttoqassutsimut ikiliartuutaassappata tututtarineqartartut amerlissineqartariaqarput. Taamaattumik ukiuunerani tuttunniarnermi qamuteralaat atorveqarsinnaanerat Namminersorlutik Oqartussat eqqarsaatersuutigisariaqarpaat. Taamaattoqassappat Pinngortitaleriffimmit tullinnguuttunik makkuninnga siunnersuuteqartoqassaaq:

- 1) Kulavaat norrallit tamakkiisumik illersorneqassasut, tassa imaappoq kulavaat norrallit piniarneqassanngitsut. Tuttoqatigiit ilaartortuarnissaat pingaaruteqarpoq aamma

tuttunniarfiup nalaani kulavaat norrallit tassaapput tuttoqatigiinnik amerlisaasut (Appendiks 2 takuuk).

- 2) Kangerlussuarmit mittarfiup kujataa'tungaani ukiuunerani umimmarniarnissap tungaanut tamaani qamuteralanneq inerteqqutaassasoq. Sumiiffimmi qamuteralattoqarpit sumiiffimmi umimmannik Pinngortitaleriffimmiut kisitsinissaannik ajoqusersuinerussaaq aammalu nalinginnaasumik umimmannik siammakaatiterinerussalluni, taamaalilluni kisitsinitsinni angusanik atorneqarsinnaasunik pissarsinnaassanngilagut. Tamatuma saniatigut mittarfiup kujataa'tungaani tuttuq mittarfiup avannaa'tungaaningarnit imminnut qaninnerujussuupput.

Nunap immikkoortua 3, Qeqqani nunap immikkoortua, Akia-Maniitsoq (AM)-mi tuttuq amerlassusiat

Sumiiffimmi tuttuq 2010-mi 31.200-iunissaat missingerneqarpit, taamaalillutillu nunatsinni tuttoqatigiit amerlanersaasa tulleralugit. Ukiuni kingullerni qulini tuttoqatigiit ikiliartuaarsimasorivavut, tuttoqatigiilli siunnersuutigineqartumit 13.000-inik sulii amerlanerupput. 2010-mi tuttuq ukiukkut najortagaanni tuttuq km²-mut marluk sinnerlugit amerlassuseqartutut missingerneqarpit, taamaalillutik tuttoqatigiit amerlavallaarpasippit. Arriitsuinnarmik ikiliartornerat 1998-miilli tuttuq imminnut qanippallaarneranni pissutsinik pissuteqarsimassagatinnarpoq; tassa imaappoq tuttuq ikinnerusunik ernisartut aamma tiggaat kulavannit ikinnerusut – tassa imaappoq suiassusaat nikingasumik agguataagaasut. Km²-imut tuttuq 1,2-junissaannik anguniagaq anguniarlugu tuttoqatigiit ikiliseqqinneqartariaqarpit, naak tamatuma aqunniarnissaa ajornakusoorsinnaagaluartoq. Amerlanerusunik tuttuq tuttoqartarnissaa siunnersuutigaarpit.

Kangerlussuaq-Sisimiut, Ameralik aamma Qeqertarsuatsiaanisuq ukiakku killeqanngitsumik piffissamilu killilimmi tuttuqniartoqassasoq Pinngortitaleriffimmit siunnersuutigineqarpoq. Tamatuma saniatigut 2012-mi ukiukkut tuttuqniartoqarnissaa siunnersuutigaarpit.

Tuttutarineqartartut tuttoqassutsimut ikiliartuutaassappata tuttuqarqartut amerlineqartariaqarpit. Taamaattumik 2012-mi ukiukkut qamuteralannik tuttuqniartoqarsinnaanera Namminersorlutik Oqartussat eqqarsaatersuutigisariaqarpat. Taamaattoqassappat Pinngortitaleriffimmit tullinnguuttunik makkuninnga siunnersuuteqartoqarpoq:

- 1) Kulavaat norrallit tamakkiisumik illersorneqassasut, tassa imaappoq kulavaat norrallit piniarneqassanngitsut. Tuttoqatigiit ilaartortuarnissaat pingaaruteqarpoq aamma tuttuqniarfiup nalaani kulavaat norrallit tassaapput tuttoqatigiinnik amerlisaasut (Appendiks 2 takuuk).
- 2) 2012-imi ukiuunerani tuttuqniarnermi qamuteralaat taamaallaat atorneqarnissaat akuersissutigineqassasoq.

Nunap immikkoortui 4 aamma 5, Kujataani nunap immikkoortui, Ameralimmi aamma Qeqertarsuatsiaani (QEQ)tuttuq amerlassusiat

Sumiiffinnit taakkunannga paasisutissanik nutaanik peqanngilagut; 2006-imi tuttoqatigiit 9.680-iussagatinneqarlutillu 5.224-iussagatinneqarpit, tuttoqatigiikkaataat taakku km² –imut 1,2-t missaanniissagatinneqarpit, tassalu tamanna anguniakkatsinnut naapertuuppoq. Siunnersuinerput kingullermik siunnersuunitsit (Cuyler & Witting 2006) ippoq, tassa imaappoq Kangerlussuaq-

Sisimiut aamma Akia-Maniitsumisut piffissami aalajangersimasumi killeqanngitsumik tutunniarnissaq, ukiukkulli tutunniartoqarani.

Nunap immikkoortua 6, Paamiuni Qassini tutut amerlassusiat

Sumiiffimmit tassannga paasissutissanik nutaanik peqanngilagut; 2000-imi sumiiffinni taakkunani tuttoqatigiit 196-iussagatinneqarput (ikinnerpaatut kisinneqartut). Tutunniarnissamik siunnersuinivut nunap immikkoortuinut 4 aamma 5-imut siunnersuinitta asigaa, tassa imaappoq ukiakkut piffissami aalajangersimasumi killeqanngitsumik tutunniarnissaq, ukiukkulli tutunniartoqarani.

Nunap immikkoortua 7, Paamiuni Neriamilu tutut amerlassusiat

Sumiiffinnit taakkunannga paasissutissanik nutaanik peqanngilagut; 2000-imi sumiiffinni taakkunani tuttoqatigiit 1.600-juussagatinneqarput (ikinnerpaatut kisinneqartut). Tutunniarnissamik siunnersuinivut nunap immikkoortuinut 4 aamma 5-imut siunnersuinitta asigaa, tassa imaappoq ukiakkut piffissami aalajangersimasumi killeqanngitsumik tutunniarnissaq, ukiukkulli tutunniartoqarani.

Nunap immikkoortua 11, Ivittuuni/Arsummi-Ivittuuni tutut amerlassusiat

Sumiiffimmit tassannga paasissutissanik nutaanik peqanngilagut; tuttoqatigiit amerlassusilerneqarsimangillat. Sumiiffik Namminersornerullutik Oqartussanit tutunniarfittut 2005-imi ilanngunneqarpoq. Tutunniarnissamik siunnersuinivut nunap immikkoortuinut 4 aamma 5-imut siunnersuinitta asigaa, tassa imaappoq ukiakkut piffissami aalajangersimasumi killeqanngitsumik tutunniarnissaq, ukiukkulli tutunniartoqarani.

Nalunaaruteqarnissamut immersuiffissat immikkut ittut – Aqutsisoqarfiup piniartullu akornanni suleqatigiittuarnerat suleqatigiinnerunissaallu nukingisaarutigineqarpoq, taamaalilluta nalunaaruteqarnissamut immersuiffissat immikkut ittut siuarsarsinnaaniassagatsigit. Aqutsisoqarfinni aqqaniliusuni tamani tuttutarineqartut tamarmik suaassusiilu *Piniarneq*-mut ilanngunneqassasut sakkortuumik siunnersuutigaarput, tassami paasissutissat tamakku qanoq amerlatigisunik tuttuttoqatarneranik naliliinissamut pisariaqartinneqarmata, tamatumanili ajornartorsiuteqartoqarsinnaanera nassuiarutigaarput.

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Appendix 1

Background

Populations

The wild caribou and reindeer in west and northwest Greenland are currently recognized to consist of about 11 more or less discrete populations (Fig. 1, Table 1, 2). Ivittuut was added by the Greenland government in 2005. The Ivittuut population consists of feral semi-domestic reindeer that established themselves in the area after having wandered north from the Isortoq reindeer husbandry district in southern Greenland.

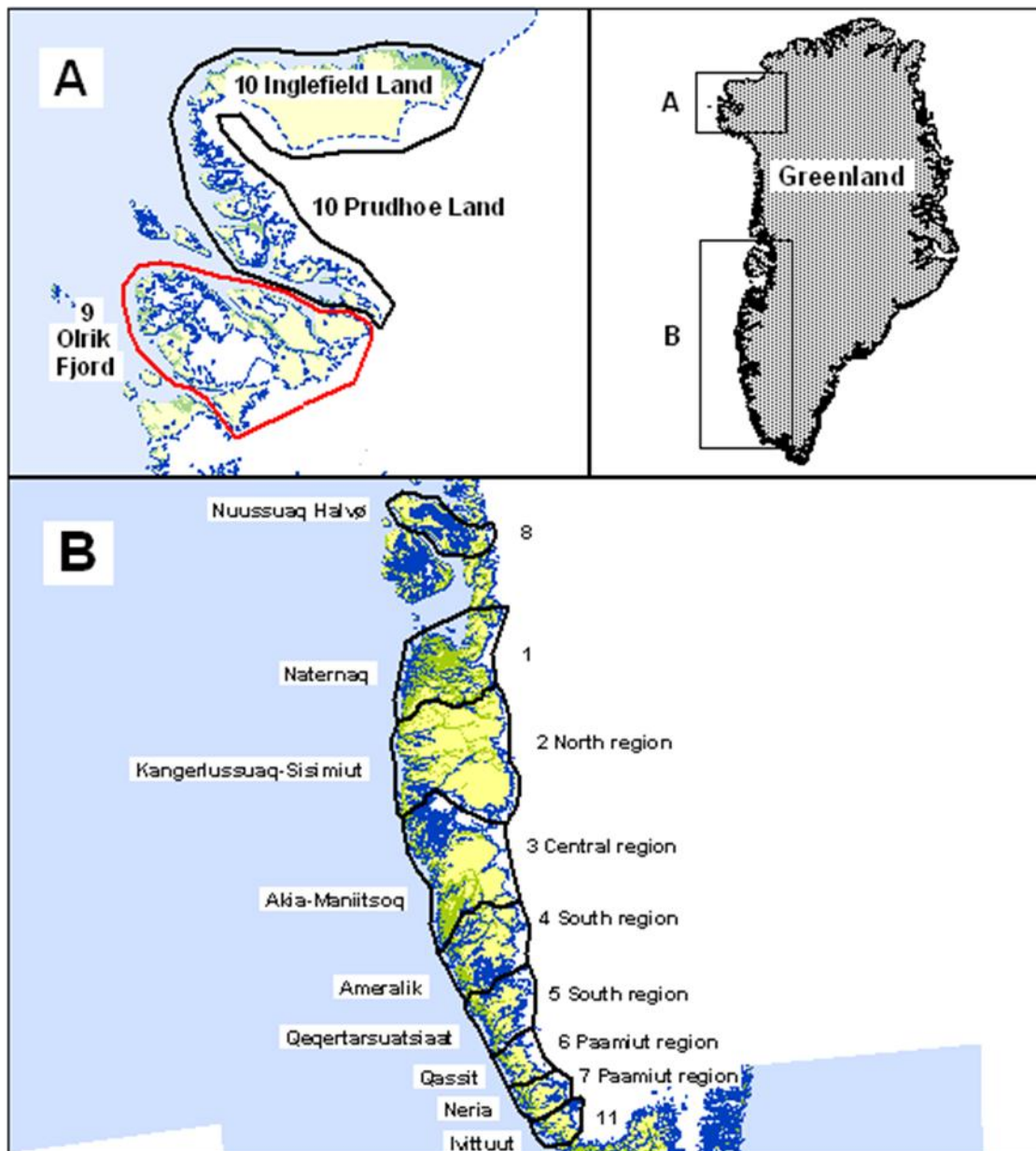


Figure 1. Names and locations of Greenland caribou / feral reindeer populations in 2011, with corresponding harvest region number, and where applicable a region name

Table 1. Population estimates and minimum counts of wild caribou / reindeer in Greenland, given in order from north to south. All population size estimates are approximate¹.

Caribou / Reindeer Population	Region No.	Region Name	1977 / 78	1993	1994	1995	1996	1999	2000	2001	2002	2005	2006	2010
Inglefield Land	10	-	-	-	-	100	-	2,260	-	-	-	-	-	-
Olrik Fjord	9	.	-	-	-	-	-	-	-	38*	-	-	-	-
Nuussuaq Halvø	8	-	170	-	-	400	-	-	-	400	1.164*	-	-	-
Naternaq	1	Naternaq	100	80	-	271	-	-	-	-	-	-	-	-
Kangerlussuaq-Sisimiut	2	North	17,900	3,788	7,727	6,196	10,869	-	51,600 ³	-	-	90,464 ³	-	98,300
Akia-Maniitsoq	3	Central	5,300	3,506	3,080	6,408	6,806	-	-	46,236	-	35,807	-	31,200
Ameralik	4	South	-	-	-	-	-	-	-	31,880	-	-	9,680	-
Qeqertarsuaiaa t	5	South	-	1,341	1,458	4,553	4,458+	-	-	5,372	-	-	5,224	-
Qassit	6	Paamiut	-	-	-	-	-	-	196*	-	-	-	-	-
Neria	7	Paamiut	-	-	181	407	-	-	1,600 (332*)	-	-	-	-	-
Total Greenland Approximate Estimate			-	9,000	13,000	18,000	22,000	-	-	140,000²	-	-	-	-

¹Estimates from 2000 to 2010 were obtained using survey methods and design unlike those employed from 1993 to 1999. Therefore herd size differences between these two time periods are not assumed readily comparable.

²Rough sum of population estimates from 1999, 2000 and 2001.

³ Kangerlussuaq-Sisimiut estimates from 2000 and 2005 were obtained using somewhat dissimilar methods, i.e. the 2005 survey reduced flight altitude by 85 m, speed by ca 45 km/hr, and strip width by 400 m. The two estimates are therefore not assumed readily comparable and should not be interpreted as indicating population trend for this herd for the time period 2000-2005.

* Minimum counts.

Sources: Ydeman & Pedersen 1999, Linnell et al. 2000, Landa et al. 2000, Cuyler et al. 2002, 2003, 2004, 2005, 2007 and 2011

Table 2. Caribou and feral reindeer populations in order from north to south, their possible genetic mixing, population size and abundance trend.

Population			Region	Size	Trend
Caribou	Feral Reindeer	Mixed			
Inglefield/Prudhoe Land			Qaanaaq	Small	?
	Olrik Fjord/Pituffik	Probably	Olrik Fjord	Small	?
Nuussuaq Halvø	Nuussuaq Halvø	Probably	Nuussuaq H.	Small	?
Naternaq			Naternaq	Small	?
Kangerlussuaq-Sisimiut			North	Large	Stable
Akia-Maniitsoq		Yes	Central	Large	Declining
Ameralik		Yes	South	Medium	Expect Stable
Qeqertarsuatsiaat		Probably	South	Small	Expect Increase
Qassit			Paamiut	Small	?
Neria			Paamiut	Small	?
	Ivittuut	Maybe	Ivittuut	Small	?

New information

Kangerlussuaq-Sisimiut - the largest Greenland population

The 2010 estimate of population size, 98,300 (Table 1), for the Kangerlussuaq-Sisimiut (KS) caribou was still far above the target caribou density of 1.2 per sq km, which was first recommended in 2002 (Kingsley & Cuyler 2002). There has been no reduction in abundance. Density is currently up to seven times greater than recommended on primary winter range.

Akia-Maniitsoq - the second largest Greenland population

Although reduced since 2001, the 2010 estimate of population size, 31,200, for the Akia-Maniitsoq (AM) caribou was still above the target density. Surveys since 2001 indicate declining calf recruitment and increasing bull mortality, which suggests that density dependent effects are behind the slow decline in Akia-Maniitsoq caribou numbers (Cuyler et al. 2005, Cuyler & Witting 2006, Cuyler et al. 2011).

AM & KS Rump fat depths from hunter reports 1996-2007

Rump fat depth is a good indicator of caribou body condition, which determines reproductive success among cows. Since 1996 cows have made up an increasing proportion of the annual harvest, even exceeding the number of bulls. Hunter reports provide an approximation of fall fat reserves, which also reflect the quality of the summer range. Summer range can vary from year to year according to the weather and length of summer. Rump fat among KS swings, often from year to year, which is normal (Table 3). In contrast, rump fat for AM cows remained low from 1997 to 2006, with 2005 as the only exception. Further, rump fat depth for AM cows

is consistently below KS levels. This suggests limitations on the AM summer range, which might include, short summers, poor forage quantity relative to caribou numbers and severe insect harassment. Whatever the reasons behind AM's low rump fat depth in Aug-Sept, it will likely result in reduced reproductive success among cows. The lower AM calf recruitment relative to KS supports this (Appendix 3).

Table 3. Rump fat depth on adult caribou cows as per hunter harvest reports for the Kangerlussuaq-Sisimiut and Akia-Maniitsoq caribou populations.

Year	Kangerlussuaq-Sisimiut		Akia-Maniitsoq	
	August	September	August	September
1996	2.36 ±1.3 n = 14	1.87 ±1.1 n = 39	---	2.30 ±0.79 n = 10
1997	2.71 ±1.1 n = 29	2.56 ±1.2 n = 51	1.83 ±0.8 n = 6	1.95 ±0.9 n = 21
1998	2.83 ±0.9 n = 14	2.33 ±1.3 n = 31	---	2.00 ±1.3 n = 6
1999	1.52 ±1.2 n = 31	1.72 ±1.5 n = 62	---	1.19 ±0.7 n = 16
2000	1.59 ±1.1 n = 232	1.65 ±1.1 n = 309	1.31 ±1.1 n = 53	1.44 ±1.0 n = 83
2001	2.50 ±1.3 n = 15	2.39 ±1.0 n = 57	0.88 ±0.6 n = 24	1.42 ±1.0 n = 52
2002	2.8 ±1.9 n = 73	3.01 ±1.9 n = 231	1.14 ±1.2 n = 532	1.49 ±1.5 n = 880
2003	1.53 ±1.3 n = 78	1.87 ±2.0 n = 122	1.07 ±1.3 n = 21	0.91 ±1.2 n = 50
2004	2.66 ±1.6 n = 65	2.73 ±1.4 n = 164	1.50 ±1.6 n = 11	1.80 ±1.7 n = 51
2005	2.20 ±1.5 n = 103	2.76 ±1.8 n = 187	2.15 ±2.1 n = 17	2.95 ±1.8 n = 39
2006	2.22 ±1.7 n = 63	2.51 ±1.4 n = 213	1.52 ±1.8 n = 17	2.12 ±1.4 n = 61
2007	1.98 ±0.9 n = 33	2.82 ±1.3 n = 46	---	---

Late winter body condition & size: 1997 versus 2008-09

Late winter fat reserves and food intake among AM caribou are now significantly less than a decade ago (Table 4). Forage may be a limiting factor.

Late winter fat reserves among KS caribou generally appeared unchanged, with only a significant decrease in mesenteric fat (Table 5). Food intake and body size, however, are significantly less than a decade ago. Forage may be limited.

We suggest that the slow decline in AM caribou numbers since 2001 (Table 1) is related to their poor autumn and winter fat reserves (Table 3, 4). Low fat reserves in autumn among cows will reduce the number participating in the rut and

reproduction will decline, as supported by the low calf recruitment in 2010 (Cuyler et al. 2011). Low fat reserves in winter can increase mortality, again supported by the low calf recruitment and poor bull to cow ratio (Cuyler et al. 2011). Further the low late winter food intake indicates limited winter forage.

Table 4. Comparison of body condition parameters from the adult (age > 3-years) Akia-Maniitsoq caribou cows, collected late winter 1997 and 2008 in West Greenland, using two-tailed t-tests assuming unequal variances. Significant differences are when alpha < 0.05.

Parameter	Akia-Maniitsoq caribou cows				±	df	P alpha	t Stat
	1997		2008					
	Mean	±SD	Mean	±SD				
Rump fat, all cows weight (kg)	152.0	246.7	94.3	149.5	-	20	0.39	0.864
Rump fat, all cows depth (cm)	0.80	1.1	0.66	0.7	-	20	0.63	0.485
Rump fat, fat cows weight (kg)	398.7	255.7	117.4	130.1	-	6	0.04	2.604
Rump fat, fat cows depth (cm)	2.1	0.6	0.91	0.6	-	8	0.002	4.604
Mesenteric fat weight (g)	267.1	107.5	169.4	90.8	-	23	0.005	3.068
Chest girth (cm)	109.9	3.9	102.0	3.6	-	26	<0.0001	6.962
Rumen contents weight (kg)	7.3	0.7	6.5	1.4	-	45	0.01	2.695
Total body weight (kg)	60.6	4.2	59.2	5.0	-	34	0.31	1.031
Cold carcass weight (kg)	29.8	2.5	28.7	2.6	-	30	0.17	1.421
Metatarsus length (cm)	24.9	0.6	25.1	1.0	+	51	0.19	-1.313
Jawbone total length (cm)	23.1	5.8	22.8	0.7	-	59	0.07	1.836
Jawbone Anterior ratio (%)	0.533	0.008	0.534	0.012	+	54	0.78	-0.278
Kidney weight (g)	63.7	6.8	67.5	8.9	+	38	0.11	-1.636
Liver weight (g)	610.9	78.5	682.3	72.5	+	27	0.005	-3.070

Table 5. Comparison of body condition parameters from adult (age > 3-years) Kangerlussuaq-Sisimiut caribou cows, collected late winter 1997 and 2009 in West Greenland., using two-tailed t-tests assuming unequal variances. Significant differences are when alpha < 0.05.

Parameter	Kangerlussuaq-Sisimiut caribou cows				±	df	P alpha	t Stat
	1997		2009					
	Mean	±SD	Mean	±SD				
Rump fat weight (kg)	119.1	228.5	99.0	118.0	-	39	0.72	0.357
Rump fat depth (cm)	0.57	0.8	0.45	0.7	-	43	0.58	0.564
Rump fat, fat cows weight (kg)	271.7	286.0	297.1	0.7	+	15	0.81	-0.239
Rump fat, fat cows depth (cm)	1.3	191.3	1.3	0.6	-	17	0.89	0.144
Mesenteric fat weight (g)	142.9	83.7	70.7	60.7	-	37	0.001	3.578
Chest girth (cm)	116.2	4.2	107.8	3.1	-	37	< 0.001	8.195
Rumen contents weight (kg)	15.8	2.3	12.2	1.9	-	38	< 0.001	5.945
Total body weight (kg)	72.36	6.2	65.2	4.9	-	39	< 0.001	4.698
Cold carcass weight (kg)	30.8	3.8	31.2	2.7	+	36	0.63	-0.480
Metatarsus length (cm)	25.6	0.7	24.6	0.5	-	54	< 0.001	4.234
Jawbone total length (cm)	23.3	0.8	23.3	0.4	-	65	0.73	0.345
Jawbone Anterior. ratio (%)	0.532	0.008	0.515	0.092	-	32	0.32	1.009
Kidney weight (g)	81.4	9.1	75.2	10.4	-	51	0.02	2.400
Liver weight (g)	814.2	137.0	816.6	92.4	+	35	0.94	-0.074

The KS caribou numbers have remained stable the past decade (Table 1), likely owing to their relatively constant winter fat reserves and generally good autumn fat reserves. Their body size, however, has decreased significantly since 1997, which suggests forage limitation of growth. Further, the low late winter food intake also indicates limited winter forage. At a density of 7 caribou per sq km on core range, it is likely that density dependant factors will soon initiate a decline in numbers.

Low late winter calf recruitment and bull number, decreased fat reserves, low food intake and body size changes over the past decade observed for the KS or AM populations indicate problems ahead. To what extent that same situation applies to the other West Greenland herds is unknown.

Table 6. Greenland caribou population estimates, harvest quotas, reported harvest and the percentage by which the quota was filled: Harvest records are from "Piniarneq 2011" published by the Ministry of Fisheries, Hunting & Agriculture, Imaneq 4, P.O. Box 269, 3900 - Nuuk, Greenland.

Year	Estimate of total caribou in Greenland	Quota	Reported Harvest (Piniarneq)	Amount of quota filled
1995	ca. 18,000	2,000	1,398	69.9%
1996	ca. 22,000	2,600	2,048	78.8%
1997		3,111	2,755	88.6%
1998		3,680	3,692	100.3%
1999		4,050	3,957	97.7%
2000		13,600	9,671	71.1%
2001	ca. 140,000	24,300	13,490	55.5%
2002		36,150*	16,901	52.3%
2003		Open	18,951	-
2004		Open	15,226	-
2005		Open	13,719	-
2006		Open	15,057	-
2007		Open	15,092	-
2008		Open	15,872	-
2009		Open	Not yet available**	-

* The 2002 harvest quota was originally set at 32,150 caribou; however, the number of licences permitted exceeded that number by 4,000.

** The 2009 is expected to be similar to harvests since 2001.

Hunter harvest Kangerlussuaq-Sisimiut

Given that the North region is ca. 26,000 sq km, if the recommended density of 1.2 caribou per sq km was attained, then an appropriate KS population size might be ca. 31,200 caribou. The 2010 estimate exceeds this by ca. +67,000 caribou. Even if we assume the KS population is at the lower end of the CI 90%, i.e., 71,500, still this is more than 'double' what is assumed somewhat in balance with range carrying capacity for a sustainable caribou population.

Although annual harvest results per population are unavailable, the total numbers of caribou reported harvested in Greenland (Table 6) are low relative to the numbers

required for KS population reduction even if all of the current harvest applied to just the KS caribou in the North region. Therefore, despite the large quotas in 2000-2001 followed by open harvests from 2002 through 2010 and long hunting seasons, hunting has not been sufficient to reduce the KS caribou population size. In fact, hunting has had no clear affect on KS abundance. This may be because the KS interior is inaccessible to the majority of hunters, and of course that is where the caribou are (Figure 6). Caribou in the interior are 'hidden' from hunters. Animals are seldom seen on the coast or along the shores of the fjords. After a decade of open harvests and long hunting seasons, one could expect that caribou have learned to avoid the coast and shorelines. Caribou numbers are extremely high, but hunters do not see them, with the results that too few animals are harvested.

Hunter harvest Akia-Maniitsoq

Although the AM population abundance estimate has decreased since the first helicopter survey in 2001, when numbers were ca. 46,200, it remains high in 2010 at ca. 31,200 caribou. Given that the Central region is ca. 15,362 sq km, if the recommended density of 1.2 caribou per sq km was attained then a suitable population size for the range available might be ca. 18,400 caribou. The 2010 AM caribou population estimate exceeds this by almost 13,000 caribou. In 2001, caribou density on core winter range was four-times the recommended target density, in 2005 was three-times, and in 2010 was about double. The trend is decreasing towards the recommended target level. Hunting is not assumed the primary cause responsible for the decline in AM caribou number, because the AM interior is relatively inaccessible to hunters. The situation is reminiscent of the KS interior, making harvests insufficient, despite the great numbers of hunters, who are well equipped with modern technology and able to patrol long distances of coast and fjord shorelines in speed boats.

Hunter harvest Ameralik & Qeqertarsuatsiaat

Hunter harvest appears to have been an effective tool in reducing the Ameralik populations (Witting & Cuyler In Press). Unlike the North and Central region, accessibility to caribou is high in the South region, where the many long fjords bisect the land, while the rapid elevation changes bring caribou down to the coast and fjord shorelines as snow and frost cover the highlands.

Appendix 2

Hunting by Skidoo

Hunting caribou by skidoo – Pros?

The recent past and current high density and abundance of the AM and KS caribou are not likely sustainable under any natural conditions. The majority of AM and KS caribou are primarily distributed in the inaccessible interiors during winter. Local knowledge says this is also true for summer and autumn. Harvesting by hunters has been an effective tool for reducing caribou abundance in Ameralik (South Region), where caribou are accessible (Witting & Cuyler In Press), because topography and indented coastline bring animals close to shorelines. At present, AM and KS caribou harvests are insufficient to reduce population number because, on foot, it is impossible to reach the majority of animals.

Raising hunter access to caribou would increase harvests. Motorized vehicles, however, are generally prohibited in the terrain beyond the cities and settlements, and their use requires written permission from the Greenland government (Hjemmestyret 1999a, 2000). Further hunting caribou by airplane, helicopter or motorized vehicle is prohibited (Hjemmestyret 1999b). At present only commercial hunters are allowed a winter caribou season. Their access to, and harvest of, caribou would be increased if transport by skidoo was approved and given dispensation. Access to caribou by skidoo could promote an efficient effective reduction in AM and KS caribou numbers.

Hunting caribou by skidoo – Cons?

A management scheme permitting a winter skidoo harvest of caribou would require several important considerations. Hunters may oppose increasing harvests using skidoos. Skidoo & ATV's disrupted normal winter distribution of the AM caribou. For the first time in 2010, we observed extensive skidoo use over the Akia-Nordlandet area, which is preferred winter range of the AM population (Cuyler & Linnell 2004). Although hunting caribou from skidoo is prohibited (Hjemmestyret 1999b), we received reports that a full-time hunter harvested many caribou by skidoo in the Akia-Nordlandet area during the winter 2010. In contrast to the AM surveys of 2001 and 2005, in 2010 we observed few caribou on this winter range. Instead, a high number and large aggregations of caribou were observed in the adjacent and less 'skidoo' accessible Narssarsuaq Valley (Cuyler et al. 2011). We propose that this skidoo and ATV activity was the principle cause behind the abnormal clumped distribution of AM caribou observed in March 2010. Caribou appeared to have been driven away from their preferred range and crowded into adjacent habitat where their densities could create intra-specific competition for food. If faced with severe stochastic winter weather events, under such conditions the resilience of the AM population could suffer. Further, a clumped caribou distribution jeopardises the abundance surveys as they are presently designed. Our surveys are based upon the normally even distribution of small groups of caribou throughout the high-density stratum. If large aggregations occur and escape the few random transects, this can create problems when estimating abundance.

Skidoo hunting would likely increase the negative energy budget of caribou in winter. We assume skidoo hunting would disrupt the amount of time spent foraging and ruminating by caribou. This would further reduce already low winter food intake and lower the digestibility of what is consumed. Energy uptake would decrease further than observed. Considerable skidoo hunting would also substantially increase caribou activity energy costs. The excessive and negative impacts on body condition, fecundity and survival of the remaining caribou are undesirable.

The declining AM population makes difficult the management use of winter skidoo harvesting. If herd size were to suddenly drop in response to a catastrophic weather event or perhaps just unfavourable trends, skidoo hunting could worsen that situation, postponing a future population recovery. Furthermore, the majority of caribou taken in any hunter harvest are likely the most resilient and reproductively valuable individuals, i.e., males and females in their prime, rather than the young, sick or old. Population resilience depends on sex and age structures that favour abundance recovery. Thus because hunters take high quality animals the effect on the entire herd could be greater than the total number harvested would suggest.

Current prohibition of skidoo use in the terrain exists only in the former municipalities of Upernavik, Uummannaq, Sisimiut, Kangerlussuaq and Maniitsoq (Hjemmestyret 1999a, 2000). Is driving a skidoo in the terrain legal in Nuuk, Ilulissat, Qaanaaq, Paamiut, South & East Greenland? Hunting or transporting caribou by skidoo (or dog team) is illegal everywhere in Greenland (Hjemmestyret 1999b). The government may give dispensation to specific individuals or group for one year at a time (Hjemmestyret 1999a). If the government permits skidoo hunting for caribou in one or more regions, what is to prevent the Greenland populace from assuming that skidoo hunting is allowed in all regions, including species other than caribou? What is to prevent people from assuming skidoo hunting, or just skidoo travel, is permitted for everyone everywhere anytime, and that first obtaining dispensation from NNPAN (*Departementet for Indenrigsanliggender, Natur & Miljø*) is no longer needed to drive a skidoo in the Greenland terrain? Skidoo hunting could evolve into a gigantic management headache.

Possible management strategies for a skidoo harvest of caribou:

- 1) A winter 'total-allowable-catch' quota be set. Once reached the hunt would be closed regardless of initial season length.
- 2) Either each commercial hunter, or the local KNAPK division, must apply for dispensation for hunting and transporting caribou by skidoo, specifying the names and numbers of hunters and skidoos involved. This may retard a chaotic free-for-all attitude about hunting caribou from skidoos.
- 3) In years when scientific aerial surveys are to occur. All skidoo winter hunting for caribou must end at the minimum by the 15th February, to allow a period of time for caribou to redistribute themselves normally in the terrain prior to aerial surveys.

- 4) Permission for skidoo hunting/transport is to be considered a temporary management measure.
- 5) Forbid all skidoo or other motorized travel south of the Kangerlussuaq airport until the start of the winter muskoxen hunt, which is when the muskoxen hunters have dispensation to use motorised vehicles. GINR's semi-annual scientific minimum count of muskoxen abundance and herd structure is always done just prior to the start of the winter muskoxen harvest. Having been left in peace, the muskoxen are naturally distributed throughout the terrain when we arrive. Use by others of skidoos or motorized vehicles in the area south of the Kangerlussuaq airport in the months prior to the start of the winter harvest will disturb the distribution of muskoxen before we arrive. The results from the semi-annual scientific minimum count of muskoxen abundance and herd structure will become unreliable and useless. NOTE: There are fewer caribou south of Kangerlussuaq airport relative to the many north of the airport.

Appendix 3

2010 Aerial Survey Results

GN technical report no. 78 available at www.natur.gl .

Table 7. Survey information and preliminary raw and corrected population size estimates for Kangerlussuaq-Sisimiut caribou, North region, 03-08 March 2010.

Parameter	High-density	Low-density	Totals
	Stratum	Stratum	
Area size	8,000 km ²	18,000 km ²	26,000 km ²
Number strips	40	19	59
Length of each strip	7.5 km	7.5 km	
Total strip width	2x 300 m	2x 300 m	
Area covered	180 km ²	85.5 km ²	265.5 km ²
% Coverage of North region	2.3 %	0.5 %	1.0 %
Flight height	15 metres	15 metres	
Flight speed (km/hr)	46 to 65	46 to 65	
Total caribou seen (<i>n</i>)	1217	212	1429
Raw Density (caribou / km ²)*	6.8	2.5	2 to 7
Raw estimate herd size*	54,089	44,632	98,721
Corrected Density (caribou / km²)**	6.9	2.5	+2 to 7
Corrected estimate herd size**	54,700	42,900	98,300
90% Confidence Interval (CI)	40,500 – 70,700	21,+300 – 73,700	71,500 – 132,400
Coefficient of Variance (CV)	0.16	0.36	0.19
Standard Error (SE)	9100	16100	18500

* From raw data with no correction for missed caribou.

** Herd size estimate after bootstrapping and correction for missed caribou has been made.

Table 8. Herd Structure for two caribou herds in West Greenland, March 2010.

Parameter	Kangerlussuaq-Sisimiut	Akia-Maniitsoq
	Caribou Population	Caribou Population
Region (Hunting area)	North (2)	Central (3)
Time period	03-08 March 2010	09-13 March 2010
Method	Helicopter	Helicopter
Total observed	2215	1482
Total sexed & aged (<i>n</i>)	1735	1351
Number of groups observed	752	306
Average group size	2.96 ± 2.14 SD	4.84 ± 4.22 SD
Maximum group size	17	31
Minimum group size	1	1
Bull (> 1 year)	519 (29.9%)	318 (23.5%)
Cow (> 1 year)	952 (54.9%)	839 (62.1%)
Calf from 2009	264 (15.2%)	194 (14.4%)
Recruitment (calf/100cow)	27.7	23.1
Bull to Cow ratio	0.54	0.38

Table 9. Survey information and preliminary raw and corrected population size estimates for Akia-Maniitsoq caribou, Central region, 09-13 March 2010.

Parameter	High-density	Low-density	Totals
	Stratum	Stratum	
Area size	10,037 km ²	5,325 km ²	15,362 km ²
Number strips	39	15	54
Length of each strip	7.5 km	7.5 km	
Total strip width	2x 300 m	2x 300 m	
Area covered	175.5 km ²	67.5 km ²	243 km ²
% Coverage of Central region	1.7 %	1.3 %	1.6 %
Flight height	15 metres	15 metres	
Flight speed (km/hr)	46 to 65	46 to 65	
Total caribou seen (<i>n</i>)	276	104	380
Raw Density (caribou / km ²)*	1.6	1.5	1.6
Raw estimate herd size*	15,785	8,204	24,023
Corrected Density (caribou / km²)**	2.2	1.7	+2
Corrected estimate herd size**	21,900	9,100	31,200
90% Confidence Interval (CI)	14,300 – 31,600	4,100 – 14,900	21,800 – 42,200
Coefficient of Variance (CV)	0.24	0.36	0.20
Standard Error (SE)	5300	3300	6200

* Herd size estimate from raw data with no correction for missed caribou.

** Herd size estimate after bootstrapping and correction for missed caribou has been made.