Antler possession by west Greenland female caribou in relation to population characteristics

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Abstract: The frequency of antlerless adult female caribou (*Rangifer tarandus groenlandicus)* was studied in four separate populations in west Greenland. Between the herds antlerlessness varied from 21% to 79%. An inverse relationship between winter range quality and percentage of unantlered cows is demonstrated. Relationship between calf percentage and maternal antler status was studied in one population and antlerless cows showed higher reproductive rate than antlered ones. In another population antlerless cows were almost absent outside the calving area. Calves of antlerless mothers were more susceptible to diseases and had significantly higher summer mortality than other calves, 42% and 27% respectively. The relative importance of factors influencing antler development under various environmental conditons are assessed and a close relationship between antlerlessness, physical condition, lactation, and length of period between calving and midsummer is discussed.

Key words: caribou, *Rangifer,* Greenland, antler, reproduction, calf mortality, antler status, antler cycle.

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Introduction

As an exception in *Cervidae* both sexes in genus *Rangifer* normally grow antlers. The female antler might be largely of social importance. When adult bulls loose their antlers in early to midwinter they are also deprived of their previous rank in the feeding hierarchy. During winter adult antlered females acquire highest ranks, thereby getting access to the best forage patches (Espmark, 1964, 1971; Henshaw, 1968; Shea, 1979). Development of antlers as a defensive structure in female *Rangifer* has been proposed by Bubenik (1975) and Espmark (1964). Parturient cows often still have antlers and are therefore capable of defending their calves against predators (Espmark, 1964). *Rangifer* often aggregates in big groups during insect season and migration and resulting intra-specific interactions might account for the development and function of antlers in the females (Clutton-Brock *et al.*, 1982). Goss (1976, 1977) demonstrated antler development to be dependant on day length in white-tailed deer. To our knowledge similar experiments have not been done with *Rangifer.* Skjenneberg and Slagsvold (1968) stated that antlers are shed earlier in strong and healthy individuals than in animals in poor physical condition. Bergerud (1976) reported that even pregnant cows might have antlers in velvet and the same may occur in Greenland. (P. Aastrup, unpublished data).

In the Hardangervidda (Norway) and Ameralik (Greenland) populations antler chewing on both shed and unshed antlers is widespread

decline an epidemical summer mortality caused by E. coli arthritis has removed up to 65% of the calf crop annually (Clausen *et al.*, 1980, Thing and Clausen, 1980). Hunting pressure is very strong during the fall and winter seasons and the populations are apparently still decreasing (Ministry for Greenland, 1985; C.R. Olesen, unpublished data). The calving season is from 29 May to 23 June.

Sermilik herd: This herd is close to the present southern limit of caribou distribution in Greenland. Little data have been available for this population. Herd size was around 400 animals in July 1980 (Reimers, 1980; Aastrup, 1983). Very strong hunting pressure prevents animals from extending their home range into adjacent, more favorable range. Carrying capacity of the present range is believed to have been exceeded during recent years. Range lies in the coastal zone and heavy precipitation as well as above-zero temperatures are part of the winter weather pattern. The calving season is around early-mid June.

Materials and methods

Each of the four populations has been surveyed on foot. Field work took place in July-September 1977-84 in all ranges except Nuuk where data were collected in April 1979.

To minimize possible biases in registration of long-term antler status data collected between early May and early July were not used in the tables because parous females drop their antlers at various times.

Whenever adult females were encountered (during mid July - early April) at close range antler status, calf-leading, not calf-leading, and physical conditon of the calf was registered using 10 x 50 binoculars or 25 x 60 spotting scope. An adult female with no antlers nor any visible pedicles protruding through the skin was recorded as antlerless.

(Fig. 2C). Half-antlered cows were characterized by the absence of just one antler beam including pedicle either left or right (Fig. 2B). Fully antlered cows showed a complete set of antlers (Fig. 2A). Antlerless individuals may sometimes have dark-colored hairs on the spot where the pedicles should have protruded.

Close examination of their skull revealed that some of them were in fact truly antlerless while some had a small but detectible raised part of *os frontale* interpreted as the reminiscence of a resorbed pedicle (Fig. 2D).

Results

Antler and range data

Table 1 shows the percentages of antlerless and half-antlered females at various localities in Greenland together with reported percentages from Canada and Svalbard. Using the range as an indicator of the nutritional status of the herds we have furthermore tried to rank the localities.

Accordingly there seems to be an inverse relationship between range quality and the frequency of individuals without antlers. The two exceptions to this, the Disko and Itinnera herds, are both of *R. t. tarandus* origin and both calve 3-4 weeks before the *R. t. groenlandicus* herds. The Ameralik herd seems to be genetically influenced by the Itinnera herd.

Calf production and mortality in relation to antler status

Table 2 shows the relation between calf production and mortality parameters and antler status of the Sisimiut herd, July 1979.

The frequency of disease and mortality among calves is assumed to be an indicator of the health and nutritional status of the mother.

Four trends are apparent: 1) More antlerless females and fewer antlered females than expected were leading calves (X^2-test; P (x) $<<0.005$). 2) More antlerless and fewer antlered cows than expected were leading *sick* calves (X^2-test; P (x) $<<0.005$). 3) The disease frequency among calves lead by antlerless cows was greater than among calves lead by antlered cows (X^2-test; P (x) <0.025,) and 4) 80.2% of the diseased calves were lead by antlerless cows compared to 6.3% lead by half-antlered and 13.5% by antlered mothers.

Furthermore, summer mortality among calves was greatest among calves lead by antlerless cows (P (x) <0.05). In mid-August the calf ratio per 100 antlered adult females was 37.5 (N = 66) compared to 31.3 in July (N = 71) and for antlerless cows 36.4 (N = 75) compared to 55.9 in July (N = 238). The indicated increase in calf ratio for antlered cows is not absolute but purely a result of relative dependency of the decreasing calf ratio of unantlered cows.

(Wika, 1982; Aastrup, 1984). Antler growth might therefore be interpreted as part of a mineral saving strategy. In several *Rangifer* populations in Eurasia, Svalbard, Greenland, and North America a varying percentage of females are antlerless. Antlerlessness in this context is defined as the condition in which no sign of an antler is visible. The question of whether the absence of antlers is an inherited or environmentally determined condition has not yet been discussed. This paper presents circumstatial evidence that 1) in some years antlers may fail to sprout depending on the nutritional status of the individual and 2) that pedicles may be partly or fully resorbed in periods of antlerlessness. The scars from a dropped antler may heal so well that they can not be detected by ordinary field observations.

We set forth to examine and discuss the following:

I. The status of antlers in different herds in Greenland.
II. Possible correlations between this and range conditions.
III. A hypothesis that possession of antlers is environmentally determined.
IV. Testing this across subspecies.

Study areas

This paper deals with data collected between 1977 and 1984 in four populations of west Greenland caribou (*Rangifer tarandus groenlandicus)*: 1) Ameralik, 2) Nuuk, 3) Sisimiut, and 4) Sermilik (Fig. 1). These areas exhibit various range conditions based on assessment of the amount of fruticose lichen stands. The Ameralik range is documented to be a near optimal condition (Aastrup, 1983), whereas the Nuuk, Sisimiut, and Sermilik ranges represent an increasing deprivation of the winter food resource of lichens (Reimers, 1980; Thing, 1983). All study areas have bordering topographical features that render exchange of animals between neighbouring herds unlikely.

Ameralik herd: The population was estimated at 2100 animals in 1983 (Aastrup, 1984). Winter climate in recent years has been very adverse with heavy snowfall which seems to have prevented access to the lush lichen stands (2-250 g dry weight/m^2) in the coastal areas. The history of the population is unknown until 1982 but the herd is apparently stable or slightly increasing. Fall hunting pressure is relatively light. Calving season is from 18 May to 15 June.

Nuuk herd: This herd numbered approximately 8000 in March 1982 (Strandgaard *et al.*, 1983) and population size is stable or slowly decreasing. Hunting pressure is strong - recently approaching 30% of the fall population (Ministry for Greenland, 1985). There are reports of many animals in poor physical condition in recent years but heavy winter mortality has not been recorded. Calving time is from early to late June.

Sisimiut herd: Latest peak in this population occurred around 1970 with ca. 30 000 animals. Since then the herd has decreased to 3000 in March 1982 (Thing, 1982; Strandgaard *et al.*, 1983). Long-term carrying capacity is believed to be around 10-12 000 individuals (Strandgaard *et al.*, 1983). During at least the last 8 years of

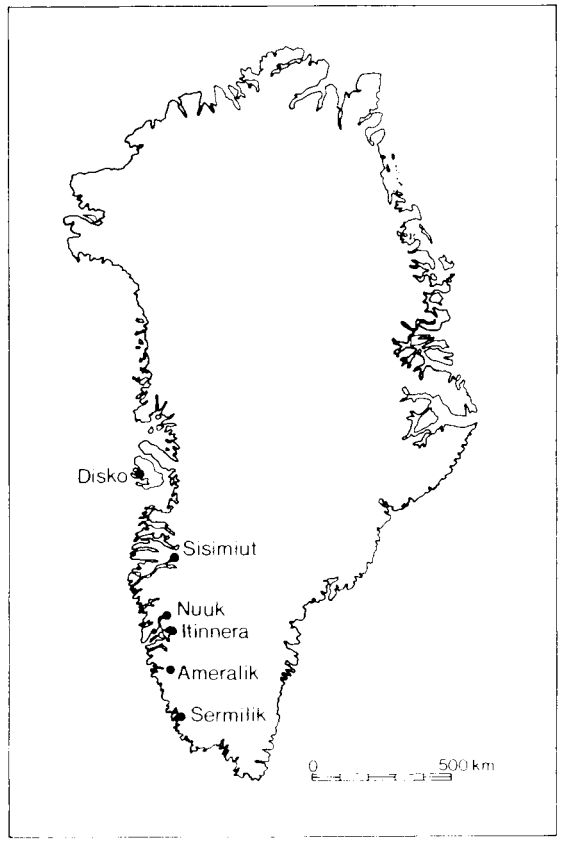


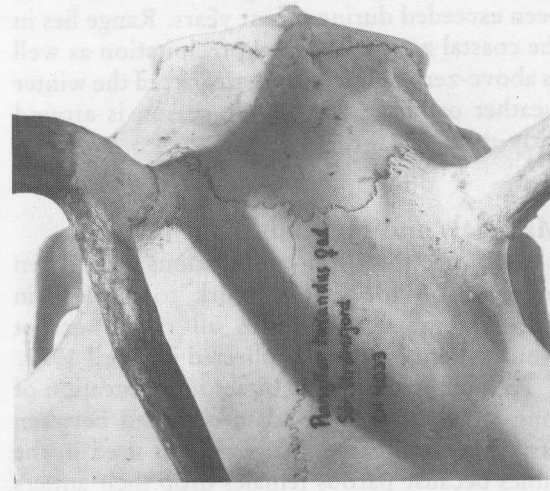
Fig. 1. Map of Greenland showing location of the six study herds. Disko: c. 70°N; Sisimut: c. 67°N; Nuuk: c. 65°N; Itinnera: c. 64°N; Ameralik: c. 64°N; Sermilik: c. 62°N.

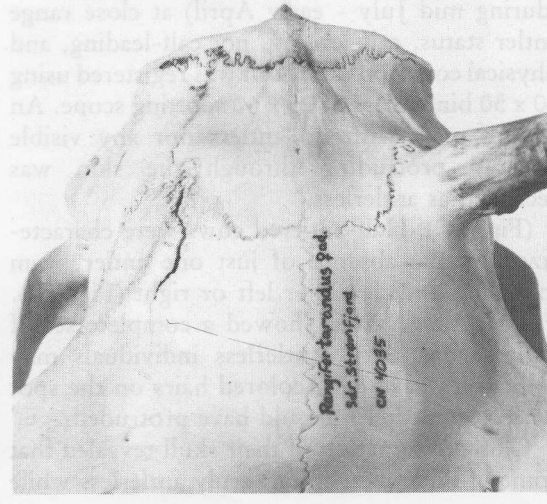
Discussion

The annual antler cycle in female caribou has been studied by several authors and time differences in antler shedding and initiation of new growth have been related to hormonal and behavioral parameters (Lent, 1965; Henshaw, 1968; Espmark, 1964, 1971). The pattern of antler shedding in parturient caribou cows in the Sisimiut and Amęralik herds is not in accordance with that reported by Lent (1965), Espmark 1971), and Bergerud (1976) but rather complex. Around calving time cows exhibited all possible stages of antler status in the immediate *post partum* period (Table 1) similar to the situation described long ago by Müller (1906) in west Greenland.

Some females had growing antlers up to 10 cm long at the time they gave birth. Since the mid 1970's winter forage conditions in the Sisimiut range have been very poor with virtually no lichens to be found (Thing, 1983). Frequency of polled cows in 1977-84 varied between 45% and 64% with a general increase during the period.

The Nuuk and Sermilik herds both occupy ranges where winter food regime is comparable to the situation in the Sisimiut herd and high percentages of antlerlessness were observed. The different populations of *Rangifer* in west Greenland are fluctuating out of phase (Strandgaard *et al.*, 1983). In the Ameralik range good quality winter food is still abundant and the animals are generally in good physical condition





(Aastrup, 1984) and a relatively low frequency (21%) of polled females was recorded. Thus the frequency of antlerless adult females appears to be inversely related to winter range quality (Table 2). This would support the theory of competitive mineral use between gestation/lactation and antler development (Wika, 1980).

Two west Greenland *Rangifer* populations originating from domestic Norwegian reindeer, the Disko and Itinnera herds, have high quality winter ranges available and just one antlerless cow has been observed in the Itinnera herd (Reimers, 1980; Lassen and Aastrup, 1982). These observations are remarkable when compared with *R. t. groenlandicus* herds as calving occurs three to four weeks earlier than in caribou and because of possible genetical differences.

Gossow (1977) reported 17% antlerless cows in the Sassendalen herd on Svalbard (*R. t. platyrhynchus*). Winter range quality in Sassendalen was considered sub-optimal when compared to the range of the Nordenskiöld Land herd and an inverse relationship between winter range quality and percentage of unantlered cows was documented.

Antlerlessness in female caribou was also observed on Newfoundland (Bergerud, 1971, 1975, 1976) but lack of range quality data made correlation between antler and range status impossible.

In Greenland antlerless females are extremely rare in the Itinnera and Disko herds while both

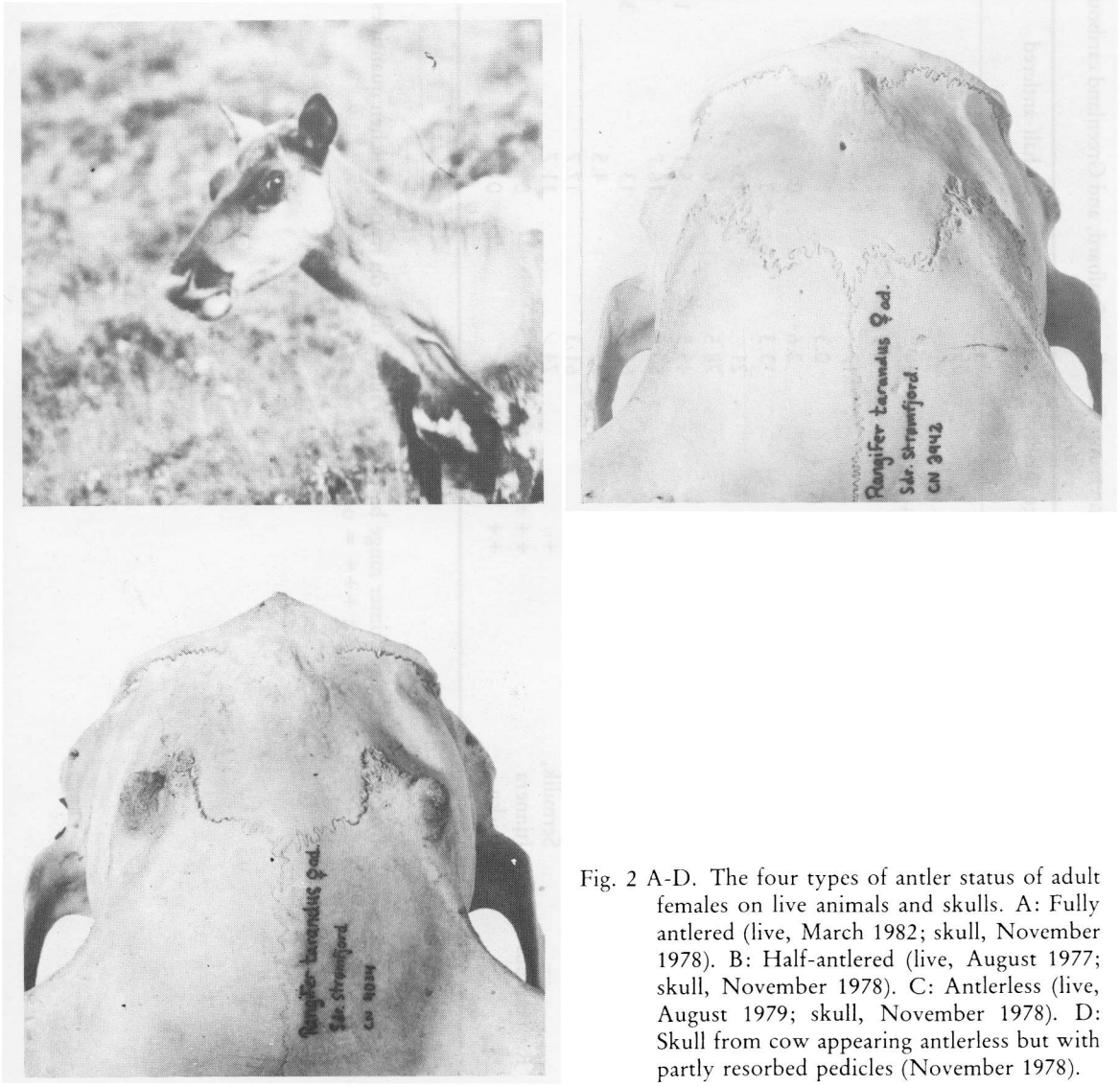


Fig. 2 A-D. The four types of antler status of adult females on live animals and skulls. A: Fully antlered (live, March 1982; skull, November 1978). B: Half-antlered (live, August 1977; skull, November 1978). C: Antlerless (live, August 1979; skull, November 1978). D: Skull from cow appearing antlerless but with partly resorbed pedicles (November 1978).

Table 1. Summary of comparative range and antler data in various Canadian, Svalbard, and Greenland caribou herds.

Subspecies	Locality	Range quality°	Antlerless %	% half-antlered	N	Sample time	Reference
R.t.caribou	Interior,N.fl.*)**	++	55	?	?	1958-63	Bergerud, 1974, 1975
—	Avalon, N.fl.	+	91	?	?	1962-64	Bergerud, 1974, 1975
—	Humber,N.fl.	+++	29	?	?	?	Bergerud, 1974, 1975
—	NE Alberta	?	8	?	?	?	Fuller and Keith, 1980
R.t.platyrhynchus	Sassendalen**	++	17	17	59	Aug.1972	Gossow, 1977
—	Nordenskiöld Land**	++	0.3	?	?	Aug.1972	Gossow, 1977
—	Adventdalen	++	2.6	0	78	Oct.1980	Tyler, pers.comm.
—	—	++	3.3	0	171	Oct.1981	Tyler, pers.comm.
R.t.groenlandicus	Ameralik, W.Greenland**	++	21	13	316	Aug.1983	Aastrup, 1984
—	Tasersuaq, — **	+	78.5	6	240	Apr.1979	H. Thing, unpubl.data
—	Sisimiut, — **	+	45.5	5.1	1373	Aug.1977	H. Thing, unpubl.data
—	—	+	50.6	16.7	925	Aug.1978	H. Thing, unpubl.data
—	—	+	64.3	13	3684	Aug.1979	H. Thing, unpubl.data
—	—	+	55	4.5	43	Aug.1982	Aastrup, 1983
—	—	+	61.3	17.7	181	Jul.1984	H. Thing, unpubl.data
—	Sermilik,	+	74	11.7	77	Jul.1980	Reimers, 1980
R.t.tarandus	Itinnera	+++	≤0.5	0	480	Sep.1977	Aastrup, unpubl.data
—	Disko	++	0	0	?		Reimers, 1980

*) N.fl. = Newfoundland, Canada,
** late calving
° subjective appraisal of relative quality of winter range based on available data on fruticose lichen quantities.
+ = heavily exploited; ++ = sub-optimal; +++ = optimal.

Table 2. Calf production and mortality parameters in relation to antler status of cows in the Sisimiut herd, July 1979.

Antler status of mother	No. of calf-leading cows			Calf/cow ratio		No. of cows leading sick calves			Disease freq. among calves %	Distribution of diseased calves
	Observed	Expected	P (x)*	July	mid-Aug.	Observed	Expected	P(x)*		
Polled	213	186		55.9	36.4	89	68		41.8	80.2
Half-antlered	36	33	<.0005	53.7		7	12	<.0005	19.4	6.3
Fully antlered	55	86		31.3	37.5	15	31		27.3	13.5

* Significance levels tested with X^2 test.

belong to *R. t. tarandus*. The Itinnera herd has winter ranges comparable to the Amaralik herd where unantlered cows are as frequent as 20%. Calving time occurs 2-3 weeks earlier in the Itinnera herd than in the Ameralik herd. Besides, they are genetically different.

Herds where females without antlers occur frequently seem to have late calving date in common. In our examples, these herds belong to the *R. t. groenlandicus* subspecies which might lead to the conclusion that the phenomenon is genetically determined. However, we feel that the evidence for environmental control is so strong that another explanation is more likely.

Goss (1976) suggests that the shift of antlers in deer is triggered by the alteration of increasing and decreasing daylength. We assume that the initiation of antler growth in *Rangifer* is dependent on the shift between increasing and decreasing light at midsummer. We hypothesize that a late calving date and subsequently late antler shedding might result in a high probability of the animal not being physiologically capable of initiating new antler growth because the triggering date was passed before initiation of new antler growth.

In the process of antler shedding osteoclastic erosion occurs at the line between the dead antler and the pedicle (Goss, 1963). This process might proceed to the pedicles in case new antler development was not commenced resulting in resorption of the pedicles.

According to our theory late calving combined with pregnancy and poor nutritional status would be expected to lead to at high proportion of antlerless females in the herd.

The demonstrated difference in proportion of antlerless females in the Sisimiut herd in 3 consecutive years corroborates that being antlered is not a permanent condition in the individual and that pedicles may be resorbed (Fig. 2D). It seems likely that the nutritional status of the individual in part determines whether the antlers sprout. This is further supported by the fact that antlerless non-pregnant females from the Ameralik herd were rare outside the calving ground at calving time. Non-pregnant females are most often in better nutritional condition and grow new antlers before pregnant or maternal females. Skjenneberg and Slagsvold (1968) state that in bad years antlers shedding and development are delayed and that females shed the antlers before calving on good ranges. According to Bergerud (1976) females may grow new antlers earlier when in good nutritional condition following e.g. mild winters. This might apply to non-pregnant females too.

The higher than expected calf/cow ratio and heavier than expected calf mortality for antlerless females in the Sisimiut herd (Table 2) also points towards a relation between antler status and nutritional status.

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