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The Greenland caribou – zoogeography, taxonomy, and population dynamics

Morten Meldgaard

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The Greenland caribou – zoogeography, taxonomy, and population dynamics

MORTEN MELDGAARD

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A comprehensive survey of all available geological, archaeological, historical, ethnohistorical, statistical, and game-biological data concerning the past and present status and distribution of the Greenland caribou is given. Based on this information a reconstruction of postglacial caribou zoogeography is presented. The main conclusions are: (1) Prior to c. 6000 BC small (*Rangifer tarandus pearyi* sized) caribou migrated from Ellesmere Island into Greenland (three new C-14 datings are presented), (2) prior to c. 2000 BC large (*Rangifer tarandus groenlandicus* sized) caribou migrated across Nares Strait and/or across Davis Strait to the northern parts of West Greenland, (3) c. 1500 BC West Greenland was inhabited by both large and small caribou separated by Sukkertoppen Iskappe, (4) between c. 1500 BC and c. 1000 AD the small West Greenland caribou disappeared, (5) from c. 6000 BC to c. 1300 AD caribou have periodically inhabited North Greenland, (6) prior to c. 300 AD the isolated Ammassalik region was colonized by caribou either from Northeast Greenland or from Southwest Greenland. The Ammassalik caribou were quite dwarfish and they became extinct after c. 1100 AD (7 new C-14 datings are presented), (7) c. 1900 AD the small Northeast Greenland caribou became extinct, (8) through the last 1000 years the range of the Greenland caribou has been reduced through population extinctions starting in Southeast Greenland and progressing north and south along the coasts leading to the present concentrations in central West Greenland and Inglefield Land.

These major zoogeographical events are the result of recurring population fluctuations and related distributional changes. In West Greenland these fluctuations have been recorded through the last 250 years. A number of features characterize changes in population size and distribution: (1) The duration of a population cycle varies from 65 to 115 years, (2) population decrease (and increase) is drastic often exceeding 90% of the population, and in some cases extinction is the end result, (3) fluctuations in different caribou populations in major geographical areas appear to be synchronized, (4) when the populations increase in numbers they expand their ranges while range contraction is associated with population declines.

The population fluctuations are primarily caused by climatic changes and secondarily by predation, overgrazing, and other factors.

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Introduction

Since 1976 I have participated in interdisciplinary investigations of archaeological sites in different parts of West Greenland. In 1978, the object was a West Greenland caribou hunting site which yielded almost half a ton of caribou bone from six time horizons (Grønnow, Meldgaard & Nielsen 1983, Meldgaard 1983). Inspired by the zoological perspectives in this work I proceeded to collect archaeological as well as geological, historical, ethnohistorical, statistical, and game-biological data to throw light on the history of the Greenland caribou. This effort has resulted in the present paper which presents a description and an analysis of the zoogeography, taxonomy and population dynamics of the Greenland caribou in the Late Glacial and Holocene period.

The heterogeneous nature of the source material has necessitated a division of the paper into a descriptive part and an analytical part. The descriptive part presents the geological, archaeological, historical, and recent material in twenty "caribou regions" covering all Greenland. Each regional description is supplemented by a map on which is plotted all place-names mentioned in the text, all significant archaeological localities with caribou remains, and all C-14 dated caribou remains found in geological context. Every archaeological locality on the map is assigned a serial number, e.g., 14-2. The first cipher designates the region (in this case Inglefield Land), the second designates the site in question (in this case Ruin Ø) or one well-defined time horizon on a site (one site may have several serial numbers). Every C-14 dated caribou bone is designated with a normal regional number and the second part of the serial number is a Roman numeral (e.g., 19-IV). Both geological and archaeological localities are presented chronologically according to region and dating in Appendix 1a and 1b. These appendices provide further information concerning dating of the localities. Also, references to collections and literature may be found here. Furthermore, they list the number of caribou bones that have been measured for taxonomic purposes and these measurements can be found in Appendices 2a, 2b, and 2c.

The first half of the analytical part presents an analysis of the zoogeography and taxonomy of the Greenland caribou, mainly based on geological and archaeological source material, the second half is devoted to an analysis of caribou population fluctuations, their causes and their effects on caribou zoogeography within the last 250 years.

The *geological source material* consists of caribou bones and shed antlers that in most cases have been found in situ on the soil surface. The sedimentation rate in many parts of Greenland is extremely slow and such surface-collected pieces may be several thousand years old. Nine antlers collected in the Ammassalik region and in the North Greenland region have been C-14 dated in the course of this study. The geological caribou material is kept at the Zoological Museum, Copenhagen.

The *archaeological caribou material* has been excavated from c. 120 different sites with more than 150 well-defined time horizons ranging from 2500 BC to the present. This long list of archaeological sites with cari-

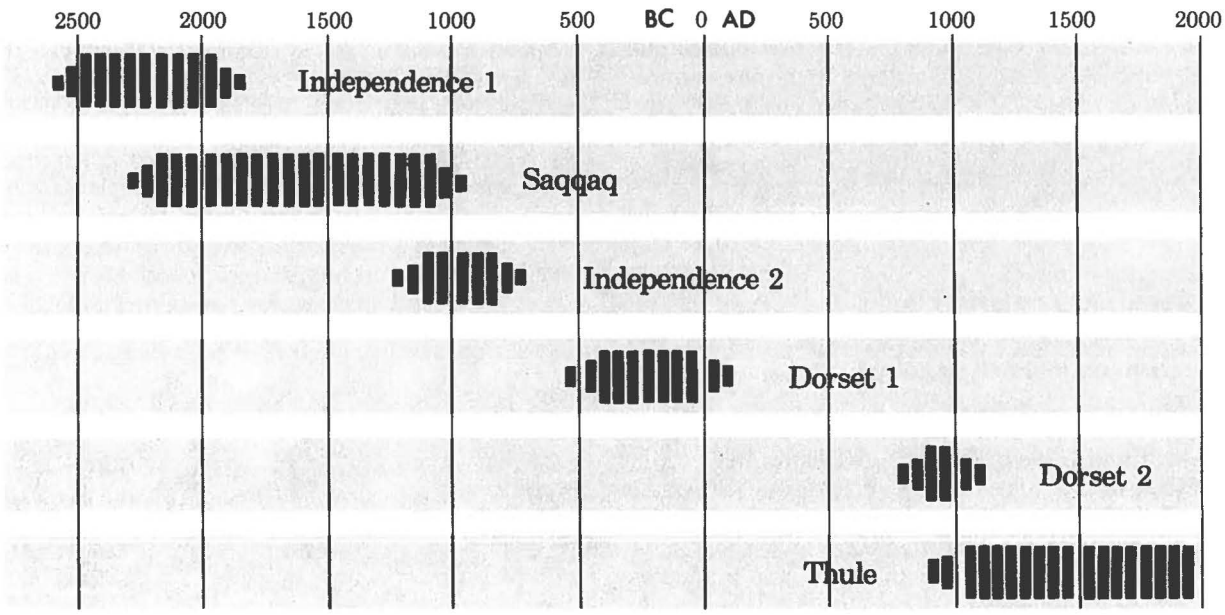


Fig. 1. The Greenlandic cultural chronology (after Gynther & J. Meldgaard 1983).

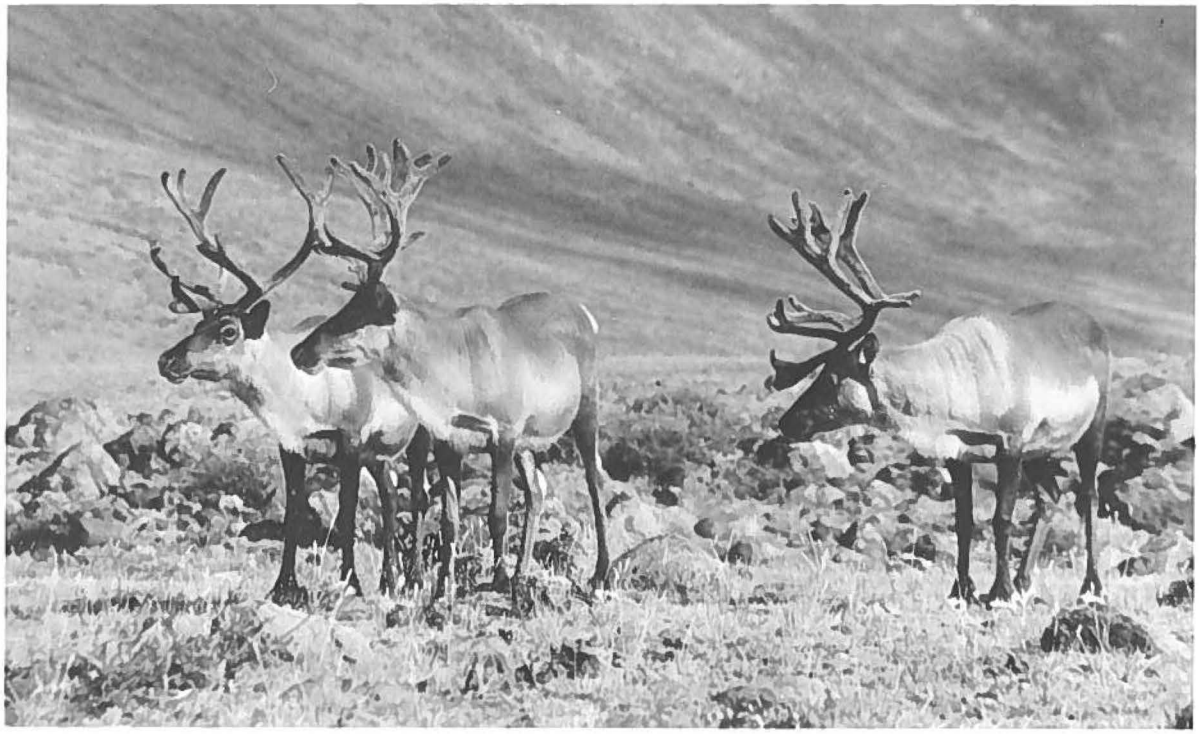


Fig. 2. A group of male caribou with their antlers still in velvet. Sarfartôq, August 1982 (photo by Bjarne Grønnow).

Fig. 3. Antlerless (polled) females constitute between 50 and 70% of the females in some West Greenland caribou populations. This female and its calf were photographed in Sarfartôq in August (photo by Henning Thing).

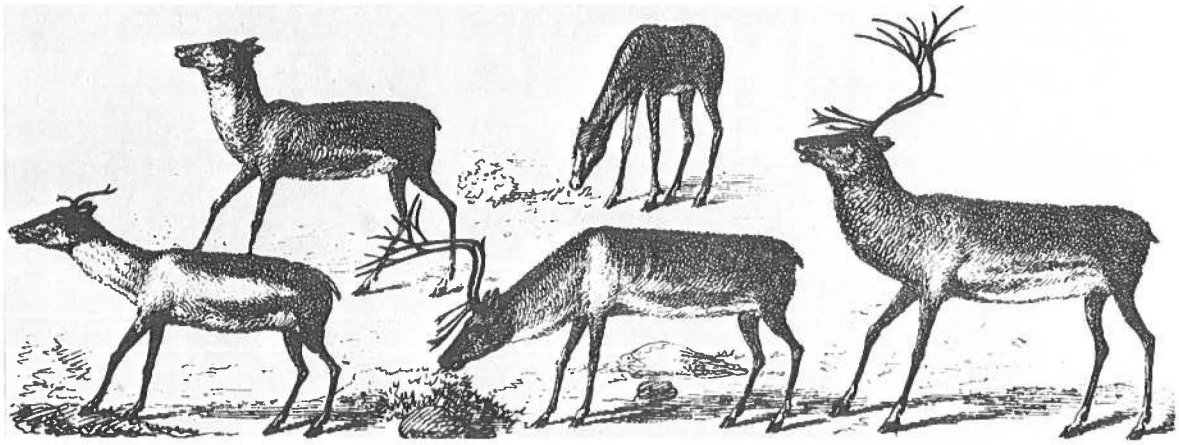


Fig. 4. Lithography by the Greenland artist Aron of Kangeq (1822–1869) (Rink 1877: 101).

bou remains is the result of a systematic registration of the archaeological collections from Greenland kept at the National Museum, Copenhagen, and of the archaeological bone material from Greenland kept at the Zoological Museum, Copenhagen. The caribou bones are usually very fragmented because the tasty bone marrow has almost always been extracted, but in rare cases the long bones have been preserved whole as tools, e.g., two-handed scrapers made from metacarpals.

Some care should be shown when using caribou bones and antlers as decisive indicators for the presence of caribou in the region in question. Antler has always been a valued tool material and as such it could have been brought to the site from another region. Generally, if fragments of caribou bones with low food value and little or no value as tool material (e.g., phalanx and vertebrae (Grønnow et al. 1983: 78–80)) are found in an archaeological material, it is assumed that the animals were shot nearby. If there is any doubt as to the origin of the caribou material in an archaeological context, it will be mentioned in the text. Owing to the fragmentary nature of the archaeological material, measurements in this study have been confined to distal and proximal ends of long bones. Distal metacarpi, metatarsi, and humeri have been chosen because of their good "survival value" and because good standardized measurements can be taken (Driesch 1976).

The *historical information* on caribou is scattered in numerous expedition narratives, diaries of colonial administrators and priests, whaling journals, etc. This literature has been compiled as far as possible and is presented under the relevant region.

Valuable *ethnohistorical information* concerning caribou has been extracted especially from the written answers from Inuit caribou hunters to an ethnographic questionnaire drawn up by K. Birket Smith in 1948 (NES unpubl.). The collection of written answers is on file at Kalaallit Nunaata Katersugaasivia (Grønlands Landsmuseum) and at the National Museum (Dept. IV), Copenhagen.

Game and trading statistics are the only source materials that provide relatively comparable data on caribou population status at different times through almost 200 years. Caribou skin trade has in some regions been registered since 1793. Raw-data on caribou skin trade from 1793 to 1882 are unpublished but the account books are available at Rigsarkivet. Chr. Vibe, who has extracted this material and published it in summarized form (1967), has kindly placed the raw-data at my disposal. Caribou skin trade after 1882 has been published in "Meddelelser fra Direktoratet for den Kongelige Grønlandske Handel" 1882–1908, in "Beretninger og Kundgørelser vedrørende Styrelsen af Grønland" 1909–1937, in "Beretninger vedrørende Grønlands Styrelse" 1938–1968, and in "Grønland. Årsberetninger udarbejdet af Ministeriet for Grønland" 1968–1981 (after 1968, however, there is no specification as to from where in Greenland the skins are procured).

"Fangstlisterne" (the hunting records), which list the number of caribou shot by each hunter in every settlement, have been kept since 1900, and they have been published in "Sydgrønlandske Fangstsammendrag" from 1900 to 1955, in "Nordgrønlandske Fangstsammendrag" from 1903 to 1955, and in summarized form in "Sammendrag af Grønlands Fangst Lister. Ministeriet for Grønland" 1955–1981 (see also Anon 1944, Rosendahl 1961).

The annual skin trade and the annual hunting bag from most West Greenland caribou regions are presented in graph form in the descriptive part.

Social and economic change since 1793 has altered the basis for the hunting and trading statistics and these bias should be considered before an interpretation of the statistics is made. Examples of such bias are, e.g., the many attempts that were made in the early colonial period to keep the Greenlanders from caribou hunting

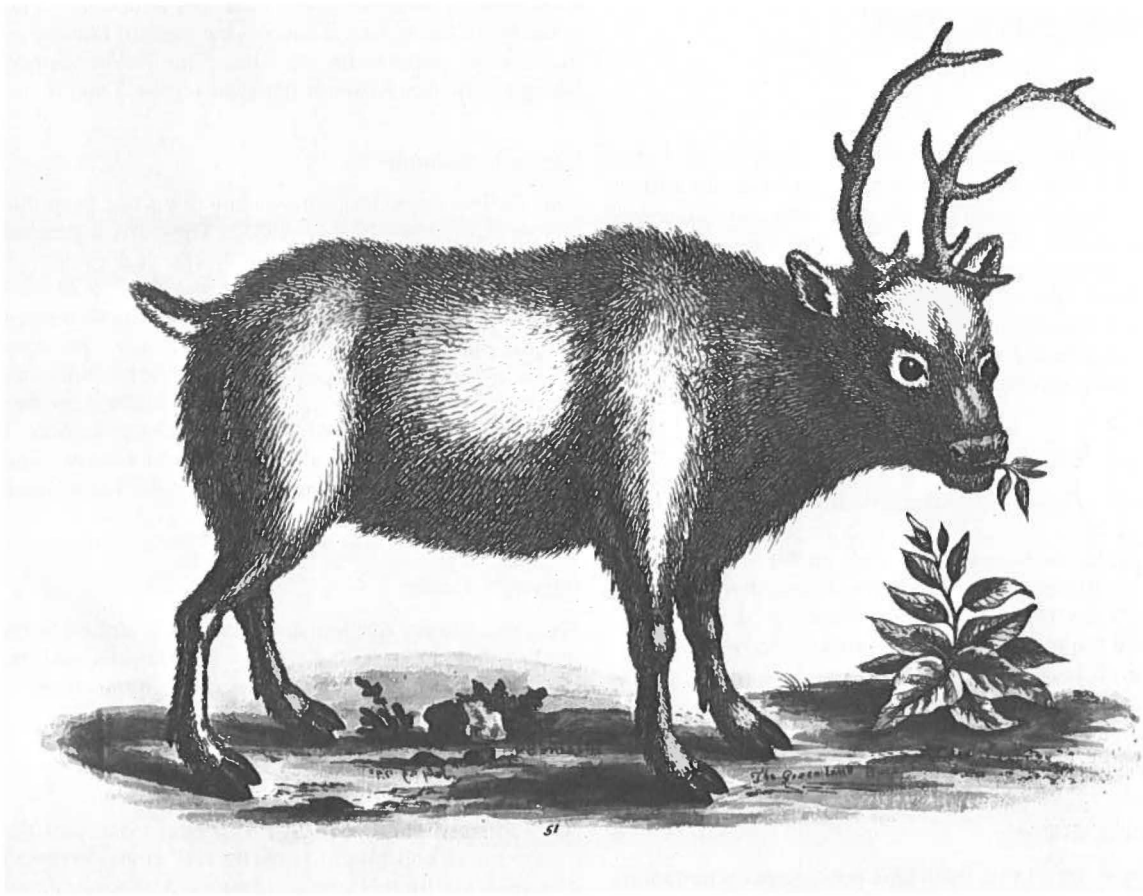


Fig. 5. "The Greenland Buck" in winter clothing. In 1738 Captain Craycott brought a male and a female caribou to England from Greenland. They were presented to the Duke of Richmond who kept them in his park in Sussex. George Edwards depicted the male in 1740 (Edwards 1743).

because it only paid little profit (Dalager 1752, Gad 1976: 211–212, Grønnow et al. 1983, Thorhallesen 1775: 96). Hunters from the Nuuk region also hunt caribou in the Sisimiut region. These Sisimiut caribou turn up in the Nuuk trading and game statistics (Benjamin Benediktsen (NES unpubl.), Grønnow et al. 1983). Many caribou that are killed, especially in recent years, never turn up in the hunting and trading statistics, and in some years data from some settlements simply have not been reported for registration (Holthe & Lassen, unpubl.; Strandgaard et al. 1983).

However, when due consideration is taken to these bias, the game and trading statistics still provide a unique and important source material which allows us to monitor major changes in caribou population size.

Game-biological investigations have been undertaken in West Greenland since 1976 and a number of reports and papers on the present status and distribution of the caribou and on caribou ecology have been published (see Strandgaard et al. 1983).

Earlier contributions to the zoogeography of the Greenland caribou have been published by Degerbøl (1957) who analyzed archaeological and historical material concerning the distribution and taxonomy of the Northeast Greenland caribou. Chr. Vibe (1967) presented a study of caribou zoogeography in Greenland in his "Arctic Animals in relation to Climatic Fluctuations". Also Banfield (1961) and Roby et al. (1984) have discussed aspects of Greenland caribou zoogeography.

However, the present paper represents the first attempt to make a systematic survey of all source materials, including geological and archaeological caribou material, from all of Greenland in order to present a synthesis of the history of the Greenland caribou in the Late Glacial and Holocene periods.

Concerning the Greenlandic orthography in this publication, it should be noted that the old orthography is used except for the names of major towns which have been written in the new orthography.

Descriptive part

Introduction

The West Greenland caribou are presently divided into a number of populations that are geographically rather isolated and between which only very restricted exchange occurs (Rink 1852: 127, Thing 1984: 4). Based on information concerning the present distribution of Greenland caribou and on archaeological, historical, and ethnohistorical sources describing past caribou distribution in all Greenland, Greenland has in the present paper been divided into "caribou regions" (Fig. 6):

Region 1, Southwest Greenland

This region has in historic and prehistoric times been inhabited by a substantial caribou population. Caribou have never been known to occur on the southeasternmost coast-line of Greenland, and I have therefore chosen to draw the southeastern boundary of the region through Lindenow Fjord. The northwesterly borderline is difficult to draw because of our lack of knowledge of caribou distribution in this border area, but a line somewhere between Ikerssuaq and Kobberminebugt would be a good choice.

Region 2, Ivigtut

We know very little about this now extinct population. But no doubt the northern borderline of the region should be drawn through the glacier fjord Sermiligârssuk which today acts as a southern barrier for caribou from region 3, Paamiut.

Region 3, Paamiut

Today there are in reality two caribou populations in this region, the Neria population and the Qagssit population, separated by two glacier fjords Sermilik and Kvanefjord. The historical sources treat these populations as one, which is the reason for treating them as one here. The northern boundary of this caribou region is drawn through the huge glacier tongue Frederikshåb Isblink.

Region 4, Qeqertarsuatsiaat

The present population of caribou is towards the north delimited by the glacier fjord Sermilik which thus provides a borderline between region 4 and 5.

Region 5, Nuuk

There are two populations of wild caribou in this important caribou region. They are separated by Nûp kangerdlua (Godthåbsfjord) and by Ameralik. The character of the historical sources has made it feasible to treat these populations as one. The Sukkertoppen Iskappe provides a barrier between region 5 and 6.

Region 6, Sisimiut

Four caribou populations have been described from this region (Strandgaard et al. 1983). They are separated from each other by non-glacier fjords and rivers but these are not to be regarded as serious obstacles to caribou movement on par with for example Sukkertoppen Iskappe and Sermiligârssuk (Rink 1852: 125). Because of the apparent difficulties in drawing borderlines between "populations" in this region and because the historical sources in many cases treat the area as a whole, I have chosen also to regard the region as an entity. The northern limit of the region is drawn by the Jakobshavn Isfjord.

Region 7, Disko

The now extinct caribou on Disko have always been rather isolated from other caribou populations, and the island is therefore treated as a caribou region by itself.

Region 8, lands and islands between Jakobshavn Isfjord and Torssukátaq

No records of caribou from this region exist, and the reason for establishing it is partly that many historical sources deal with this area as an entity, and partly that it would have little meaning to draw a single borderline between region 6 and 9 in this area.

Region 9, Nûgssuaq

The caribou population in this region is well delimited by the glacier fjords Torssukátaq and Qarajaq.

Region 10, lands and islands between Nûgssuaq and Svartenhuk Halvø

This region is only rarely visited by caribou and the reasons for establishing it are the same as for region 8.

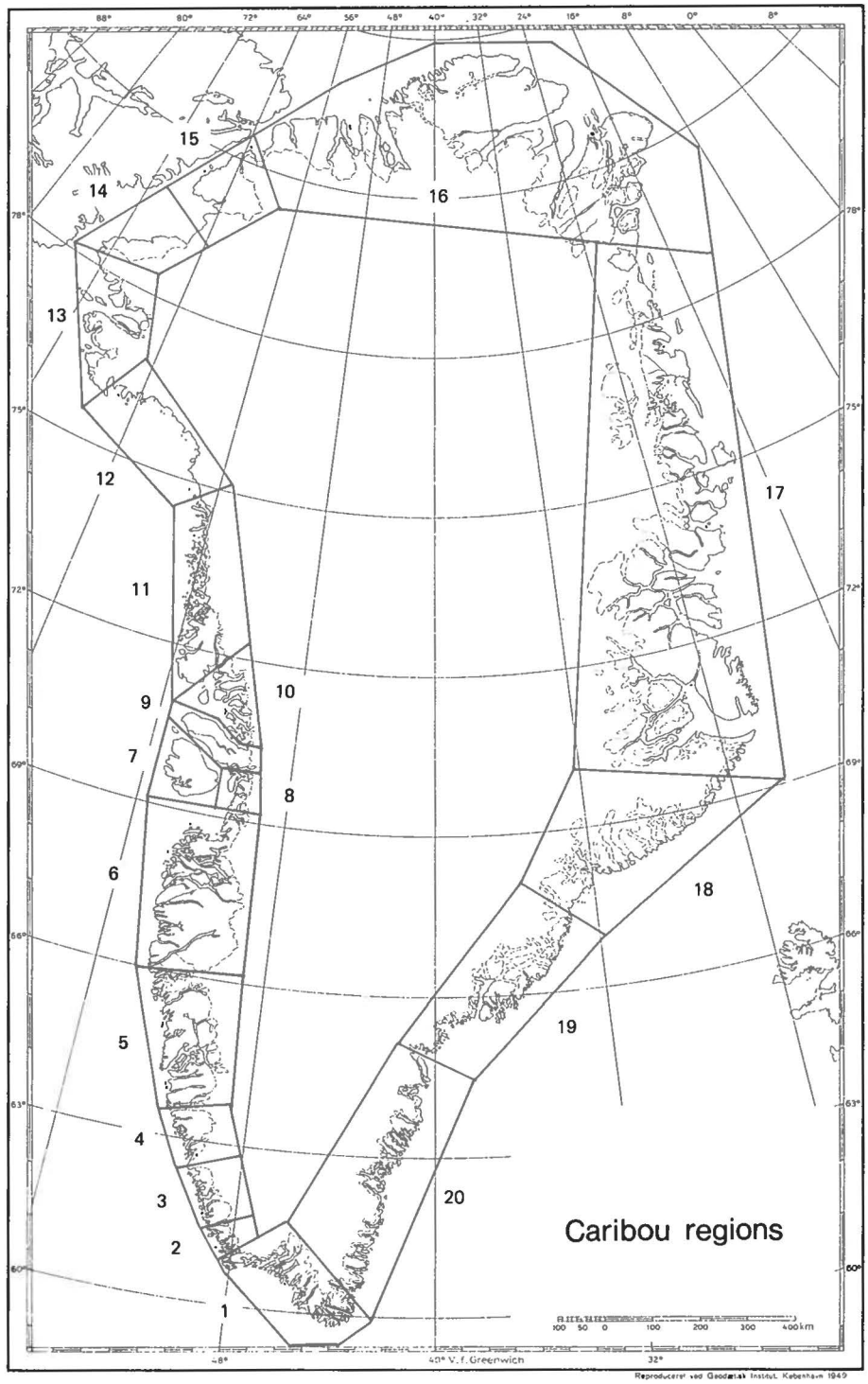
Region 11, Upernavik

A small caribou population may possibly survive on Svartenhuk Halvø today. A northern borderline is drawn at Holm Ø which is the northernmost larger "landmass" in the Upernavik archipelago.

Region 12, Melville Bugt

The region is dominated by glaciers and the lands and islands that have provided a living for caribou are few, small and far apart. The region has been established for

Fig. 6. Twenty "caribou regions" provide the framework for a systematic description of the zoogeography of the Greenland caribou.



reasons similar to regions 8 and 10. Kap York is chosen as the northern limit of the region.

Region 13, Thule

The now extinct caribou of the Thule region were divided into two rather distinct populations, one around Wolstenholme Fjord and one around Inglefield Bredning. The scarcity of historical data has nevertheless made it practical to treat these populations under one heading. The northern limit is the westernmost point of Greenland, Kap Alexander, where the Inland Ice reaches the sea in several places.

Region 14, Inglefield Land

Caribou occur in most of Inglefield Land. The region is to the north delimited by the huge Humboldt Gletscher.

Region 15, Washington Land

Caribou are extinct in the region today. Washington Land is seperated from the rest of North Greenland by the Petermann Gletscher.

Region 16, North Greenland

This vast landmass has sustained one or more caribou populations during one or several periods in the past. Our knowledge of caribou occurrence in the region is of a very fragmentary nature, making further division of the area unpractical. The eastern boundary of the region as been drawn at Nioghalvfjerdsfjorden.

Region 17, Northeast Greenland

Once this region was an extensive caribou territory but around 1900 AD the population went extinct. As was the case for North Greenland, this vast region may have been inhabited by several more or less isolated caribou populations but on account of the very fragmentary information which is available it has been treated as an entity. The southern borderline has been drawn at Kap Dalton which is the northernmost point of the Blosseville Kyst.

Region 18, Kangerdlugssuaq

Caribou may have existed around the Kangerdlugssuaq. The southern boundary is placed at Kap Louis Ussing.

Region 19, Angmagssalik

The area around the Angmagssalik Fjord has once been the stronghold of a caribou population. The southern borderline is drawn at Pikiutdleq.

Region 20, Tingmiarmiut

Caribou may once have existed around the Tingmiarmiut Fjord. The region shares its southern boundary with Region 1, Southwest Greenland.

The twenty caribou regions

Region 1 – Southwest Greenland (Fig. 7)

The archaeological record. – The earliest trace of caribou can be dated to the Norse period (1000–1500 AD). Caribou bones have been found in the wasteheaps of 11 Norse farms (Appendix 1b, nos 1-1 to 1-11). The relative frequency of caribou bones in the faunal material from this "East Settlement" is quite low (c. 10%) compared to the frequency found in the middens of the "West Settlement" (c. 25%) (McGovern 1979, 1981).

Eskimo middens excavated by Therkel Mathiassen in the 1930es and dated to 1350–1650 AD (Appendix 1b, nos 1-12 to 1-14) and to 1650–1800 AD (Appendix 1b, nos 1-15 to 1-18) also produced caribou bones.

Judging from the size of the caribou bones from the Norse period (Appendix 2b), these animals have been of the same general size as today's West Greenland caribou.

The historical record. – Ivar Bårdssön's account of Norse Greenland written c. 1360 (:26) is the earliest historical source describing the occurrence of caribou in the East Settlement. Hans Egede (1741) mentioned the existence of a caribou population in the area, and from then on the historical sources tell a story of population decrease and finally of extinction. Thus, Walløe (1753), travelling in the area in 1751–52, wrote that the Greenlanders complained about a large decrease in the caribou population. From 1800 to 1850 a number of authors describe the population as being extinct or almost extinct (Winge 1902). Rumours of caribou tracks are told well into the twentieth century but they are never confirmed (Bendixen 1921: 439). It seems reasonable, therefore, to assume that the Southwest Greenland caribou went extinct some time during the first half of the 19th century.

In 1921, O. Bendixen (p. 439) wrote that a few years earlier the body of a recently dead young caribou was found at Sarqamiut timât where this stretch of land borders to Ikerasagssuaq (just north of Sermilik). The animal was probably a straggler from the, at that time, southernmost caribou population in Paamiut (region 3).

In 1973, 48 domestic reindeer from the Itivnera domestic herd (Nuuk municipality) were released in the Qíngua area, and in 1974 it was supplemented with 50 animals more. This feral herd has since grown to about 600 animals (Strandgaard et al. 1983).

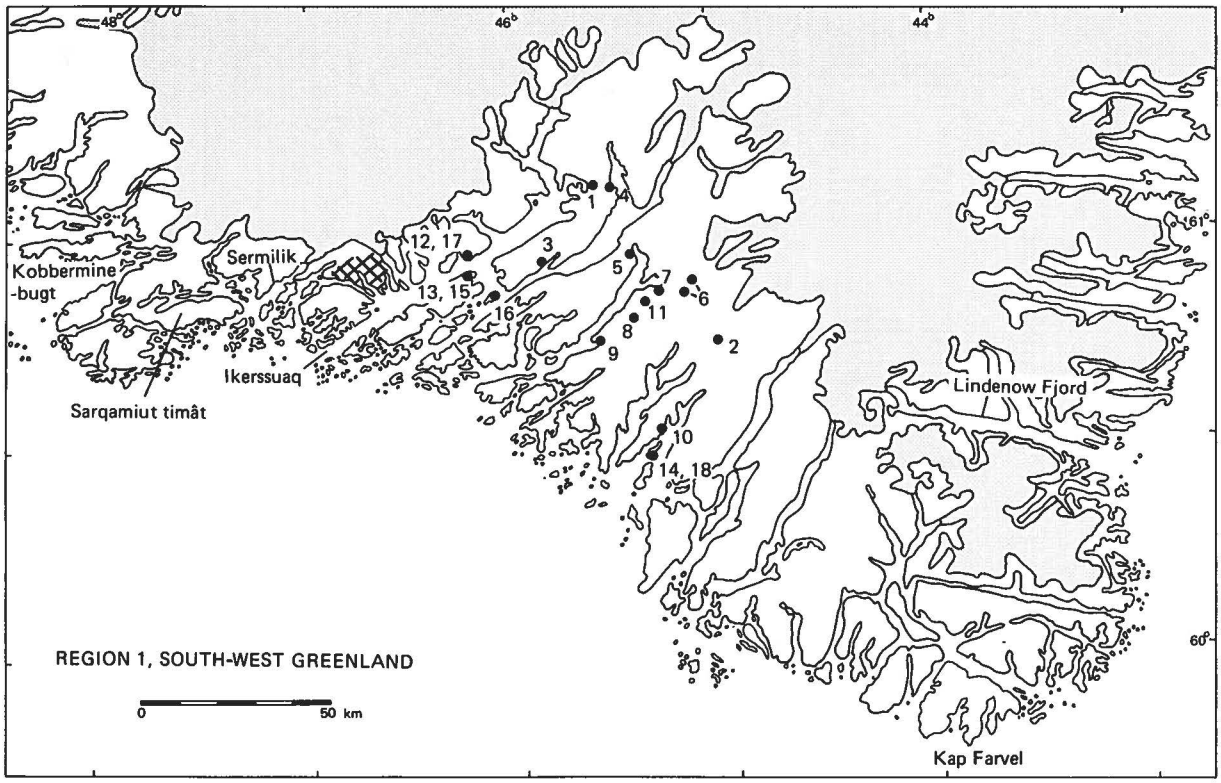


Fig. 7. Map of region 1, Southwest Greenland. Cross-hatching stands for distribution of domestic reindeer. Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).

Region 2 – Ivigtut (Fig. 8)

The archaeological record. – The excavation of a Norse farm in Arsuk Fjord produced a few fragments of caribou bone dating to 1000–1500 AD (Appendix 1b, no. 2-1). These few fragments do not prove that a local caribou population existed in the area in Norse times. They may have been brought to the farm by Norsemen hunting caribou north or south of Ivigtut.

But the existence of Eskimo shooting coverts in the area does prove that caribou hunting was carried out in prehistoric times (Winge 1902: 460; concerning the function of shooting coverts, see Grønnow et al. 1983).

The historical record. – The Greenlanders were hunting caribou in the inner parts of Arsuk Fjord some time between the 1860'es and the 1880'es. This practice came to an end when the caribou population went extinct at the end of the 19th century, probably in the 1890'es (Winge 1902: 460).

Region 3 – Paamiut (Fig. 9)

The archaeological record. – During archaeological survey work in 1982, a few caribou hunting camps were observed in Qagssit, indicating that caribou hunting has long traditions in the area (Grønnow & Meldgaard 1982).

The historical record. – Walløe, who visited Paamiut in August, 1751, was told by the Greenlanders that caribou were getting scarce (1753: 64). This is con-

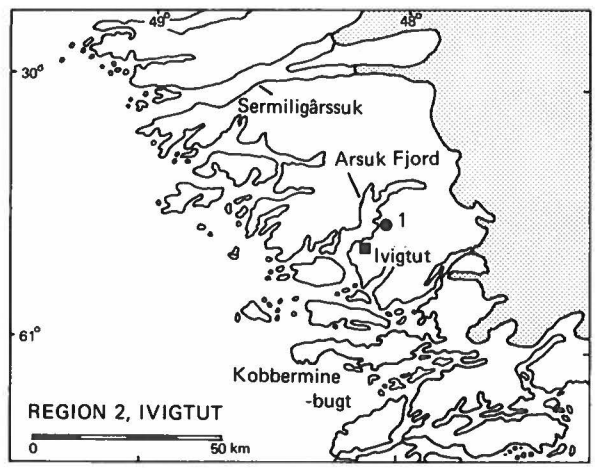


Fig. 8. Map of region 2, Ivigtut. Dot stands for an archaeological locality with caribou remains (listed in Appendix 1b).

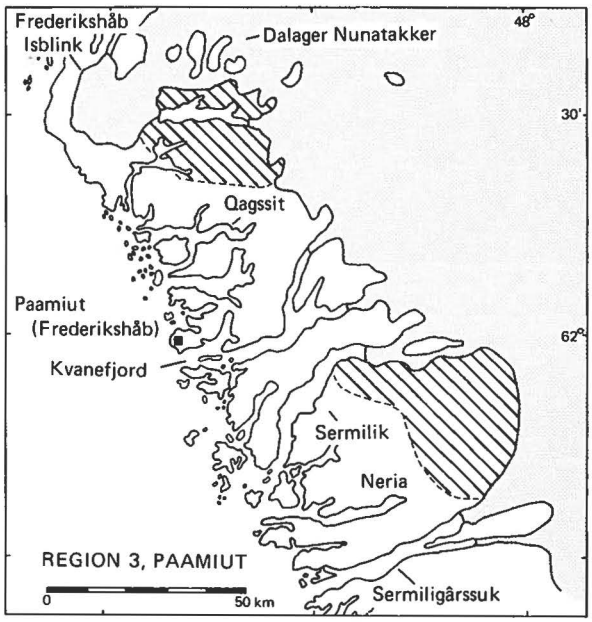


Fig. 9. Map of region 3, Paamiut. Hatching stands for present distribution of caribou (after Strandgaard et al. 1983).

firmed by the minister Otto Fabricius who was living in the Paamiut area from 1768 to 1774. He states: "In earlier times it [the caribou] lived in large numbers everywhere between the mountains of the mainland, but now it is becoming rarer and can almost only be found in the most remote parts of the land." (1780: 69). In 1828, Vahl travelled through the district, and he noted that only few caribou were to be found in the area (Winge 1902: 461). Twelve years later the caribou seem to have become common again (Winge 1902: 461), and another 10–15 years later (1850'es) the population was small once more (Rink 1857: 174).

Hunting and trading statistics for caribou from Paamiut commence c. 1900 (Fig. 10). They give the impression that the hunting bag increased around 1910, probably a reflection of the increasing caribou population. This population increase is also described by other sources (Bendixen 1921: 325, Winge 1902: 461). For c. 10 years the number of caribou killed and skins traded stayed high, then from 1919 to 1925 bag and trade dropped to a much lower level. The decrease in population size is mentioned in the annual reports from The Royal Danish Trading Company (Anon 1927: 627). From 1925 till 1970 the annual bag fluctuated around a comparatively low level, and c. 1972 there was a slight increase.

In the early 20th century caribou were distributed between Frederikshåb Isblink and Kvanefjord, they were found on the narrow tongue of land between Kvanefjord and Sermilik, and they were living between Sermilik and Sermiligârssuk, their southernmost distribution in West Greenland at that time. On account of superstition among the local hunters caribou were not hunted between Kvanefjord and Sermilik (Birket-Smith 1917: 38).

Present status. – There are two distinct caribou populations in the Paamiut area today: A) the Neria population and B) the Qagssit population (Fig. 9) (Aastrup 1983c, Reimers 1980, Strandgaard et al. 1983).

Ad A. The Neria population inhabits the area between Sermilik and Sermiligârssuk. It numbers c. 400 animals, 250 of which are concentrated close to the inland ice. In the areas closer to the coast, the caribou density is much lower (Reimers 1980). It is believed that this general pattern shows little seasonal variation (Reimers 1980).

Ad B. The Qagssit population is found between Frederikshåb Isblink and Qagssit. It is estimated to number c. 200 animals, of which the main part is concentrated in the area just south of Frederikshåb Isblink (Aastrup 1983c), while the areas closer to the coast have much lower densities (Aastrup 1983c). The area north of Kvanefjord has good potential as winter pasture but it is not used (Aastrup 1983c).

According to Reimers (1980), the antlers of both bulls and cows were rather poorly developed and the animals themselves were clearly smaller than the feral reindeer he had studied on Disko.

Caribou on Dalager Nunatakker (Fig. 9). In September, 1751, the merchant Lars Dalager made an expedition to some nunataks situated a few kilometres from the mainland on Frederikshåb Isblink. On one of the lower nunataks he found several caribou, and on the upper nu-

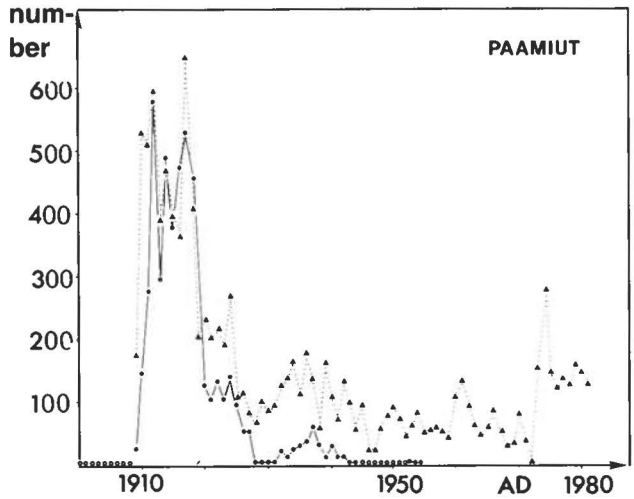


Fig. 10. Trading and hunting statistics from Paamiut (region 3). Dots connected by solid lines stands for number of caribou skins traded annually to The Royal Danish Trading Company. Triangles connected by broken lines stands for number of caribou killed annually. Open signatures stands for no skins traded or no caribou killed. Minus-signs stands for missing data.

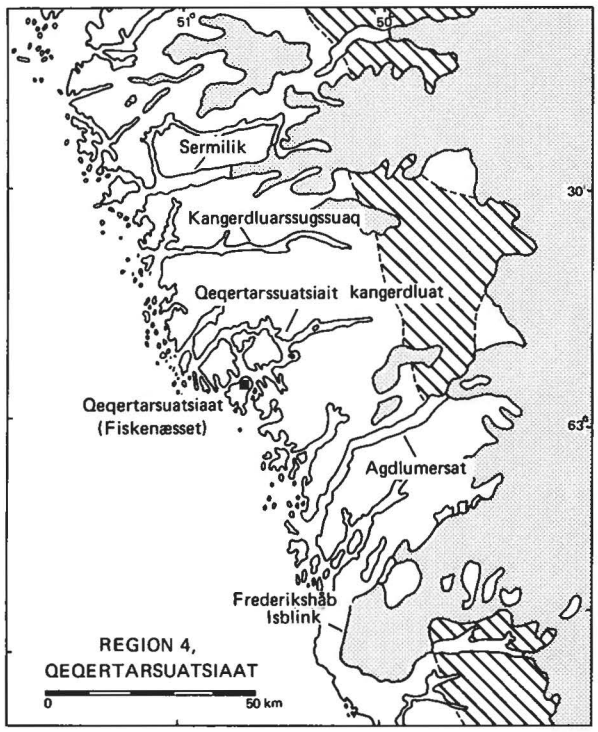


Fig. 11. Map of region 4, Qeqertarsuatsiaat. Hatching stands for the present distribution of caribou (after Strandgaard et al. 1983).

natak further east he saw one animal (Dalager 1752: 69). More than a hundred years later, in 1879, J. A. D. Jensen made the same journey, and on the Inland Ice itself between the mainland and Dalager Nunatakker he found a shed antler (Winge 1902: 461).

Region 4 – Qeqertarsuatsiaat (Fig. 11)

The archaeological record. Caribou hunting camps and shelters are found in the inland of this region, and no doubt caribou hunting has long traditions in the area (J. Berglund Nielsen, pers. comm.).

The historical record. Several sources mention that caribou were plentiful in the area in a period from c. 1820 to 1840–45 (Rink 1857: 173, Winge 1902: 461) (Fig. 12). After 1840–45, the caribou population declined drastically, and following 1850 the hunting bag became so small that no skins at all were traded to the Royal Danish Trading Company (Bendixen 1921: 212, Rink 1857: 173). From 1888 to 1900, the caribou population increased (Anon 1889: 71, 1891: 122, 1897: 9, 1898: 39, 1899: 74, 1905: 157, 1908: 96), and the population high was followed by a rapid decline between c. 1915 and 1925 (Anon 1915: 294, 1919: 116, 1920: 257, 1922: 468, 1923: 54, 1927: 627). In the 1960'es and 1970'es, the population was comparatively large (Jørn Berglund Nielsen, pers. comm.). The most important caribou hunting grounds in Qeqertarsuatsiaat were mapped in 1859 by the caribou hunter Benjamin Peter and Samuel Kleinschmidt (Meldgaard 1982: 102). They were situated between the heads of the fjords Kangerdluarssugssuaq, Qeqertarssuatsiaat kangerdluat, Agdlumersat, and the Inland Ice, mainly close to the ice margin.

Present status. – Based on an air survey in the winter of 1982, the population size was estimated at c. 300. The animals were found in the inland region between the heads of the three fjords Kangerdluarssugssuaq, Qeqertarssuatsiait kangerdluat, and Agdlumersat and the Inland Ice (Strandgaard et al. 1983: 17–18). In the last few years, caribou hunters have found many dead calves and adult caribou in the inland areas and the bag has become smaller. A general population decrease may well have started (Jørn Berglund Nielsen, pers. comm.).

According to local hunters, shifts in the distribution of caribou in the region take place from time to time. In some years (e.g. 1983), the largest concentrations of caribou are found around Kangerdluarssugssuaq, in other years around Agdlumersat (Jørn Berglund Nielsen, pers. comm.).

The caribou also undertake annual movements in the area. In September–October they migrate towards the coastal lower-lying areas where they spend the winter. In spring they move towards the inland calving grounds and summer ranges (Jørn Berglund Nielsen, pers. comm.).

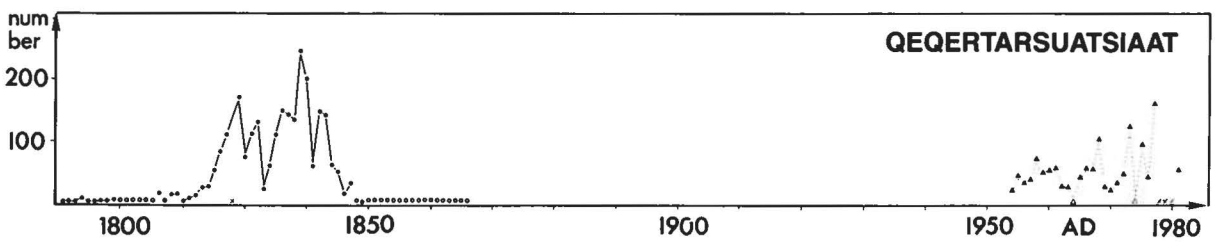
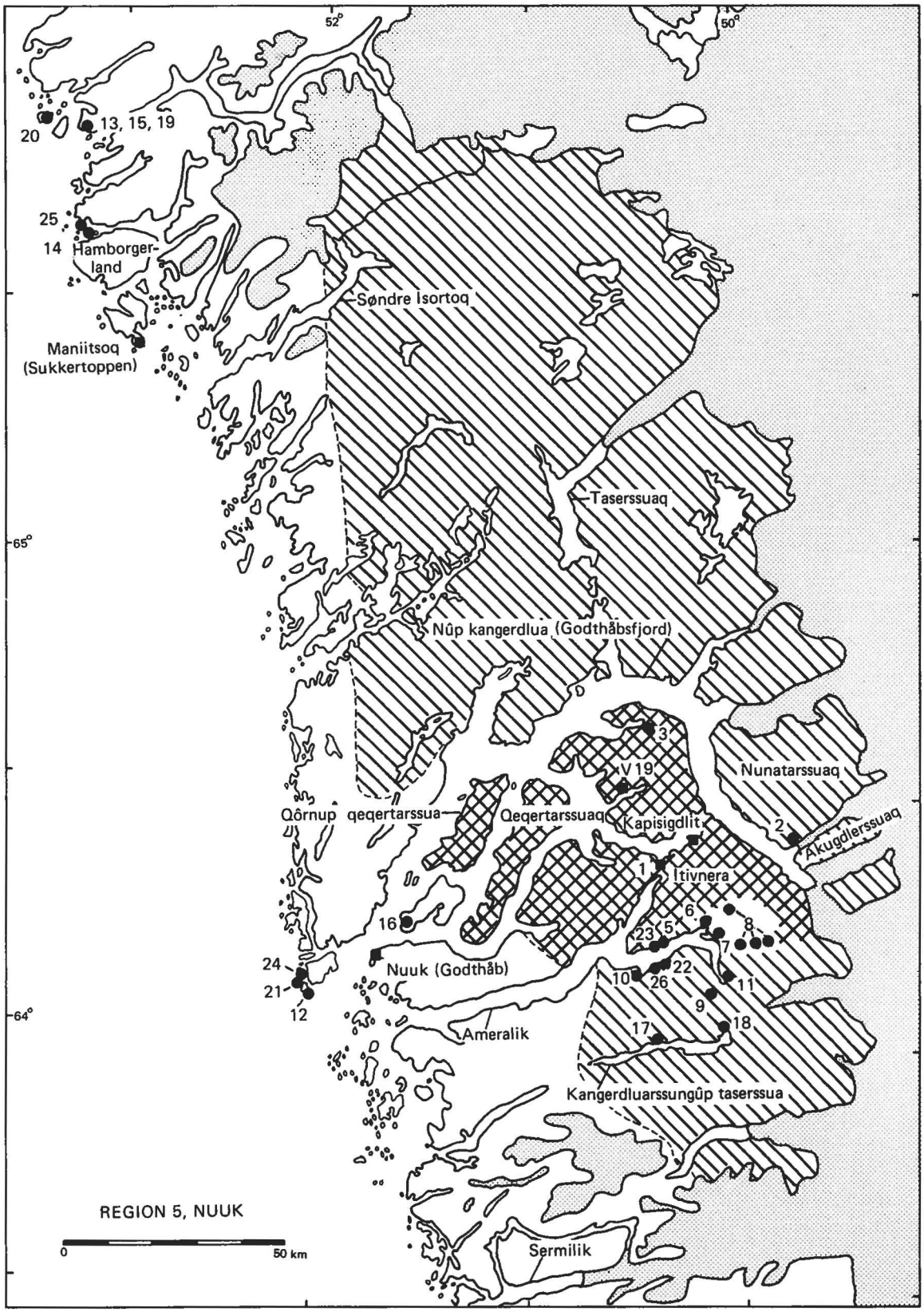


Fig. 12. Trading and hunting statistics from Qeqertarsuatsiaat (region 4). Dots connected by solid lines stands for number of caribou skins traded annually to The Royal Danish Trading Company. Triangles connected by broken lines stands for number of caribou killed annually. Open signatures stands for no skins traded or no caribou killed. Minus-signs stands for missing data.


52°
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Taserssuaq
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3
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Qôrnup qeqertarssua
Qeqertarssuaq
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16
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8
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Nuuk (Godthåb)
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11
21
9
12
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Ameralik
17
Kangerdluarssungûp taserssua
REGION 5, NUUK
0
50 km
Sermilik

Region 5 – Nuuk (Fig. 13)

The archaeological record. – The earliest evidence of caribou in the Nuuk area comes from the midden of a caribou hunting site at Itivnera (Fig. 14). It is dated to c. 1500 BC (Appendix 1b, no. 5-1). These caribou differed in many respects from the caribou that have been trotting the ranges for at least the last 1000 years. They were extremely small, much smaller than the succeeding populations, and somewhat smaller than todays Peary caribou (Fig. 46–49) (Appendix 2b). They were also smaller than the contemporary caribou from the neighbouring Sisimiut region (Appendix 2b).

They differed morphologically by having exceptionally small lower M_3's, often with a rudimentary or completely absent posterior lobe, something which is not found in the recent Nuuk-population or in other recent caribou populations (Degerbøl & Krog 1959: 71–72, Møhl 1972). The existence or non-existence of the posterior lobe and the size of the third molar are traits that are genetically based (Sjøvold 1977: 71, Poul Henrichsen pers. comm.). Thus, it seems that the caribou 3500 years ago were genetically different from today's caribou.

In 1984 the distal end of a caribou metatarsal probably dating to the Early Dorset Culture (c. 550 BC–c. 150 AD) was excavated at Kilârsarfik (Sandnæs) (located at 5–6, Fig. 13) (Bryan Hood pers. comm.).

Judging from the large amount of caribou bones in stratified midden deposits from Norse farms (Appendix 1b, nos 5-2 to 5-11), caribou were common right from the founding of the Western Settlement around 1000 AD and until its abandonment c. 1400 AD. The people of the Thule Culture show up in the Nuuk area somewhat before the Norse disappear (Appendix 1b, nos 5-12, 5-13) and the bone material from their habitation sites reveals that they have pursued the caribou in all parts of the region ever since they arrived (Appendix 1b, nos 5-12 to 5-26).

The caribou which the Norse encountered were of a size comparable to today's West Greenland caribou, as were also the caribou that were hunted by the Thule people (Fig. 46–49) (Appendix 2b) (see also Degerbøl 1957: 37).

Analyses of bones from Eskimo sites both in the coastal and in the inland region show that the faunal material from true inland camps (Appendix 1b, nos 5-17, 5-18) and from many inner fjord sites (Appendix 1b, no. 5-1) are completely dominated by caribou bones (>80%), while the faunal samples from the coastal and outer fjord sites are mostly dominated by seal (Appendix 1b, no. 5-12, 5-21). It is also in the inland tracts that caribou hunting structures (shooting coverts, caribou drive systems, etc.) are concentrated (Blehr 1982, Nellemann 1969/70, Rosing 1958). Seasonal dating of the caribou hunting sites have shown that they have primarily been used during the summer half of the year.

For more than 3500 years the pattern has been the same: caribou hunters returning year after year in summer and fall to the inland area to take a toll of the caribou population. This prehistoric hunting pattern suggests that the caribou have always been most common in the inland tracts, at least during the summer and fall seasons.

The historical record. – We hear for the first time of caribou in the early 18th century through Hans Egede (1741). Around the middle of the 18th century, the merchants Lars Dalager and Peter O. Walløe (1752: 80, 1753: 46) and the missionary Eigil Thorhallesen (1775: 62–63) complain that the caribou are getting very scarce as compared to the situation a few years before. Then, caribou were plentiful and people came from distant settlements to go caribou hunting in the area.

From 1795, trading statistics are available. Less than 100 skins annually were traded to The Royal Danish Trading Company (KGH) from 1795 to 1820 (Figs 15 and 16) and then between 1823 and 1830, trade increases drastically. In the 1830'es, more than 4000 skins were traded annually. This trading "boom" reflects the existence of a very large population of caribou in the Nuuk district between 1825 and 1850 (Rink 1857: 173; see also Winge 1902: 462). The decrease in the early 1850'es was recognized by Rink (1857: 173) who compared it with the almost simultaneous decrease in the trade at Qeqertarsuatsiaat and with the still quite good trade in the Sisimiut and Maniitsoq districts. The caribou skin trade never recovered and the number of skins traded annually between 1860 and 1954 did not exceed 20.

According to the annual reports from The Royal Danish Trading Company, there was a caribou population high between 1890 and 1920. It did not show up in the trading statistics, but it can be seen in the game statistics, which commence in 1910, as a period where between 500 and 1000 animals were shot annually. The population grows and reaches a maximum from c. 1885 to 1900 (Anon 1889: 71, 1897: 9, 1898: 39, 1899: 74, 1905: 157, 1908: 96, Bruun 1918: 38–39, Møller 1907, Nielsen 1907). And then reports of a decline become still more common (Anon 1915: 294, 1919: 116, 1920: 257, 1922: 468). In 1927, Sydgrønlands Landsråd (The South Greenland Council) discussed the possibility of a total protection of the caribou on the grounds that "all members of the Landsråd recognized the continued decline of the caribou population in all of South Greenland, [i.e., from Aasiaat to Paamiut]" (Anon 1927: 627). The decline can also be traced in the hunting sta-

◀ Fig. 13. Map of region 5, Nuuk. Hatching stands for present distribution of caribou (after Strandgaard et al. 1983). Cross-hatching stands for present distribution of domestic and feral reindeer (after Strandgaard et al. 1983). Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).

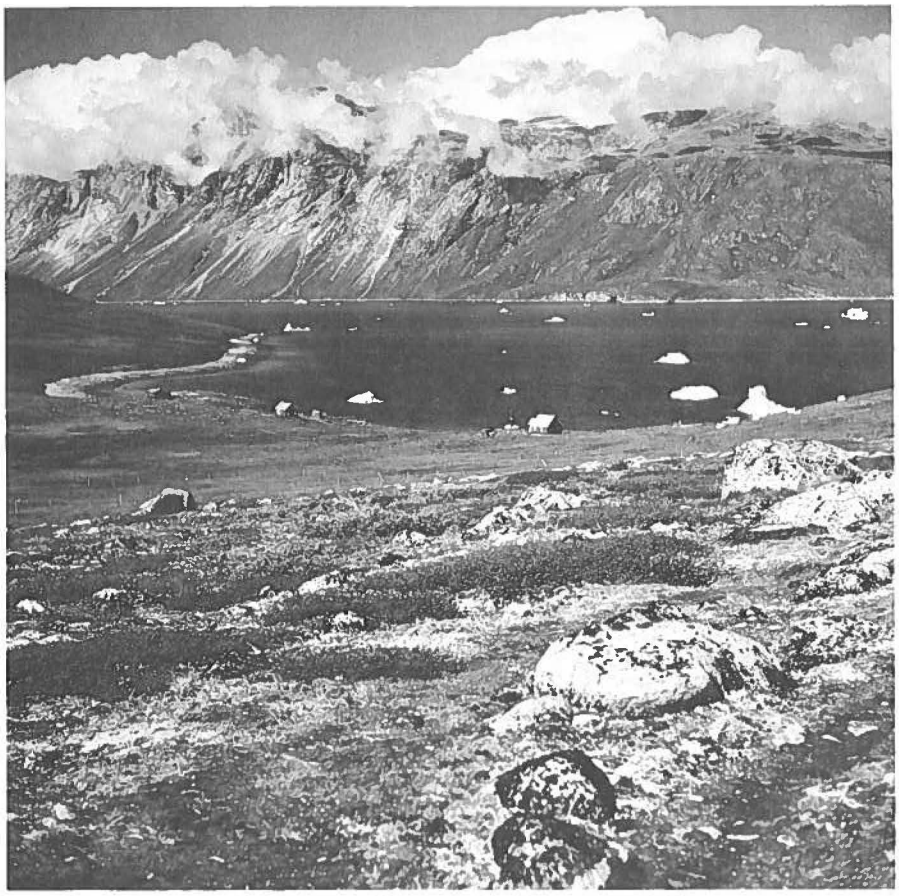


Fig. 14. Itivnera, a caribou hunting site from the Saqqaq Culture (c. 1500 BC). The site is situated on the shore in the center of the picture (Appendix 1b, no 5–1). Since 1952 Itivnera has served as a reindeer herding station (photo by Jørgen Meldgaard, July 1960).

tistics and between 1920 and 1959 the bag stayed low, usually below 400 animals annually. Then in 1960, the bag increased, and it has stayed high till today – often well above 1000 animals annually.

Gerhardt Lyberth (NES unpubl.), a caribou hunter from Maniitsoq, described how the caribou population, when it reached high levels (probably the 1825–1850 maximum) around Søndre Isortoq, spread into the coastal regions, even reaching the island Hamborgerland. When the caribou population declined and was at a minimum for a period (probably 1850–1950), the animals retreated to the inland areas (Petersen 1970: 184).

The distributional pattern of the caribou around the turn of the century is described by Bendixen (1921: 200). Caribou occurred in largest numbers between Taserssuaq and the Inland Ice and on the nunataks Nunatarssuaq and Akugdlerssuaq. The nunataks were though isolated by ice favoured pastures for the caribou, and the hunters often crossed the glaciers to hunt them (Bendixen 1921: 200; H. Josefsen, NES unpubl., Nielsen 1907). On this northern range the caribou undertook annual movements, migrating into the highland closer to the inland ice in summer and returning to the lowland areas in winter (Bendixen 1921: 200). Caribou were also common between Taserssuaq and Søndre Isortoq. They became rare north of Søndre Isortoq, and west of Sukkertoppen Iskappe they only occurred when the population was large.

The population south and east of Ameralik is described by Bendixen (1921: 200) as being quite large.

Caribou dwarfs? – Local caribou hunters tell stories of exceptionally small caribou which they have encountered on the nunataks (e.g., Nunatarssuaq) between Nûp Kangerdlua (Godthåbsfjord) and the Inland Ice (Jens Rosing pers. comm.; Josef Josefsen from Kapisigdlit interviewed in 1952 by J. Meldgaard). In 1984, just south of Ameralik, three biologists observed an unusually small adult female caribou. It was the size of a small 2 year old animal, it had fully developed antlers, the pelage was dark brown, and there did not seem to be any relative shortening of the legs (Anette Engraf pers. comm.). To some extent this discription corresponds to discriptions of small caribou from the Sisimiut region (p. 21). Such small size could be caused by malnutrition or some kind of physiological disorder.

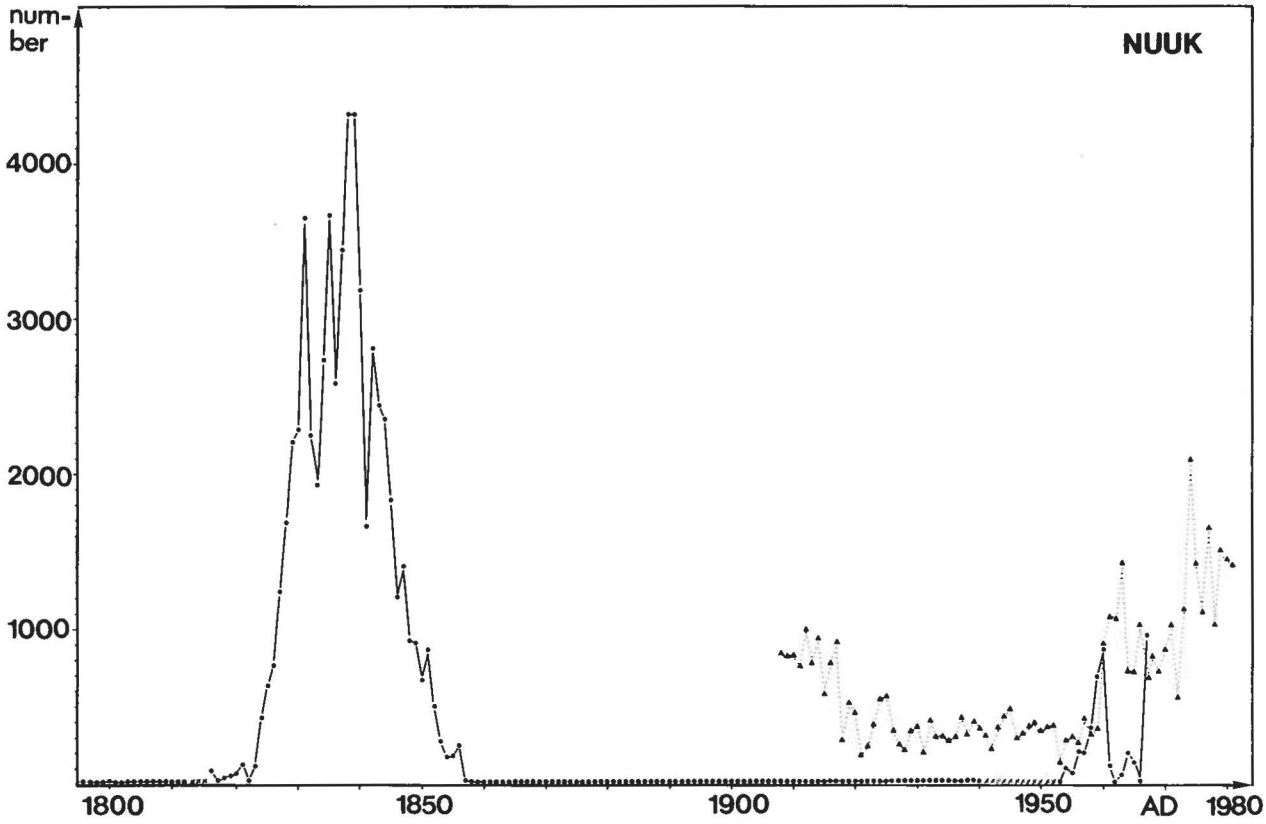


Fig. 15. Trading and hunting statistics from Nuuk (region 5). Dots connected by solid lines stands for number of skins traded annually to The Royal Danish Trading Company. Triangles connected by broken lines stands for number of caribou killed annually. Open signatures stands for no skins traded or no caribou killed. Minus-signs stands for missing data.

Present status. – The caribou population on the northern part of the Nuuk range (north of Nûp kangerdlua) is estimated at 6700 animals (March 1982) (Strandgaard et al. 1983: 13). The population seems to undertake the same type of seasonal migrations as described by Bendixen from the beginning of this century: the caribou move north into the central highlands in spring and in fall they migrate back south to the lower-lying areas closer to the Nûp kangerdlua. The animals are distributed across most of the region except for the outer coastal tracts. Six hundred and fifty caribou were found on the three nunataks east of Nûp kangerdlua (winter 1977).

The central part of the Nuuk range has since 1952 been occupied by the Itivnera domestic reindeer herd (Lassen & Aastrup 1981). From time to time domestic reindeer are seen together with wild caribou both north and south of the Itivnera herd's range. Domestic reindeer were in 1975 and 1976 transferred to the two islands Qeqertarssuaq and Qôrnup qeqertarssua where two feral herds now seem to have been established (Strandgaard et al. 1983).

South and east of Ameralik the range supports c. 2100 animals (November 1983). These caribou spend the winter primarily in the areas north and south of Kangerdluarssungûp taserssua (Fig. 17). When spring comes in April–May, the animals move inland where the snow melts early giving the forage an early start. The cows give birth to their calves in this continental area, and in summer the animals disperse. Finally in the fall when the rutting season is over, the caribou follow their old trails westward towards their more coastal winter quarters (Aastrup 1984a). This annual migration pattern has much in common with that of the Sisimiut population (Fig. 25).

Region 6 – Sisimiut (Fig. 18)

The geological record. – Two metacarpal bones from two individuals were recently excavated "in situ" from a river bank in the Sarfartôq valley near Kangerdlugssuaq (Søndre Strømfjord) (Fig. 19) (Bjarne Grønnow pers. comm.). These metacarpals are small,falling outside the size range of the present West Greenland caribou and comparing in size with the Northeast Greenland caribou *(R. t. eogroenlandicus)* (Appendix 2b) (Figs 46 & 48). No dating is available but they were both embedded

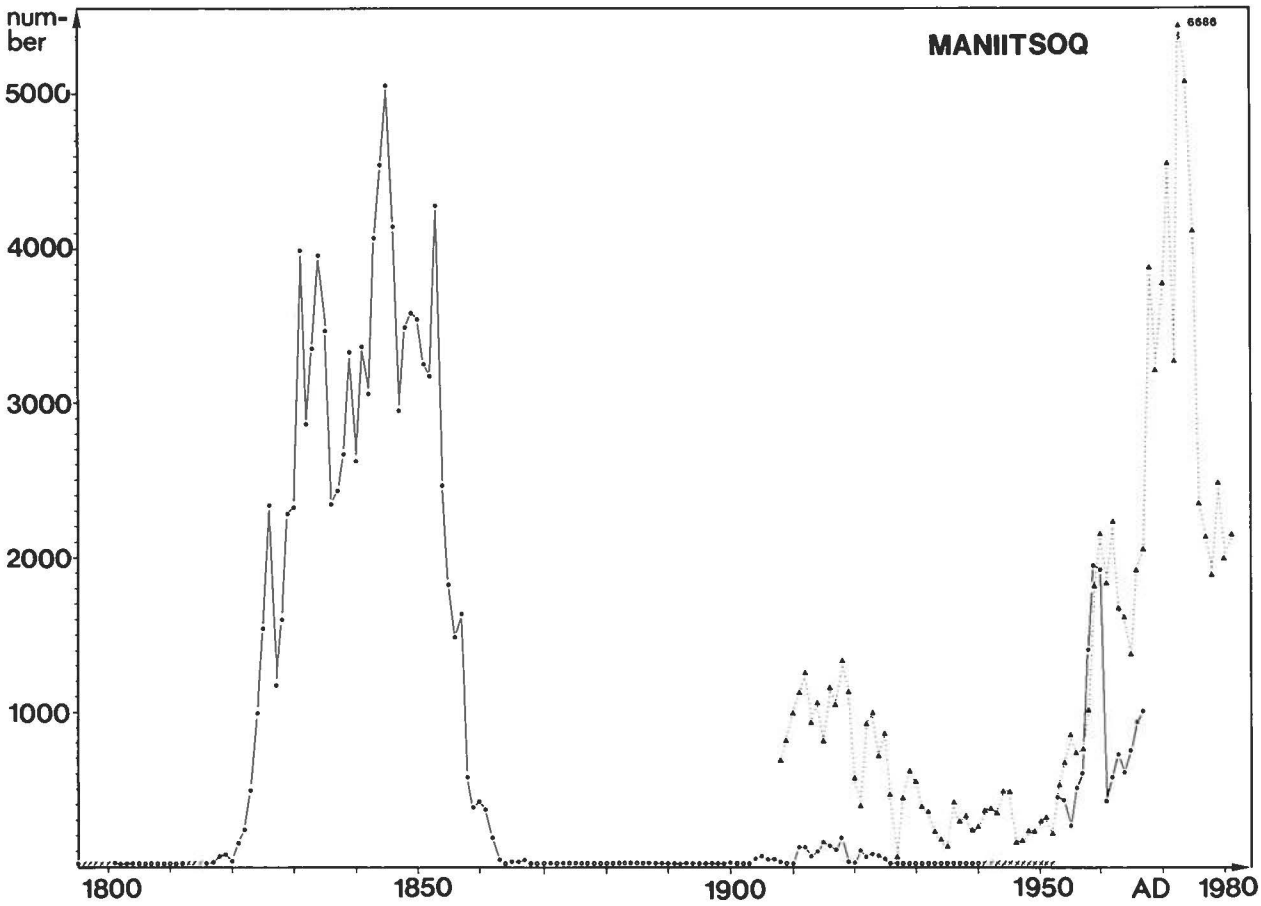


Fig. 16. Trading and hunting statistics from Maniitsoq (region 5). Dots connected by solid lines stands for number of skins traded annually to The Royal Danish Trading Company. Triangles connected by broken lines stands for number of caribou killed annually. Open signatures stands for no skins traded or no caribou killed. Minus-signs stands for missing data.

deeper than neighbouring cultural deposits of Thule Culture age, thus suggesting a fairly high age.

The archaeological record. – Caribou have been hunted in the Sisimiut region throughout the Saqqaq period from c. 2200 BC to c. 900 BC (Appendix 1b, nos 6-1, 6-2, 6-3). These caribou were of the same size as today's West Greenland caribou (Appendix 2b). This is particularly interesting because around 1500 BC there was a contemporary population of dwarfish caribou living in the Nuuk region, just separated from the Sisimiut caribou population by the glacier tongue Sukkertoppen Iskappe.

Caribou bones have been excavated from a Dorset Culture site in Kangerdlugssuaq (Søndre Strømfjord) dated to c. 500 BC (Appendix 1b no. 6-4). These animals correspond well in size with today's caribou (Appendix 2b).

The existence of many large caribou hunting camps in the inland (e.g., Appendix 1b, nos 6-5, 6-11) and the excavation of caribou bones from the middens of a large number of Thule Culture sites in general (Grønnow et al. 1983, Grønnow 1985) document that caribou have been hunted heavily all over the region throughout at least the last 800 years.

One site in particular, the caribou hunting site Aussivigssuit (Figs 20 & 21), yielded important information regarding the distribution and condition of caribou in the Sisimiut region. Stratigraphic investigations of the midden at Aussivigssuit show layers of almost compact caribou bone alternating with layers with very few bones. In this partiqular case this may be interpreted as an expression of periods of high caribou densities alternating with periods of low densities (Grønnow et al. 1983, Meldgaard, M. 1983). The most distinct caribou bone layers (and accordingly periods of large caribou populations) are dated to (a) a short period (c. 25 years) around 1700 AD, (b) a period in the first half of the 19th century.

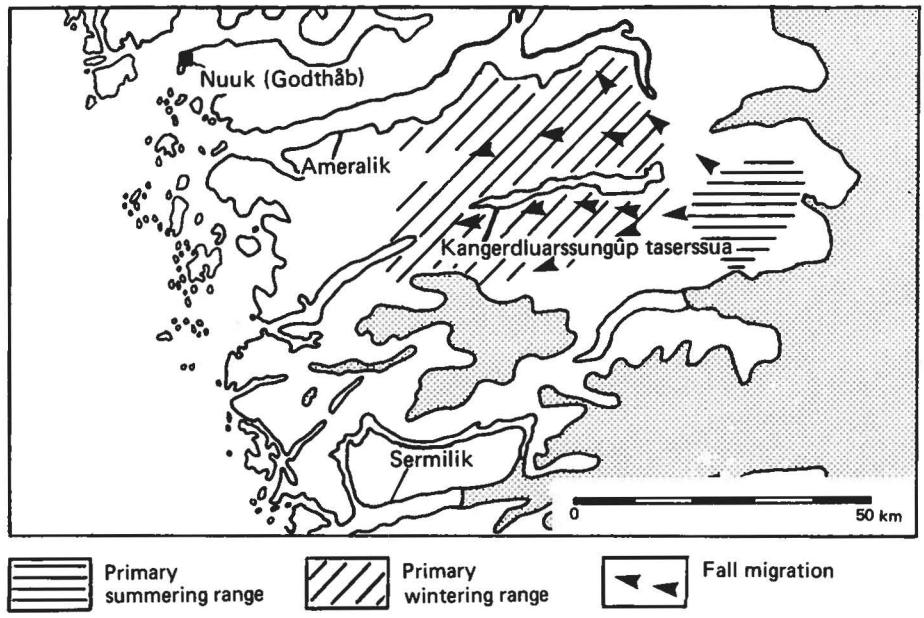


Fig. 17. Map of the Kangerdluarssungûp taserssua area showing annual movements of caribou (after Aastrup 1984a).

More than 90% of the 20000 bones identified from this site were caribou, and an analysis of these bones provided evidence that throughout the 800 years the site was used, it had been used primarily during summer and fall. This is also the case with other caribou hunting sites in the area (Grønnow et al. 1983, Meldgaard, M. 1983). It therefore seems reasonable to assume that the caribou have used the interior areas as their main summering and calving grounds for at least the last 800 years. This is supported by the recent discovery of numerous stone-built caribou hunting structures in the inland (Grønnow et al. 1983, Grønnow 1985). Both shooting coverts and large complex drive hunting structures are oriented towards the east in order to intercept caribou migrating towards the coast. It is difficult to date these structures, but they reach back at least to the 17th century and a few maybe to the palaeoeskimo period. This shows that the caribou must have maintained at least periodically an east–west oriented migration pattern through at least 400 and maybe through 2000 years, in fall migrating towards the coast and in spring back towards the interior.

The caribou living in the Sisimiut region from c. 1400 AD and till today were of a size comparable to the size of the caribou from 500 BC and 2200–900 BC (Figs 48 & 49) (Appendix 2b).

The historical record. – In 1770, Niels Egede, at the time missionary in Sisimiut, wrote that in recent years very few caribou had been killed and hardly any were to be seen as compared to earlier times (at least 13 years before 1770) (Egede 1770: 260). According to the trading statistics from both Sisimiut and Aasiaat, Qasigiannguit, and Illulissat combined, the caribou population stayed low until the 1820'es and 1830'es when there was a very sudden and large increase in trading from 0 to several thousand skins annually (Figs 23 & 24) (see also Rink 1852: 127). The population high lasts into the 1850'es and it is described vividly by both hunters, missionaries and colonial administrators (Jannsen 1913: 24–25, 77; Mikiassen 1864; Müller 1906: 370; Rink 1852: 127; Jak. Rosing 1926/27: col. 90). The caribou were not only very numerous in this period, they also expanded their ranges towards the coast where they were shot "standing in the doorways of people's houses" and northward towards Jakobshavn Isfjord – the northern limit of the region (Brown 1868: 354; Jannsen 1913: 70; Müller 1906: 365–66, 368; Rink 1852: 127; Otto Sandgreen NES unpubl.). They even reached the off-shore islands Tugtulik and 'Simioak' near Agto (Rink 1852: 125).

Rink also observed that the initiation of large scale migrations within the district accompanied the population increase and the range expansion in the 1840'es (Rink 1852: 127).

The succeeding population crash was as dramatic as the increase. In just 10 years from 1850 to 1860, trading went down from c. 4000 skins to 0 skins annually in both the southern and the northern parts of the Simisiut region. People were complaining that hunting was miserable and only few caribou could be found (Gedion Larsen NES unpubl.; Müller 1906: 369F; Enok Storch NES unpubl.; Winge 1902: 463).

During the following c. 30 years the caribou population was very small and the range much reduced. They disappeared, e.g., from the narrow strip of land west of

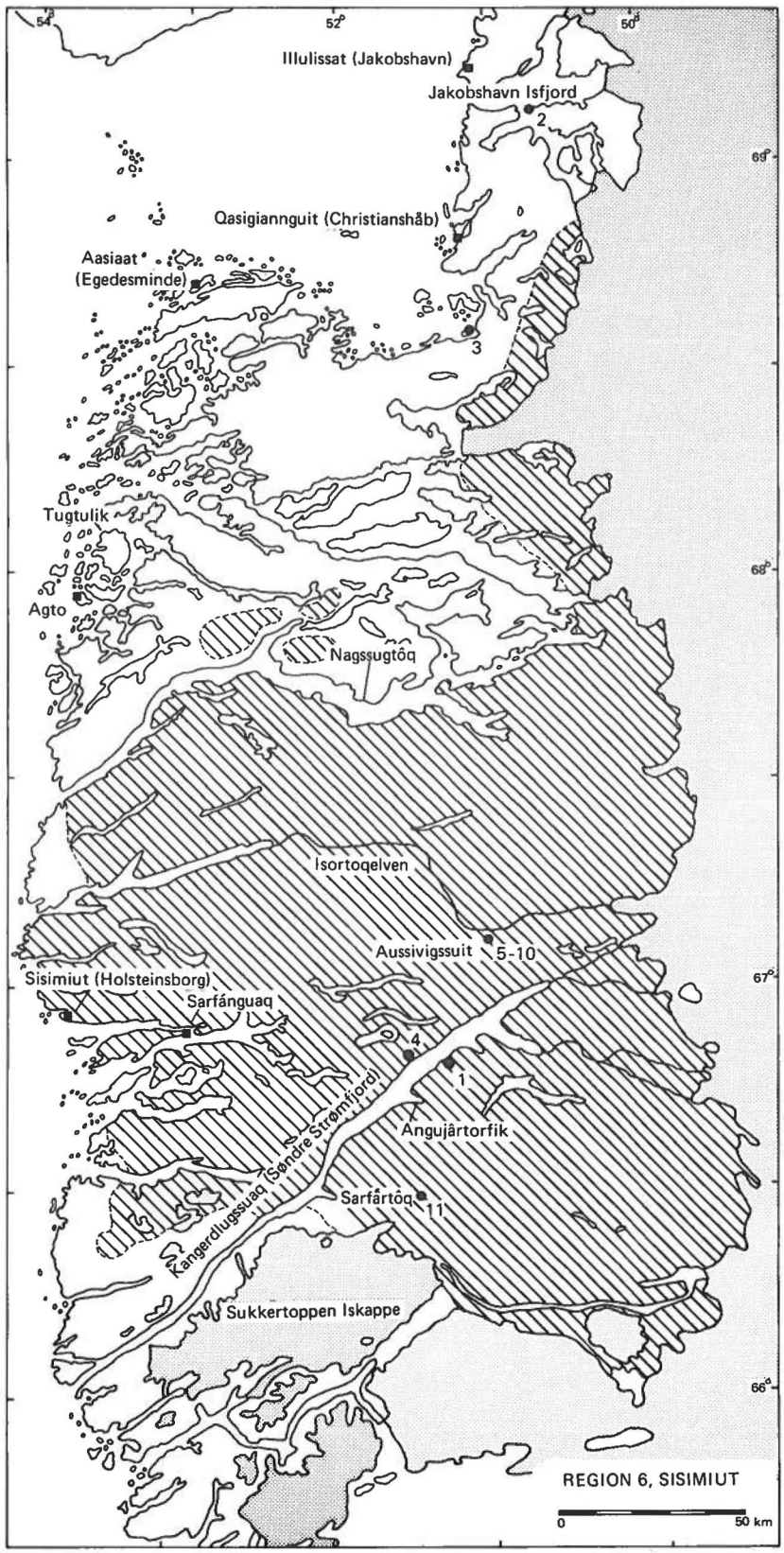


Fig. 18. Map of region 6, Sisimiut. Hatching stands for present distribution of caribou (after Strandgaard et al. 1983). Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).

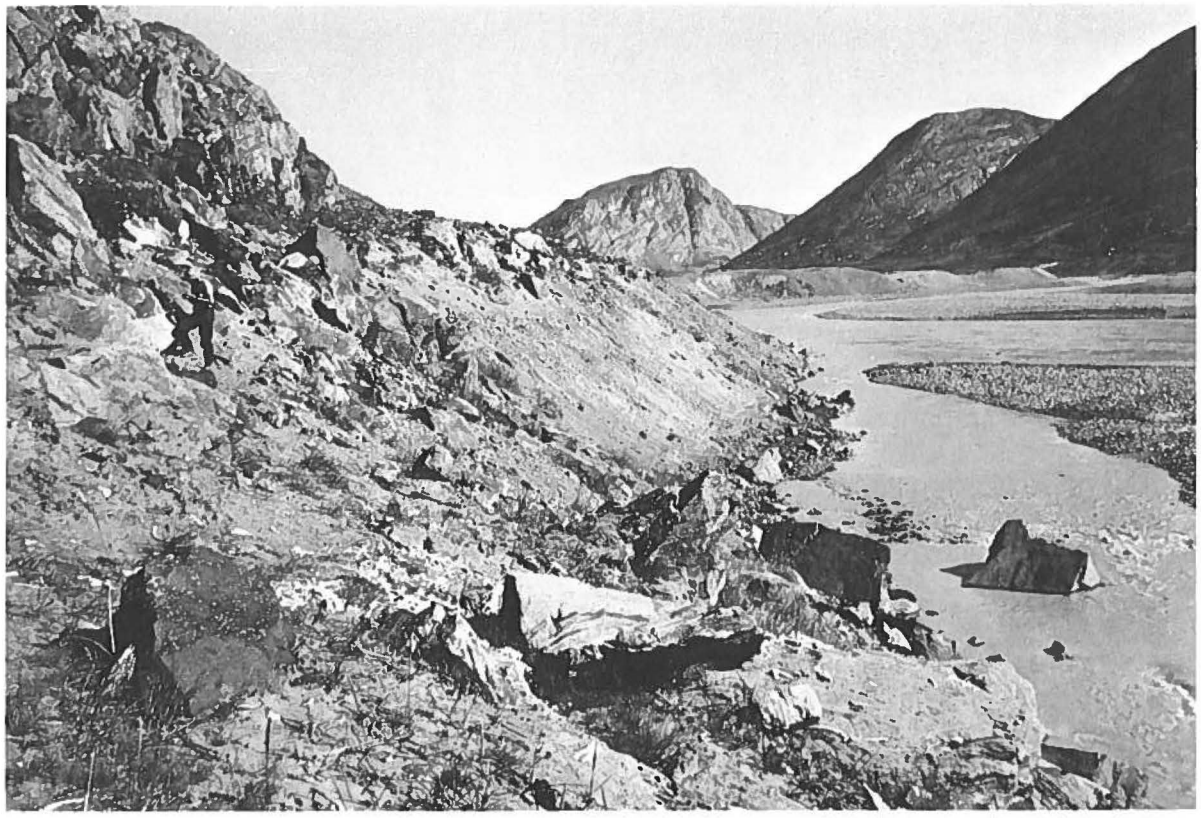


Fig. 19. Eroding banks of the Sarfartôq river (near Kangerdlugssuaq/Søndre Strømfjord). Naturally as well as culturally deposited caribou bones were excavated from the river bank (photo by Bjarne Grønnow, August 1983).

Sukkertoppen Iskappe and from the off-shore islands near Agto, and they became rare on the northernmost part of their range (north of Qasigiannguit) (Müller 1906: 365–66, Otto Sandgreen NES unpubl.). In general they retreated to the interior towards the inland ice and the nunataks (Bendixen 1921: 34, Müller 1906: 491, 504). According to the annual reports from the Royal Danish Trading Company (Anon 1889: 71, 1897: 9, 1898: 39, 1899: 74, 1905: 157, 1908: 96), there is a general increase in the caribou population in South Greenland (Paamiut to Aasiaat) between 1890 and 1900, followed c. 1915 by a decline (Anon 1915: 294, 1919: 116, 1920: 257, 1922: 468). The population maximum around 1900 does not show up in the hunting and trading statistics. Rasmus Müller (1906: 372) was convinced that this was due to the fact that most Greenlanders in the Sisimiut region were preoccupied with fishing while the people, e.g., in Nuuk attended their traditional caribou hunts.

During the 1960'es the caribou population increased dramatically and in less than 10 years the annual bag rose from c. 100–200 to 8000 and 4000 caribou for the northern and southern part of the range, respectively.

Simultaneously with the population increase observations were for the first time made of caribou migrating past the Søndrestrømfjord Air Base. Starting November 6th, 1959, the caribou have been moving north in November and December passing between the air base and the inland ice and returning south in April and May following the same route (Vibe 1967: 174–178).

For c. 10 years the population stayed high but already in the late 1970'es a decline, as drastic as the increase just 15 years earlier, set in and the population reached a 1984 minimum of 5900 animals (Strandgaard et al. 1983). Simultaneously with the population decrease the migratory behaviour changed once again, the long migrations between coast and inland have partly ceased, and most animals seem to have become stationary and to winter in the interior parts of the region (Strandgaard et al. 1983).

Caribou dwarfs? – According to caribou hunters from the Sisimiut district, a special and very rare caribou can be found in the most interior parts of the range (Müller 1906: 382). These caribou were short-legged, they had different antlers, darker pelage, and they were fatter, but otherwise they had a trunk like a normal West Greenland caribou. Hunters from Sarfánguaq were sup-

Fig. 20. Aussivigssuit, one of the largest inland caribou hunting camps in West Greenland. It has been used periodically for more than 2000 years (Appendix 1b, nos 6-5 to 6-10). View to the West (photo by the author, July 1978).

posed to have shot several of them, and Müller tried by putting a bounty on these caribou to retrieve a specimen, but he never succeeded.

The question arises whether these fat, shortlegged caribou really existed, or if they sprung from myths and legends. It is important to recognize the fact that the Greenlanders have a highly developed tradition of orally relating information concerning specific hunting adventures, animal behaviour, etc. in a detailed and accurate way. On the other hand, mythical and strange animals do occur in legends and tales, but these animals are almost always extraordinary in some respect, e.g., giant worms or animals with iron tails (Birket-Smith 1971: 189, Holm & Petersen 1885: 184–85).

I believe that the rather detailed descriptions of shortlegged fat caribou are more likely to be the result of real observations by skilled caribou hunters than they are to be materialized myths. Similar observations of small caribou in the Nuuk region speak in favour of this conclusion. But it is difficult to say whether the observations were made c. 1890 or 10 generations before.

Present status. – The caribou population in the Sisimiut region number approximately 5900 (Strandgaard et al. 1983). C. 600 caribou are found in the northern part of the region north of Nagssugtôq, mainly close to the Inland Ice (April 1978). C. 2300 caribou make a living between Nagssugtôq and Isortoqelven and primarily east of 53°W (spring 1982). And finally, c. 3000 caribou are estimated to inhabit the area between Isortoqelven and Sukkertoppen Iskappe (March 1982). These caribou utilize both the inland area and part of the coastal range.

The caribou living between Isortoqelven and Sukkertoppen Iskappe are the best studied caribou in the region, and a number of papers that deal with population dynamics, feeding ecology, migratory behaviour, etc. have been published in recent years (List of literature in Strandgaard et al. 1983).

From the beginning of November to late April, most cows, calves, yearlings, and younger bulls are found on their coastal winter ranges (Fig. 25). Some cows, calves, yearlings, younger bulls, and the majority of older bulls spend the winter on the inland part of their range. In May the caribou that have wintered on the coastal range migrate towards the interior summering and calving areas, a journey of c. 70 kilometres. From June to late

Fig. 21. Sample of marrow-cracked caribou bones dating to c. 1700 AD from one square meter of midden deposit at Aussivigssuit (Fig. 20) (photo by the author, 1978).

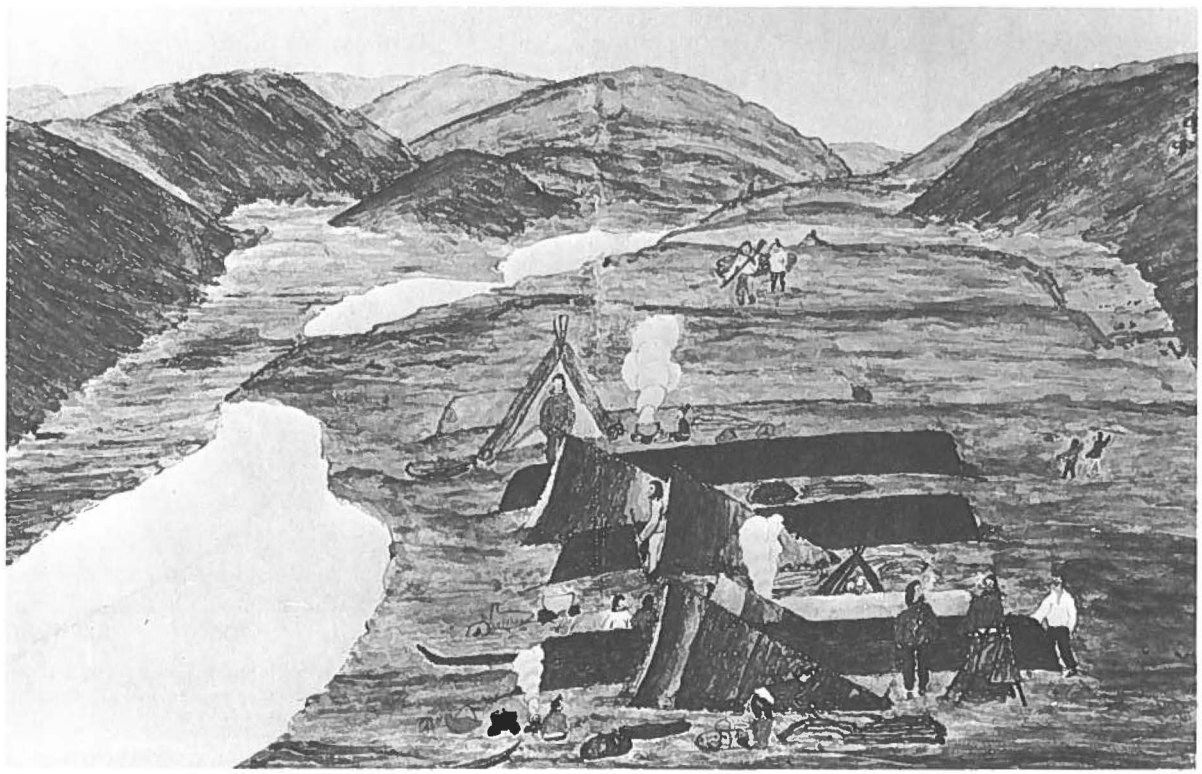


Fig. 22. Angujârtorfik, a famous meeting place for caribou hunting parties. Notice the overturned umiaqs, the drying racks for caribou meat, and many other details concerning everyday life during a traditional caribou hunt. Water colour by the Greenlandic artist and caribou hunter Aron of Kangeq (1822–1869). The original is kept at the Kalaallit Nunaata Katersugaasivia (Grønlands Landsmuseum), Nuuk.

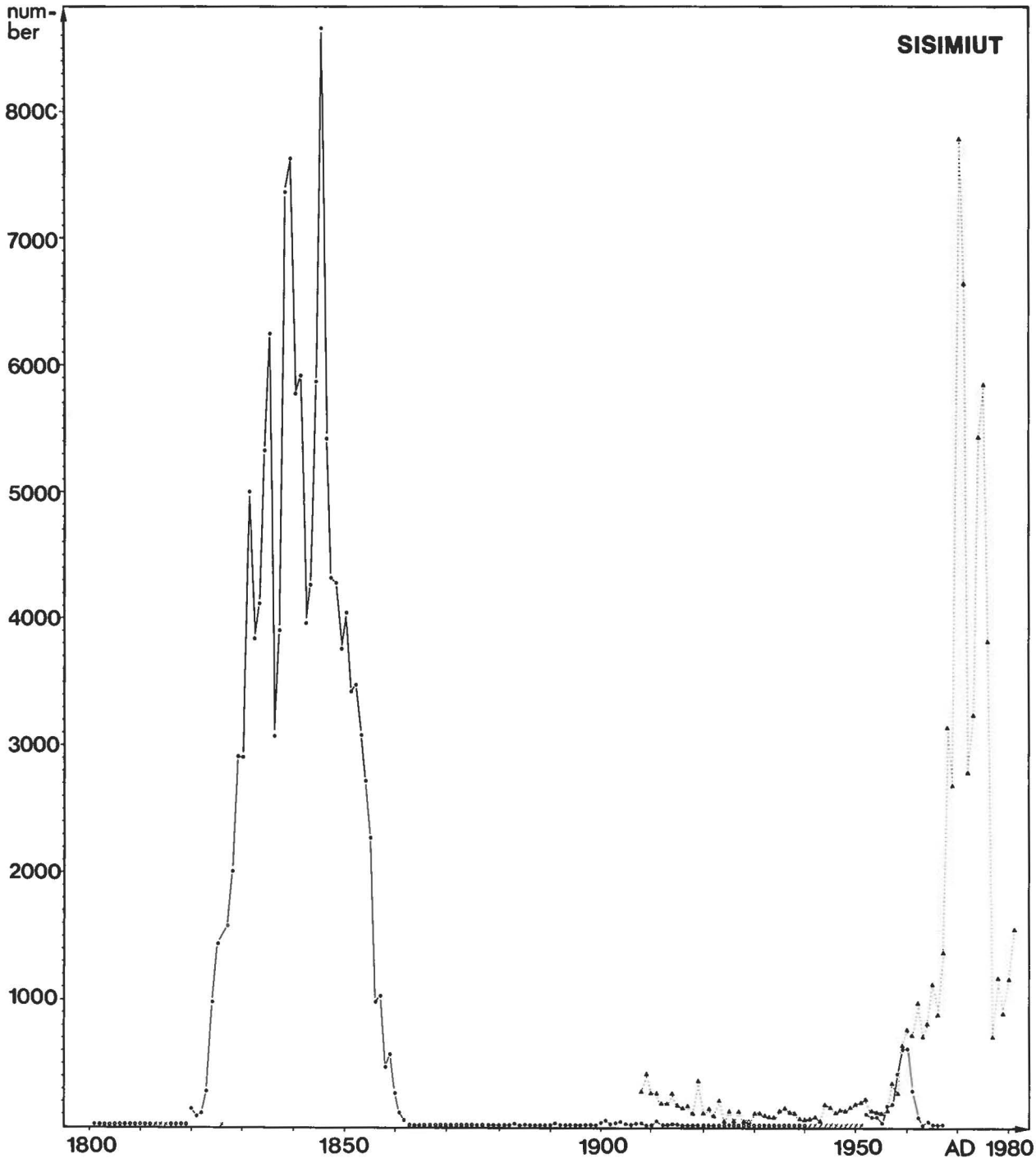


Fig. 23. Trading and hunting statistics from Sisimiut (region 6). Dots connected by solid lines stands for number of skins traded annually to The Royal Danish Trading Company. Triangles connected by broken lines stands for number of caribou killed annually. Open signatures stands for no skins traded or no caribou killed. Minus-signs stands for missing data.

August, the animals are found on the inland ranges, and in September the cows, calves, and subadults migrate towards the coast, leaving a contingent in particular of old bulls behind.

This migratory pattern, which was typical in the 1960'es and early 1970'es, seems, however, to have changed with the marked reduction in population size in the 1970'es and early 1980'es. It looks like long distance

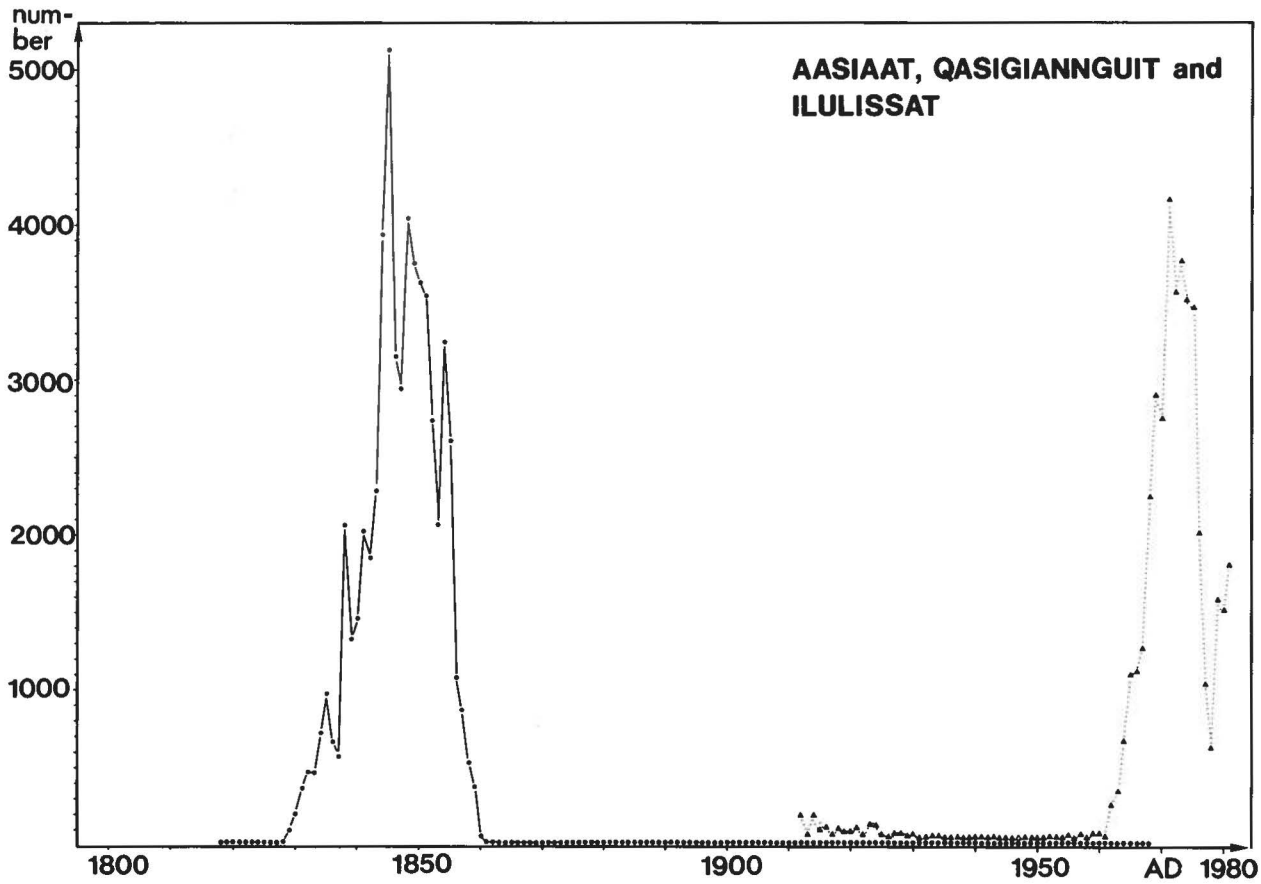


Fig. 24. Trading and hunting statistics from Aasiaat, Qasigiannguit, and Ilulissat (region 6). Dots connected by solid lines stands for number of skins traded annually to The Royal Danish Trading Company. Triangles connected by broken lines stands for number of caribou killed annually. Open signatures stands for no skins traded or no caribou killed. Minus-signs stands for missing data.

migrations have ceased and the majority of all age and sex groups have become more stationary, spending the whole year on their former summering grounds in the inland region.

South of Kangerdlugssuaq in the Sarfartôq area there is a rather small stationary population of caribou that has only little interchange with the population north of Kangerdlugssuaq.

Region 7 – Disko (Fig. 26)

The archaeological record. – Shooting coverts used during caribou hunting and archaeological sites with caribou bones eroding from the middens are known from the island (Porsild 1921: 290). These prehistoric remains may indicate that caribou were living on Disko before 1700 AD.

The historical record. – Caribou were described for the first time from Disko in 1727 (Bobé 1936: 144) and the island was mentioned as being inhabited by quite a large caribou population (Egede 1744: 197). According to Giesecke, this population declined substantially in the last half of the 18th century (in Winge 1902). They were most common on the northern part of the island (Nordlandet) (Porsild 1921: 290). It is difficult to say precisely when the caribou population went extinct, but it probably happened some time in the 19th century. In the first half of the 20th century, caribou tracks were from time to time observed on the northern parts of the island. Probably these animals were strays that had crossed Vaigat from Nûgssuaq where there was a population of caribou (Porsild 1921: 225, 290; Reimers 1980: 5).

Present status. – There are no wild caribou on Disko today, but in 1968 10 domesticated reindeer from the Itivnera herd were released at Nordfjord. In 1980, 138 feral reindeer were observed in the same general area (Reimers 1980: 4).

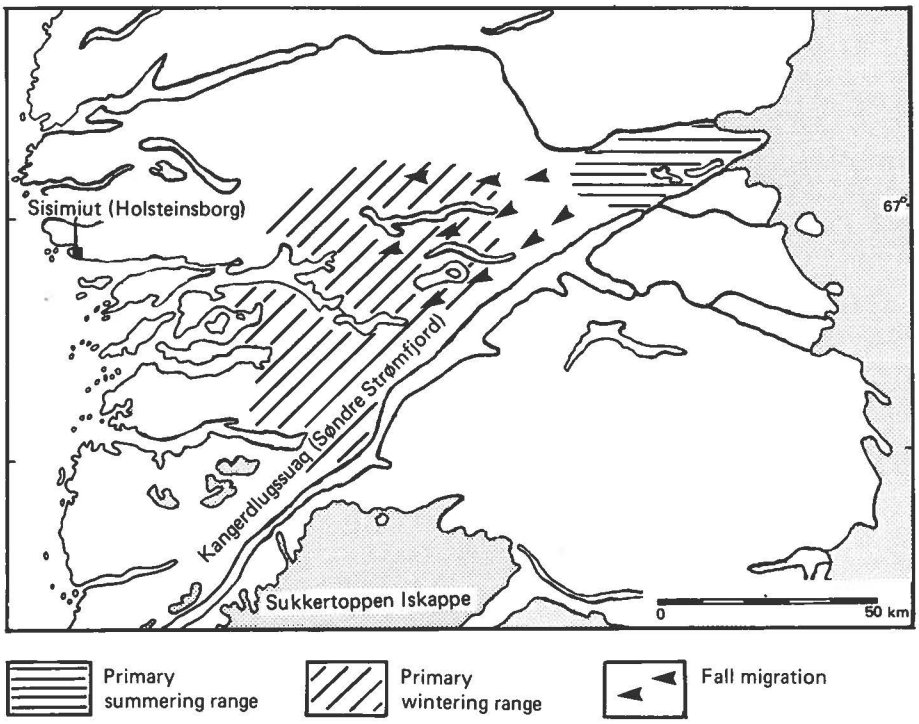


Fig. 25. Map of the Kangerdlugssuaq-Sisimiut area showing annual movements of caribou (after Thing 1984).

Region 8 – Jakobshavn Isfjord to Torssukátak (Fig. 27)

The archaeological record. – Caribou bones and antlers have been excavated from Eskimo middens dating to c. 50 AD (Appendix 1b, no. 8-1) and to the period 1200–1850 AD (Appendix 1b, nos 8-2 to 8-6). These bones could be from caribou hunted in this region, but it is more likely that they come from caribou hunted either on Nûgssuaq (see Porsild 1920: 306) or south of Jakobshavn Isfjord (which is where caribou hunters from Ilulissat today hunt their caribou).

Historical record. – Caribou have never been seen in the area and no antlers have been found, but one placename, "Netloarsuk" (i.e., the caribou crossing place), indicates that caribou may once have existed here (Rink 1857: 126). According to local tradition, caribou have been hunted on the nunatak Nunatarssuaq (Rink 1852: 126, Porsild 1921: 164).

Region 9 – Nûgssuaq (Fig. 28)

The archaeological record. – Archaeological sites with caribou bone material dated to c. 400 BC, to 1200–1400 AD, and to 1700–1800 AD prove that the inhabitants of Nûgssuaq were caribou hunters (Appendix 1b nos 9-1 to 9-4). It is most likely that the caribou bones are the remains of caribou hunted on Nûgssuaq, but it cannot be excluded that they were hunted in the large caribou districts south of Disko Bugt.

However the well-known "caribou fence" at Saputit on the southern coast of Nûgssuaq proves that caribou were present on Nûgssuaq itself in prehistoric times (Nellemann 1969/70, Porsild 1920). It is a several hundred meters long, stone-built structure stretching from a

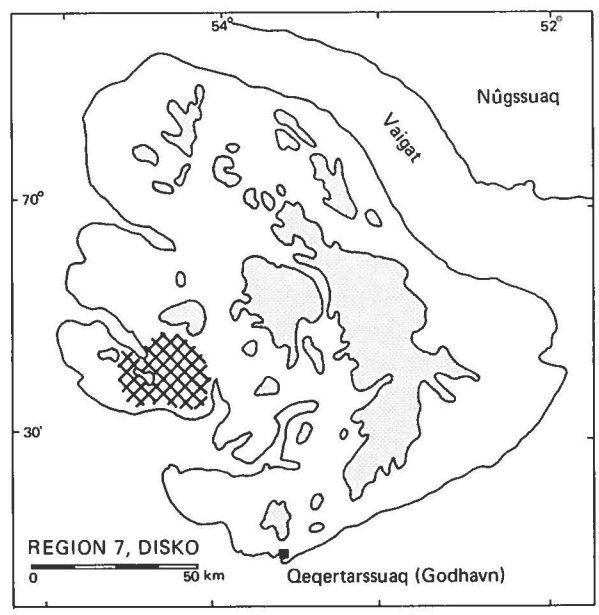
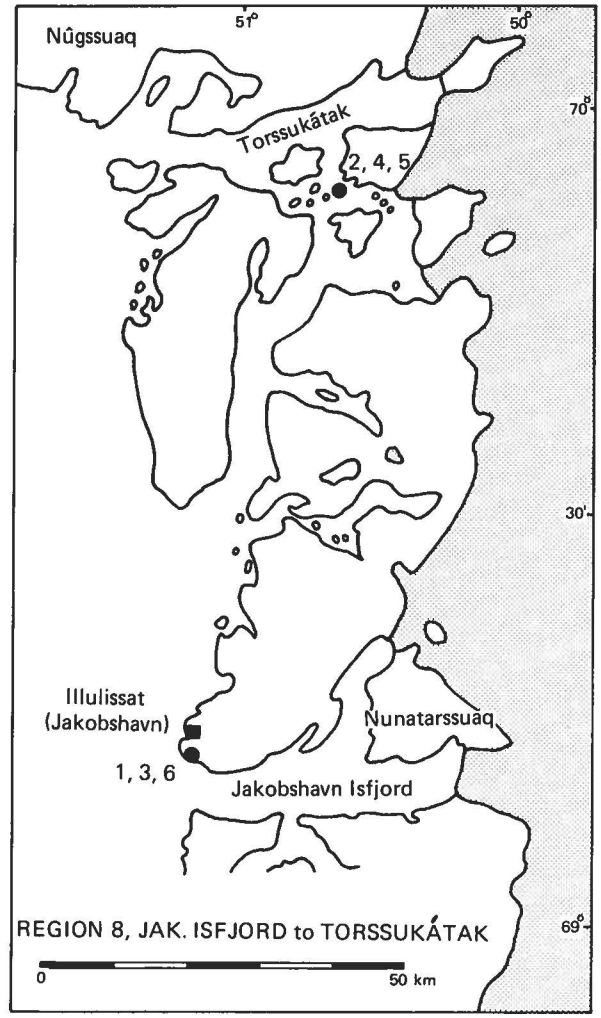


Fig. 26. Map of region 7, Disko. Cross-hatching stands for present distribution of feral reindeer.

Fig. 27. Map of region 8, Jakobshavn Isfjord to Torssukátak. Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).



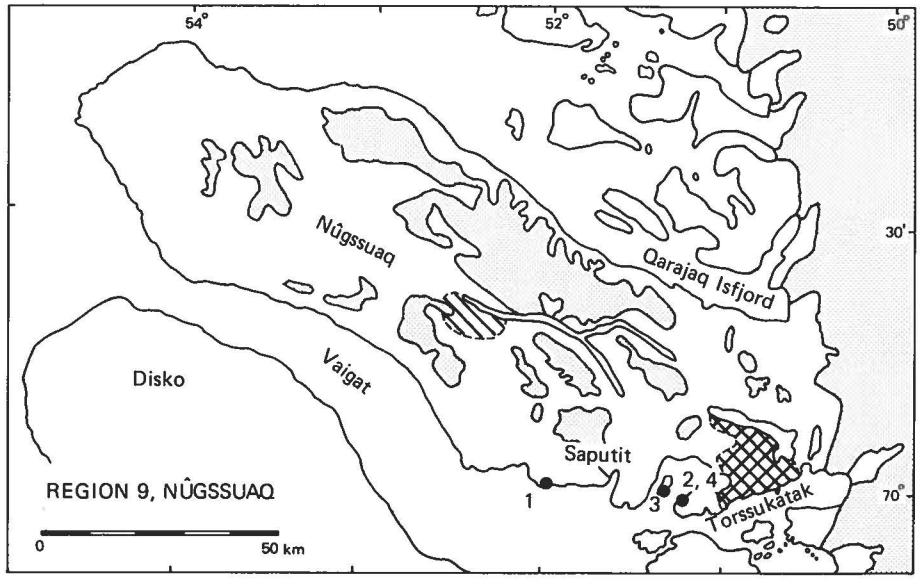
steep cliff across a stretch of level ground and down to the sea. Probably the caribou were driven towards the fence where concealed hunters were waiting, bow and arrow ready. The fence is difficult to date, but as no historical or ethnohistorical information regarding the use of the fence exists, it must have been built before c. 1750 AD. Hannibal Fencker (pers. comm.) has found arrowheads made from antler and wooden arrow shafts in the vicinity of the fence. Assuming a context with the fence, this dates it to some time between 1200 and 1700 AD. It cannot be ruled out, however, that the caribou fence dates to the palaeoeskimo period. In Labrador, this type of structure was used by the Dorset people (Fitzhugh 1979, 1981).

There are also a number of camp sites in the interior of the peninsula which have been used by caribou hunters for generations (H. Fencker, pers. comm.).

The historical record. – Caribou are mentioned from the area in 1818 (Winge 1902: 465). From later sources it appears that the animals were found mainly in the valleys of the interior (Rink 1852) where accordingly most of the hunting took place (H. Fencker, pers. comm.). But the caribou were also seen near shore (Porsild 1921: 290, Rink 1852: 126, Winge 1902: 465). The Saputit caribou fence, which is situated by the sea shore, gives the impression that caribou were once more common in the fringe areas of the peninsula than they are today.

Changes in the size of the caribou population has taken place in historic times. Porsild (1921: 225) writes that the population formerly was much larger and that

Fig. 28. Map of region 9, Nûgssuaq. Hatching stands for present distribution of caribou (after Strandgaard et al. 1983). Cross-hatching stands for present distribution of feral reindeer (after Strandgaard et al. 1983). Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).



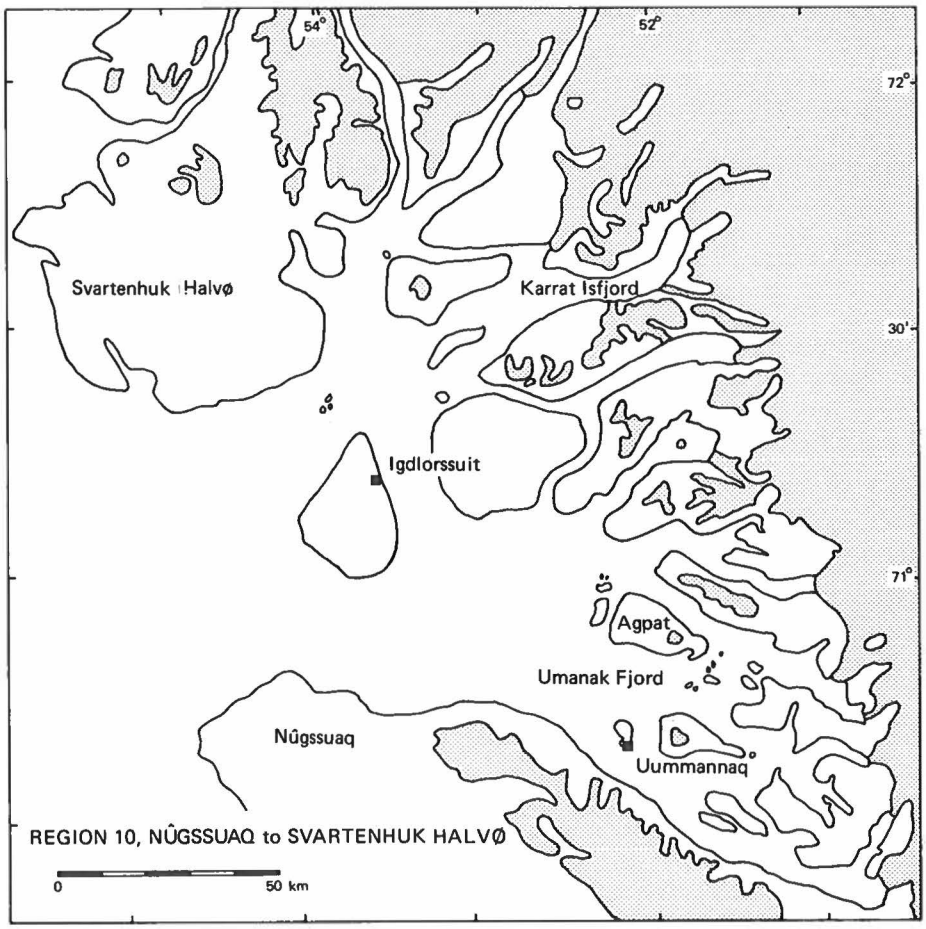


Fig. 29. Map of region 10, Nûgssuaq to Svartenhuk Halvø.

the present (1910–20) small population was isolated from the larger populations to the north and to the south. H. Fencker (pers. comm. in Strandgaard et al. 1983: 8–9) has stated that he saw more than 500 caribou on the peninsula in 1948, and that this population due to heavy hunting had shrinked to c. 20 in 1968.

Present status. – In 1980 the total population of caribou on Nûgssuaq was estimated to be 20 (Reimers 1980). The estimate is based on the sighting of one set of tracks and one recently shed antler and should therefore be looked upon as a qualified guess. One skeleton of Nûgssuaq caribou available in the Zoological Museum, Copenhagen, (Appendix 2b) corresponds well in size with caribou from the large populations in central West Greenland.

In 1968, 10 domestic reindeer from the domestic herd in Itivnera were released on the southeastern shore of Nûgssuaq. In 1980, this feral population was estimated at 250 (Reimers 1980: 10).

Region 10 – Nûgssuaq to Svartenhuk Halvø (Fig. 29)

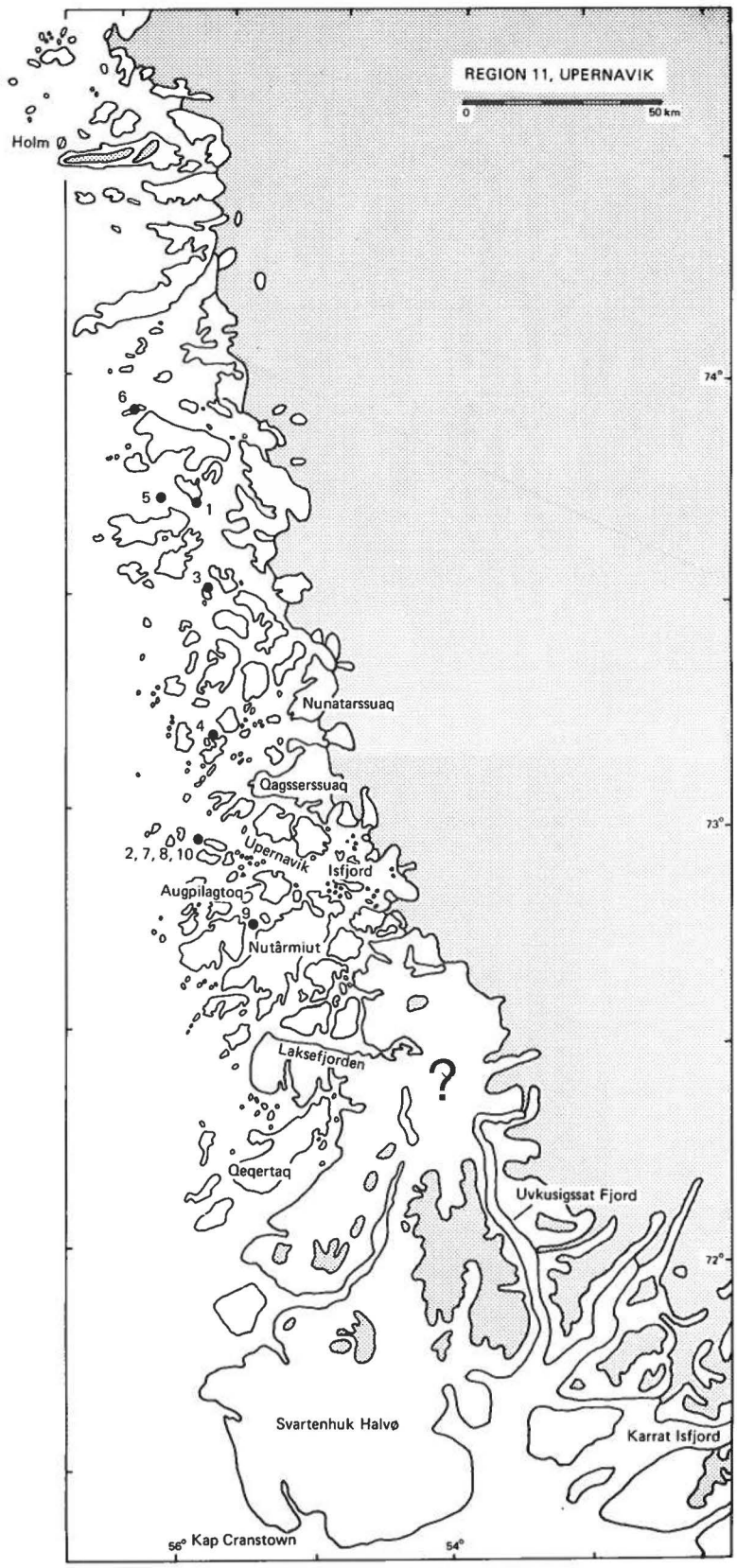
Historical record. – Rink (1852: 126) never heard of caribou in the area, but he does mention that there is a valley on Agpat called "caribou valley". In contradiction to Rink, Porsild (1921: 358) relates that more than a century ago (18th century), caribou could be hunted on the numerous islands and lands in the area. At that time there was contact between the caribou populations on Nûgssuaq and on Svartenhuk Halvø. This contact ceased before 1820, but caribou could still be found astray somewhat south of Svartenhuk (Porsild 1921: 358).

Present status. – No caribou are found in the area today.

Region 11 – Upernavik (Fig. 30)

The archaeological record. – Caribou bones have been excavated from a number of archaeological sites in the district (Appendix 1b, nos 11-1 to 11-10) and they re-

Fig. 30. Map of region 11, Upernavik. Questionmark stands for possible present distribution of caribou. Dots stands for archaeological localities with caribou remains o (listed in Appendix 1b).



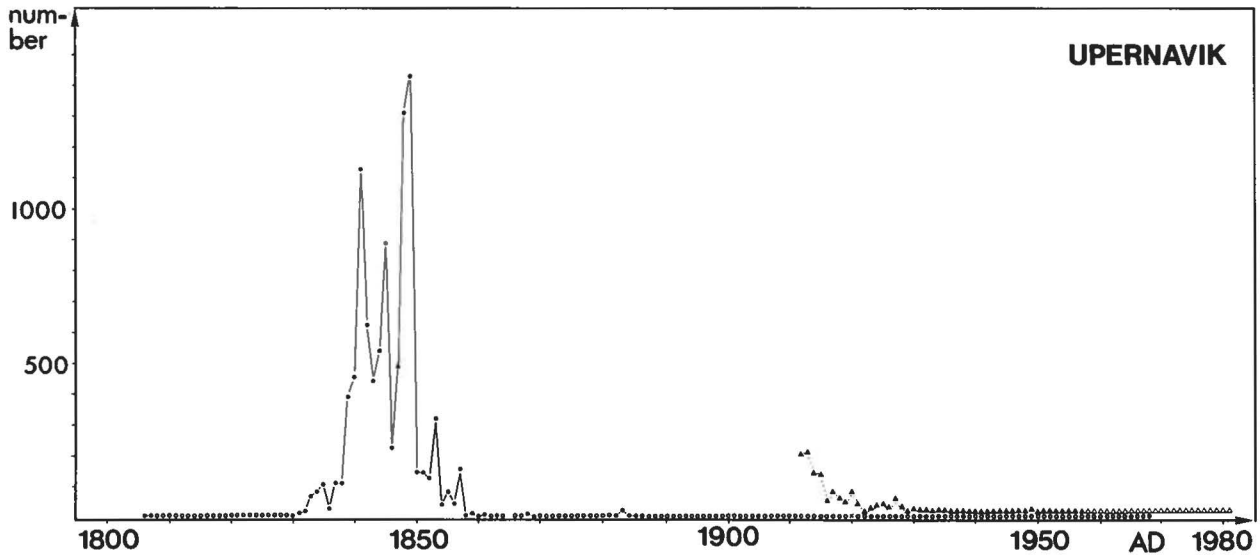


Fig. 31. Trading and hunting statistics from Upernavik (region 11). Dots connected by solid lines stands for number of skins traded annually to The Royal Danish Trading Company. Triangles connected by broken lines stands for number of caribou killed annually. Open signatures stands for no skins traded or no caribou killed. Minus-signs stands for missing data.

veal that caribou have been exploited by the people in the area throughout a period from 1200–1850 AD.

The size of these animals as expressed in the dimensions of the longbones (Appendix 2b) is comparable to the size of contemporary and recent caribou from central West Greenland (Appendix 2c).

A number of caribou hunting camps are situated in the interior of Svartenhuk Halvø (Rink 1855, fold-out map). The camps are situated in the best caribou district, and it is very probable that they were used in prehistoric times.

The historical record. – Rink (1852: 126) described how the caribou from their mainstay Svartenhuk Halvø occasionally strayed south to the nearer islands in the Umanaq Fjord. He also stated that caribou were found in quite large numbers on the islands north of the peninsula – even on islands in the Melville Bugt. The main population, according to Rink, lived on the large islands Kikertsuaq (Qeqertaq) and Nutârmiut just north of Svartenhuk Halvø, around Laksefjord at the base of Svartenhuk Halvø, and around the inner parts of the Upernavik Isfjord.

Trading statistics, which started in 1806 in Upernavik, show that caribou skin trade was very high in the 1840'es, reaching a peak of 1431 skins in 1849 (Fig. 31). This reflected a very high population level in the area during the 1840'es.

In less than 10 years, from 1849 to 1858, caribou skin trade dropped by more than 90% to less than 20 skins annually. In 1871, the inhabitants of Upernavik complained that caribou were strongly reduced in numbers so that they could hardly shoot more than 20 animals annually (Bessels 1879: 87). The area of distribution was shrinking simultaneously with the population decline. Andreas Petersen, caribou hunter from Upernavik, described how the caribou c. 1850 went extinct north of Taserssuatsiaq close to the Augpilagtoq glacier (NES unpubl.). Porsild (1921: 446) added that most of the small caribou populations on islands, nunataks, and peninsulas north of Upernavik Isfjord went extinct in the last part of the 19th century. A few populations, e.g., one on Nunatarssuaq north of Qagsserssuaq, held on into the 20th century before they died out (Porsild 1921: 446).

According to the annual reports from the Royal Danish Trading Company (Anon 1889: 71, 1897: 9, 1898: 39, 1899: 74, 1905: 157, 1908: 96), there was an increase in the caribou population from 1890 to 1900. The population high was not as pronounced as the 1840–50 maximum, and already c. 1915 a decline sets in (Anon 1915: 294, 1919: 116, 1920: 257, 1922: 468). The hunting statistics – which start in 1912 – are in agreement with the reports. Between 1913 and 1932, the hunting bag diminishes from more than 200 caribou annually to less than 20 annually.

Samuel Møller, a hunter and catechist from Igdlorssuit, described how the caribou retreated at first from the coastal and westernmost tracts around Kap Cranstown and then from the coastal areas around the mouth of Uvkusigssat Fjord until they were found only at the head of Uvkusigssat Fjord. Hunters who visited the land between Uvkusigssat Fjord and the Inland Ice found that it too was empty of caribou (Møller 1936: 859).

From 1932 onwards, the bag was very low and after 1966 no animals have been killed.

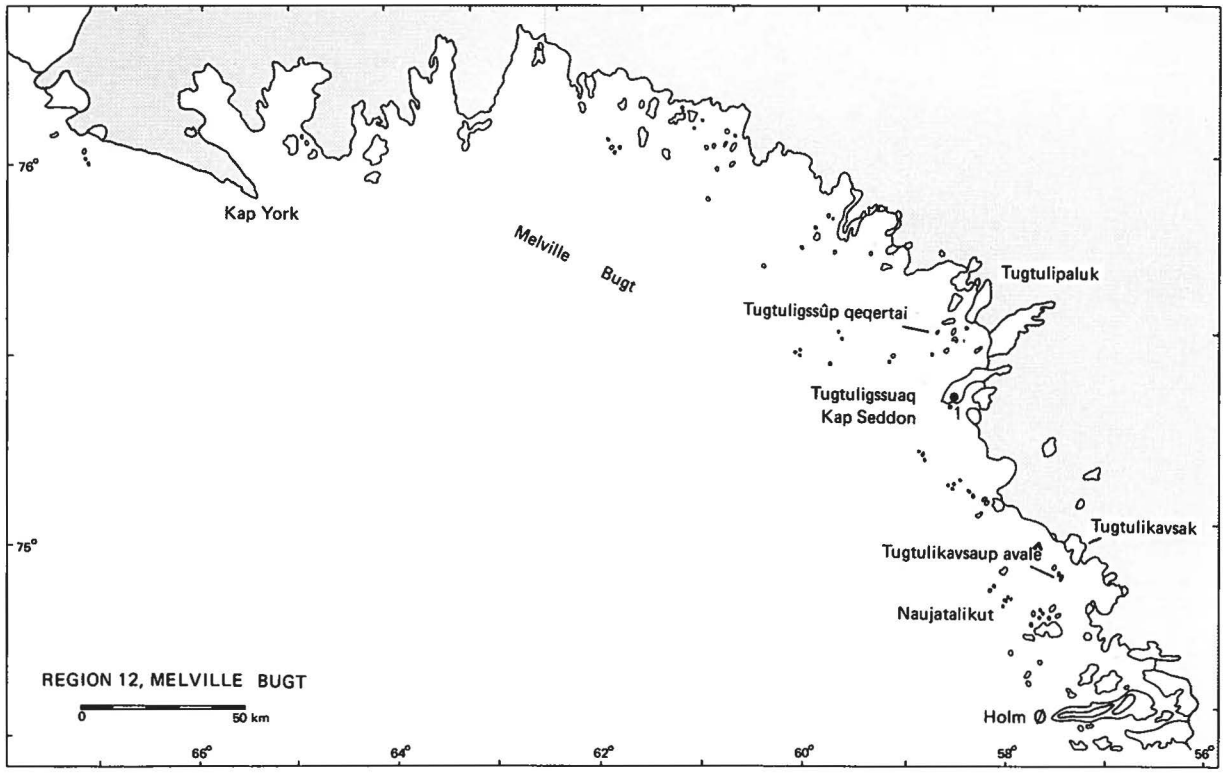


Fig. 32. Map of region 12, Melville Bugt. Dots stands for archaeological localities with caribou remains (listed in Appendix 1 b).

Present status. – The present caribou population on the Svartenhuk Halvø is assumed to be very small or possibly extinct (Finn Jessen Jensen, pers. comm., Strandgaard et al. 1983).

Region 12 – Melville Bugt (Fig. 32)

The geological record. – A few caribou bones and antlers picked up on islands and peninsulas in the bay supplement our knowledge of caribou distribution in the area.

A large shed antler from a bull was collected on the small islands Naujatalikut (Garde Øer) in 1979 (Appendix 2a). More than 10 fragments of antlers and intact antlers and a number of limb bones were collected on Tugtuligssuaq in 1979, most of them on the eastern part of the peninsula close to the Inland Ice. The dimensions of these limb bones place these caribou within the size range of recent caribou from the central West Greenland range (Appendix 2a & c).

The archaeological record. – Excavations on Tugtuligssuaq ("the great caribou land") of 13th and 14th century Thule Culture eskimo houses have brought a number of caribou bone and antler fragments to light (Appendix 1b, no. 12-1). The bone material consists of scrap from bones of poor food value (e.g., phalanx) and of waste products from working in antler. Probably the caribou were hunted and killed close by, either on Tugtuligssuaq itself or on an island or peninsula in the vicinity.

The historical record. – Rink (1852: 226) described briefly how caribou were found on islands in the Melville Bugt, and in 1887 several caribou were seen north of Nûgssuaq (situated just south of Holm Ø) by Ryder (Winge 1902). In 1910, the animals were so few that the far-travelling hunters of the Thule district knew their exact whereabouts and numbers (Freuchen 1911: 144). On a small nunatak south of Tugtuligssuaq (probably Tugtulikavsak, "the small caribou land"), 4 caribou were found. Tugtuligssuaq (Fig. 33) had quite a large population of caribou that was discovered in 1905 (Rasmussen 1919: 64) and hunted to extinction in 1909 by Eskimos residing on the peninsula (Freuchen 1911). According to Knud Rasmussen, the Tugtuligssuaq caribou populated nearby islands where they seemed to thrive, but they were exterminated between 1910 and 1920 (1921: 522). Further north on the peninsula of Umanak, two caribou were surviving in 1910, and on a nunatak close by, 7 of a flock of 12 were shot the same year (Freuchen 1911). According to Knud Rasmussen, all these small populations were killed off by the Eskimos (1921: 522). Maybe a few survived on a nunatak just north of Tugtuligssuaq because of its assumed inac-

Fig. 33. Oblique aerial photograph of Tugtuligssuaq "The Great Caribou Land". Geodetic Institute, Copenhagen, 19-7-1949/rute 542 B-NØ nr. 1872.

cessability. In any case, Tugtuligssuaq was repopulated with caribou in the 1940'es (Degerbøl 1957: 18), as was also the land just north of Tugtuligssuaq (Nikolaj Jensen, pers. comm.). They were all killed before the end of the decennium (Nikolaj Jensen, pers. comm.).

Present status. – There are no caribou in Melville Bugt today.

Region 13 – the Thule area (Fig. 34)

The archaeological record. – The earliest trace of caribou in the area is dated to 900–1000 AD (Appendix 1b, no. 13-1). The material is rather scanty and consists of antler fragments that could have been imported as raw material for tool making from other districts. The same goes for antler fragments from 1200–1300 AD and from 1300–1400 AD (Appendix 1b, nos 13-2, 13-3). From 1400–1500, 1500–1600, and 1800–1900 AD, marrow-cracked caribou bones as well as antler fragments have been found and very probably these caribou were killed in the Thule area (Appendix 1b, nos 13-4, 13-5, 13-6).

In Narssârssuk's hinter land between Kap Atholl and Dundas, stone-built drive hunting structures have been observed (E. Knuth, pers. comm.). The dating of these structures is unknown. Shooting coverts have also been described from 'Adam Bierring's nunatak' (Freuchen 1911: 145).

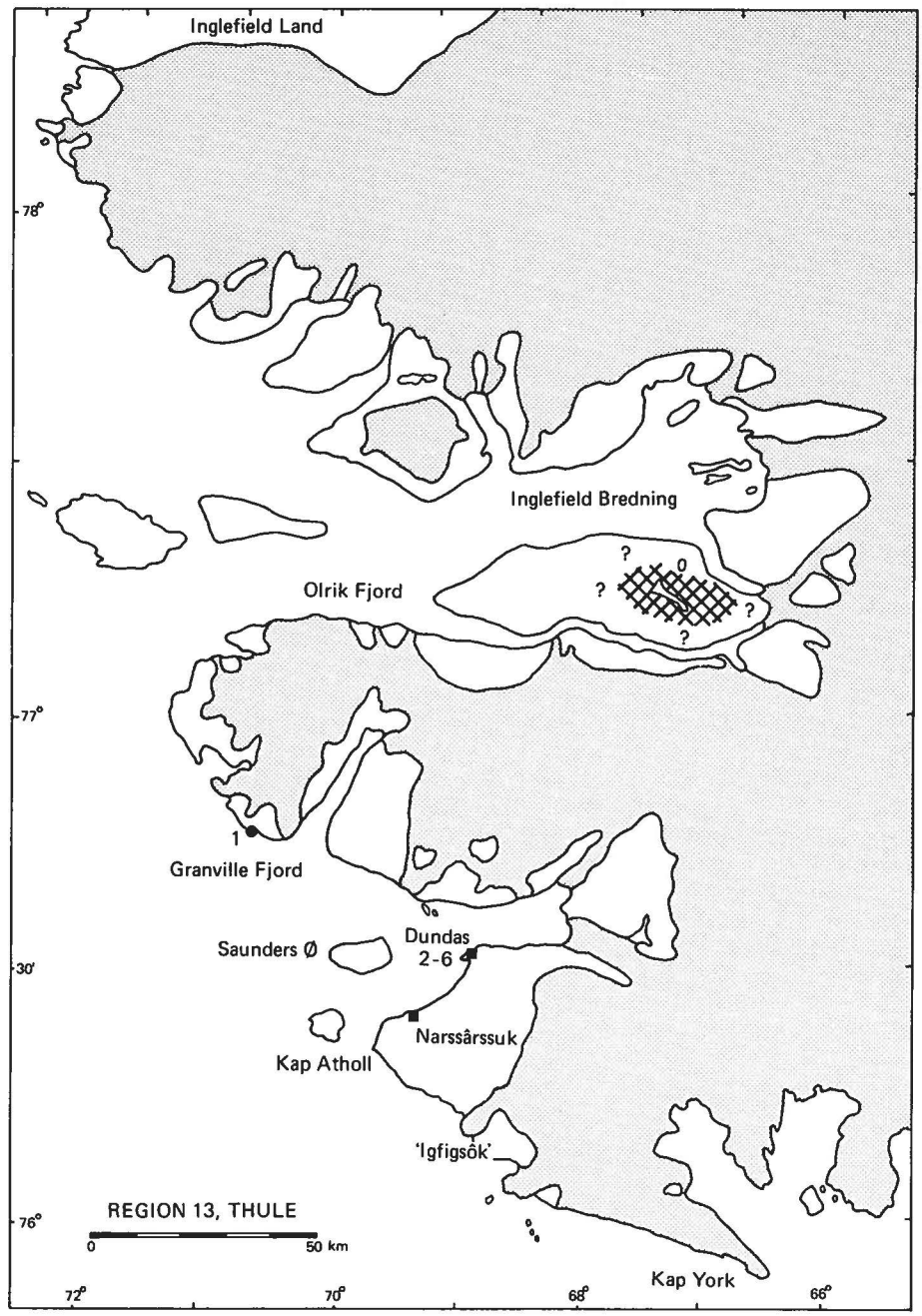


Fig. 34. Map of region 13, Thule. Cross-hatching stands for approximate present distribution of feral reindeer. Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).

The historical record. – The first explorer mentioning caribou in the Thule area was Kane who visited the area in 1853–55 (Steensby 1910: 260), and according to Peter Freuchen, who interviewed the Eskimos on this matter, caribou were living in the area at least from the beginning of the 19th century (1911: 145–6). Up till the end of the 19th century, caribou were plentiful in the district and they were found almost everywhere, even on small islands and nunataks (Rasmussen 1921: 531, Steensby 1910: 271).

At 'Igfigsôk', caribou were common and even on the very narrow strip of land between Kap York and 'Igfigsôk', caribou bones have been found. Also the land around the Thule Station itself (now named Dundas) was populated by caribou, as were the lands around Granville Fjord (Rasmussen 1921: 530–32, Winge 1902: 466).

The Inglefield Bredning area, especially the land around the inner parts of Olrik Fjord, was well known for its very large caribou population. The caribou in the

Olrik Fjord area undertook annual migrations between the coast and the inland areas. In spring they migrated towards the coast where they spent the summer foraging primarily on the extensive grass-covered Little Auk colonies. In fall the by now fat caribou returned to the inland plateaus where they stayed through the winter. The numerous hard-trodden paths created by migrating caribou were visible many years after the population decline in the late 19th/early 20th century (Freuchen 1911: 145, Freuchen & Salomonsen 1958: 79, Peary 1898: 72, Rasmussen 1905: 97, 1921: 534, Steensby 1910: 271, 291).

Caribou were rare in the region after the reduction around the turn of the century (Freuchen 1911, Rasmussen 1921: 534). They probably went extinct in the area around the Thule Station itself (now Dundas) c. 1916 (Freuchen, in Degerbøl 1957: 17) but they survived somewhat longer around Olrik Fjord. In 1937, 1938 and in 1939, 3, 3 and 5 caribou, respectively, were shot in Olrik Fjord and tracks of more were seen (Vibe 1948: 21–27). I think they may have held their ground on the nunataks (as is also suggested by Vibe (1948: 23)) where they formerly were known to have occurred (Freuchen 1911: 145, Steensby 1910: 271, Winge 1902: 466) but the possibility that these animals had immigrated from Inglefield Land or Baffin Island of course exists.

Since 1939 there are no reports of caribou around Olrik Fjord. The area is nowadays only rarely visited, and it is possible that caribou may have survived unrecognized there for a number of years.

According to Steensby (1910: 278), the caribou in the Thule area belonged to the subspecies *Rangifer tarandus groenlandicus* because of their size, colour, antler shape, and other anatomical features. Measuring five crania obtained from the Thule caribou population, Degerbøl (1957: 17–18) agrees that the animals are larger and of a more powerful build than animals of the subspecies *Rangifer tarandus pearyi*. On the other hand, Banfield (1961: 64) identified a skin from Olrik Fjord to be an intergrade between *Rangifer tarandus groenlandicus* × *R. t. pearyi*.

Present status. – In 1965, nine domestic reindeer from the Itivnera herd were released in Olrik Fjord. Their present status is unknown (Strandgaard et al. 1983: 7).

Region 14 – Inglefield Land (Fig. 35)

The archaeological record. – A Dorset Culture midden at Inuarfigssuaq dated to 700–950 AD produced worked antler fragments (Appendix 1b, no. 14-1). Together with hunting implements meant for caribou hunting, these antler fragments show that caribou were hunted by these Dorset people (Holtved 1944b: 61, 63, 241 & 260). It cannot be decided, however, whether the caribou were shot on Inglefield Land or on Ellesmere Island, but the following finds taken into consideration, the former possibility is the most likely. From the following periods within the Thule Culture sequence, marrow-cracked caribou bones and antler fragments have been excavated: 900–1000, 1100–1300, c. 1150, 1150–1200, 1200–1250, 1200–1300, and c. 1300 AD (Appendix 1b, nos 14-2 to 14-9). Thus, there is reason to believe that caribou have been present on Inglefield Land from c. 700 to c. 1300 AD.

From the excavations at Inuarfigssuaq, five complete metacarpal bones dated to 1150–1250 AD exist (Appendix 2b, nos 14-4, 14–6). They have all been made into two-handed scrapers which is the reason why they were saved by the archaeologist. Three of them fall within the size range of the present central West Greenland caribou while two of them are very small with dimensions corresponding to the small Peary caribou of Ellesmere Island (Fig. 52). If all five metacarpi come from caribou killed on Inglefield Land, then two types of caribou, a large and a small, corresponding in size to *R. t. groenlandicus* and *R. t. pearyi* have been contemporary in the area.

The historical record. – From 1853 to 1855, Kane anchored in Rensslaer Bugt and caribou were observed in quite large numbers both around the bay and southeast of the bay towards the Ice Cap. Caribou were also encountered further west along the coast (Kane 1856 vol. I: 235, vol. II: 80, 343–4). Hayes wintered in Foulke Fjord in 1860–61. Caribou were seen throughout the year, sometimes in flocks of almost a hundred. In winter, large stretches of land had been thoroughly cratered by feeding caribou and before departure the expedition had killed somewhat over 100 caribou in the Foulke Fjord area (Hayes 1867: 95, 107, 152, 269, 388). In 1872–73 and in 1875, caribou were once again hunted in the same area (Davis 1876: 453, 456, 478, 487; Nares 1878 vol. I: 53).

In July and August 1915, a few Polar Eskimos were hunting caribou close to the Inland Ice just east of Inuarfigssuaq, Marshall Bugt. They killed at least 100 animals (Rasmussen 1927: 30–31). This central part of Inglefield Land had been the Polar Eskimos' main caribou hunting grounds for a number of years when MacMillan visited them in 1913–17 (1925: 109, 117). Apparently, the caribou had disappeared from the western part of Inglefield Land in the late 19th century or the early 20th century, and much to the surprise of the Eskimos they reappeared in this area in the winter of 1914 (MacMillan 1925: 109, 215). These caribou were very small, the heaviest weighing 54 kg (winter weight) but according to MacMillan they were not Peary caribou but a variety of the West Greenland caribou (MacMillan 1925: 216; see also Roby et al. 1984).

In recent years Polar Eskimos have succesfully hunted caribou in Inglefield Land. A few have been shot in the western regions (Roby et al. 1984) but most are killed in the interior central and eastern regions (Rune Dietz, pers. comm.). The caribou population ap-

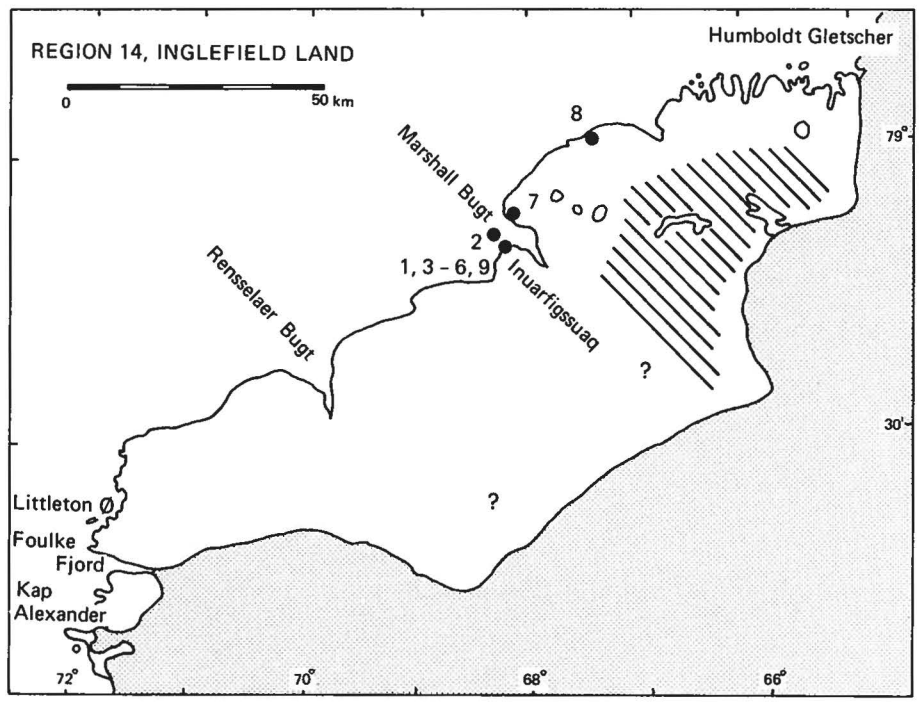


Fig. 35. Map of region 14, Inglefield Land. Hatching stands for approximate present distribution of caribou. Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).

pears to be fairly widespread, but there is no reliable information concerning population size.

Region 15 – Washington Land (Fig. 36)

The archaeological record. – Knud Rasmussen (in 1916–18) and Lauge Koch (in 1922) both visited an archaeological site in Cass Fjord at Kap Webster (Appendix 1b, no. 15-1) which was dated to the Thule Culture (1200–1700 AD). Koch gave Mathiassen the following description of the site: "... there were many animals' bones; seal and bear were in the majority but muskox and caribou were also represented" (Mathiassen 1928: 189). These caribou could have been hunted on Grinell Land, but it is more likely that they were hunted on Washington Land itself. This opinion is also expressed by Koch: "Reindeer antlers and horns of muskoxen were common along the shore, evidently the Eskimos that had once lived in this place had had successful hunt inland" (Koch 1926: 141–42).

Present status. – Caribou do not exist on Washington Land today.

Region 16 – North Greenland (Fig. 37)

The geological record. – Seven caribou antlers from Peary Land and the Independence Fjord area have recently been C-14 dated (Appendix 1a). The oldest antler fragment was dated to 6030 BC, a dating that pushes the history of the Greenland caribou and of Greenland land-mammals in general c. 4000 years back in time (Fig. 44). The six remaining dates are: 5160 BC, 4390 BC, 2045–2130 BC, 135 BC, 135–210 AD, 1265–1280 AD (Appendix 1a) (Fig. 38).

In 1912, members of the 1st Thule expedition found numerous antlers on Kap Schmelck, in Adam Biering Land and in Vildtland. The antlers were all more or less

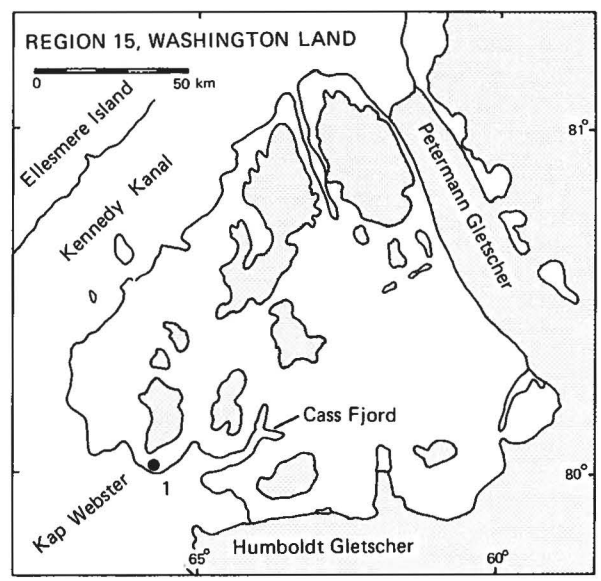


Fig. 36. Map of region 15, Washington Land. Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).

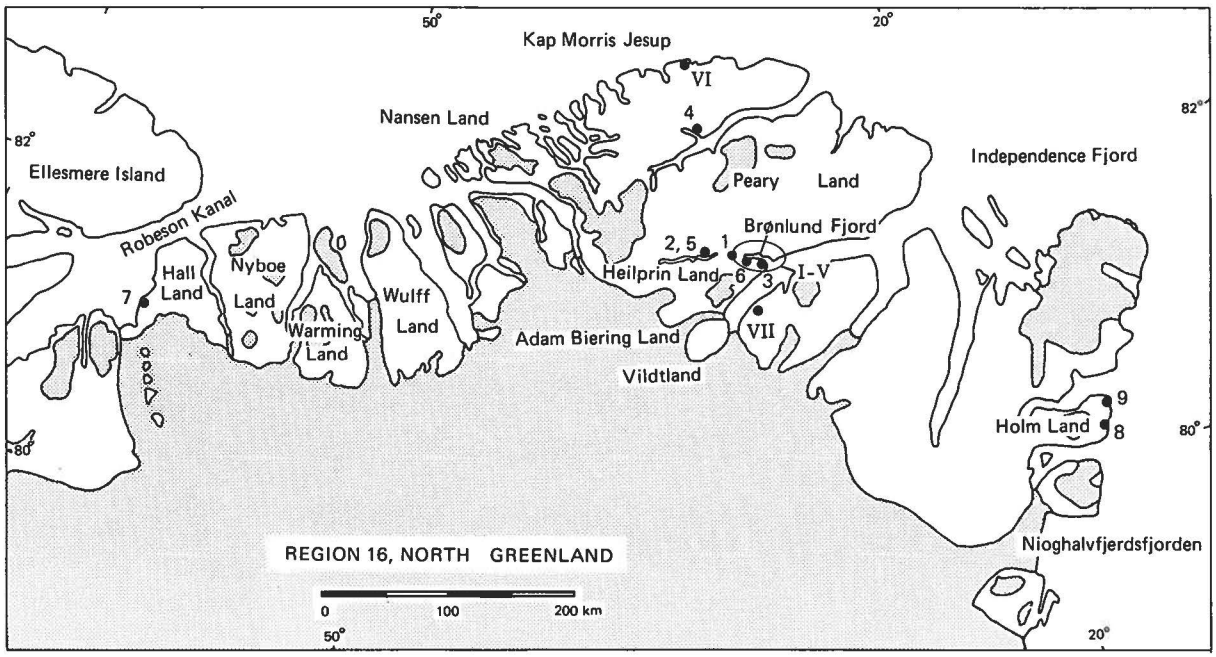


Fig. 37. Map of region 16, North Greenland. Dots numbered with Arabic numerals stands for archaeological localities with caribou remains (listed in Appendix 1b). Dots numbered with Roman numerals stands for C-14 dated caribou antlers found in non-cultural context (Appendix 1a).

disintegrated and overgrown with algae. No tracks, excrements or live animals were seen (Freuchen 1915: 406). In contrast to the numerous antlers found by Freuchen and others, the members of the Danish Peary Land Expedition 1947–50 found only three poorly preserved fragments of antler despite the fact that quite large stretches of land were surveyed (Johnsen 1953: 128–9) (Appendix 1a, no. 16-VII, Appendix 2a, no. CN 2790, 2792). From this information Johnsen concluded that caribou, when they existed here, were more common close to the ice cap in Adam Biering Land than in Peary Land itself (Johnsen 1953: 128–9). Antlers found in Peary Land have been found to differ by more than 6000 years in age. In this light, conclusions regarding distribution based on picked-up antlers should be drawn with care. Differential preservation for one thing might account for difference in frequency in the two areas.

As early as in 1872, a caribou antler was found on Hall Land, the westernmost part of the region (Davis 1876: 378).

A century later in 1984 during geological (Grønlands Geologiske Undersøgelse) and biological (Grønlands Fiskeri- og Miljøundersøgelser) survey in western North Greenland more antlers and longbones were found. A subadult metatarsus found on Hall Land and an adult metacarpus found on Nyboe Land both fall outside the size range of West Greenland *Rangifer tarandus groenlandicus* while they compare well with the smaller Peary caribou and the Northeast Greenland caribou (Appendix 2a, c) (Fig. 46, 47 & 52). These bones have not yet been dated.

Banfield (1961: 35) cites Feilden (1877) in Hay (1923) for one piece of evidence that suggests that caribou occurred in Northern Greenland during the Wisconsin Glaciation. Unfortunately, Feilden does not speak of caribou remains from Greenland, but he does give some information on caribou remains from Ellesmere Island. Commenting on some marine deposits at Shift-rudder Bay, Ellesmere Island (80°50′N), Feilden writes: "From this locality commander Parr, R. N., procured an antler of the reindeer *(Cervus tarandus)* which, I do not doubt, came out of these shell-bearing beds" (1877: 487). Likewise he "... procured fossil remains of *Cervus tarandus, Ovibos moscatus* and *Phoca barbata...*" from Kane Valley in northeastern Ellesmere Island (82°33′N) (Feilden 1877: 488, Jeffreys 1877: 231).

Hay (1923: 244) cites these observations: "At another station in latitude 82°25′ [should be 82°33′] there were obtained remains of *Rangifer tarandus, Ovibos moscatus, and Phoca barbata...* In case the beds are of Pleistocene age, they are probably those of a late stage."

It should be remembered, however, that Feilden found many shed antlers and a skeleton of a caribou (Feilden 1878: 198) on Ellesmere Island and that the caribou remains claimed to come from the deposits were not found in situ!

It would seem reasonable to assume that these caribou remains are quite similar to the C-14 dated,

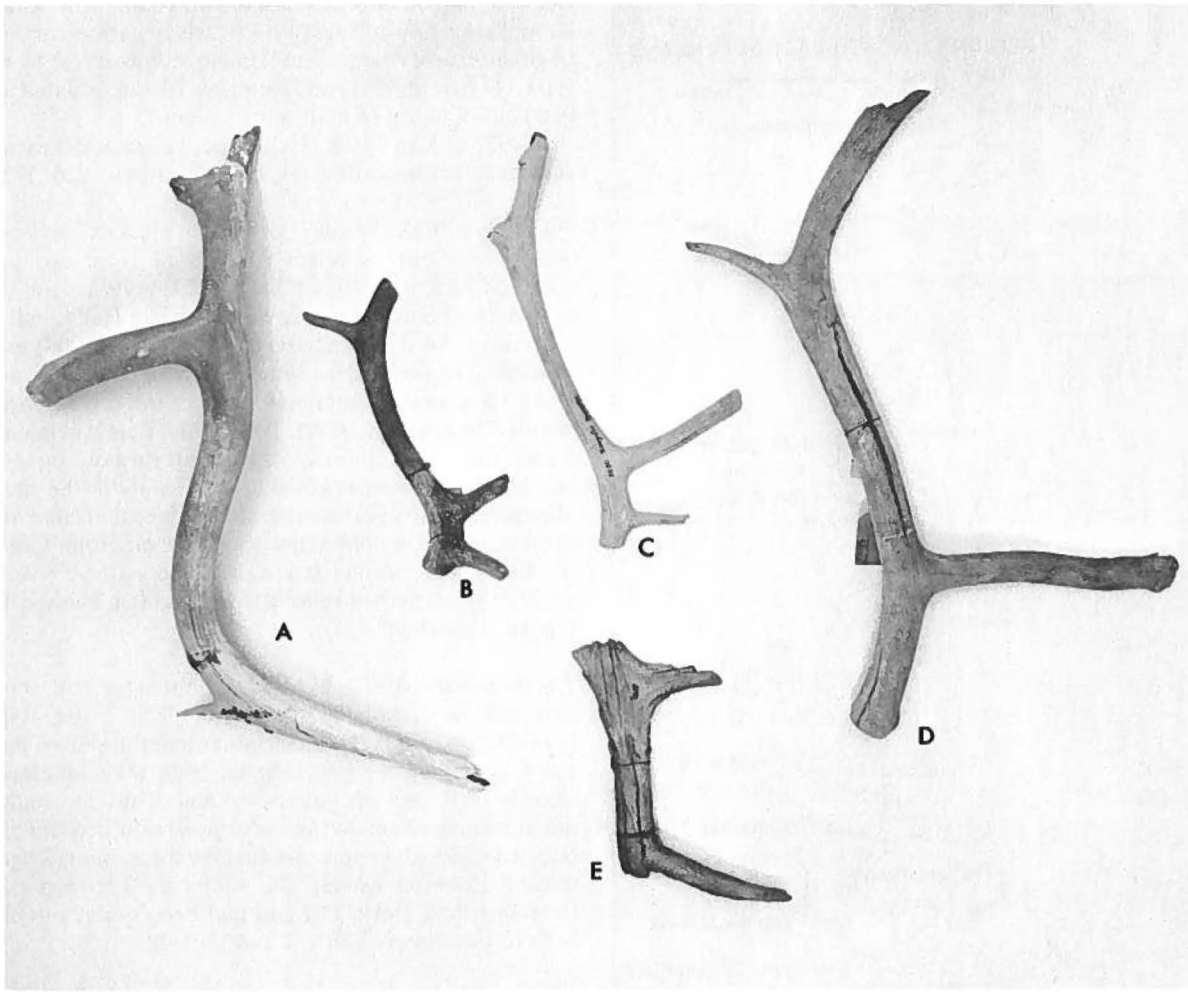


Fig. 38. Caribou antlers picked up in the Peary Land area: A. 16-IV, B. 16-VII, C. 16-II (all in Appendix 1a), D. CN 2790, E. CN 2792 (both Appendix 2a).

Post Glacial caribou antlers from neighbouring Peary Land, and consequently a Wisconsin age for the Ellesmere Island antler and other caribou remains is questionable (see also Harrington 1971: 83).

The archaeological record. – Four Independence-I sites dated to between 2300 and 2100 BC have produced caribou remains (Appendix 1b nos 16-1 to 16-4). In three of them only antler fragments were found, in the fourth, 'Pearylandville' (no. 16-2), the faunal material included the proximal fragment of a caribou metacarpal bone. Eigil Knuth (1967: 30) believes that the antler fragments may have been imported by the Independence-I people, maybe for tool making. In the light of the recent discovery of the high age of antlers from Peary Land it could also be hypothesized that the small antler waste pieces come from antlers picked up by the Independence-I people. One of the fragments though, the metacarpal fragment from 'Pearylandville', is not a typical tool-piece. It is marrow-cracked and has not represented any value as raw material or food item. It would therefore be reasonable to assume that the caribou from which this particular bone originated has been killed in the vicinity of 'Pearylandville' by Independence-I hunters. But further evidence is needed before any conclusions can be drawn regarding the existence of caribou in Peary Land in the Independence-I period.

A single piece of caribou antler has been found in Independence-II context, dated to c. 1550 BC (Appendix 1b, no. 16-6). The problems of the origin of this piece are the same as those concerning the Independence-I antler pieces: they may have been imported as raw material, they may stem from animals killed in the area, or they may come from far older, picked-up antlers. More material is needed before it can be decided which solution is the right one.

Palle Johnsen (1953: 129) mentions two archaeolog-

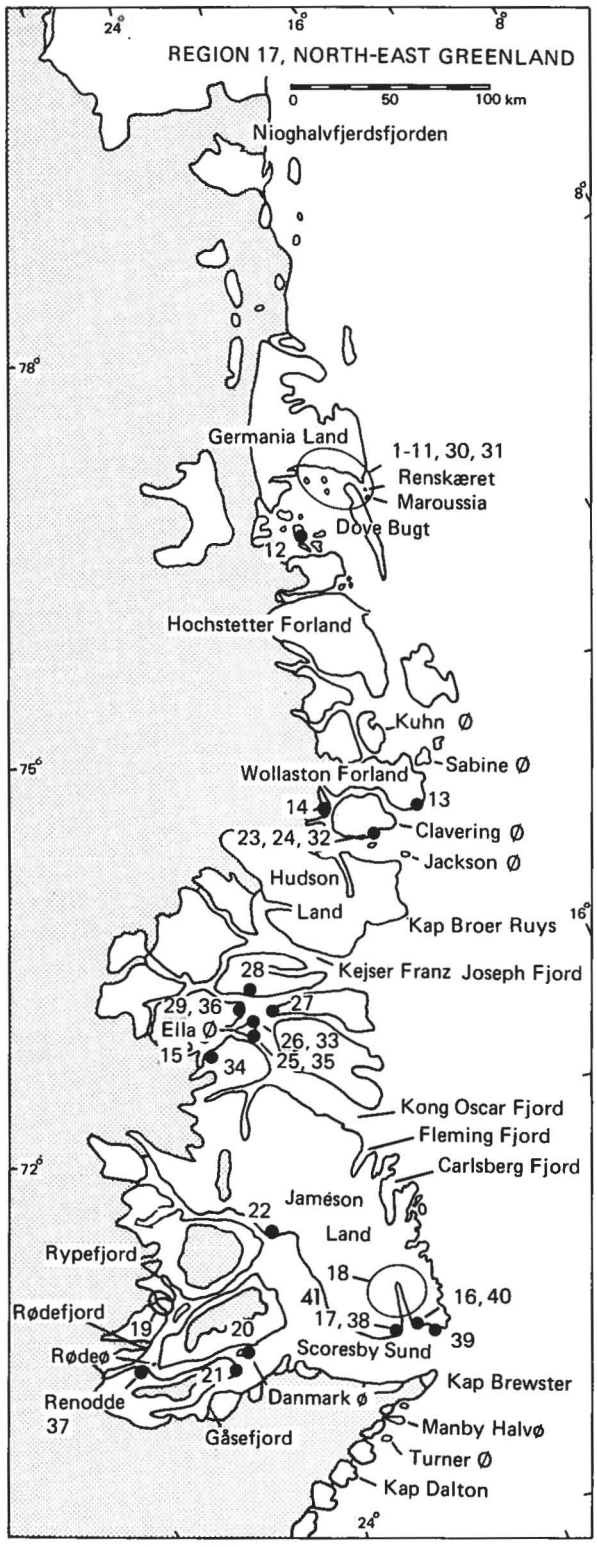


Fig. 39. Map of region 17, Northeast Greenland. Dots stands for archaeological localities with caribou remains (listed in Appendix 1b).

ical sites, one on the east coast of Peary Land (the 'Umiaq site') and one at Neergård Elv, where caribou antler fragments were found. The 'Umiaq site' is dated to c. 1500 AD (Knuth 1967) and Neergård Elv site is dated to the Thule Culture (Knuth, pers. comm.).

In 1922 at Kap Tyson, Hall Land, Lauge Koch excavated a late Dorset site (700–950 AD) (Koch 1926: 177, Mathiassen 1928) (Appendix 1b, no. 16-7). He found a few caribou bones besides bones from muskox, fox and hare. These caribou bones could come from caribou killed on Ellesmere Island, but there is good reason to believe (see below) that they were killed on Hall Land.

Members of the Danmark Expedition (1906–08) examined and excavated a number of Eskimo dwellings on Holm Land in the easternmost part of the region (Appendix 1b, nos 16-8, 16-9). Among the faunal remains found were several marrow-cracked caribou bones, probably from animals killed in the vicinity of the site. Manniche (1910: 91) also mentions the occurrence of caribou antlers in old Eskimo dwellings on Holm Land (probably these dwellings are the same as those excavated. The excavated ruins are dated to the Thule culture (c. 1200–1800 AD)).

The historical record. – In May 1922, three caribou were seen and one shot on the plain north of Kap Tyson, Hall Land (Koch 1926: 171). Koch writes that the skin of the killed animal in no way differed from the numerous skins he had seen on Inglefield Land. Thus, he could not refer it to *Rangifer tarandus pearyi* on account of hue, even though he was sure that the three animals had crossed Robeson Kanal. The winter ice between Ellesmere Island and Hall Land had been quite smooth both of the winters 1920–21 and 1921–22.

Present status. – There are no caribou in North Greenland today. But Hall Land is within easy range of straying Peary caribou from Ellesmere Island. It would not be surprising if a few stragglers were encountered in this northwestern corner of Greenland.

Region 17 – Northeast Greenland (Fig. 39)

The geological record. – Large numbers of antlers and caribou bones have been picked up in Northeast Greenland over the years. In a monograph on the extinct reindeer of East Greenland, Degerbøl (1957) presents the osteological material. Following an analysis of the bones and antlers, Degerbøl concludes that (a) the Northeast Greenland caribou were fairly small, of about the same size as *Rangifer tarandus pearyi,* and much smaller than the West Greenland caribou *Rangifer tarandus groenlandicus* (Fig. 46–49); (b) the Northeast Greenland caribou had a fairly short facial part and protruding orbits, features shared with other high arctic caribou populations *(R. t. pearyi* and *R. t. platyrhynchus);* (c) the majority of antlers are of the 'tarandus type' (Jacobi); (d) the pelage is dirty white or greyish,

the coat and skin is rather hard and coarse (based on two skins collected in the 1890'es).

Based on this diagnosis Degerbøl gives the Northeast Greenland caribou subspecific rank: *Rangifer tarandus eogroenlandicus*.

The archaeological record. – A large number of sites containing caribou bones were excavated in Dove Bugt and on Germania Land by members of the Danmark Expedition (Appendix 1b, nos 17-1 to 17-11; 17-29 to 17-31). They have all been dated to somewhere between 1200 and 1850 AD (the last living Eskimos in Northeast Greenland were seen on Clavering Ø in 1823).

Excavations on Clavering Ø in 1931–34 (Appendix 1b, nos 17-23, 17-24, 17-32) demonstrated the occurrence of caribou in the Wollaston Forland/Clavering Ø/ Hudson Land area in the periods 1350 to 1500 AD, 1600 to 1700 AD, and 1700 to 1800 AD.

In the Kong Oscar Fjord area, archaeological excavations (1931–34) produced substantial amounts of caribou remains from a number of sites (Appendix 1b, nos 17-25 to 17-29, 17-33 to 17-36). The ruins were dated to the periods 1600 to 1700 AD and 1700 to 1800 AD.

Finally in the Scoresby Sund area, a number of sites containing caribou bones and antlers were excavated in 1891 and 1892 (Appendix 1b, nos 17-20 to 17-22). On account of the state of preservation, they were dated to 1700–1800 AD.

A century later in 1984 excavations of a late Thule Culture winter house (1750–1850 AD) on the south coast of Jameson Land also produced caribou bones (B. Sandell, pers. comm.). (Appendix 1b, no. 17-41).

Altogether the archaeological data document the existence of caribou in Northeast Greenland throughout the period from c. 1350 to c. 1800 AD.

The historical record. – The first record of caribou in Northeast Greenland was made by the whaler William Scoresby (1823) who landed briefly on Traill Ø, Jameson Land and Kap Brewster in 1822. He saw no live caribou but found antlers and bones.

Clavering and Sabine visited Clavering Ø and Sabine Ø and Kap Broer Ruys very briefly in August and September 1823, but they saw neither caribou nor their remains.

In 1869 and 1870, members of Die Zweite Deutsche Nordpolarfahrt observed live caribou on the coast. They found them on a number of small islands along the coast between 74° and 75°N (Jackson Ø, Clavering Ø, Sabine Ø and Kuhn Ø), and on Hochstetter Forland and Hudson Land. In general, the expedition observed that caribou were more common in the southern part of their range and that they tended to concentrate in the more interior parts of the lands (Koldewey 1873, Koldewey et al. 1873, Pansch 1873, Payer & Copeland 1873: 524–25, Peters 1874: 167).

In 1889, caribou were seen again on Hudson Land (Knudsen in Winge 1902: 467).

From 1891 to 1892, C. Ryder mapped the Scoresby Sund complex. During the extensive survey work caribou were observed on many occasions both in the interior parts, e.g., Renodde, Rødeø, Danmark Ø, Rypefjord and Gåsefjord (Bay 1894: 19, Ryder 1895) and at the head of Scoresby Sund on Jameson Land (op. cit.). Ryder was surprised of the caribou's tameness (1895: 38–39, 49, 51), as was also Peters (1874). During a sledge journey in April 1892 from Danmark Ø through Fønfjord, Rødefjord and Rypefjord, Ryder states: "The caribou have left the tracts where we had seen so many during the summer and they had gone to the more snowfree hills close to the glaciers and the Inland Ice." (1895: 96). Ryder did not actually see the caribou on their wintering grounds, but his statement about their disappearance from the summering grounds is interesting in itself. Bay also comments on the possible migration pattern. He suggests that the caribou summering in the northwestern part of the fjord may in winter migrate to the less snowcovered Jameson Land (Bay 1894: 19–20).

Caribou were also observed on a peninsula south of Kap Brewster, probably Manby Halvø (Bay 1894: 20).

In the summer of 1899, A. G. Nathorst surveyed and mapped the Kejser Franz Joseph Fjord complex and he also visited Kong Oscar Fjord and Hurry Inlet. In Kejser Franz Joseph Fjord and Kong Oscar Fjord the expedition primarily observed caribou in the innermost parts and it was emphasized how shy they were (Nathorst 1900: 252–54, 326). During a week's stay in Hurry Inlet only two animals were seen, very few compared to the numbers seen by Ryder seven years earlier, and Nathorst commented that the caribou population everywhere was much smaller than he had expected. He explained this decline as a result of the immigration of wolves to Northeast Greenland (1900: 253, 329).

Gustav Kolthoff visited Northeast Greenland in the summer of 1900. During a two days' visit on Hudson Land no caribou were seen, neither were any seen during a survey of the Moskusoksefjord (Kolthoff 1901: 138, 187). The same summer, part of the Amdrup Expedition surveyed the southern coast of Jameson Land (including a 2-week stay in Hurry Inlet), Carlsberg Fjord, Fleming Fjord and Gåsefjord (Hartz 1902). Especially large parts of Jameson Land were thoroughly investigated, but nowhere did the expedition encounter live caribou, only antlers and hair and fresh carcasses were found (Jensen 1909: 25, 28). Fresh signs of caribou were found as far south as on Turner Ø and Kap Dalton (Jensen 1909: 25, 28).

From 1906 to 1908, much of the coast between Wollaston Forland and Independence Fjord was mapped by the Danmark Expedition. They found shed antlers and excrements on the mainland as well as on many even very small islands (e.g., Maroussia and Renskæret) (Manniche 1910: 91). No caribou were observed alive.

Professional Norwegian and Danish hunters were living on the coast north of Scoresby Sund from c. 1920,

and the first thorough surveys of Scoresby Sund since Ryder's in 1890–91 was done by Alwin Petersen in 1924–25 (1926: 204–06) and Rosenkrantz in 1926–27 (in Jensen 1928: 36), but neither hunters nor scientists saw any sign of live caribou.

The above presented observations of Northeast Greenland caribou which were made in the 19th and early 20th century are of a very uneven quality. Some expeditions spent just a few hours on land while others did thorough survey work for several years in a row. Only rarely do we have proper surveys done in the same geographical region more than once in the critical period when the caribou population declined and went extinct, and this of course makes it difficult to compare observations and monitor changes, e.g., in population size and distributional pattern.

Despite these problems, far-reaching conclusions concerning population fluctuations and zoogeography have been drawn (Jennov 1953a, b). Even if this type of conclusions are not always well founded, a number of important points concerning the zoogeography of the Northeast Greenland caribou can never the less be made. (1) Some time before 1906, probably in the 19th century, the caribou between Germania Land and Hochstetter Foreland went extinct. (2) The caribou on Hudson Land seems to have disappeared some time between 1889 and 1891 or 1899. (3) The caribou in the Kong Oscar Fjord and Kejser Franz Joseph Fjord areas probably went extinct some time between 1899 and 1920. (4) The caribou population in the Scoresby Sund area went extinct some time between 1899 and 1924, probably just around 1900. (5) Observations around Hurry Inlet and on Jameson Land in 1891–92, 1899 and 1900 gives the impression that the caribou population on Jameson Land declines drastically in 10 years finally followed by extinction c. 1900.

Region 18 – Kangerdlugssuaq (Fig. 40)

The archaeological record. – There is evidence of Eskimo habitation in the area between c. 1350 and c. 1800 AD (Mathiassen 1934b, Degerbøl 1936c), but there is nothing to indicate that caribou were ever hunted in the area – not even worked pieces of antler.

The historical record. – Alwin Petersen gives the only known reference to caribou in the Kangerdlugssuaq region: "Am Kangerdlugssuaq soll das Rentier früher vorgekommen sein" (1930: 424). He does not cite his source but probably this piece of information was given to him by an East Greenland Inuit.

Region 19 – Ammassalik (Fig. 41)

The geological record. – According to Degerbøl (1957: 8), four fragments of antler, an antlered braincase, a metatarsus, and a distal tibia from the region was kept at the Zoological Museum (Appendix 1a, nos 19-II, -IV, -VI, -VII; Appendix 2a) Degerbøl made a detailed osteological analysis of this caribou bone material and he concluded: "These very small limb bones together with the afore-mentioned small braincase and several small antlers point to the fact that at one time there existed a small population of very small or dwarfish reindeer in the Ammassalik area" (1957: 39).

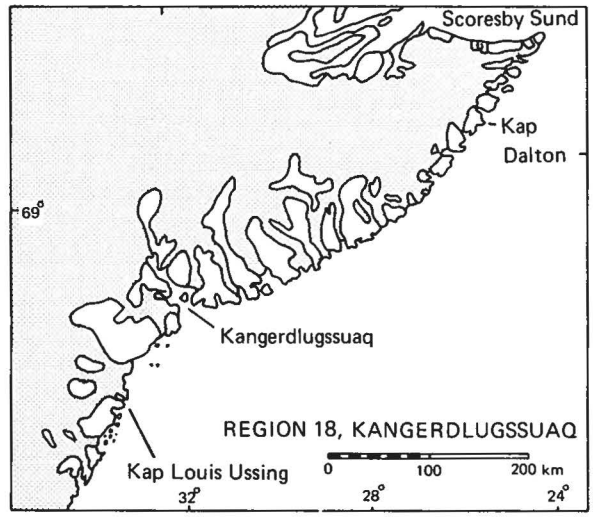


Fig. 40. Map of region 18, Kangerdlugssuaq.

In addition to the material described by Degerbøl, the Zoological Museum of Copenhagen today houses eight antler fragments and three cervical vertebrae (Appendix 2a). The vertebrae are extremely small, supporting Degerbøl's conclusion.

A series of C-14 datings have been made on Ammassalik caribou remains in the course of the present study. The oldest C-14 dating is 355–385 AD and it was made on a shed antler from Vahl Fjord (Appendix 1a, no. 19-I). The rest of the dated antlers come from the Angmagssalik Fjord / Sermilik Fjord area and they gave the following results: 720–770 AD, 900–975 AD, 1005–1020 AD, 1025 AD, 1035–1150 AD, 1165–1190 AD (Appendix 1a, nos 19-II to 19-VII) (Fig. 42). These datings add an important dimension to Degerbøl's analysis. It is now possible to conclude that caribou were living in the area at least in the 4th century AD and from c. 700 to c. 1200 and that at least the 11th century population consisted of very small animals (Fig. 47 & 49).

The archaeological record. – In two house ruins at the archaeological site 'Sukersit' (1350–1500 AD), Therkel Mathiassen found seven pieces of antler (Appendix 1b, no. 19-1). Four of these had been made into tools and may have been imported, three were typical "... waste pieces, pieces of tines that have been cut away and scrapped as useless, and it can scarcely be imagined that they were imported" (Mathiassen 1933: 49). In addition he found arrowheads that may have been used for

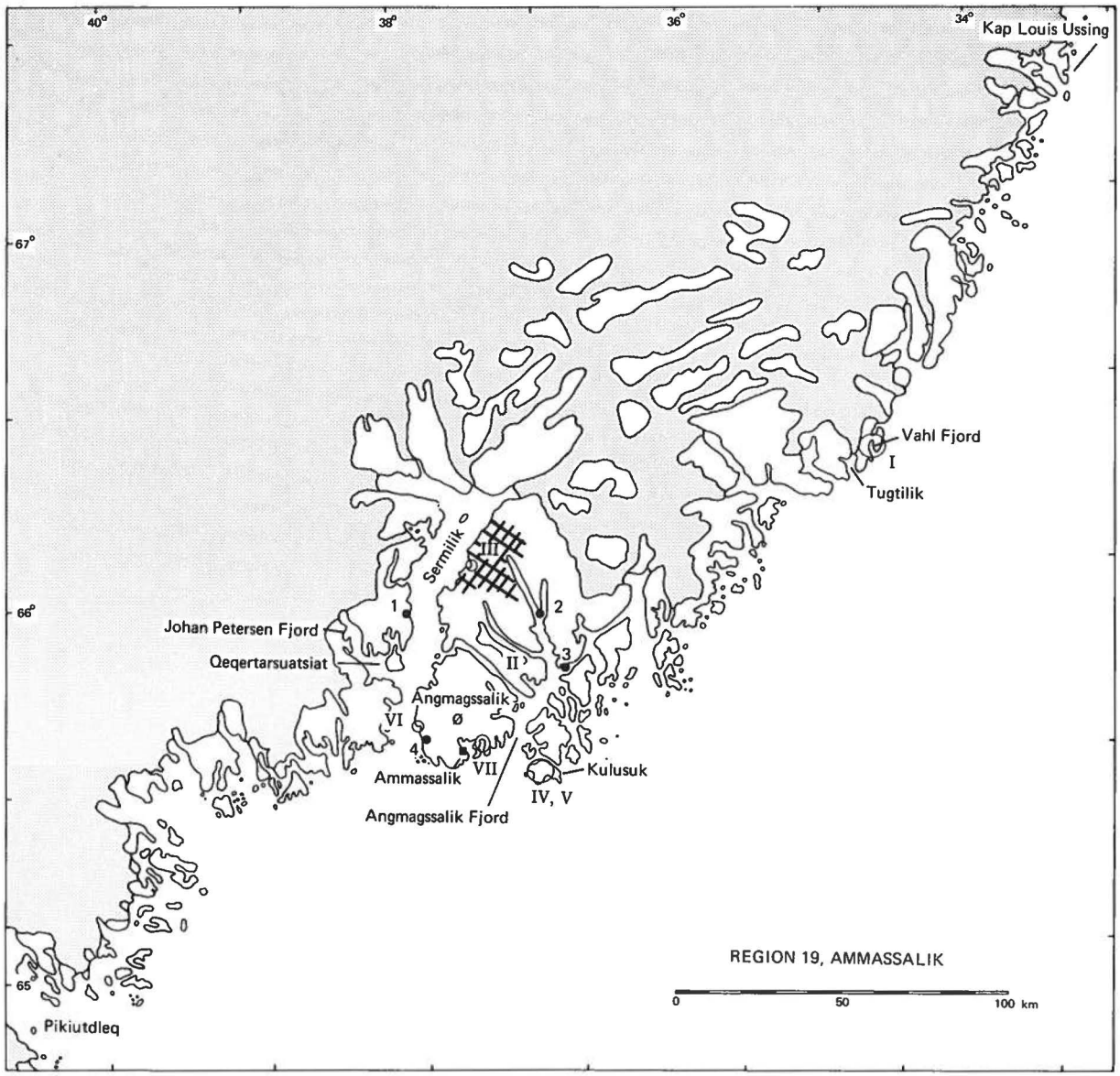


Fig. 41. Map of region 19, Ammassalik. Cross-hatching stands for approximate present distribution of feral reindeer. Dots numbered with Arabic numerals stands for archaeological localities with caribou remains (listed in Appendix 1b). Dots numbered with Roman numerals stands for C-14 dated caribou antlers found in non-cultural context (Appendix 1a).

caribou hunting in ruins at 'Misigtoq', Kangârtik and 'Savanganeq' (all 17th century) (Appendix 1b, nos 19-2, 19-3, 19-4).

The caribou remains might, as Therkel Mathiassen suggests it, stem from caribou that were killed by 14th or 15th century Eskimos. But in the light of the new C-14 datings, the antler waste pieces could just as well come from an, e.g., 10th century antler which had been picked up by 14th or 15th century Eskimos.

Caribou hunting structures have been found on two localities in the Ammassalik area. From Kulusuk a large stonebuilt wall and associated shooting coverts have been described (Thalbitzer 1912: 405–06). Thalbitzer gives a very detailed description of this particular hunting system and of its use, as it was related to him by the East Greenlanders (Thalbitzer 1912: 405–06). According to Thalbitzer, this structure was used in fairly recent times, maybe just a few generations ago (Thalbitzer 1912: 405–06), but investigations in 1984 (Jørn Berglund Nielsen, pers. comm.) suggest that it is much older – maybe of Palaeoeskimo origin.

The situation of a caribou hunting system on one of the outer islands may seem strange, but according to Holm the rather extensive plains that occurred here in

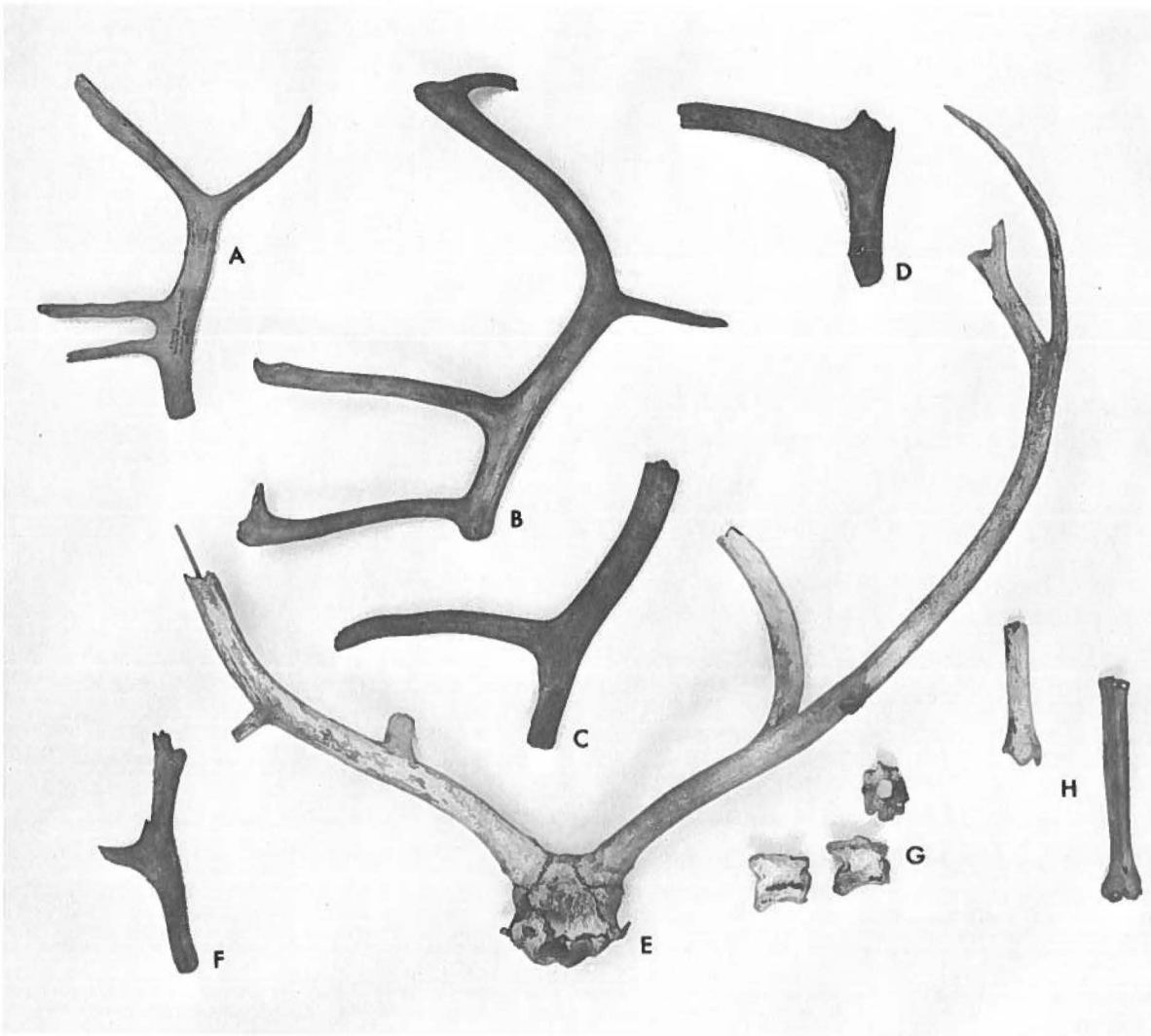


Fig. 42. Caribou remains picked up in the Ammassalik region: A. 19-II, B. 19-VII, C. 19-V, D. 19-VI, E. 19-IV (all Appendix 1a), F, G, H (all Appendix 2a).

the 'old days' were favoured by the caribou (1887: 84). Several pieces of caribou antler and limb bones including the antlered braincase (960 AD), the dwarfish metatarsus and the very small cervical vertebra have been found in the vicinity of the hunting structures.

Knud Rasmussen describes shooting coverts from the western shores of the Sermilik Fjord close to Qeqertarsuatsiat (in Ostermann 1938: 21). A sure sign that caribou once were common in these tracts, too.

The historical record. – In 1884, when Holm and his crew discovered the small Ammassalik tribe, they were told that formerly both muskox, caribou and hare had been hunted in the area but they had since gone extinct (Holm 1887: 84, 1911). They were also told that at one time a caribou in white pelage had been found drifting in the Sermilik Fjord, and an old man, Ilinguaki, related how he 50 years earlier (c. 1840) had pursued a live caribou in the area (Holm 1887: 84, 1911., Hansen 1885). These two observations of caribou are probably synonymous with those obtained by K. Poulsen (in Winge 1902: 466), by Knud Rasmussen (in Ostermann 1938: 21) and by Christian Vibe in 1967 (pers. comm.). Vibe was told that besides the caribou found drifting in a fjord some time before 1900, another one was encountered drifting in Johan Petersen Fjord. This caribou is probably synonomous with the one Abel Christiansen found drifting in the Sermilik Fjord in the summer of 1942 (Jens Rosing, pers. comm.). The pelage was still intact, the head was battered and the hindquarters were partly eaten, but the carcass must have been relatively

fresh, as the skin was used by Abel Christiansen as bedskin.

Approximately 150 kilometres north of Ammassalik there is a small fjord called Tugtilik meaning 'the place with caribou' (Holm 1911: 111).Holm's informants told him that caribou had been plentiful in this area in the old days and that fresh excrements from caribou had been found there. It is of interest that Vahl Fjord where the shed antler dated to 355–385 AD was found is situated immediately north of Tugtulik. Another placename in the Ammassalik region: 'Natusit' or 'the caribou antler place' also reveal the former occurrence of caribou (Vibe, pers. comm.).

Hanserak (Hansen 1885) related that the East Greenlanders often found shed antlers in the Ammassalik region and he described how one of the hunters they met on the east coast was carving a powder horn from a caribou femur which he had procured from a carrion found in the Ammassalik region. This powder horn may be identical to the one G. Holm brought back to the National Museum, Copenhagen (1888: fig. 26). Two other implements (both scrapers) made from caribou long bones were also collected by Holm.

I believe that the geological, archaeological and historical observations regarding caribou distribution in the Ammassalik area can be grouped in two: (1) The C-14 dated caribou remains, the hunting structures, and the excavated antler fragments. These sources reveal that caribou were living in the area at least between c. 200 and c. 1200 AD, and I believe that these were the animals hunted by Palaeoeskimos and/or Thule people using drive hunting systems and shooting coverts. This caribou population probably went extinct some time between 1200 and 1500 AD. (2) In the second category belong the probably 19th century descriptions of the encounter with a live caribou and of a dead caribou found drifting in the Sermilik. The description of the live animal may be a product of strong imaginative powers, but the dead drifting caribou is probably real.

These animals must be stragglers that have reached Ammassalik from Northeast Greenland on drifting icefloes – an amazing journey of c. 1000 kilometres. The drifting caribou found in 1942 must have taken an even longer journey as the Northeast Greenland caribou went extinct c. 1900. Probably it was trapped on drift ice and transported to the Southeast Greenland coast. Maybe it originated in Svalbard or some part of arctic Eurasia (like the driftwood so well known from the Greenland shores). This theory is confirmed by muskoxen that from time to time make a similar journey (Hansen 1885, Vibe 1981). For example, a dead muskox was found on the beach in Ikerssuaq in August 1949 (Vibe, pers. comm.).

Domestic reindeer. – In 1971, 22 domestic reindeer from the Itivnera herd were released in 'Ikasanlup itivnera'. In 1980, this feral herd was estimated to number 80 animals (Reimers 1980, Strandgaard et al. 1983).

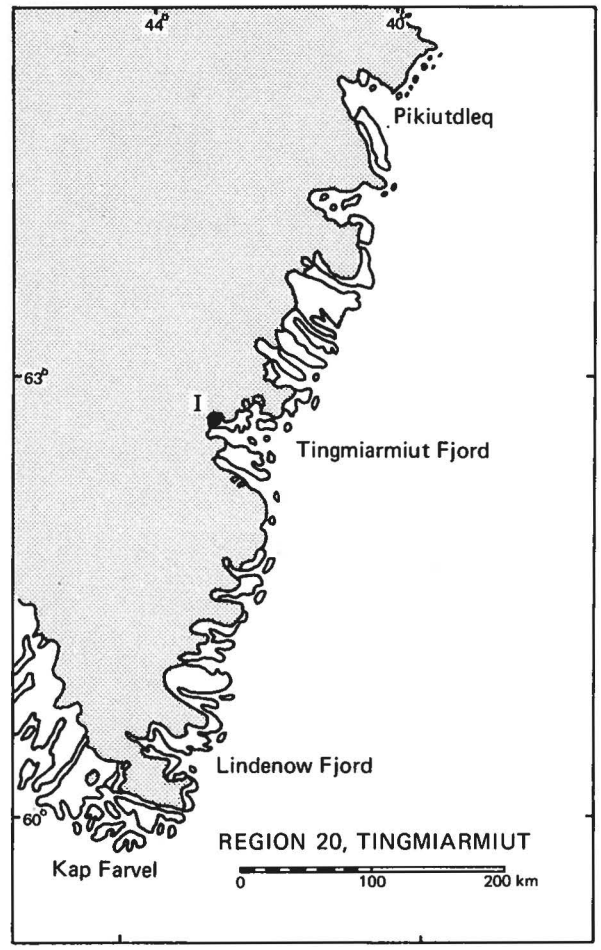


Fig. 43. Map of region 20, Tingmiarmiut. Dot stands for C-14 dated antler (Appendix 1a).

Region 20 – Tingmiarmiut (Fig. 43)

The geological record. – The only evidence of caribou found in this region is part of a small antler picked up in the Tingmiarmiut Fjord and dated to 695–770 AD (Appendix 1a). The find is quite isolated, the closest known caribou ranges being 300 kilometres south and 400 kilometres north of the area.

Analytical part

Zoogeography and taxonomy

North Greenland (regions 15 and 16)

Zoogeography. – A caribou antler fragment found near the southern shore of Brønlund Fjord in Peary Land has recently been C-14 dated to 6030 BC (7980 BP) (Fig. 44) (Appendix 1a). This is the hitherto oldest dating of

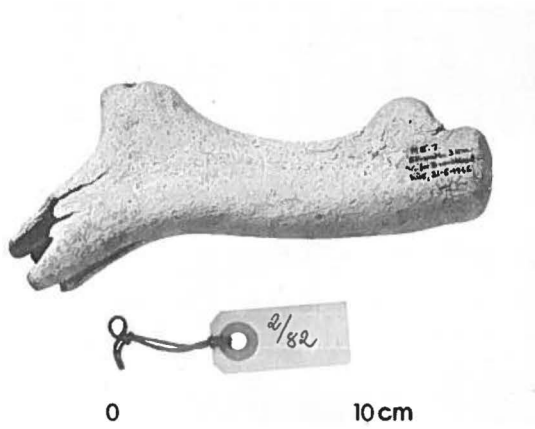


Fig. 44. C. 8000 years old antler fragment found near Brønlund Fjord (Appendix 1a, no. 1). The oldest dated caribou remain from Greenland.

any land mammal in Greenland. Six other shed caribou antlers from Peary Land and the Independence Fjord area have been C-14 dated to: 5160 BC (6240 BP), 4390 BC (5470 BP), 2045–2130 BC (3710 BP), 135 BC (2080 BP), 135–210 AD (1830 BP), and 1265–1280 AD (740 BP) (Appendix 1a). Antlers and other caribou remains have also been picked up in Hall Land, Nyboe Land, Warming Land, and Nansen Land (Appendix 2a). But none of these have been C-14 dated.

Apart from naturally deposited caribou remains, caribou bones and antler fragments have been found in cultural contexts documenting caribou hunting in the area. From Peary Land there is one piece of evidence suggesting that caribou hunting took place c. 2300 BC (Appendix 1b, no. 16-2), and on Washington Land and Hall Land caribou were hunted some time between 700 and 950 AD and some time between 1200 and 1700 AD. Finally on Holm Land in eastern North Greenland, caribou hunting took place some time between 1200 and 1800 AD.

The C-14 datings and the archaeological datings show that caribou have been present in North Greenland at least periodically through a period of c. 8000 years. Freuchen's (1915: 406) observations of numerous shed antlers in Adam Biering Land, Vildtland, and on Kap Schmelck, and the recent discovery of caribou remains between Peary Land and Hall Land indicate that the North Greenland caribou were not just rare and casual stragglers from Northeast Greenland or Ellesmere Island. Rather, these caribou remains give an impression of a once relatively numerous and geographically widespread population. The even temporal spread of C-14 datings and archaeological datings may indicate that the presence of caribou in North Greenland was a re-occurring and normal situation.

However, as Eigil Knuth (1984: 143–44) points out, there is a significant lack of caribou bones among the thousands of especially muskox bones from Independence I (c. 2500–2000 BC) and Independence II (1500–500 BC) house ruins in Peary Land. Probably caribou have been absent or at least very rare in these periods, but it cannot be ruled out that the Independence I or II people for some reason or other were reluctant to hunt the caribou and that the lack of caribou material is culturally conditioned.

The last live caribou to be observed in North Greenland were seen on Hall Land in 1922. Probably they were *R. t. pearyi* stragglers from Ellesmere Island.

Survey work in 1983–84 in western North Greenland has documented the presence of muskox on Nyboe Land, and wolves have been observed on several occasions in this general area (Ole Bennike, pers. comm.; P. Aastrup, pers. comm.; Dawes et al. 1985). Vibe (pers. comm.) is of the opinion that these areas are receiving an increased amount of precipitation and that living conditions have and will become more favourable for terrestrial land mammals.

Perhaps it won't be long before North Greenland is repopulated by Peary caribou from Ellesmere Island.

Taxonomy. – A subadult caribou metatarsus found on Hall Land and an adult metacarpus found on Nyboe Land have sizes that correspond well with the size of metatarsi and metacarpi from *Rangifer tarandus pearyi* and *R. t. eogroenlandicus* but they fall completely outside the range of *R. t. groenlandicus* (Fig. 46 & 47) (Appendix 2a, 2c). These as yet undated metapodials document the presence of small caribou in central and western North Greenland probably some time between 6000 BC and the present. In 1922, three caribou were observed and one shot on Hall Land (Koch 1926: 171). They were probably *R. t. pearyi* immigrants from Ellesmere Island. There is no evidence of large caribou from North Greenland.

The Peary Land refugium – an unsolved problem. – Since Koch (1928: 329, 448) suggested that northern North Greenland had remained unglaciated during the last ice age, much has been written about this refugium (Matthews 1979: 63–65). Based on the present distribution in North Greenland and the Canadian high arctic islands of subspecies of arctic hare, varying lemming, muskox, caribou, grey wolf, and eremine, Rand (1954) Banfield (1961, 1963), Harrington (1964), and MacPherson (1965) proposed that the progenitors of one or more of these animals had been isolated in a Peary Land – Queen Elisabeth Island refugium during the Wisconsin-Weichsel glaciation. They evolved into the present subspecies "in situ", and following the retreat of the ice they spread south from their refugium into Northeast Greenland and the Canadian arctic islands.

However, the geological evidence of such a high arctic refugium is very ambiguous. Fredskild (1973: 173–74, 189) and Weidick (1976: 438) seriously question the existence of a large unglaciated area in North Green-

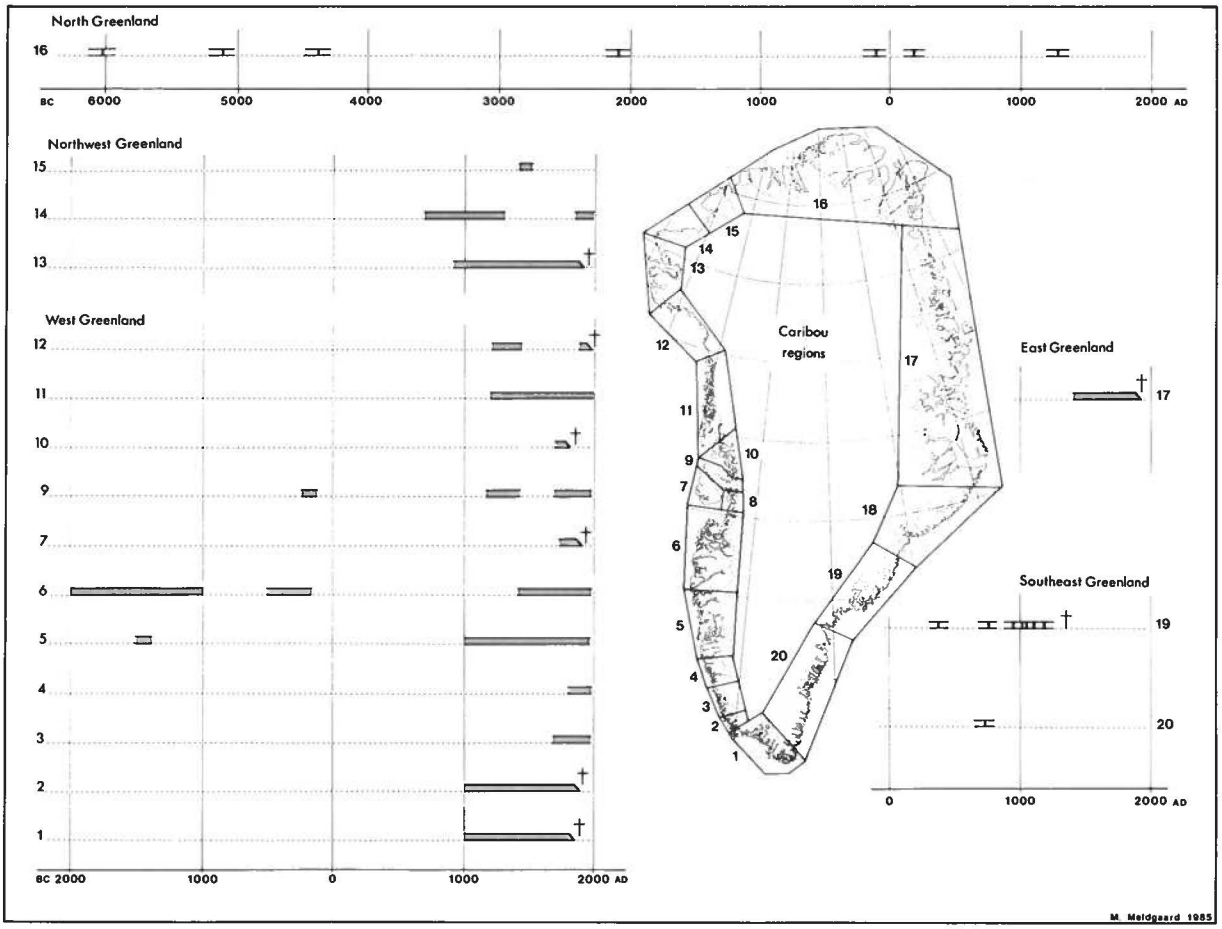


Fig. 45. Distribution of Greenland caribou through time. Horizontal bars stands for presence of caribou as documented by geological, archaeological, and historical/ethnohistorical data (for references see discriptive part). Short vertical lines within the bars stands for caribou presence as documented by C-14 datings. Crosses stands for extinction of regional caribou populations.

land during the late Wisconsin-Weichsel glaciation, and geological field work in the last few years has not found any evidence in favour of a refugium (Ole Bennicke, pers. comm.).

Banfield (1961), Harrington (1964), and MacPherson (1965) all find support for their theory of a northern Wisconsin refugium in Feilden's (1877) observations of possibly Pleistocene deposits in Northeastern Ellesmere Island with remains of caribou, muskox, and lemming. The Wisconsin-Weichsel age of these remains should, however, not be trusted until further documentation is procured (p. 36–37).

Even if North Greenland and the northern Queen Elisabeth Islands can be shown to have been free of ice during the last glaciation, I agree with Matthews (1979: 63–65) and Degerbøl (1957: 47) that living conditions in such a refugium probably were too severe to allow long-termed survival of most animals, including *Rangifer*.

The idea of a northern Greenland – northern Queen Elisabeth Islands refugium for land mammals during the Wisconsin-Weichsel glaciation or at least during the last part of this glaciation should be reconsidered. Consequently, the place of origin of mammalian subspecies like *Rangifer tarandus pearyi* and *R. t. eogroenlandicus* must be sought elsewhere.

Northeast Greenland (region 17)

Zoogeography. – The Thule people (c. 1200 – c. 1850) hunted caribou throughout Northeast Greenland from Germania Land in the north to Scoresby Sund in the south. Archaeological datings from Scoresby Sund and Kejser Franz Joseph Fjord document that caribou were present in these areas from c. 1350 AD to c. 1850 AD.

Between 1870 and 1895, caribou were observed between Hochstetter Forland and Scoresby Sund, a north–south range of c. 1000 kilometres (Fig. 50). In the late 19th century the population declined sharply, and c. 1900 the Northeast Greenland caribou became extinct. The possible causes of this disappearance will be discussed in Part II.

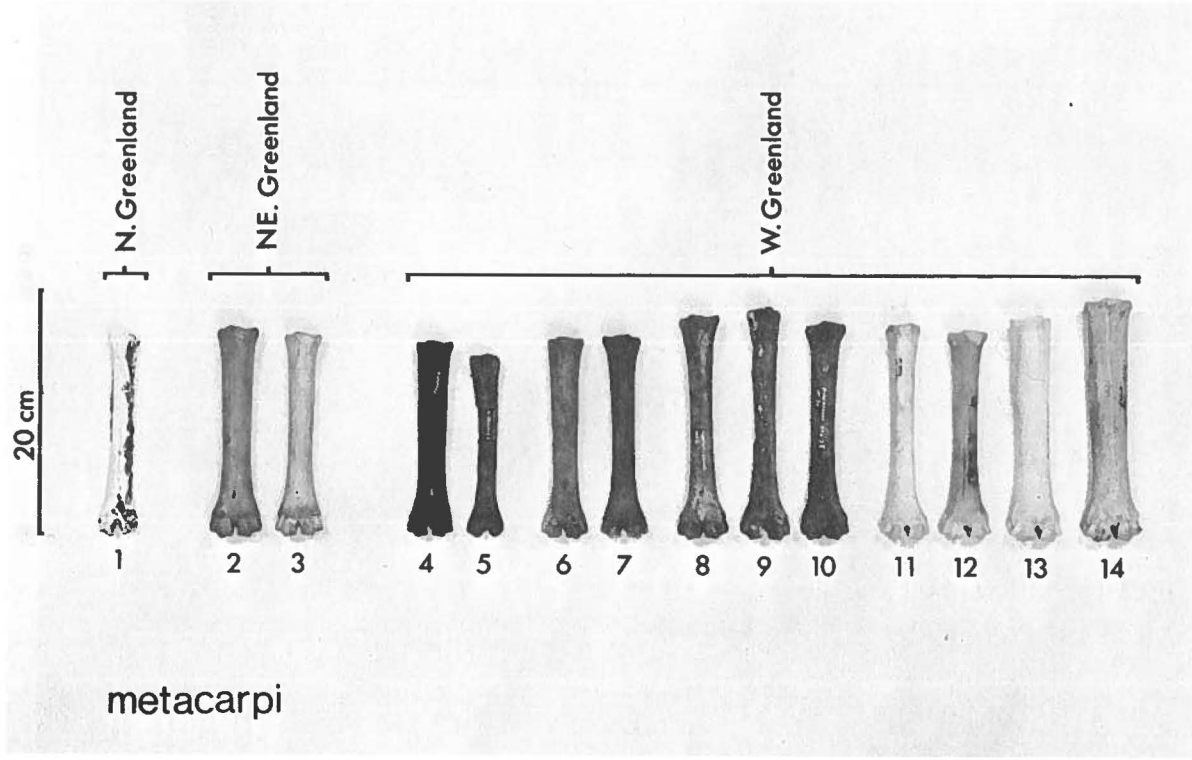


Fig. 46. Caribou metacarpus from North Greenland (1) in comparison with metacarpi from Northeast Greenland (2 and 3) and West Greenland (4 to 14).
1. North Greenland, Nyboe Land, age unknown (Appendix 2a), 2, 3. Northeast Greenland, 1890'es (Appendix 2c, CN 591 (♂?), 592 (♀)), 4, 5. Nuuk region, c. 1500 BC (Appendix 1b, no. 11-9), 6, 7. Sarfartôq, Sisimiut region, age unknown (Appendix 2a), 8. Upernavik region, 1650–1850 AD (Appendix 1b, no. 11-9), 9. Nuuk region 1000–1350 AD (Appendix 1b, no. 5-6), 10. Southwest Greenland region, 1000–1500 AD (Appendix 1b, no. 1-6), 11, 12, 13, 14. Sisimiut region, recent (Appendix 2c, CN 4033 (♀), 4036 (♀), 4029 (♂), 1048 (♂)).

Taxonomy. – The size of the archaeologically recovered caribou bones is comparable to the size of the small historically known Northeast Greenland caribou (Degerbøl 1957) (Figs 48 & 49) (Appendix 2b, 2c).

Degerbøl (1957: 47) suggested that caribou migrated into Northeast Greenland in late glacial times. He speculated that these early North American immigrants were "primitive" *Rangifer tarandus groenlandicus* (or perhaps *R. t. pearyi*) and that they subsequently developed into the Northeast Greenland subspecies *Rangifer tarandus eogroenlandicus* Degerbøl (Fig. 51).

Banfield (1961: 55), however, questioned the occurrence of three subspecies of caribou in Greenland and he indicated that *R. t. eogroenlandicus* and *R. t. pearyi* were very closely related (p. 65). The characters which Degerbøl (1957: 44–45) used to distinguish *eogroenlandicus* from *pearyi* were, (1) the shape and large spread of the antlers and (2) the more coarse and dirty white colour of the skin. Antler shape has later been shown to have limited taxonomic significance because of its large variability (Banfield 1961: 24, Bubenik 1975), and Banfield (1961: 65) stated that the two skins on which Degerbøl based his analysis were taken at an unknown season and that the coarse and dirty white pelage corresponds well with the late spring pelage of *R. t. pearyi.* Banfield's (1961) studies revealed, however, that the facial part of *R. t. eogroenlandicus* was slightly shorter than in *R. t. pearyi,* something also noticed by Degerbøl (1957: 27).

Banfield's doubt concerning the existence of three subspecies of caribou in Greenland does seem well founded, and it is open to question if a slight difference in facial length is sufficient to maintain *R. t. pearyi* and *R. t. eogroenlandicus* as separate taxonomic units.

The documentation of a prehistoric North Greenland caribou population does indicate that *R. t. pearyi* and *R. t. eogroenlandicus* were in close contact probably on several occasions and Banfield (1961: 65) implied that the two "forms" could have been intergrading in Peary Land.

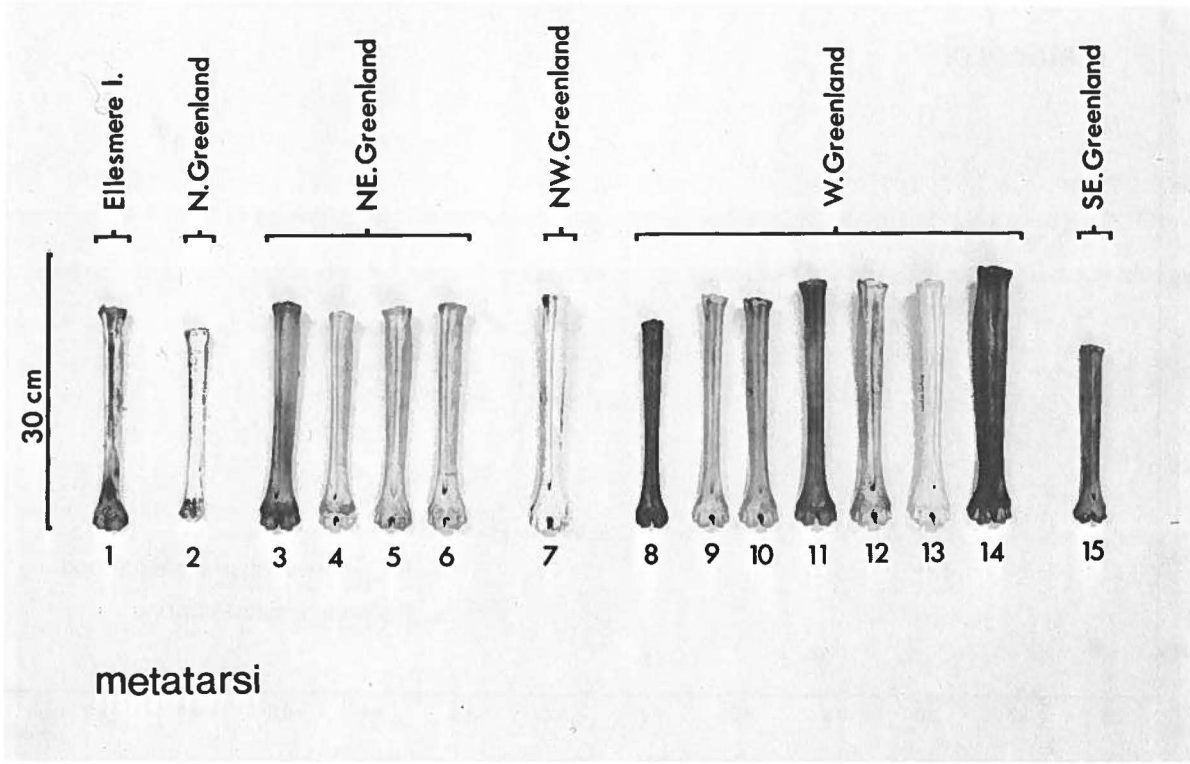


Fig. 47. Caribou metatarsus from North Greenland (2) in comparison with metatarsi from Ellesmere Island (1), Northeast Greenland (3 to 6), Inglefield Land (7), West Greenland (8 to 14), and Ammassalik (15).
1. Ellesmere Island, recent (CN 3465), 2. Hall Land, North Greenland region, age unknown (Appendix 2a), 3, 4, 5, 6. Northeast Greenland region, 1890'es (CN 591 (♂(?)), 592 (♀) both Appendix 2c, CN 985, 1485 both Appendix 2a), 7. Inglefield Land region, age unknown (Appendix 2a), 8. Nuuk region, c. 1500 BC (Appendix 1b, no. 5-1), 9, 10, 11, 12, 13, 14. Sisimiut region, recent (Appendix 2c, CN 4033 (♀), 4036 (♀), 2720 (♂), 3946 (♂), 4029 (♂), 1048 (♂)), 15. Kulusuk, Ammassalik region, probably 300–1200 AD (Appendix 2a).

Northeast Greenland lowland and nunatak refugia. – A substantial number of nunataks (i.e., ice-free mountain tops surrounded by Inland Ice) were probably in existence in Northeast Greenland throughout the Pleistocene (Weidick 1976: 437) and recently, fairly large lowland areas on Jameson Land and possibly on Wollaston Forland, Hochstetter Forland and around Kejser Franz Joseph Fjord were shown to have been ice-free since the Sangamon-Eem interglacial (Funder 1982, Hjort 1981, Weidick 1984).

Funder (1982) suggests that a number of plant species may have survived the Wisconsin-Weichsel glaciation in the lowland refugia while he considers the nunataks to have been too unstable to allow the survival of plants.

Considering the relatively small size and the geographically isolated position of these lowland refugia, it seems very improbable that they should have been inhabited by caribou during the late Wisconsin-Weichsel glaciation (20 000–10 000 BP). The unstable environment would invariably wipe such a caribou population out (much as it happened c. 1900 with the Northeast Greenland caribou population) and a recolonization which would have to come from Banks Island or further west (Matthews 1979: 63) would be practically out of the question.

Northwest Greenland (regions 13 and 14)

Zoogeography. – According to the archaeological record, caribou were hunted in the Thule region (13) between 1400 (perhaps 1200) AD and 1600 AD and between 1800 and 1900 AD. The last caribou in the region were shot in 1939.

Caribou hunting was also practised in the Inglefield Land region (14) throughout a period from 700 to 1300 AD, and they have been hunted there again since the 1850'es. A few Inuit families from the Thule region have in recent years undertaken successful caribou hunting trips to the central and northeastern parts of Inglefield Land (R. Dietz, pers. comm.).

Consequently, caribou must have immigrated to Northwest Greenland some time prior to 700 AD, and probably they have inhabited both the Thule and the Inglefield region continuously since that time.

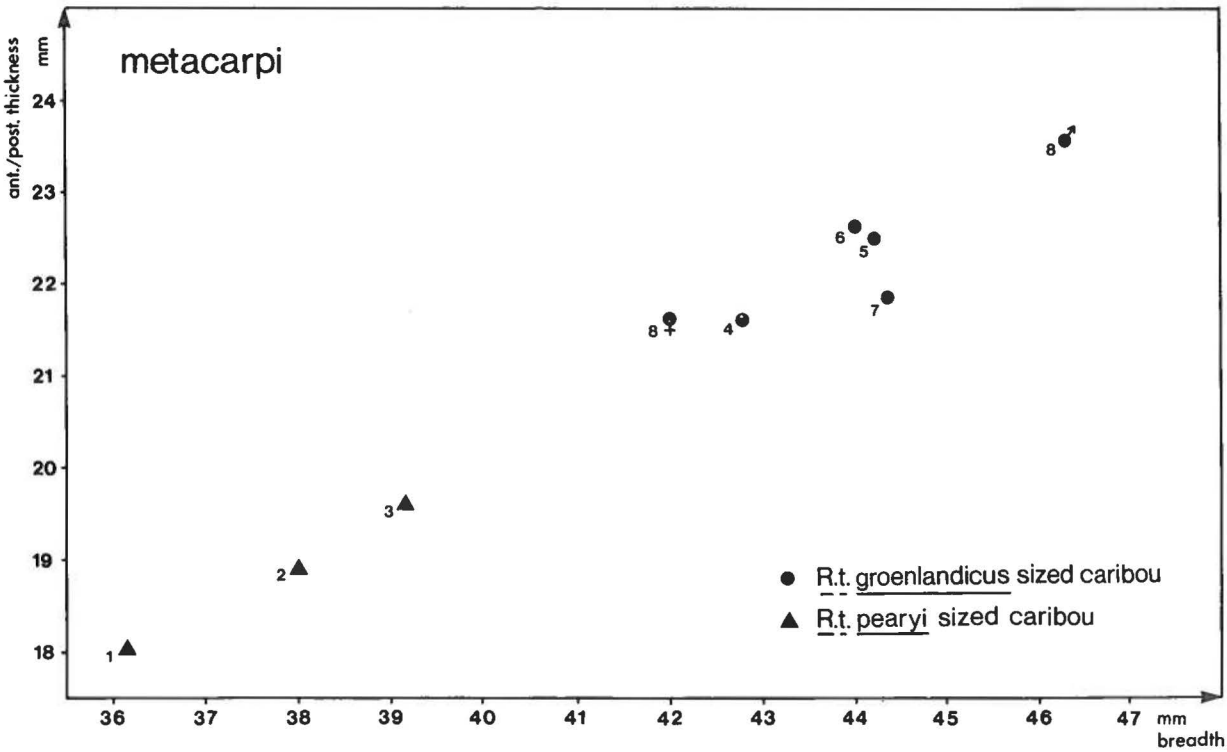


Fig. 48. Dimensions of the metacarpal distal epiphysis from Greenland caribou populations. (1) Itivnera caribou, Nuuk region, c. 1500 BC (Appendix 2b, no. 5-1). (2) Sarfartôq, Sisimiut region, unknown age (Appendix 2a). (3) Northeast Greenland, c. 1300–1900 AD (Appendix 2b, nos 17-2 to 17-34). (4) Southwest Greenland region, c. 1000–1500 AD (Appendix 2b, nos 1-1 to 1-8). (5) Nuuk region, c. 1000–1350 AD (Appendix 2b, nos 5-2 to 5-9). (6) Sisimiut region, c. 1650–1750 AD (Appendix 2b, no. 6-8). (7) Sisimiut region, c. 450 BC (Appendix 2b, no. 6-3). (8) Male and female *R. t. groenlandicus* from Sisimiut region, recently collected (Appendix 2c).

Taxonomy. – Most authors have identified the historic populations of Northwest Greenland caribou as *Rangifer tarandus groenlandicus* (Linnaeus) (Allen 1908, Degerbøl 1957: 18–19, MacMillan 1925, Roby et al. 1984, Steensby 1910: 278). Banfield (1961), however, claimed that the Northwest Greenland caribou exhibited greater similarities to *Rangifer tarandus pearyi* J. A. Allen than to *R. t. groenlandicus,* though he admitted that some influences from West Greenland *groenlandicus* could be traced. This postulated dominance of *R. t. pearyi* in Northwest Greenland was disproved by Roby et al. (1984) who demonstrated that they were in fact *R. t. groenlandicus* that, owing to environmental stress, were of a smaller stature than West Greenland *R. t. groenlandicus.*

Kane Basin and the northern parts of Smith Sound which separates the Northwest Greenland *R. t. groenlandicus* from the Ellesmere Island *R. t. pearyi* are quite narrow waters (45–100 km). In winter they are usually frozen solid and they should constitute no serious barrier to caribou (see Lindroth 1957: 292) (Fig. 51). Freuchen (1911) and Steensby (1910) do in fact state that the Polar Eskimos have observed caribou crossing from Ellesmere Island to Northwest Greenland.

The immigration of *R. t. pearyi* to Inglefield Land was recently documented by the finding of a very small caribou mandible from a recently killed animal (1978). The size of the mandible clearly fell outside the range of mandibles of *R. t. groenlandicus* (Roby et al. 1984).

Based on the fact that *R. t. pearyi* have been reported from the Bache Peninsula just across from Inglefield Land and on the retrieval of the small *R. t. pearyi* mandible, Roby et al. (1984) concluded that there has been a small influx of Peary caribou into Inglefield Land within the last century.

Five caribou metacarpals excavated in Inglefield Land in early Thule Culture house ruins dated to 1150–1250 AD add an important time dimension to the discussion of the occurrence of *R. t. groenlandicus* and *R. t. pearyi* in the area. Three of these metacarpals belong to small *pearyi*-sized caribou and two belong to large *groenlandicus*-sized caribou (Appendix 2b, nos 14–2, 14–4) (Fig. 52). Assuming that these caribou were all killed on Inglefield Land, these 800 years old caribou bones may document a situation which was much like the present one: a resident population of *R. t. groenlandicus* and an influx of *R. t. pearyi* from Ellesmere Island. Even if the small caribou were killed on Ellesmere

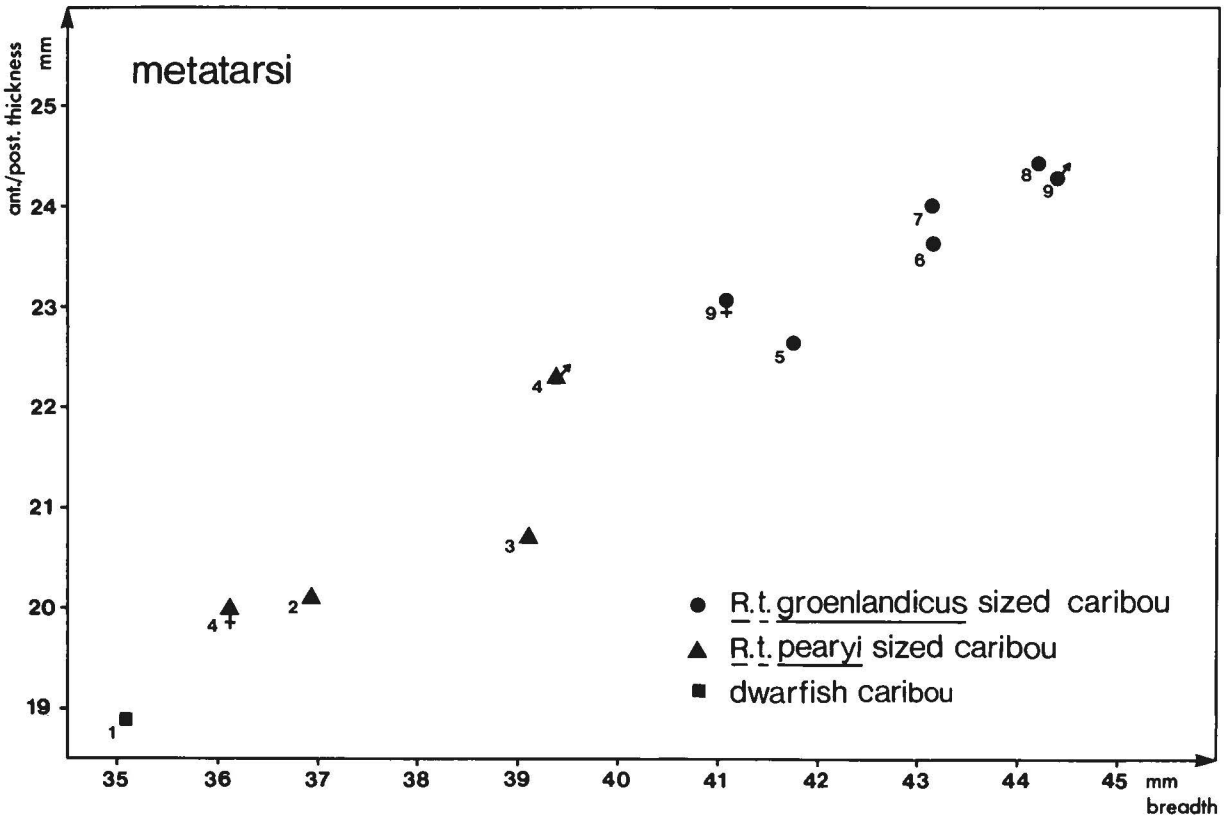


Fig. 49. Dimensions of the metatarsal distal epiphysis from Greenland and Ellesmere Island caribou populations. (1) Ammassalik region, c. 300–1200 AD (Appendix 2a). (2) Itivnera caribou. Nuuk region, c. 1500 BC (Appendix 2a). (3) Northeast Greenland region, c. 1300–1900 AD (Appendix 2b, nos 17-2 to 17-34). (4) Male and female *R. t. pearyi* from Ellesmere Island, recently collected (M. Meldgaard, unpublished). (5) Sisimiut region, c. 1900–900 BC (Appendix 2b, no 6-2). (6) Nuuk region, c. 1000–1350 AD (Appendix 2b, nos. 5-2 to 5-9). (7) Sisimiut region, c. 1650–1750 AD (Appendix 2b, no. 6-8). (8) Sisimiut region, c. 450 BC (Appendix 2b, no. 6-4). (9) Male and female *R. t. groenlandicus* from Sisimiut region, recently collected (Appendix 2c).

Island and brought to Inglefield Land by Eskimos, this would still show that the two forms were geographically very close and that interchange between the populations was potentially possible. There is no evidence of hybridization between the two subspecies and in this respect the situation could be similar to the one described by Manning and MacPherson (1961) from Prince of Wales Island, Somerset Island, and Boothia Peninsula where *R. t. pearyi* and *R. t. groenlandicus* seem to have developed isolating mechanisms through character displacement (see also Manning 1960 and Thomas & Everson 1982).

The immigration of Peary caribou to Inglefield Land has been going on for more than 800 years, but there are no observations of a similar immigration to the Thule region. I suspect that this is due to the fact that Inglefield Land lies just opposite the ice-free Bache Peninsula where Peary caribou are known to occur (Roby et al. 1984), while the Thule region is situated just across from ice-clad and barren parts of Ellesmere Island where Peary caribou must be very scarce. The extensive polynia the "North Water" which is situated between the Thule region and the southeastern coast of Ellesmere Island (Smith & Rigby 1981) may also act as a barrier, preventing the immigration of caribou directly from Ellesmere Island to the Thule region (Fig. 55). The Thule region caribou are probably in closer contact with the West Greenland caribou populations via the Melville Bugt which has been populated periodically with caribou at least since c. 1200 AD.

This regional difference in the degree of interaction with Peary caribou and West Greenland caribou should be taken into consideration when dealing with the taxonomic status and history of the Northwest Greenland caribou. Unfortunately this has not been the case previously. Both Degerbøl (1957), Banfield (1961), and Roby et al. (1984) pooled caribou material from both Inglefield Land and the Thule region in their investigations and thus obscured possible differences between the regions.

West Greenland (regions 1 to 12)

Zoogeography and taxanomy. – The West Greenland caribou were hunted by the Saqqaq people between c. 2300 BC and 900 Bc, by the Dorset people between c.

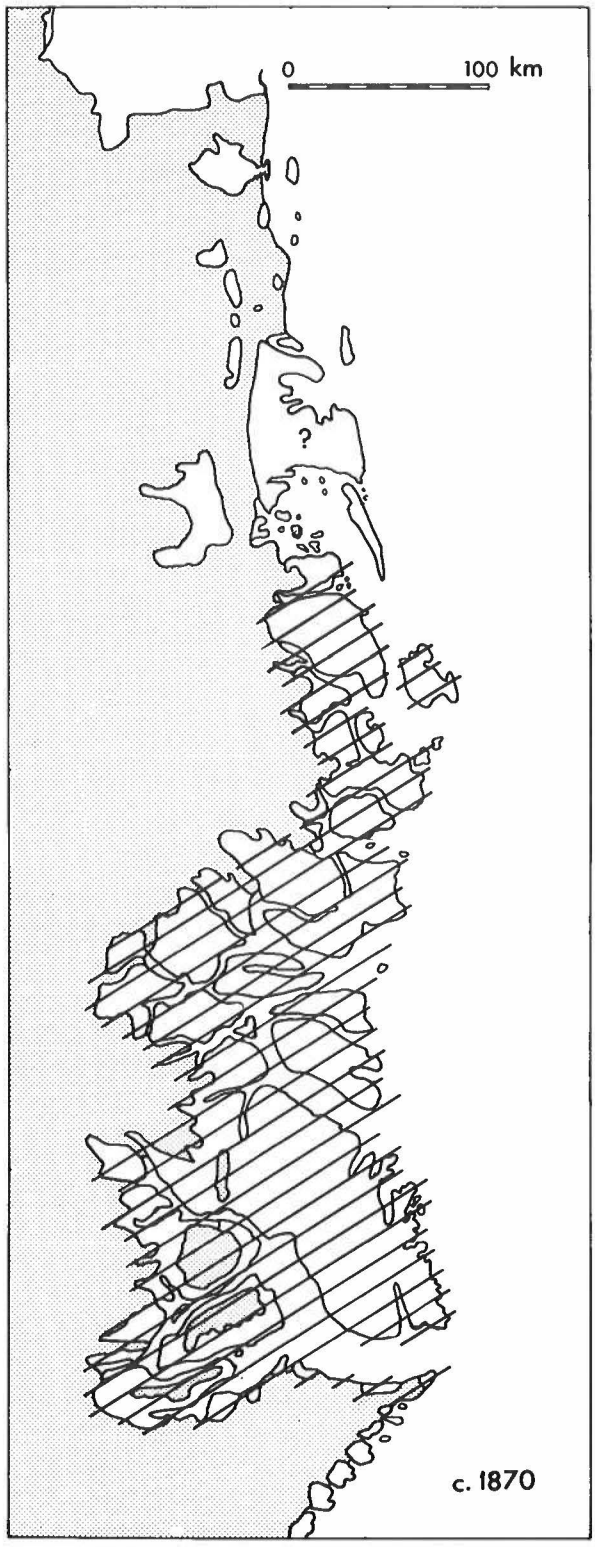


Fig. 50. Distribution of caribou in North East Greenland c. 1870. Approximately 30 years later (c. 1900) the caribou population become extinct.

500 BC and 200 BC, and by the Thule people after 1200 AD.

The size of the caribou inhabiting the Sisimiut region (6) between c. 2000 and c. 1000 BC fell within the size range of modern West Greenland caribou, but the discovery in 1983 of two *R. t. pearyi*-sized metacarpi in the banks of the Sarfartôq river indicates that the Sisimiut caribou were not always large (Appendix 2a) (Figs 19, 46 & 48).

South of Sukkertoppen Iskappe in the Nuuk region there was a population of small caribou c. 1500 BC. They were very small, somewhat smaller than *Rangifer tarandus pearyi* and *R. t. eogroenlandicus* (Figs 46 to 49). Møhl (1972) and Vibe (1967) assumed that the smallness of the "Itivnera caribou" (so named after the locality where the excavation of a Saqqaq Culture caribou hunting site (Fig. 14) first documented their existance (Appendix 1b, no. 5-1)) was due to environmental stress and Møhl (1972) suggested that this small form could have evolved into the present West Greenland caribou following an environmental change. However, there is at present no evidence of environmental differences north and south of Sukkertoppen Iskappe c. 1500 BC that could account for the differences in caribou size. Rather, the difference in size was genetically conditioned and it seems reasonable to recognize the small Itivnera caribou and the contemporary large caribou as two subspecies. The peculiar reductions in the dentition of the Itivnera caribou (Degerbøl & Krog 1959: 71–72, Møhl 1972) support this conclusion (p. 15). Taxonomically the Itivnera caribou probably belonged to a basic stock of small nearctic caribou with very close affinities to *Rangifer tarandus pearyi* and *R. t. eogroenlandicus*, while the contemporary large caribou probably was the direct ancestor to today's West Greenland *Rangifer tarandus groenlandicus*.

The two populations were probably separated by the only physical barrier of real significance between the Nuuk and the Sisimiut regions: the Sukkertoppen Iskappe, a huge glacier tongue that splits central West Greenland in half, almost reaching the outer coast. During population maxima, caribou can be found between the western fringe of the Iskappe and the sea (Müller 1906: 265–66) and on nunataks in the Iskappe (Strandgaard et al. 1983). Generally, however, the exchange between the Nuuk and the Sisimiut regions must be characterized as minimal (Rink 1852, Thing 1984). Weidick (1976: 446) stated that the position of the Inland Ice margins probably did not change by more than c. 20 kilometres through the last 5000 years, thus indicating that this caribou barrier has been active for at least 5000 years.

Banfield (1961), Vibe (1967), and Roby et al. (1984) suggested that *Rangifer tarandus groenlandicus* immigrated directly from Baffin Island across the Davis Strait to West Greenland. This suggestion was mainly based on an inference from the fact that *R. t. groenlandicus* presently can be found on Baffin Island just oppo-

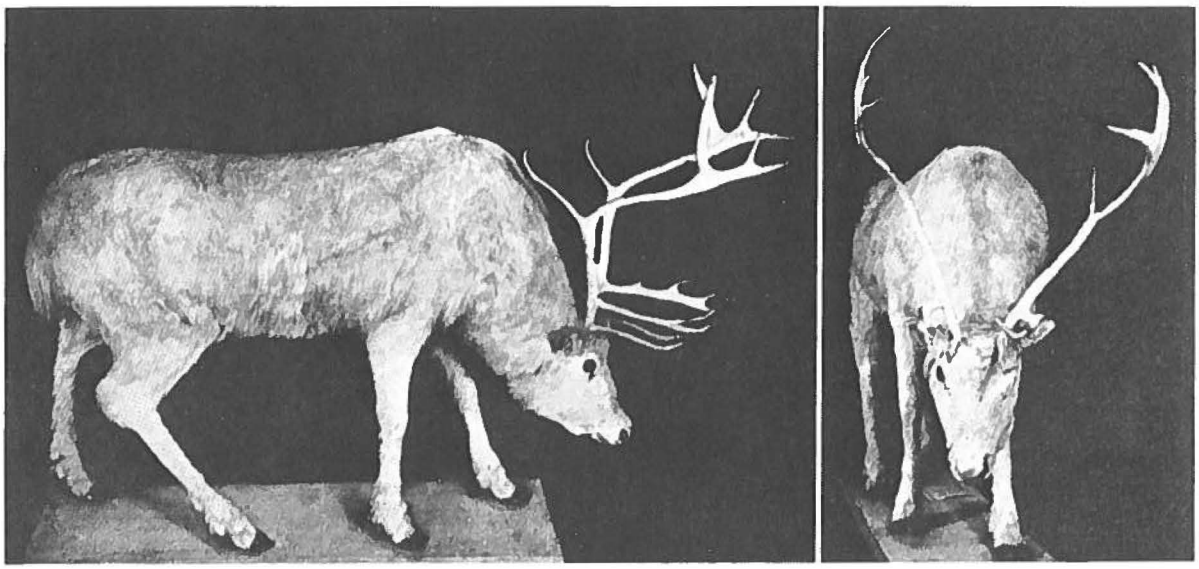


Fig. 51. The only known mounted specimen (CN 647, Zoological Museum, Copenhagen) of the extinct Northeast Greenland caribou (*R. t. eogroenlandicus*). It was collected in 1892 by Ryder in the Scoresby Sund area. The antlers stem from another specimen (from Degerbøl 1957: 43).

site the West Greenland coast. According to the archaeological record, the large caribou *(R. t. groenlandicus)* immigrated to West Greenland more than 4000 years ago. This was probably during the postglacial hypsithermal (c. 7500 BP to c. 2500 BP) which among other things was characterized by a generally warmer climate and a northward migration of the Canadian forest (Nichols 1974, Weidick 1976). The range of *R. t. groenlandicus* may in this period have extended further north, perhaps even reaching Devon Island, Ellesmere Island, and finally Northwest Greenland. Caribou bone material from archaeological pre-Dorset and Dorset sites in the Pond Inlet area (Rousselieré 1976) document the presence of caribou in the Melville Peninsula/Baffin Island area from at least 2000 BC, and the size of caribou longbones from c. 500 BC shows that these animals were comparable in size to the caribou presently inhabiting these regions (M. Meldgaard, unpubl.). The migration of *Rangifer tarandus groenlandicus* to West Greenland is probably the result of a simple and gradual range extension but it may also be the result of a colonization by a few caribou taking the sweepstakes route across the Davis Strait.

Recent trends in West Greenland caribou distribution. – During the past three centuries there has been a general reduction of the West Greenland caribou range. In the 18th and the beginning of the 19th century, *R. t. groenlandicus* was distributed all along the West Greenland coast from Kap Farvel in the south to Inglefield Land in the north (Fig. 53). But already c. 1825, following the population decline in the 1750'es, the Southwest Greenland caribou became extinct. The Disko caribou and the Ivigtut caribou followed suit c. 1850 and c. 1900, and so did the caribou populations in the Melville Bugt in the 1940'es and the population in the Thule region c. 1920. The caribou population presently inhabiting Nûgssuaq and the population possibly inhabiting Svartenhuk Halvø are presently very small and on the verge of extinction (Fig. 53).

The general picture through the past two centuries is that of progressive extinctions of small, marginal and geographically restricted caribou populations, and that of the survival of caribou populations in central and geographically extensive regions. The north–south extent of West Greenland caribou distribution has altogether been reduced by more than 50% from c. 2000 kilometres to less than 1000 kilometres in c. 200 years.

Summary. – West Greenland was probably inhabited by small *R. t. pearyi*-sized caribou prior to the immigration of *Rangifer tarandus groenlandicus* which took place prior to c. 2000 BC. These large migrants may have come across the sea ice directly from Baffin Island, but probably they reached Northwest Greenland first and from here spread south into West Greenland. The large caribou must have been better adapted to the environmental conditions prevailing in West Greenland in the millenia around 2000 BC and they ousted the smaller residents. The Sukkertoppen Iskappe prevented *groenlandicus* from spreading to the regions south of it for more than 500 years. But judging from the large size of the caribou bones found in Norse and Eskimo middens, *R. t. groenlandicus* must have passed the barrier and spread south along the Greenland coast between 1500 BC and 1000 AD.

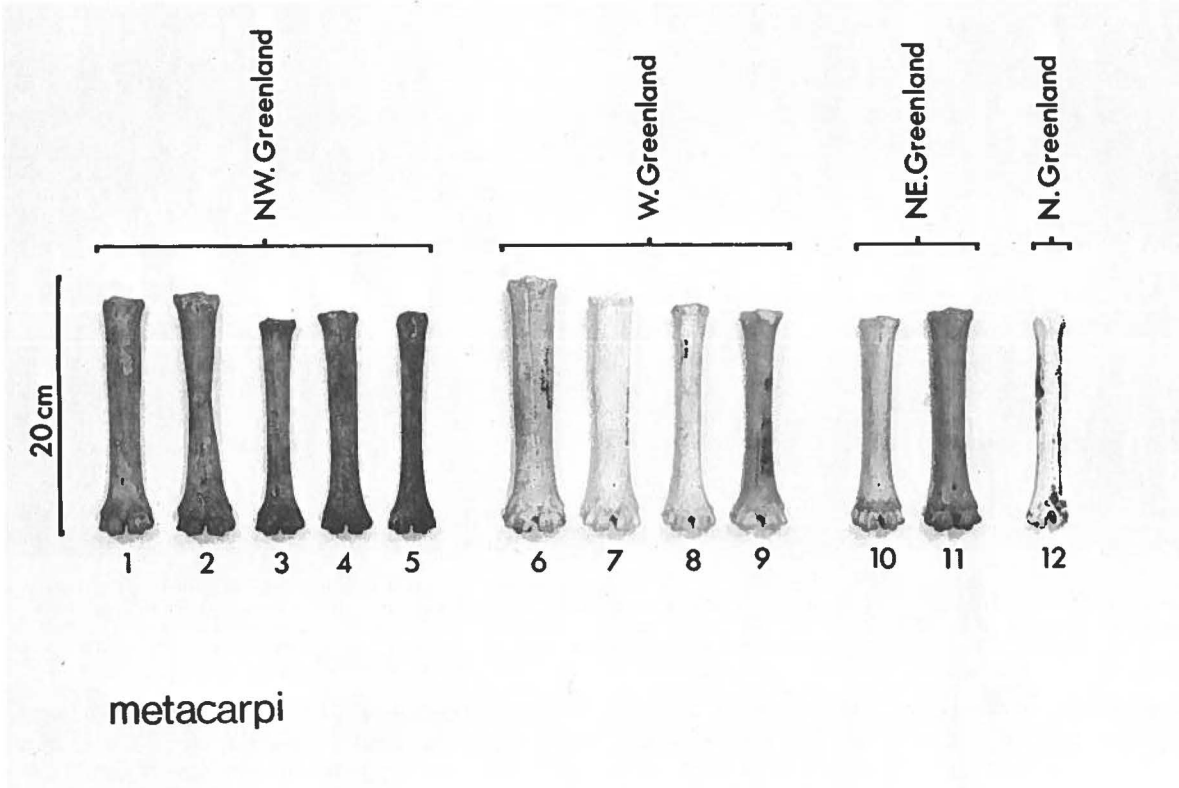


Fig. 52. Caribou metacarpi from the Inglefield Land region (1 to 5) in comparison with metacarpi from West Greenland (6 to 9), Northeast Greenland (10 and 11), and North Greenland (12).
1, 2, 3, 4, 5. Inglefield Land region, 1150–1250 AD (Appendix 1b, nos 14-4, 14-6), 6, 7, 8, 9. Sisimiut region, recent (Appendix 2c, CN 1048 (♂), 4024 (♂), 4033 (♀), 4036 (♀)), 10, 11. Northeast Greenland region, 1890'es (Appendix 2c, CN 592 (♀), 591 (♂?), 12. Nyboe Land, North Greenland region, age unknown (Appendix 2a).

Since that time, West Greenland has been inhabited exclusively by *Rangifer tarandus groenlandicus,* but in the last 200 years their range has been reduced by more than 50%.

Antler condition and taxonomy. – A certain fraction of the females in the different West Greenland caribou populations are polled (antlerless) (Aastrup 1984a, Müller 1906: 376, Rosing 1955), a phenomenon which has also been observed in North American and Eurasian caribou populations (Banfield 1961: 19, Jacobi 1931: 47–48).

Four female crania with different degrees of polling were collected in the Kangerdlugssuaq area (Sisimiut region) in November and December, 1978 (Fig. 54). A is completely polled with no trace of a pedicle and an almost smooth frontale, B is also polled but it has two small knobs in place of the pedicles, C lacks the left antler and pedicle completely while the right antler is fully and normally developed, and finally D is a normally antlered female.

Aastrup (1984a) discussed the possible causes of polledness. He stated that polledness may be caused by poor physical condition resulting from insufficient nutrition or from a genetically based inability, during starvation periods, to synthesize the hormones that are necessary for antler growth.

If polledness was solely a result of insufficient nutrition, then it would be expected that left and right antlers in each individual would be affected to the same degree. This is not the case. The female cranium in Fig. 54C clearly shows how one antler may be fully developed while the other is completely missing (including the pedicle). The development of only one right or left antler in West Greenland caribou females is described by Müller (1906: 376) and Rosing (1955). Reimers (1980) and Aastrup (1983a, b, c, 1984a) have also documented this condition and they state that the frequency of one-antlered females ranges between 2.8 and 14.1% in 3 different populations (Table 1).

The one-antlered condition may well be genetically controlled and consequently this must to a large extent be the case with the fully antlered and completely polled condition. Lönnberg (1909: 22) also implied that the polled condition was genetically controlled and he dis-

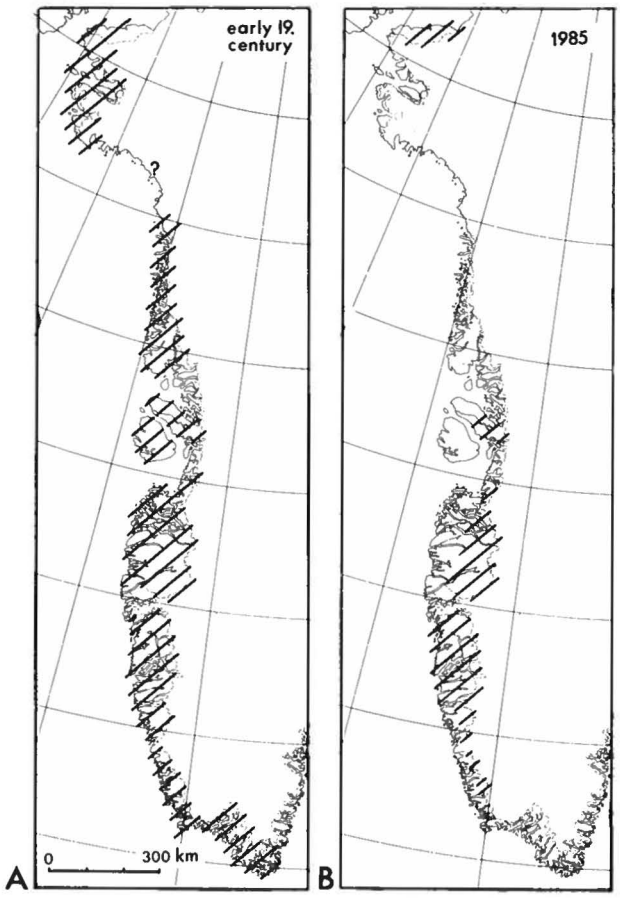


Fig. 53. (A) Caribou distribution in West Greenland in the early 19th century and (B) present caribou distribution in West Greenland.

cussed the possibility of using this character in taxonomic work.

In Table 1 are listed the frequencies of antlered, partly polled, and completely polled females in three West Greenland caribou populations. The females from the Paamiut and Sisimiut regions have very high percentages of polled and partly polled individuals (86% and 63.6%) while the Nuuk region females have a low percentage (25–34%).

These differences suggest that the gene flow between the populations has been restricted and that the physical barriers separating the populations have been and are quite effective.

Table 1. Antler condition of female caribou in three West Greenland populations (compiled from Aastrup 1983a, b, 1984a, Reimers 1980).

	Region 3, Paamiut.	Region 5, Nuuk. Ameralik fjord, South.		Region 6, Taserssuaq area.
	July 1980	Aug. 1982	Aug. 1983	Aug. 1982
No antlers	71.9	22.2	21.0	58.8
One antler	14.1	2.8	13.0	4.8
Two antlers	14.1	52.2	67.0	36.4
Total	100%	100%	100%	100%
n	64	36	270	41

Southeast Greenland (regions 18, 19, and 20)

Zoogeography. – Based on the excavation of antler fragments and arrowheads in Eskimo ruins, Therkel Mathiassen (1933) postulated that there had been a population of caribou in the Ammassalik region between 1300 and 1500 AD. Degerbøl (1957) was able to confirm the existence of such a population following the discovery of a number of shed antlers and a few limb bones. He speculated that caribou had reached the Ammassalik region during a warmer and climatically more favourable period, perhaps c. 2000 BC or 800–1000 AD, and he stated that it probably went extinct shortly after 1500 AD.

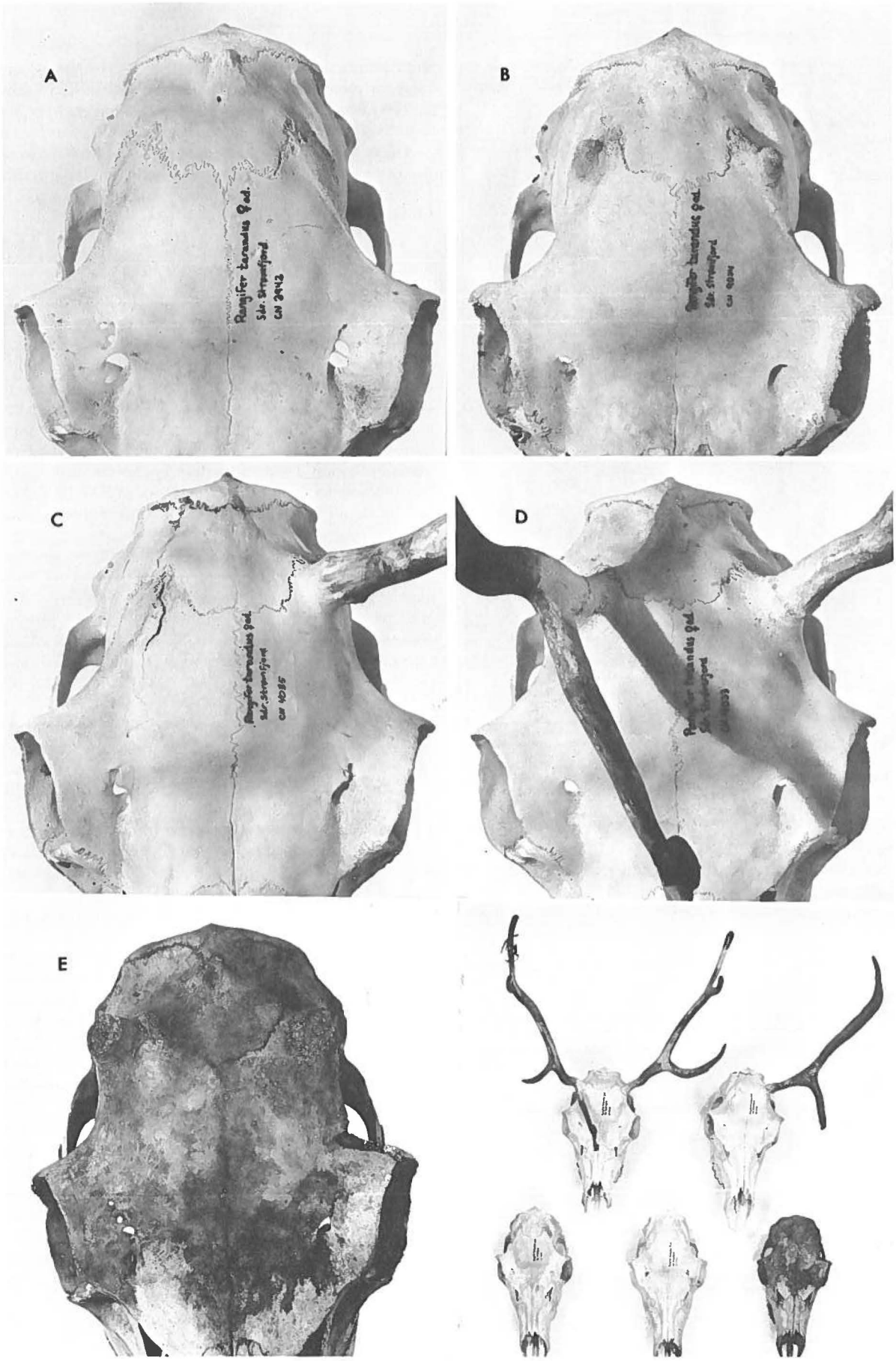
Seven C-14 datings throw new light on the zoogeography of the Ammassalik caribou (Appendix 1a). They have mainly been made on naturally shed antlers recovered particularly in the mountains and valleys around Angmagssalik Fjord and Sermilik Fjord. The resulting calibrated ages are: (1) 355–385 AD, (2) 720–770 AD, (3) 900–975 AD, (4) 1005–1020 AD, (5) 1025 AD, (6) 1035–1150 AD, (7) 1165–1190 AD.

An antler found 400 kilometres south of the Ammassalik region in Tingmiarmiut Fjord was C-14 dated to 695–770 AD (cal.).

According to these results, caribou immigrated to the Ammassalik region some time prior to c. 350 AD. And if the lumping of datings between 700 and 1200 AD is significant, then they reflect the existence of a distinct population in this period. Furthermore, the datings and the lack of caribou bones from the archaeological excavations indicate the extinction of this population shortly after c. 1200 AD.

The dating of the Tingmiarmiut antler (695–770 AD) is of particular interest because it is contemporary with the Ammassalik caribou datings and because it suggests that the Southeast Greenland caribou may have been more widely distributed than previously thought. This is also indicated by the antler which was found in Vahl Fjord well over 100 kilometres north of Angmagssalik Fjord and dated to 355–385 AD.

Probably the Southeast Greenland caribou had their mainstay around the fjords in the Ammassalik region and perhaps to a lesser degree around Tingmiarmiut Fjord. During an expansive period, the Southeast Greenland caribou could probably be found on most small islands and lands along the southeast coast between Lindenow Fjord and Ammassalik, much like what was the case in Melville Bugt c. 1900.


A
B
C
D
E

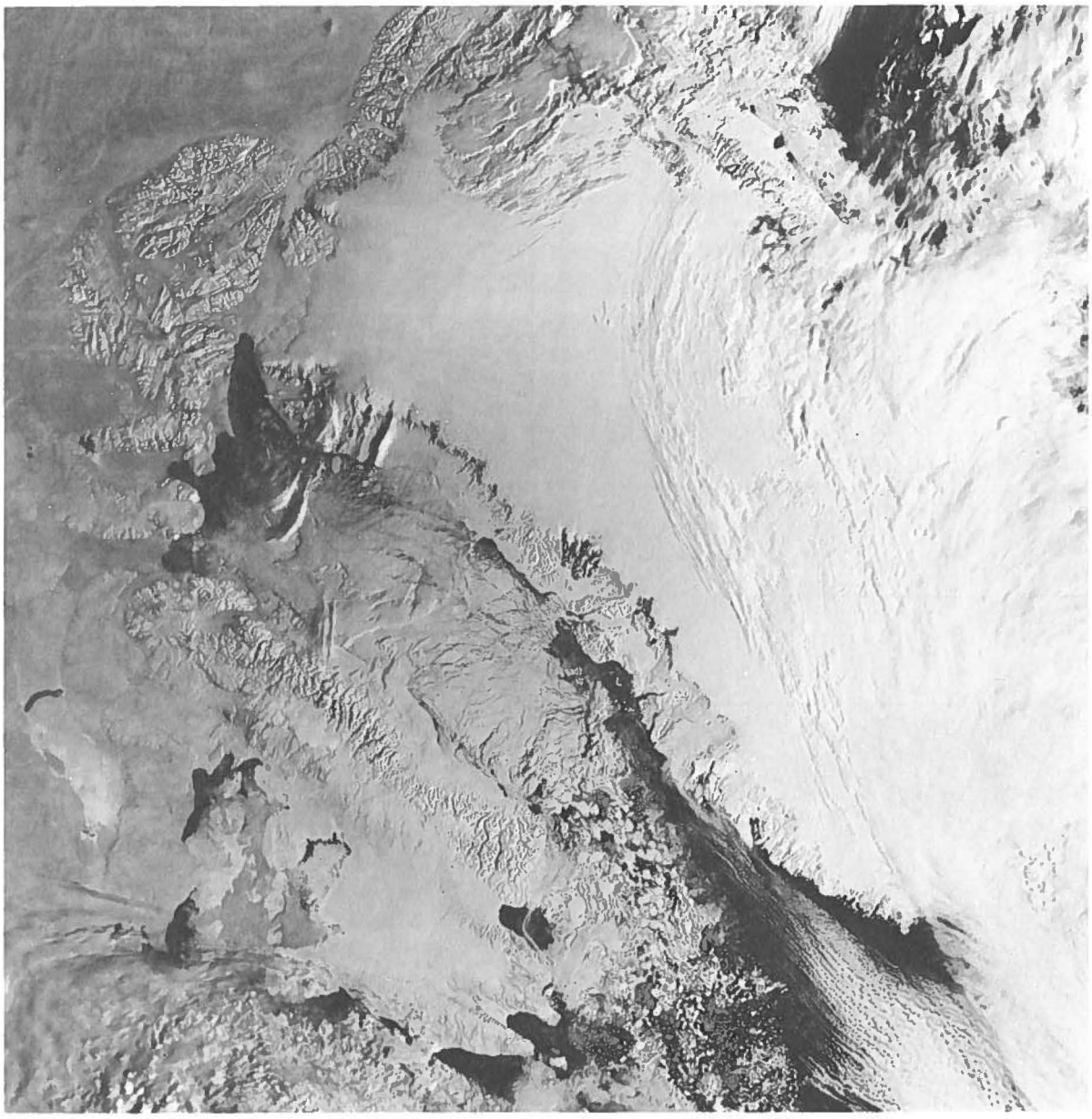


Fig. 55. Satellite immage showing Baffin Bay, Davis Strait, and surrounding land masses on the 24 April 1984. Notice: 1. Landfast ice between Inglefield Land, Washington Land, and Hall Land on one side and Ellesmere Island on the other. 2. The large polynya "the North Water" separating the Thule region from Ellesmere Island. 3. The large amounts of the drift-ice "Vestisen" in Baffin Bay and Davis Strait (NOAH 7, taken down in Søndrestrømfjord).

Taxonomy. – Based on the size of one antlered male braincase (1005–1020 AD), one metatarsus and a distal tibia, and on the size of a number of shed antlers, Degerbøl (1957) concluded that the Ammassalik caribou had been quite dwarfish, even smaller than the Northeast Greenland caribou *Rangifer tarandus eogroenlandicus* (Figs 42, 47 and 49).

The metatarsus is slender and well proportioned and

◀ Fig. 54. Antler condition of four adult female caribou. (A) CN 4034 collected 1/12-1978 near Søndre Strømfjord Air Base, (B) CN 4036 collected 22/11-1978 near Ikardlulik (coastal area near Sisimiut), (C) CN 4035 collected 29/11-1978 near Søndre Strømfjord Air Base, (D) CN 4033 collected 19/11-1978 near Ikardlulik. Further information in text. (E) A female caribou with shed antlers and intact pedicles is shown for comparison. CN 2695 collected April 1940 on Ellesmere Island.

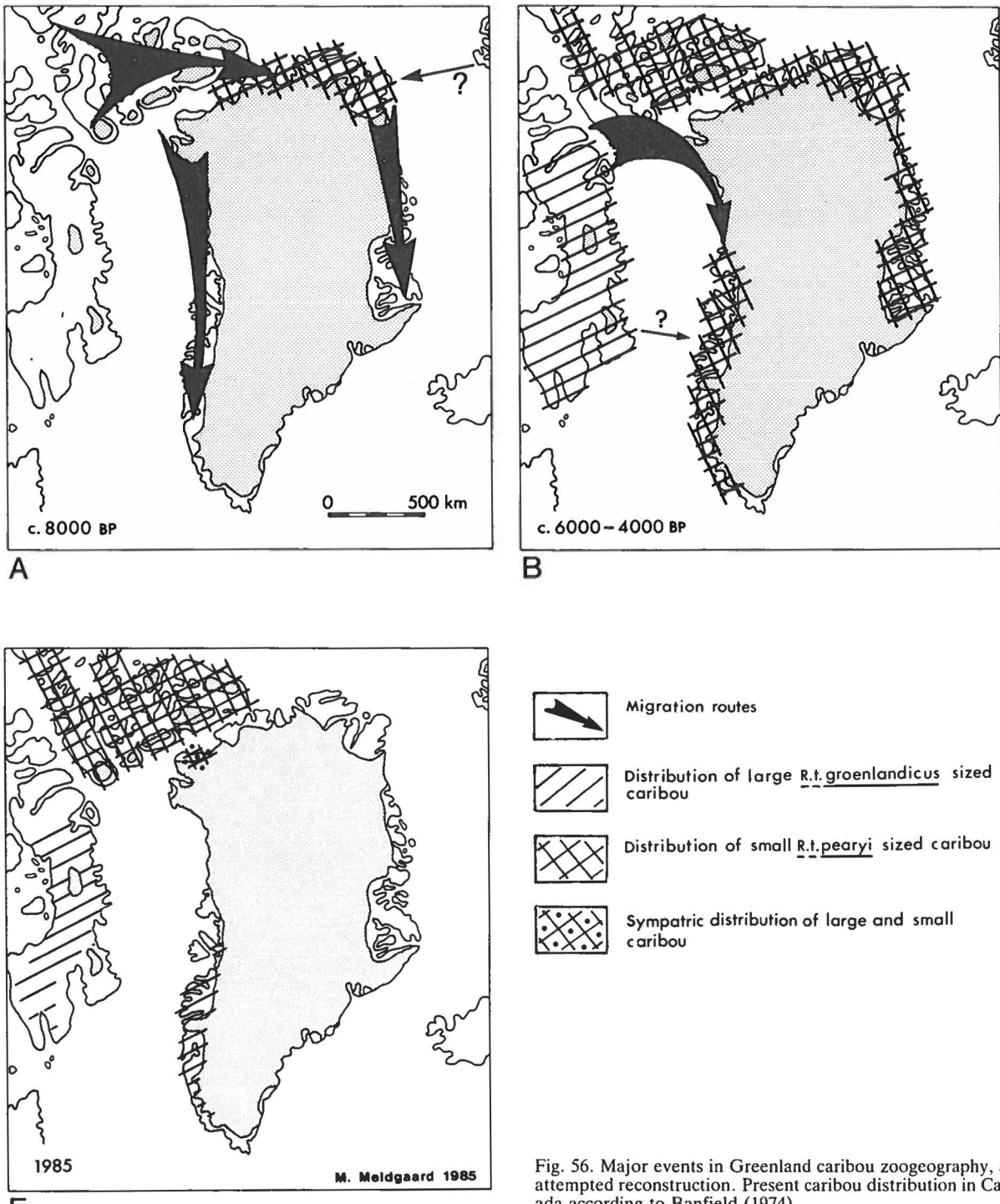
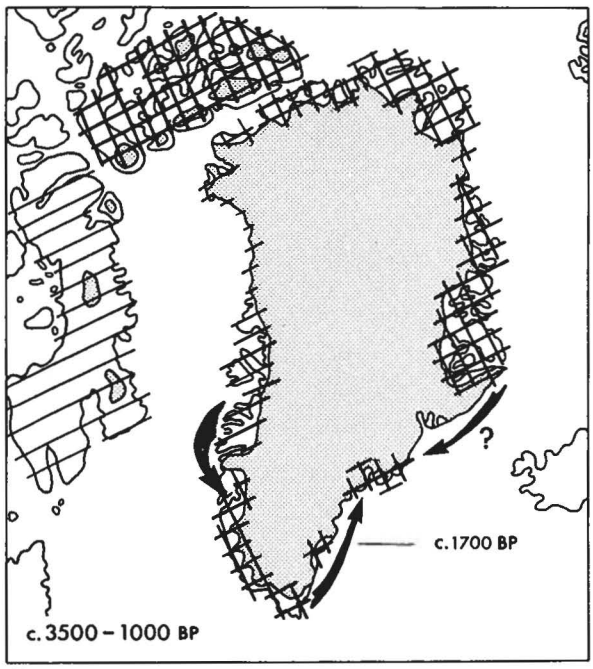
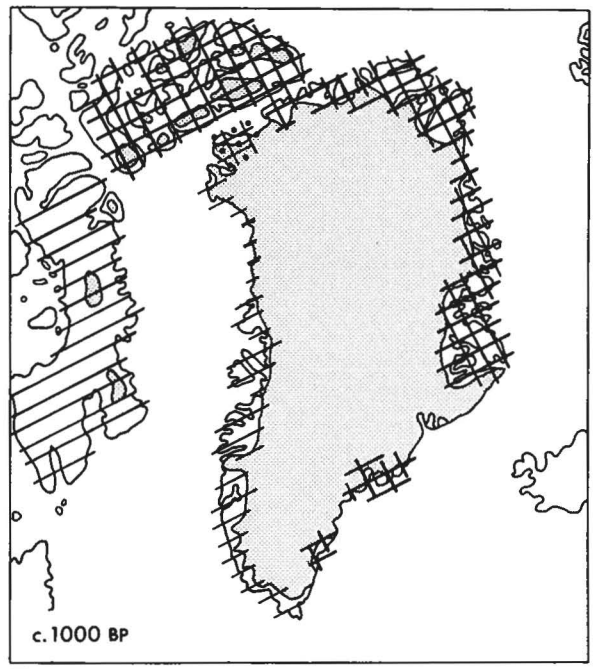


Fig. 56. Major events in Greenland caribou zoogeography, an attempted reconstruction. Present caribou distribution in Canada according to Banfield (1974).



C



D

it does not exhibit the relative shortening which is often observed as an adaptive trait among deer on oceanic islands with no predators (e.g., the Svalbard reindeer) (Klein et al. in prep., Sondaar 1977).

The origin and extinction of the Ammassalik caribou. The Southeast Greenland caribou could have immigrated either from Southwest Greenland or Northeast Greenland. However, the indented coastal stretch between Lindenow Fjord and Ammassalik seems more favourable to caribou dispersal than the coast from Scoresby Sund to Ammassalik which includes the rugged Blosseville Kyst – a major barrier to all land mammals (Degerbøl 1937). Dead caribou are known to have been transported to Ammassalik on icefloes from regions north hereof, but it is questionable whether these animals could survive this sweepstakes route which covers a distance of more than 1000 kilometres.

Presently, no firm conclusions can be drawn regarding the geographic origin of the Southeast Greenland caribou, but I favour the idea that the colonization of Ammassalik was the result of a simple northward range extension of a Southwest Greenland caribou population.

The extinction of the Ammassalik caribou was probably caused by a series of bad years (severe winters, rainy summers) following a general shift towards a more oceanic (humid) climate (p. 65–68), but caribou hunting undertaken by the Thule Culture people who immigrated to Ammassalik c. 1400 AD may also have helped to decimate the caribou population.

Concluding remarks

Banfield (1961, 1963) and MacPherson (1965) suggested that the small Peary caribou *(Rangifer tarandus pearyi)* evolved in refugia in western Queen Elisabeth Islands and in northern North Greenland during the Wisconsin-Weichsel glaciation. The existence of such refugia has, however, been questioned, and even if they did exist it is doubtful whether they could have supported significant plant or animal life. The lowland refugia that existed in Northeast Greenland throughout the Wisconsin-Weichsel glaciation were probably too small and much too isolated to support a caribou population for any longer span of time.

The Wisconsin-Weichselian "refugia" for *Rangifer tarandus pearyi* must be sought elsewhere, perhaps in Beringia, and consequently the late and postglacial history of the Greenland caribou begins with a postglacial migration into a caribou-free Greenland.

C-14 datings of caribou remains from North Greenland demonstrate that the first migration of caribou into Greenland took place prior to c. 8000 BP. The migration probably came from Ellesmere Island across the narrow Nares Strait to North and Northwest Greenland. Vibe (1981) also mentions the possibility of caribou migrating to Northeast Greenland from Sibiria via Spitsbergen, but this sweepstakes route must be considered of minor importance compared to the "landbridge" between Ellesmere Island and North Greenland (Fig. 55).

The recession of the Greenland Inland Ice began c. 9000 BC and culminated c. 6000 BC when the ice mar-

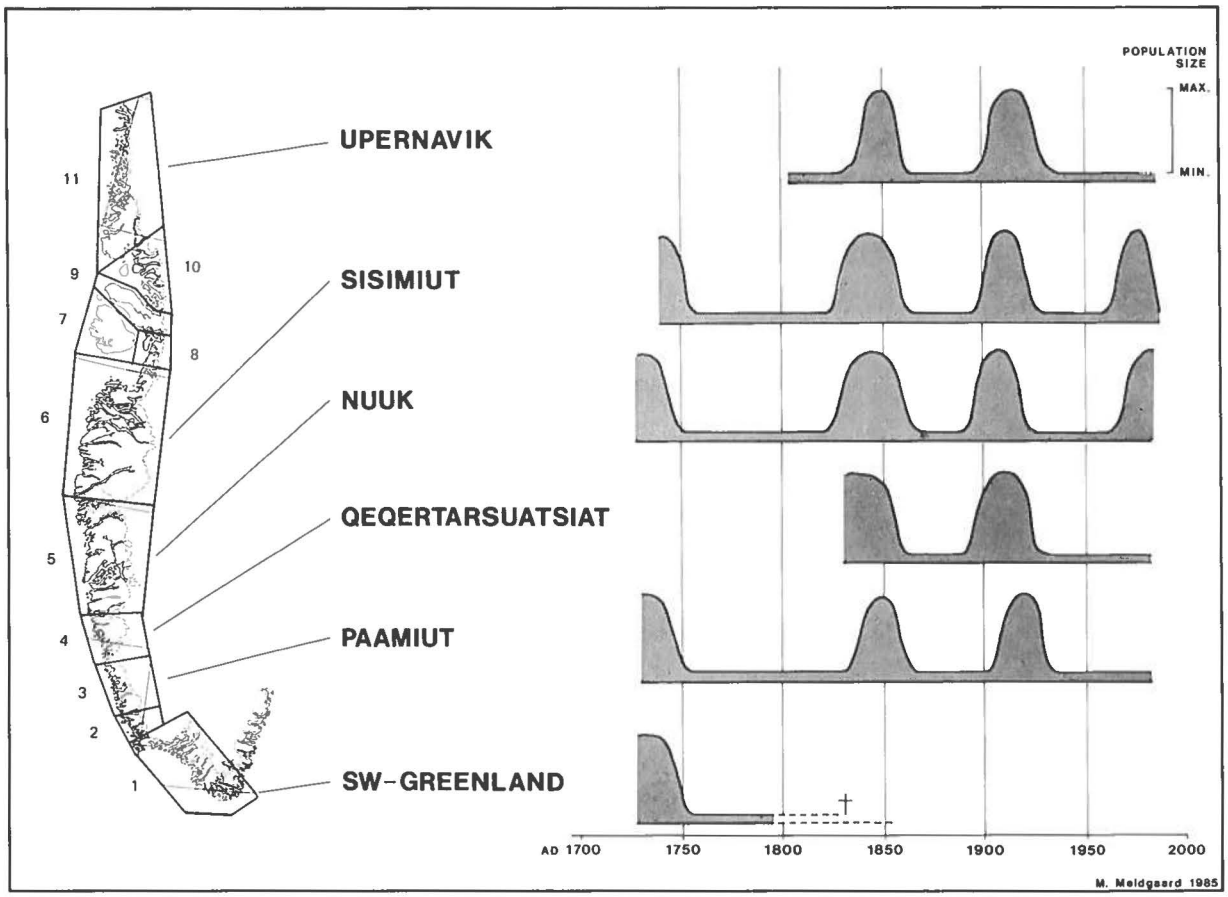


Fig. 57. Population fluctuations in six West Greenland caribou populations. The reconstructions are based on historical, ethnohistorical and game-statistical sources and on recent work done by game-biologists (for references see the descriptive part). Crosses stands for extinctions of caribou populations.

gins had almost reached their present position in most of Greenland (Funder 1978; Weidick 1976, 1984). Evidently the caribou reached North Greenland just as deglaciation was almost complete and probably they soon spread south along the east and west coast of Greenland.

Only little evidence as to the size and taxonomic status of the first migrants to Greenland is available. But it is suggestive that all diagnostic caribou bones found in North and Northeast Greenland represent small *R. t. pearyi*-sized caribou, and it is also suggestive that small caribou may pre-date the large *R. t. groenlandicus* in West Greenland. Thus, it is most likely that the first migrants to Greenland were small *R. t. pearyi*-sized caribou (Fig. 56).

The high arctic Ellesmere Island–North Greenland "landbridge" may have acted as a "filter bridge", preventing the more southerly distributed *R. t. groenlandicus* from crossing, while the small, high arctic *R. t. pearyi*-sized caribou passed the bridge with no trouble.

Probably all of Greenland was inhabited by these small *R. t. pearyi*-sized caribou from c. 6000 BC. But some time prior to 2000 BC, the large *R. t. groenlandicus* migrated to the northern parts of West Greenland. This migration thus took place well into and probably close to the termination of the postglacial hypsithermal which is dated to 5500 (3300) BC to 500 BC in West Greenland (Fredskild 1973, Funder 1978, Weidick 1976).

Banfield (1961), Vibe (1967: 167), and Roby et al. (1984) suggested that *groenlandicus* migrated directly across Davis Strait to West Greenland, a distance of c. 400 kilometres. It may be that the comparatively late arrival of *groenlandicus* was due to the low probability of survival on this sweepstakes route. But the filter effect of the Ellesmere Island–Northwest Greenland "landbridge" probably lessened during the hypsithermal, allowing *groenlandicus* to travel around Baffin Bay and the Davis Strait.

The southward expansion of *Rangifer tarandus groenlandicus* into the southern parts of West Greenland was prevented at least for 500 years by the glacier tongue

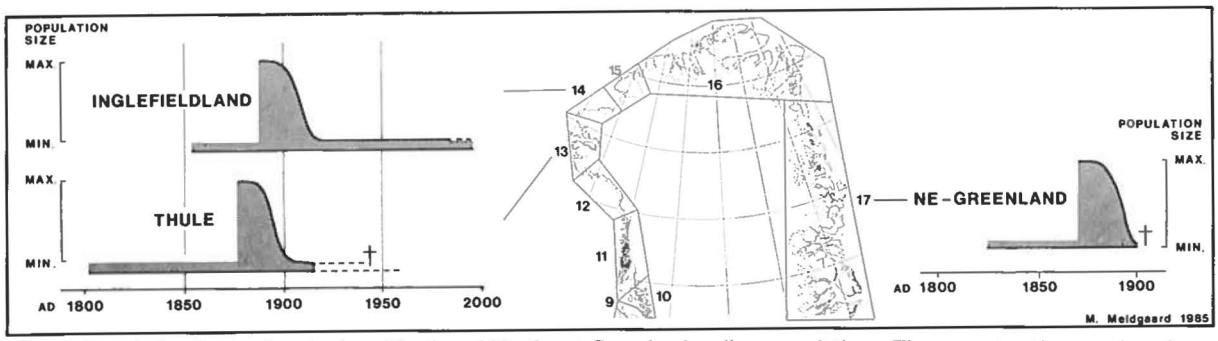


Fig. 58. Population fluctuations in three North and Northeast Greenland caribou populations. The reconstructions are based on historical and ethnohistorical sources and on recent work done by game-biologists (for references see the descriptive part). Crosses stands for extinctions of caribou populations.

Sukkertoppen Iskappe, but some time between 1500 BC and 1000 AD they surmounted the barrier and ousted the relic population of small Itivnera caribou. Reaching maximum distribution, *R. t. groenlandicus* inhabited all of West and Northwest Greenland from Kap Farvel to Humboldt Gletscher, but it never seems to have reached North or East Greenland.

North Greenland was probably inhabited periodically by small *R. t. pearyi*-sized caribou through more than 8000 years. Presumably these caribou also spread into Northeast Greenland, but the evidence of caribou in this region is limited to the period from c. 1300 AD to 1900 AD.

Some time prior to 300 AD, a group of caribou colonized the Ammmassalik region, an isolated enclave on the southeastern coast of Greenland. Probably they originated in Southwest Greenland and reached Ammassalik as the result of a northward range extension. The presence of caribou in the Tingmiarmiut region c. 700 AD is in agreement with this theory. But they may also have taken a sweepstakes route from Northeast Greenland using the East Greenland drift ice as a means of transportation. Perhaps the immigrants were small Itivnera caribou or Northeast Greenland caribou, or perhaps they were descendants from the more recently immigrated, large West Greenland caribou. At any rate, the environment favoured an adaptation towards even smaller size, and when the population went extinct some time after 1100 AD, the caribou had become quite dwarfish.

The Northeast Greenland caribou went extinct c. 1900 AD, and during the last 200 years the range of the West Greenland caribou has been reduced by more than 50%, following progressive extinctions of marginal and geographically comparatively isolated populations.

The general impression of changes in caribou distribution in Greenland during the last 1000 years is that of an overall range reduction starting in Southeast Greenland and progressing north and south along the coasts leading to the present concentrations in central West Greenland and Inglefield Land.

Population dynamics

Changes in population size

All caribou populations in Greenland are subjected to considerable fluctuations in their numbers, a phenomenon which is well known from caribou populations in other northern regions. Based on data from historical, ethnohistorical, statistical, and game-biological sources from the last 250 years, it has been possible to investigate the duration and amplitude of the fluctuations in the Greenland caribou populations and to gain some insight into the questions of periodicity and synchrony in these fluctuations.

Duration of a population cycle. – According to the data presented in the descriptive section (summarized in Fig. 57), the length of the caribou population cycles may differ from c. 65 to c. 115 years. The population decreases and increases seem to be of rather short duration, usually c. 10 years, and the same goes for the duration of the population maxima that may last from c. 10 to c. 25 years. The population minima, however, may last longer, usually from c. 35 to c. 70 years. The difference in cycle length is thus primarily due to differing lengths of the minimum phase.

In some cases the caribou populations are unable to recover from the severe reduction in numbers, and extinction is the result. Usually, extinction does not follow the decline immediately; rather the population survives in small numbers for some years before finally disappearing.

The amplitude of a population cycle. – The differences in population size at a population maximum and a population minimum are generally very large. A well documented case is the 1970 to 1980 reduction of the total West Greenland caribou population from a high of c. 100 000 to a low of c. 8000 animals (Strandgaard et al. 1983, Thing 1984). Historical and ethnohistorical sources (e.g., Müller 1906: 370, Jac. Rosing 1926/27:

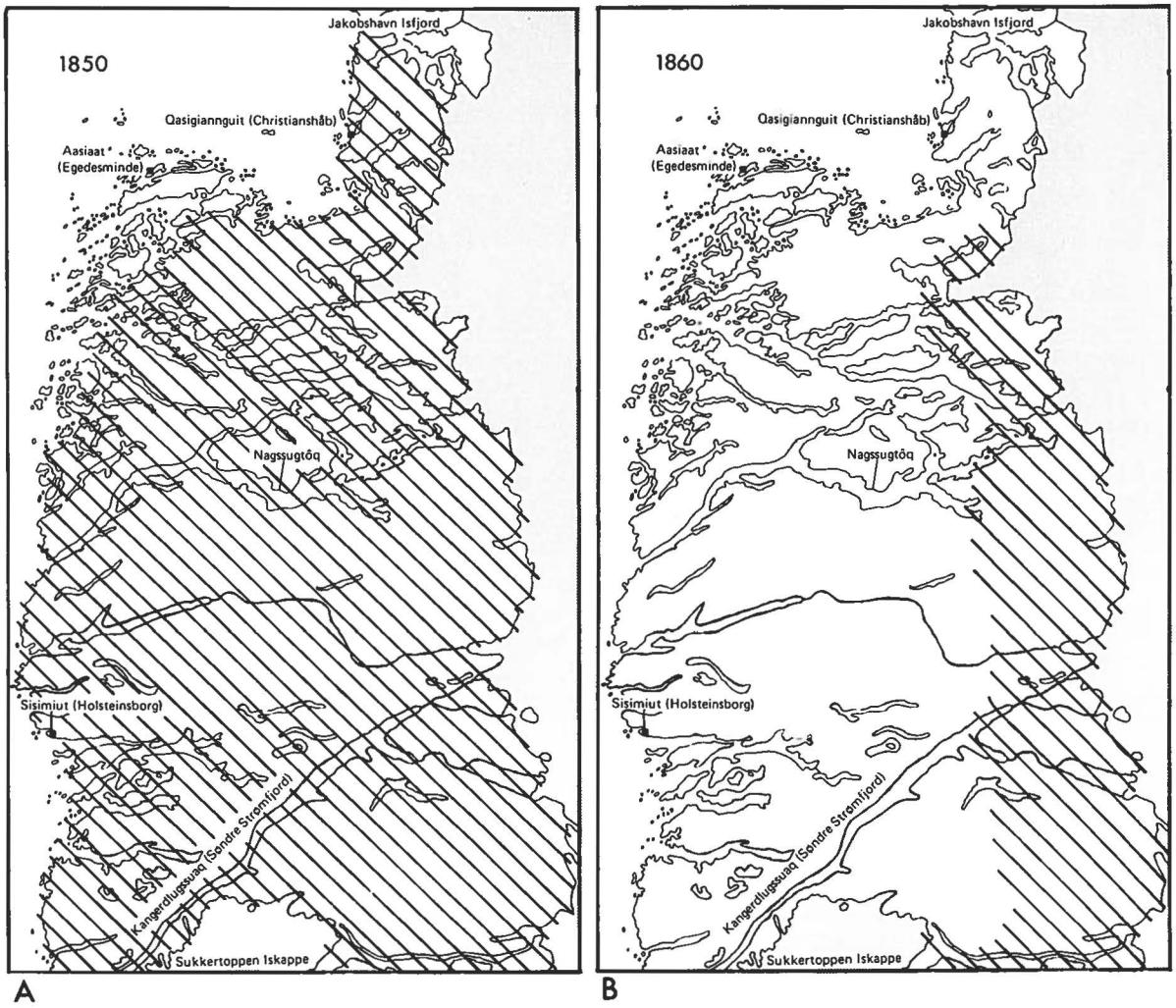


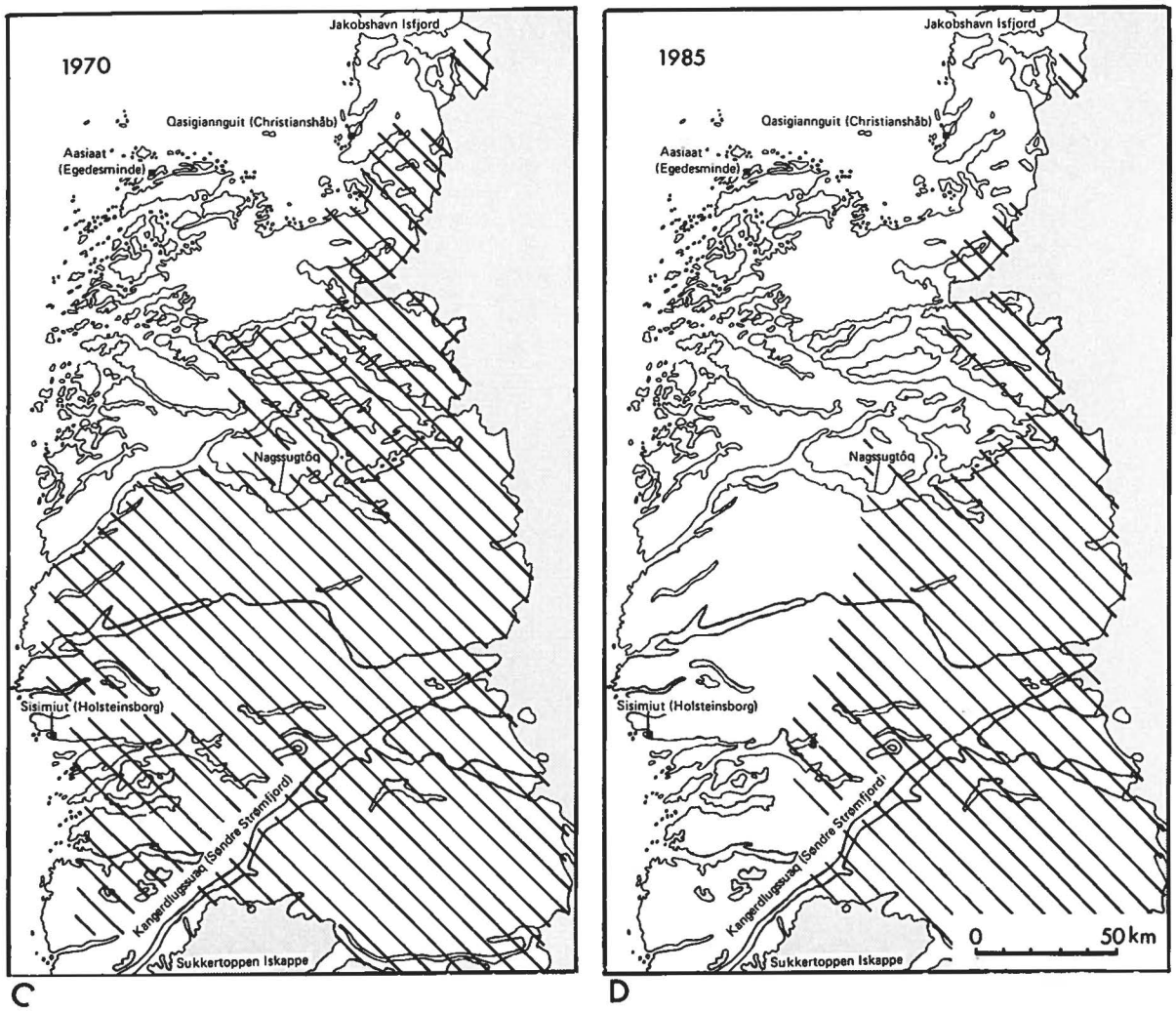
Fig. 59. Caribou distribution in the Sisimiut region during: (**A**) the population maximum c. 1850, (**B**) the population minimum c. 1860, (**C**) the population maximum c. 1970 and (**D**) the population decline in the early 1980's.

col. 90) and statistical material leave the impression that the amplitude usually is of this magnitude. A vivid account is given by Rasmus Müller (1906: 370): "Whatever the reason for this, it is a fact that caribou hunting now [1898] and 50 years ago relate to each other as a mouse to an elephant."

There are indications that the absolute population levels reached by a given caribou population during different population maxima are not the same. In region 6 (Sisimiut) the 1900 to 1915 maximum did not seem to reach the levels of the 1830 to 1853 maximum or the 1970 to 1976 maximum. Neither did the population maximum in region 11 (Upernavik) between 1900 and 1915 seem to be as pronounced as the 1840 to 1849 maximum in the same region. However, more comparative data from better documented population fluctuations is needed before this problem can be satisfactorily solved.

Periodic or aperiodic population cycles? – The population fluctuations in Greenland can be reconstructed through 250 years (Fig. 57). These 250 years cover at the most three full population cycles – too few to reveal if they are periodic or not. If the fluctuations are periodic, they follow a complicated pattern with periods varying between 65 and 115 years.

Synchronous or asynchronous population cycles? – A number of observations can be made regarding the timing of the fluctuations in the different West Greenland regions (Fig. 57). (1) A population decline occurred between 1750 and 1760 in Southwest Greenland, Paamiut, Nuuk, and Sisimiut (regions 1, 3, 5, 6). (2) A population minimum is documented between 1760 and 1820 in Southwest Greenland, Paamiut, Nuuk, Sisimiut, and Upernavik (regions 1, 3, 5, 6, 11). During this minimum, the caribou in Southwest Greenland and possibly



on Disko went extinct (regions 1, 7). (3) From 1820 to 1900 the populations from Paamiut, Nuuk, Sisimiut, Upernavik, and to some extent Qeqertarsuatsiaat (regions 3, 5, 6, 11, and 4) ran through a complete population cycle. During the minimum phase (c. 1890), the population in Ivigtut (region 2) went extinct. (4) Another population cycle is documented between 1890 and 1960 from Paamiut, Nuuk, Sisimiut, and Upernavik (regions 3, 5, 6, and 11). (5) From 1960 till today the populations from Paamiut, Qeqertarsuatsiaat, Nuuk, and Sisimiut (regions 3, 4, 5, 6) have experienced a population increase and a population maximum. (6) Between 1976 and 1982, the populations in Sisimiut and Qeqertarsuatsiaat (regions 6, 4) have decreased.

There are cases where the populations do not seem to be synchronized. In the Paamiut region (3), no population increases or maxima have been documented from 1960 till today, and the maximum in Paamiut c. 1840 is poorly documented. Furthermore, the Nuuk population (region 5) is presently at a maximum, while the Sisimiut and possibly the Qeqertarsuatsiaat populations (regions 6, 4) have started declining less than ten years ago.

Apparently the minimum phase may be prolonged in small and marginal populations like Paamiut and Upernavik, and there may be a slight displacement in the timing of the cycles from region to region. Aastrup (1984b: 32), Strandgaard (1977: 7), and Strandgaard et al. (1983: 6) have focused on these differences and discrepancies and conclude that the populations in West Greenland fluctuate independently and in an asynchronous manner. However, if all historical, statistical, etc. information is considered, synchrony, not asynchrony, seems to characterize the timing of the fluctuations in the different regions of West Greenland through 250 years.

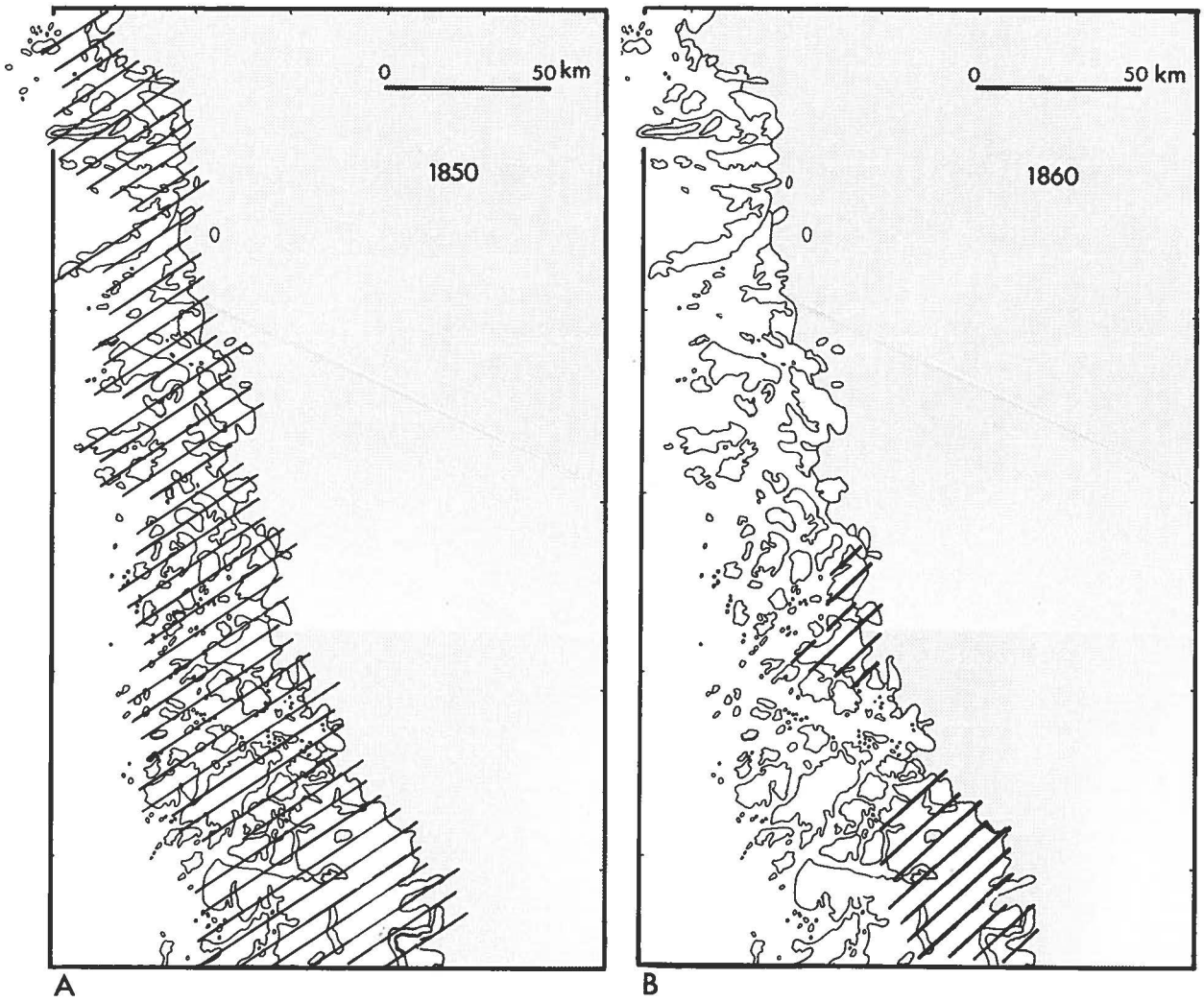


Fig. 60. Caribou distribution in the northern Upernavik region during: (**A**) the population maximum c. 1850 and (**B**) the population minimum c. 1860.

This impression is supported by the fact that the caribou populations in Thule, Inglefield Land, and Northeast Greenland (regions 13, 14, 17) experienced a drastic and apparently synchronized decline between 1895 and 1915, ultimately resulting in the extinction of the Thule and the Northeast Greenland populations (Fig. 58).

While these high arctic caribou populations were mutually synchronized, they seem to have been out of step with the West Greenland caribou populations that were increasing at the time.

Fluctuations in other regions. – From the Alaskan Nelchina Herd and the Western Arctic Herd, there is evidence of caribou population cycles lasting c. 100 years (Bergerud et al. 1984, Burch 1972, Hemming 1975). Skoog (1968: 318), however, found that the Alaskan herds took just 60 years to run through a population cycle. The Ungava Herd in Labrador/Quebec may also have a cycle lasting c. 100 years (Audet 1979), while Clarke (1940) identified a 35 year cycle among Barren Ground caribou. Clarke's cycle has later been questioned by other biologists (in Burch 1972: 356). The North American caribou cycles thus range from 60 to 100 years, but until long-termed observations have been made, it will not be possible to decide whether the fluctuations are periodic or not (see also Ingold 1980: 46, Kelsall 1968: 205). The amplitude of the fluctuations in other northern populations usually correspond to those described from Greenland. Drastic population declines have for example been described from many herds in Alaska (Burch 1972, Haber & Walters 1980), from the Ungava Herd in Quebec/Labrador (Audet 1979), from Canadian Barren Ground Herds (Kelsall 1968), from

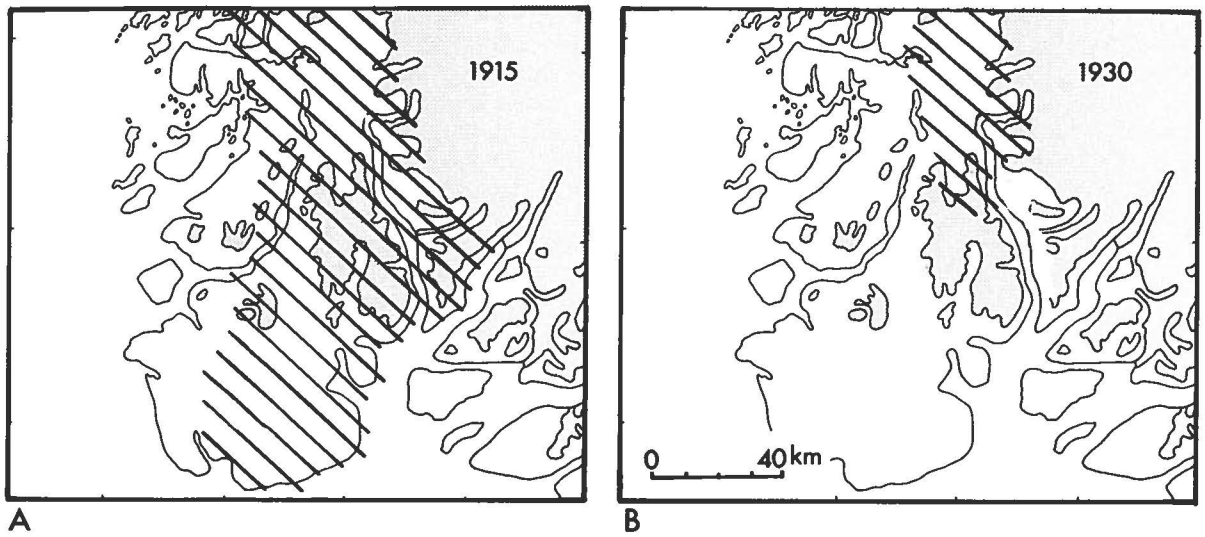


Fig. 61. Caribou distribution in the southern part of the Upernavik region during: (A) the population maximum c. 1915 and (B) the population minimum c. 1930.

the western Queen Elisabeth Islands (Gunn et al. 1980/81), and from Sibirian herds (Jacobi 1931: 155).

The information on synchronous or asynchronous caribou fluctuations in regions outside Greenland is scarce, but Burch (1972) does describe synchronous fluctuations from Alaska (see also Bergerud (1978) and Doerr (1980)).

Changes in distribution

The distribution of caribou within each region and the migratory behaviour change as the size of the populations change. The relationship between population fluctuations and distributional changes are particularly well known from region 6 and from region 11, wherefore these will be dealt with in some detail below.

Case 1: Region 6, Sisimiut. – During the population maximum c. 1840, the population also reached its widest distribution. Caribou were found everywhere between the Inland Ice and the coast where they were shot "almost standing in the doorways of people's houses". They even invaded the islands off the coast, e.g., the islands around Agto. To the north they approached Jakobshavn Isfjord and to the south they were found on the narrow strip of land west of the Sukkertoppen Iskappe. The caribou had also begun to undertake large migrations within the region (Fig. 59A).

As the population decreased in the 1850'es, the caribou disappeared from the northern part of their range and from the area just west of Sukkertoppen Iskappe. They went extinct on the offshore islands and they retreated from the coastal areas towards the Inland Ice and the nunataks (Fig. 59B).

During the population cycle from 1965 to 1984, the distributional pattern changed in a manner quite parallel to the changes that occurred during the 1820 to 1890 cycle, and again characteristic changes in the migratory behaviour were noticed. The east–west oriented migrations started as the population began to increase in the early 1960'es, and they continued throughout the population maximum (Fig. 59C). Then following the population decline in the late 1970'es, the extensive annual migrations seem to have ceased. The caribou stay in the inland area all year round, having abandoned their former primary winter quarters in the coastal areas (Fig. 59D).

Case 2: Region 11, Upernavik. – During the population maximum around 1845, caribou were found on many islands north of the Svartenhuk Halvø and even on islands in the Melville Bugt. The major part of the population was living on a few large islands just north of Svartenhuk Halvø, around the inner parts of Upernavik Isfjord, and around Laksefjorden (Fig. 60A). When the caribou population declined in the early 1850'es, the animals disappeared from the larger part of the small islands and nunataks north of Svartenhuk Halvø, surviving mainly in the Upernavik Isfjord and Laksefjorden area (Fig. 60B).

One population cycle later, following the 1915–20 decline, a similar retreat was seen on the Svartenhuk Halvø itself. At first the caribou disappeared from the westernmost parts of the peninsula, then they retreated from the southern coastal areas, and finally they were found only around the head of Laksefjorden (Fig. 61A, B).

Other cases: Region 5, Nuuk. – When the caribou population was large, the animals spread into the coastal region and on to offshore islands like Hamborgerland. In periods of low caribou numbers they retreated to the inland areas. *Region 3, Paamiut.* Following the 1750 decline in the population, the caribou retreated to "the most remote parts of the land", probably the interior areas and the nunataks.

Changes in body size

According to Inuit hunters, caribou body size is subjected to short-termed changes that are correlated to population fluctuations. During population maxima, the caribou become larger and more heavy, while they tend to be smaller and lighter during population minima (Vibe 1982).

Mandibles of bull caribou picked up in the Sisimiut and Nuuk regions and tentatively judged to be 10–30 years old turned out to be significantly larger than mandibles collected from bulls killed in 1977 and 1978 (Holthe & Lassen 1984). The difference in mandible length averaged c. 1 cm, or less than 5%. Assuming that the dating of the picked-up mandibles is correct, these represent caribou body size between 1955 and 1975, i.e., during a population increase and maximum, while the small mandibles from 1977–78 represent caribou body size during a population decrease and minimum.

Concluding remarks

Caribou distribution, abundance, migratory behaviour, and body size are dependant variables.

When the West Greenland caribou populations increase in numbers, they extend their annual movements and expand their ranges into marginal, previously uninhabited or very thinly inhabited territory (Fig. 62). The expansion is primarily directed towards the coastal regions and the acquired coastal ranges are mainly used as wintering areas. The summering areas and calving grounds, on the other hand, do not change location – they are permanently situated in the inland regions. The conditions for body growth are more favourable during population increase and maxima and the caribou attain larger size.

During population decrease the caribou abandon their coastal winter quarters, annual movements cease, and they retreat to the inland areas where they make a living throughout the year. When caribou distribution is restricted to the inland ranges, the density of animals in this area is lower than during a population maximum. The caribou seem to be smaller when the population level is low.

A relationship between caribou abundance, distribution and movement similar to the one described from West Greenland has been documented in other northern regions. In some Alaskan herds, population increase was accompanied by increased movements and by range expansion, while population decrease was followed by range contraction towards the calving grounds and a cessation of annual migrations (Bergerud et al. 1984, Hemming 1975, Skoog 1968: 202).

Skoog (1968: 202) has called the areas to which the caribou retreat when their numbers are low, "centres of habitation". The centre of habitation is the focal point from which the population during increase disperses into more marginal areas.

Other examples of correlated changes in abundance, distribution, and movements are known from Canada (Banfield 1954: 18, Kelsall 1968: 122, Parker 1972: 88–89), Siberia (Semenov-Tian-Shanskii 1975: 156), and from Norway (Skogland & Mølmen 1980: 134). And Klein (1968), Klein et al. (in prep.) and Reimers (1972) demonstrate how changes in caribou body size may be synchronized with changes in population size.

Possible causes for distributional changes and fluctuations

The dramatic caribou fluctuations have had a large impact on traditional Inuit economy and on the trade at the Danish trading posts, and the causes of these fluctuations have therefore been a topic of speculation and debate through more than 250 years.

Predation (including hunting), overgrazing, and climate are the three regulating factors that have carried most weight in the discussion of the possible causes of the fluctuations among Greenland caribou. These three factors have also been the focus of attention in similar discussions in other northern regions, e.g., Alaska and Canada.

Predation and hunting

In West Greenland, overkill by man has been given the blame for population declines on several occasions (Dalager 1752: 80; J. A. D. Jensen 1879: 125–26; Oldendow 1935; Rink 1857: 173) and the same goes for population declines in the Thule region (13) and the Inglefield Land region (14) (A. S. Jensen 1928: 35; Mac Millan 1925: 216–17; Rasmussen 1919: 101, 1921: 534, 536, 542; Roby et al. 1984).

The evidence for all these postulated overkill situations is very limited. The Danish observers were often staggered by the large numbers of caribou killed during population maxima, and terms like "overkill" and "mass murder" were commonly used by people with limited knowledge of traditional caribou hunting methods (Anon 1917: 538; Jannsen 1913: 24–25; J. A. D. Jensen 1879: 125–26; A. Nielsen 1907; Rasmussen 1907a; Thorhallesen 1775: 62–63). It is nevertheless a

fact that hunting was heavy at times; R. Müller (1906: 373) calculated, for example, that the annual yield of caribou in West Greenland during the population high from 1838 to 1855 was 25 698 animals. But still this does not prove that hunting was too heavy or that overkill was the decisive cause of the population declines.

From the small and geographically restricted caribou terrain in the northern part of the Paamiut region (3), there seems to be evidence that too high hunting pressure in the 1970'es and 1980'es has kept the caribou population from expanding (Aastrup 1983c). And in special cases where small caribou populations have been inhabiting small islands there is proof that hunting has decimated or exterminated the caribou. The Melville Bugt has from time to time housed a number of very small caribou populations (all probably less than 100 individuals, most 5–15 individuals) on islands and nunataks that rarely exceed 50 km^2 in size. At the beginning of the 20th century, most of these populations were hunted to extinction by Polar Eskimos. The history of the caribou population on Tugtuligssuaq (68 km^2) is particularly well known. These caribou were exterminated by the Eskimos in 1909. They repopulated the peninsula only to be exterminated once more in the 1940'es (Degerbøl 1957: 18; Freuchen 1911: 144; Nic. Jensen, pers. comm.; Rasmussen 1919: 64, 1921: 531).

Wolves have occurred periodically in North and Northeast Greenland (Dawes et al. 1986), and Nathorst (1900: 329) blamed the decline of the Northeast Greenland caribou just prior to 1900 AD on wolf predation.

Predation by man and/or wolves has been seen as the major population regulating factor in most North American caribou herds (Audet 1979; Bergerud 1974, 1980, 1983; Bergerud et al. 1984; Davis et al. 1980; Doerr 1980; Elton 1942: 384–86; Jacobi 1931; Kelsall 1968: 205; Haber & Walters 1980; and others).

Overgrazing

In 1953, J. G. Jennov proposed that overgrazing was the main cause of the decline and extinction of the Northeast Greenland caribou population and of the fluctuations in the West Greenland caribou populations. The hypothesis was revived and elaborated by H. Strandgaard (1977, 1980) in connection with a detailed investigation of the biology of the West Greenland caribou (List of Publications in Strandgaard et al. 1983). P. Aastrup (1984b), who has been working mainly in the Nuuk region (5), is also of the opinion that overgrazing is one of the major population regulating mechanisms.

An important test of the self-regulation hypothesis is the documentation of overgrazing. The game-biologists have therefore put a lot of effort into the study of caribou feeding ecology, and a status has been made of range conditions in parts of the Sisimiut and Nuuk regions (6 and 5) (Aastrup 1984a, Holt 1980, Thing 1984).

In order to assess the degree of "overgrazing" in the late 1970'es in the Sisimiut region, it is of course necessary with comparative data dealing with range conditions in the same area but from the period between 1965 and 1975 when the population was below carrying capacity and growing. Unfortunately, this kind of data is virtually non-existent. Rasmussen (1907b), Böcher (1954), and Vibe (1967: 178) do present observations on vegetation characteristics, but they present no evaluation of the effect of grazing on range conditions rendering their data comparable to data collected in recent years.

Fluctuations induced by overgrazing have been reported from three small and previously uninhabited islands in the Bering Sea. Typically these populations suffered a die-off following a single drastic population increase (Klein 1968, Scheffer 1951).

These cases however are special. In a more extensive geographical region where caribou and vegetation has been interacting through centuries such a herbivore-plant system, all other things being equal, will tend to stabilize at a given level and only exhibit small deviations from the equilibrium (Krebs 1978: 278). Theoretically these oscillations are insignificant compared to the irruptions that occur following introductions into previously uninhabited ranges.

Climate

Peter Freuchen drew attention to the climatic factor in connection with the dramatic decline in the Thule region caribou population around the year 1900. Periods of thaw during the winter and the subsequent formation of ice crusts prevented the caribou from reaching the vegetation, and in the spring and summer of 1901 the Eskimos found dead caribou strewn all about the hills. They related how the animals, exhausted from hunger, lost all fear of man, and how no foxes were trapped for a few years because there was plenty of caribou for them to eat (Freuchen 1911: 145, 1915: 390, 1927: 20; Freuchen & Salomonsen 1958: 79; Roby et al. 1984).

M. Degerbøl presented a similar hypothesis explaining the decrease and extinction of the Northeast Greenland caribou population around 1900 (1957). He argued that a general climatic deterioration with high frequencies of "ice winters" was the single most important reason for the population decline.

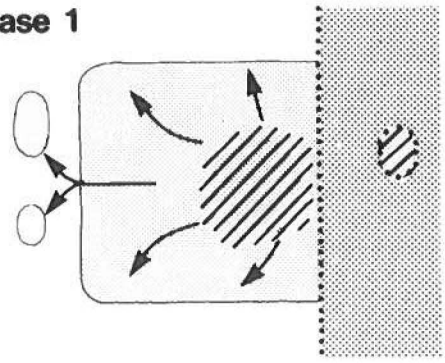
Heavy snowfall and frequent winter thaw are also reported as factors influencing caribou density in present populations on Disko (R. Møbjerg Christensen, pers. comm.), in Ammassalik (Reimers 1980), and in Sisimiut c. 1860 (Jak. Rosing 1926/27: col. 90).

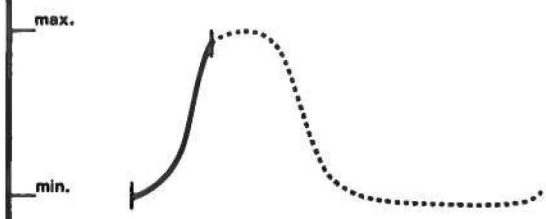
Vibe (1967, 1982, 1984) has presented a climatic model that explains the fluctuations and distributional changes that occur in the Greenland caribou populations as well as in other Greenlandic animal populations.

Distributional changes

Population size changes

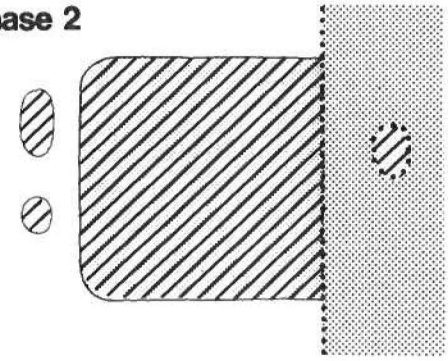
Phase 1

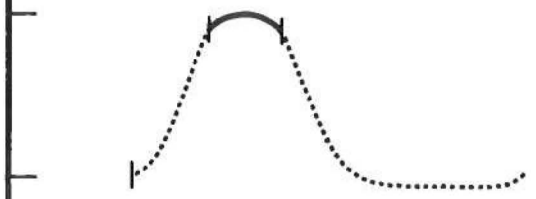




Duration ca. 10 years. Population increase.
Range expansion. Initation of annual migrations.

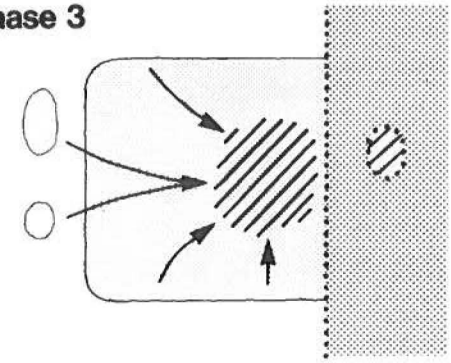
Phase 2

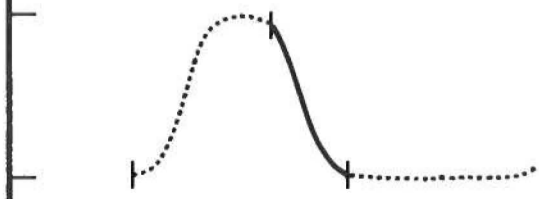




Duration ca. 10 to 25 years. Maximal population size.
Maximal distribution. Annual migrations.

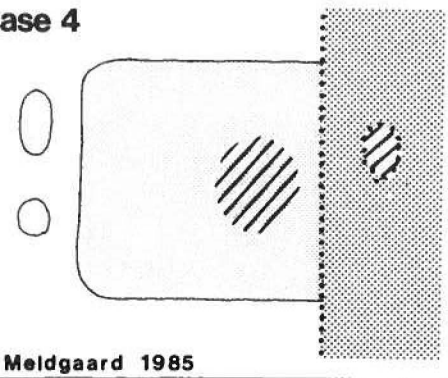
Phase 3

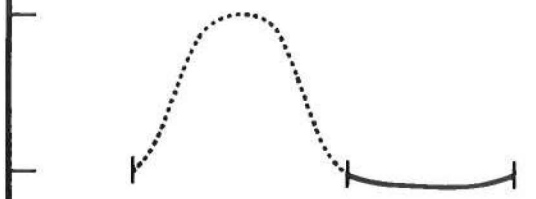




Duration ca. 10 years. Population decrease.
Range reduction. Cessation of annual migrations.

Phase 4





Duration ca. 35 to 70 years.
Minimal population size. Minimal distribution.

M. Meldgaard 1985

Land (island, mainland, nunatak) | Indland Ice | Sea & fjord | Caribou distribution | Range expansion or reduction

Table 2. Monthly average mean temperatures (°C), average winter means, summer means and annual means for three periods at Sisimiut and two periods at Søndrestrømfjord Air Base (compiled from Hasholt & Søgaard 1978 (Sisimiut: 1885–1925, 1961–1976, Søndrestrømfjord Air Base: 1946–1965), Danish Meteorological Institute, unpubl. (Sisimiut: 1977–1984, Søndrestrømfjord Air Base: 1976–1984)).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	May–Oct.	Nov.–April	Annual mean
Sisimiut (Holsteinsborg)															
1895–1925	−17.6	−17.0	−13.9	−7.7	0.7	5.4	7.6	6.9	2.7	−3.3	−8.0	−13.7	3.3	−13.0	−4.8
1961–1976	−12.2	−12.7	−14.2	−6.9	−0.1	3.6	6.2	6.1	3.4	−1.6	−5.8	−10.0	2.9	−10.3	−3.7
1977–1984	−13.1	−16.1	−13.2	−7.2	−0.5	3.3	6.4	5.8	3.0	−2.1	−5.9	−8.4	2.7	−10.7	−4.0
Søndrestrømfjord Air Base															
1946–1965	−18.0	−17.8	−16.3	−8.2	3.2	9.0	10.5	8.7	3.0	−4.9	−11.2	−16.2	4.9	−14.6	−4.6
1976–1984	−22.6	−21.6	−17.1	−8.1	2.4	8.5	10.9	8.7	3.3	−5.6	−12.8	−14.9	4.7	−16.2	−5.7

Climatic change in the Sisimiut region. – The character of ongoing climatic changes in Greenland is best illustrated by an example from one of the main caribou regions in West Greenland, the Sisimiut region.

Table 2 presents temperature data from Sisimiut (1885–1925, 1961–1976, and 1977–1984) and from Søndrestrømfjord Air Base (1946–1965, 1976–1984). Data is lacking for some years, either because no observations were made or because the data are as yet inaccessible.

The observations document drastic climatic changes in the region through the last hundred years. At the coastal station, Sisimiut, the average annual mean temperature rose from −4.8°C to −3.7°C, or by 1.1°C, between 1885–1925 and 1961–1976. This temperature rise was solely due to a strongly increasing winter temperature (from −13°C to −10.3°C). The summer temperature was actually falling in the same time interval (from 3.3°C to 2.9°C). In other words, the climate was becoming increasingly oceanic in character. Expressed in figures, the degree of oceanity defined as the temperature difference between the mean of the coldest and the warmest month changed from 25.2°C (1885–1925) to 20.4°C (1961–1976), or by 4.8°C. This tendency seems to have been reversed if data from 1961–76 are compared to data from 1977–84. The average annual mean temperature has dropped 0.3°C, again owing especially to changes in the winter temperature (a drop from −10.3°C to −10.7°C) and less to changes in summer temperature (a drop from 2.9°C to 2.7°C) (see also Hasholt & Søgaard 1978: 76).

The climatic observations from the inland station at Søndrestrømfjord Air Base show a change similar to the Sisimiut data towards a more continental climate between 1946–1965 and 1976–1984. The average annual mean has dropped by 0.8°C, from −4.9°C to −5.7°C, mainly due to a 1.6°C drop in winter temperature and a 0.2°C drop in summer temperature. The degree of continentality of the area has increased by 5°C, from 28.5°C to 33.5°C.

Precipitation measurements from Sisimiut show an increase in average annual percipitation from 270 mm in the period 1923–1929 to 358 mm in 1961–1976, indicating a change towards a more humid oceanic climate in line with change revealed by the temperature observations.

Climatic change in West Greenland. – The climatic trends that emerge from the temperature and precipitation data from Sisimiut and Søndrestrømfjord Air Base fit into a broader pattern of climatic change in West Greenland. Fig. 63 shows how temperature changes which have occurred between 1880 and 1950 have influenced West Greenland as a whole. These general climatic changes are probably governed by north–south movements of the polar front and the simultaneous changes in the pattern of the cyclonic activity over Greenland.

According to Knud Frydendahl, Meteorologisk Institut, Copenhagen (pers. comm.), the cyclonic activity in the 1920'es moved north in the wintertime, resulting in an increased winter precipitation (Hasholt 1981) and an increase in winter temperature – a more oceanic climate being the general result. Between 1955 and 1970, this oceanic tendency was reversed as the arctic air masses and the polar front moved south again (Hasholt 1981), and a more continental climate developed in West Greenland.

Climate in other arctic regions. – The effect of adverse weather and climatic change on caribou population regulation has especially been stressed in connection with fluctuations in high arctic populations, for example on Queen Elisabeth Islands and Svalbard (Gunn et al.

◀ Fig. 62. Model showing the interdependance of distribution, abundance, and migration during a population cycle in a typical West Greenland caribou population.

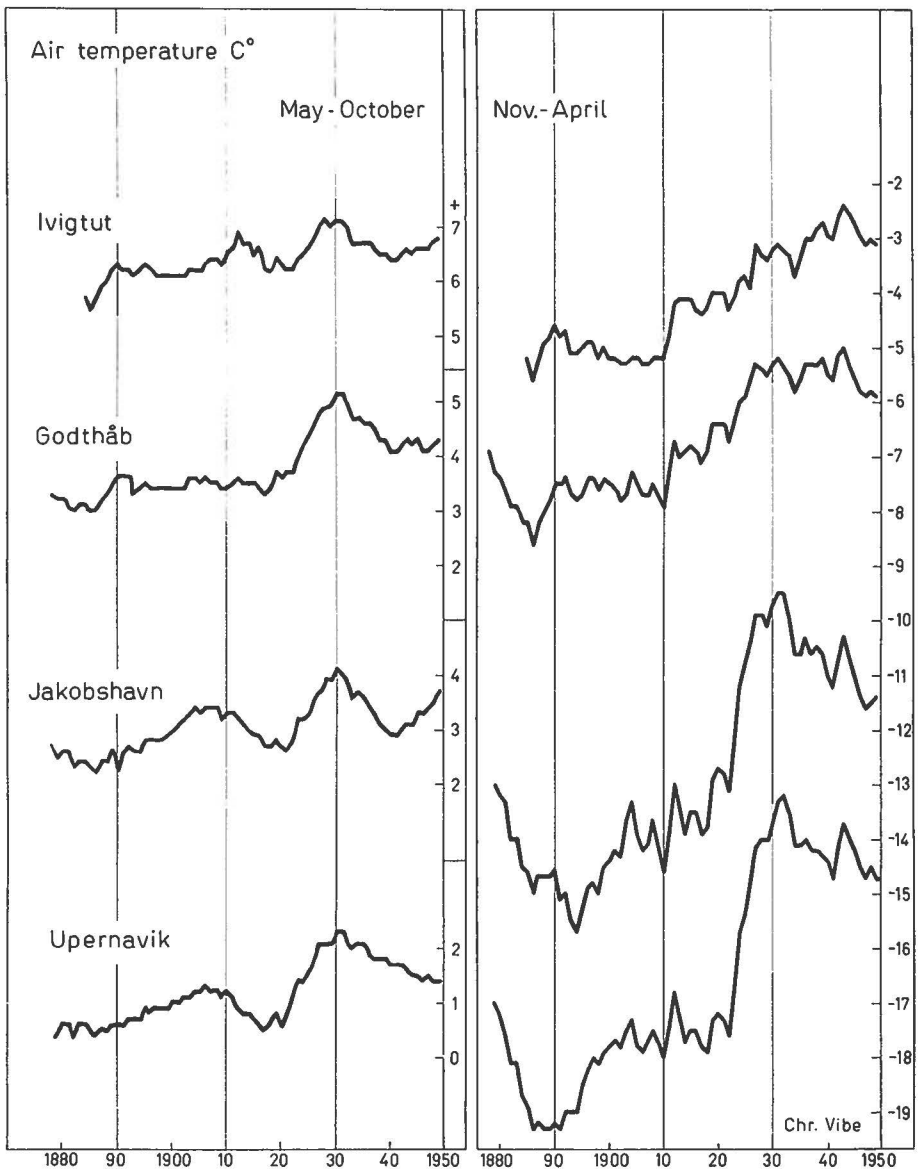


Fig. 63. Summer and winter air temperatures for four stations in West Greenland in 10-year sliding averages (from Vibe 1967: 31).

1980/81, Miller et al. 1977, Parker et al. 1975, Reimers 1977), and in connection with small isolated island populations, for example on Belcher Islands (Pierard 1979). Usually the effects of snow accumulation and ice crust formation on forage availability are cited as the direct causes of the population declines. The effects of weather and especially of snow on population size, distribution, and movement are also known both from populations of wild mainland caribou (Henshaw 1968, Miller 1982) and from herds of domestic reindeer, e.g., in Scandinavia (Helle & Säntti 1982, Lönnberg 1909: 117–19, Nieminen et al. 1982). Concerning long-termed climatic change, Gaare (1978) pointed out that meteorological data from Norwegian stations in some reindeer districts showed a 50% decrease in precipitation in just 30 years (1901–30 to 1931–60) and that these changes should be taken into consideration when modelling for example winter range carrying capacity. Mercer and Kitchen (1968) likewise accumulated evidence of climatic changes in Labrador between 1873 and 1966 and tried to evaluate moose range extensions on this background.

Migration, insect harassment, disease, and disturbance

Besides the three regulating mechanisms: predation, overgrazing, and climate, which have carried most weight in the discussion of caribou population dynamics in Greenland and other northern regions, a few additional factors which may be of importance should be mentioned.

Many early writers believed that Greenland caribou fluctuations were caused by inter-regional caribou movements.

The population declines in the 1750'es and 1850'es in West Greenland were mainly blamed on the introduction of the flint-lock gun and the breech-loading rifle. It was thought that the noise from the guns scared the caribou away, usually to some distant region like East Greenland or North America (N. Egede 1770: 254; Fabricius 1780: 70; Glahn 1768; Müller 1906: 374; Thorhallesen 1775: 62–63; Walløe 1753: 46).

The extinction of the Northeast Greenland caribou c. 1900 and the simultaneous population increase in West Greenland revived the discussion of migrations as the cause of population fluctuations. In this case, wolves were thought to have driven the caribou out of Northeast Greenland (A. Petersen 1926: 205–6, 1934: 17, Porsild 1916: 40).

There is no evidence to support the idea of these largescaled inter-regional movements. The assumed connection between the Northeast Greenland decline and the West Greenland increase is not plausible because the two areas were inhabited by two different subspecies of caribou *(R. t. eogroenlandicus* and *R. t. groenlandicus)* and there are no records of a massive invasion of small Northeast Greenland caribou to West Greenland.

It could be argued that the fluctuations in the caribou populations of West Greenland was a result of migrations between regions. But this is not the case. The exchange between the West Greenland caribou regions is negligible (Rink 1852, Thing 1984: 4) and no historical sources document any significant interchange. The relative isolation of the West Greenland caribou populations is also indicated by genetically based differences which seem to have evolved between the populations.

However, it should be noted that the caribou may undertake "erratic" movements on a small scale. For example, Müller (1906: 370) described how a number of caribou were found on the sea ice off Sisimiut during the population maximum in the 1840'es.

Insect harassment may also have a population regulating effect. Parasitic nostril flies and warble flies were introduced to Greenland in 1952 together with domestic reindeer. They may, together with mosquitoes and black flies, disturb the caribou and reduce eating time and thereby influence the build-up of winterfat reserves.

The population regulating effect of diseases were investigated by Clausen et al. (1980) in the Sisimiut region. No sign of unusual mortality caused by disease was found among adult caribou during the population decline in the late 1970'es. Mortality among calves was found mainly to be caused by coli bacteria but the resulting annual mortality for calves (60%) was normal compared to other arctic populations (Thing 1982).

Disturbance from tourism, hydro-electric damming, exploitation of minerals and oil, etc. may become important "population regulating mechanisms" in Greenland in the near future (Aastrup 1984b, Strandgaard et al. 1983), as they already have, e.g., in North America (Klein 1980).

Concluding remarks

Predation by man may have a population regulating effect, especially when the caribou populations are small and geographically isolated. The present population in the northern part of the Paamiut region thus seems to have been kept at low levels since the 1920'es due to a very high hunting pressure. The Thule region caribou may also have suffered from too heavy hunting prior to 1910. Finally there are a number of examples of small island populations in the Thule region and the Melville Bugt region that have been exterminated by man.

Strong down-cropping of lichens, grasses and other fodder plants have been observed in different regions. Because of the very limited comparative data concerning range quality in earlier years and because of the difficulties of disentangling the effects of the rapidly changing climate on plant growth from the effects of caribou grazing, it is difficult to decide if the cropped vegetation has been "overgrazed" or just "grazed". At any rate it is doubtful whether other mortality factors (weather, predators, etc.) would allow caribou on most ranges to reach such critically high population levels that forage could become the controlling factor (Miller 1982: 936). If grazing did become the controlling factor, all other things being equal, the caribou population would tend to stabilize around a given level and it would only exhibit insignificant oscillations around this equilibrium. The "overgrazing model" thus does not explain the drastic fluctuations observed in the West Greenland populations. Consequently the primary regulating factor is the existing weather (Skoog 1968, Miller 1982), and thus climatic change becomes the driving force in the long-termed population fluctuations.

The effect of rain, snow, temperature, and wind on forage availability and growth is well known, and the annual movements of the caribou are ultimately determined by temporal and geographical differences in these climatic parameters. Also, annual mortality and natality are to a large extent determined by factors such as thickness of snow cover, formation of snow and ice crusts following thaw periods, and weather conditions during calving. The existing weather thus seems to play a decisive role in the regulation of caribou numbers and in the geographic distribution of the animals on a year to year basis. Catastrophic winters have occurred, e.g., c. 1900 in the Thule, Inglefield Land, and Northeast Greenland regions where the caribou populations were exterminated or strongly decimated, but usually the regulating effect of weather is less spectacular.

Climatic change in the sense of general changes in temperature and precipitation through decades and centuries has taken and still takes place in Greenland as well as in the rest of the northern hemisphere. A good

example is the onset of a mild and oceanic climate in the 1920'es, resulting in increased winter precipitation and increased winter temperatures. Probably the increased quantities of snow and the more frequent winter thaw periods were the main factors that led to the decline in the West Greenland caribou populations between 1915 and 1925 and to the simultaneous retreat of the caribou from the coastal regions.

This conclusion is fairly consistent with observations made by two reindeer experts, the lapp Ole Nielsen Ravna and the farmer Isak Klementsen, both from Karatsjok, who visited the Kangerdlugssuaq (Søndre Strømfjord) region in the summer of 1905 to evaluate the possibilities of reindeer herding in the area. They emphasized that severe winters with "skarre sne" (ice-crusted snow) destroyed the forage and especially the lichens. They believed that the most important reason for a declining caribou population was unfavourable winters, not hunting or overgrazing (Rasmussen 1907b: 51–52). Thus, they found that the caribou ranges around Kangderdlugssuaq did show signs of recent destruction resulting from bad winters (Rasmussen 1907b: 51–52). (For a discussion of climate/vegetation/caribou interactions, see Vibe (1967: 163–180)).

The change towards a colder and drier climate in West Greenland between 1955 and 1976 must have made the forage especially in the coastal regions more accessible and thus paved the way for a population increase and an expansion of caribou territory into the coastal areas.

The generally synchronous population fluctuations among geographically isolated West Greenland caribou populations and among Northwest and Northeast Greenland caribou populations support the idea that weather and climatic change are the primary population regulating factors. Only climate can act simultaneously on such extensive geographical areas.

The synchronizing effect of climate on high latitude ecosystems has also been discussed by Pruitt (1968) in relation to small mammals and by Bock and Lepthien (1976) in relation to seed-eating birds.

The fundamental importance of weather and climatic change for the geographical and temporal distribution and density of caribou must be accepted, but it is also evident that overhunting and other density-dependent factors may be superimposed and in some situations result in a depression of the population below "natural" levels.

Fig. 64. Dead caribou on the banks of the Caniapiscau river below Limestone Falls, Quebec. Approximately 10.000 caribou drowned in september 1984 when they tried to cross the river above the falls (Anon 1984: 10).

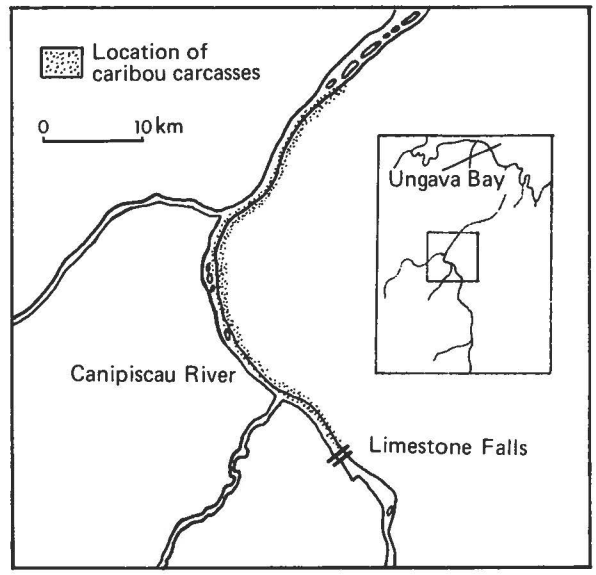


Fig. 65. Map of the Caniapiscau river showing the location of caribou carcasses (Anon 1984: 10).

Conclusion

Population size and population distribution are dependent variables. During population increase and maxima, the caribou expand their ranges, and during population decrease and minima, they reduce it (Fig. 62). These population pulsations are primarily governed by weather and climatic change and secondarily by other factors such as predation and overgrazing.

In some cases, the pulsations lead to extinctions (e.g.,

Northeast Greenland, Southwest Greenland), in other cases they cause migration into previously uninhabited areas (e.g., off-shore islands in West Greenland). Such zoogeographical events have been quite well documented in historical times. Unfortunately, the data concerning the zoogeography of the Greenland caribou prior to 1700 AD is much more fragmentary, and it only allows us to catch glimpses of early caribou prehistory. However, the mechanisms of zoogeography must have remained the same throughout the history of the Greenland caribou, and it seems justifiable to assume that the mechanisms of the well-documented historic events are also applicable to early caribou history.

One of the consequences of this assumption is that caribou distribution in Greenland through 8000 years has been extremely variable. The range of the Northeast Greenland caribou was for example reduced to nothing in less than 30 years between 1870 and 1900, and the West Greenland caribou range has been reduced by more than 50% in the last 200 years. In the light of these rapid zoogeographic changes, such sequences of C-14 datings as the one from North Greenland covering c. 8000 years may just as well represent a discontinuous habitation of the area as a continuous one, and the marginal caribou regions north and south of central West Greenland (the Nuuk and Sisimiut regions) could well have been depopulated and recolonized several times in the past millennia.

The causal relationship between population size and population distribution has also conceptional consequences for the formation of theories concerning population regulation among Greenland caribou. Thus, the factors that are proposed as population regulating (apart from hunting and other human disturbance) are also the factors that ultimately led to the colonization of Greenland more than 8000 years ago.

Future fields of inquiry

There is a general lack of caribou material pre-dating the human colonization of Greenland (c. 2500 BC), and the reconstruction of early caribou history in Greenland therefore rests on a rather fragmentary foundation.

An important research objective would therefore be to locate and excavate pre-2500 BC caribou remains imbedded in natural geological deposits. It is well known that during migrations, many caribou may drown when they try to cross swift-running rivers, especially if the crossing takes place just above rapids or waterfalls (Fig. 64) (Clarke 1940: 105). The carcasses are usually concentrated and deposited in river bends below the falls (Fig. 65) and their skeletons are soon covered by sediment from the river.

The excavation of caribou bones in a river bed in the Sarfartôq valley in 1983 (Fig. 19) demonstrated that such localities do exist in Greenland. Large melt-water rivers like Isortoqelven, the river in Ørkendalen, and Sarfartôq kûgsua (all in the Sisimiut region) seem particularly promising for future investigations.

Besides the localization of stratified deposits, it would also be of interest to continue and systematize the collection of caribou remains which are found on the soil surface in North and Northeast Greenland. Large series of C-14 datings on this material would surely promote our knowledge of caribou zoogeography in these areas.

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References

Aastrup, P. 1983a. Rensdyr. – In: Grønlands Fiskeriundersøgelser (ed.) Miljøundersøgelser for vandkraftprojekt Buksefjord, Nuuk/Godthåb, 1982: 46–56.
– 1983b. Rensdyr. – In: Grønlands Fiskeriundersøgelser (ed.) Miljø-undersøgelser for vandkraftprojekt Tasersuaq, Sisimiut/Holsteinsborg, 1982: 58–69.
– 1983c. Rensdyrbestanden nord for Kvanefjord. – In: Grønlands Fiskeriundersøgelser (ed.) Miljø-undersøgelser vandkraftprojekt Iterlaa, Paamiut/Frederikshåb, 1982: 57–63.
– 1984a. Undersøgelser af rensdyrbestanden. – In: Grønlands Fiskeri- og Miljøundersøgelser & Grønlands Botaniske Undersøgelser (eds.) Rensdyrundersøgelser og vegetationskortlægning ved vandkraftværk Buksefjord, Nuuk/Godthåb, 1983: 40–72.
– 1984b. Vandkraft i Grønland: Rensdyr. – Grønlands Fiskeri- og Miljøundersøgelser 17: 1–68.
Allen, J. A. 1908. The Peary Caribou (Rangifer pearyi Allen). – Bull. Americ. Mus. of Nat. History 24(22): 487–504.
Amdrup, G. 1909. The former eskimo settlements on the east coast of Greenland between Scoresby Sund and the Angmagssalik District. – Meddr Grønland 28: 285–328.
Anon. 1889. Meddelelser fra Direktoratet for den Kongelige Grønlandske Handel: 61–89.
– 1891. Meddelelser fra Direktoratet for den Kongelige Grønlandske Handel: 117–37.
– 1897. Meddelelser fra Direktoratet for den Kongelige Grønlandske Handel: 1–32.
– 1898. Meddelelser fra Direktoratet for den Kongelige Grønlandske Handel: 33–61.
– 1899. Meddelelser fra Direktoratet for den Kongelige Grønlandske Handel: 63–89.
– 1905. Meddelelser fra Direktoratet for den Kongelige Grønlandske Handel: 147–191.
– 1908. Meddelelser fra Direktoratet for den Kongelige Grønlandske Handel: 83–139.
– 1915. Beretninger og Kundgørelser vedrørende Styrelsen af Grønland: 285–396.

– 1917. Beretninger og Kundgørelser vedrørende Styrelsen af Grønland: 520–647.
– 1919. Beretninger og Kundgørelser vedrørende Styrelsen af Grønland: 99–240.
– 1920. Beretninger og Kundgørelser vedrørende Styrelsen af Grønland: 247–347.
– 1922. Beretninger og Kundgørelser vedrørende Styrelsen af Grønland: 457–569.
– 1923. Beretninger og Kundgørelser vedrørende Styrelsen af Grønland: 1–134.
– 1927. Beretninger og Kundgørelser vedrørende Styrelsen af Grønland: 591–870.
– 1944. Sammendrag af statistiske oplysninger om Grønland. – Beretninger vedrørende Grønlands Styrelse 1(3): 561–665.
– 1984. Canada: Inuit work to remove caribou drowned in the Caniapiscau river. – IWGIA Newsletter 40: 9–12.
Audet, R. 1979. Histoire du caribou du Québec-Labrador et évolution des populations. – In: Trudel, F. & Huot, J. (eds.) Dossier caribou, ecologie et exploitation du caribou au Québec-Labrador. – Recherches Amérindiennes au Québec 9(1–2): 17–27.
Banfield, A. W. F. 1954. Preliminary investigation of the Barren Ground caribou 1, former distribution, migrations and status. – Wildlife Management Bulletin 1(10A): 79 pp.
– 1961. A revision of the reindeer and caribou genus Rangifer. – National Museum of Canada Bulletin 177, Biological Series 66: 137 pp.
– 1963. The post glacial dispersal of american caribou. – In: Moore, J. A. (ed.) Proceedings of the 16. International Congress of Zoology, contributed papers 1, Washington 1963: 206.
– 1974. The mammals of Canada. – University of Toronto Press: 438 pp.
Bay, E. 1894. Hvirveldyr. – In: Ryder, C. (ed.) Den Østgrønlandske Expedition udført i aarene 1891–92. – Meddr Grønland 19(1): 1–58.
Bendixen, O. 1921. Beskrivelse af distrikterne i Sydgrønland. – In: Amdrup, G. (ed.) Grønland i tohundredeaaret for Hans Egedes landing. – Meddr Grønland 61(2): 1–560.
Bergerud, A. T. 1974. Decline of caribou in North America following settlement. – J. Wildl. Manage. 38(4): 757–770.
– 1978. Caribou. – In: Schmidt, J. L. & Gilbert, D. L. (eds.) Big game of North America. – Stackpole Books, Harrisburg: 83–101.
– 1980. A review of the population dynamics of caribou and wild reindeer in North America. – In: Reimers, E. et al. (eds.) Proc. 2nd. Int. Reindeer/Caribou Symp., Røros, Norway 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim: 556–581.
– 1983. Prey switching in a simple ecosystem. – Scientific American, Dec. 1983: 116–124.
Bergerud, A. T., Jakimchuk, R. D. & Carruthers D. R. 1984. The buffalo of the north: caribou (Rangifer tarandus) and human developments. – Arctic 37 (1): 7–22.
Bessels, E. 1879. Die amerikanische nordpol-expedition. – Verlag von Wilhelm Engelmann, Leipzig: 647 pp.
Birket-Smith, K. 1917. Foreløbigt bidrag til Kap Farvel-distrikternes kulturhistorie, paa grundlag af en nyopdaget ruingruppe i Julianehaab-distrikt. – Meddr Grønland 53(1): 1–39.
– 1971. Eskimoerne. – Rhodos, København: 294 pp.
Blehr, O. 1982. Når villreinen løper dit du vil: En fangstmetode, og det spor efter den idag kan fortælle om fortidens jegersamfunn. – Tromura 1: 1–29.
Bobé, L. 1936. Diplomatarium Groenlandicum 1492–1814. – Meddr Grønland 55(3): 1–430.
Bock, C. E. & Lepthien, L. W. 1976. Synchronous eruptions of boreal seed-eating birds. – The American Naturalist 110(974): 559–571.
Böcher, T. W. 1954. Oceanic and continental vegetational complexes in South West Greenland. – Meddr Grønland 148(1): 1–336.
Brown, R. 1868. On the mammalian fauna of Greenland. – Proceedings of the Zoological Society of London 1868: 330–362.
Bruun, D. 1917. Oversigt over nordboruiner i Godthaab og Frederikshaab distrikter. – Meddr Grønland 56(3): 57–148.
– 1918. Ulv og ren paa vandring. En oversigt over nyere iagttagelser. – Det Grønlandske Selskabs Aarsskrift, 1917: 34–46.
Bubenik, A. B. 1975. Taxonomic value of antlers in genus Rangifer, H. Smith. – In: Luick, J. R. et al. (eds.) Proceedings of the First International Reindeer and Caribou Symposium, Fairbanks, 1972. – Biological Papers of the University of Alaska, Special Report 1: 41–63.
Burch, E. S. Jr. 1972. The caribou/wild reindeer as a human resource. – American Antiquity 37: 339–368.
Bårdssön, I. c. 1360. Det gamle Grønlands beskrivelse. – In: Jónsson, F. (ed.) Det gamle Grønlands beskrivelse af Ivar Bårdssön udgiven efter håndskrifterne, 1930. – Levin og Munksgaards Forlag, København: 17–32.
Clark, R. M. 1975. A callibration curve for radiocarbon dates. – Antiquity: 251–266.
Clarke, C. H. D. 1940. A biological investigation of the Thelon Game Sanctuary. – National Museum of Canada, Biological Series 96(25): 135 pp.
Clausen, B., Dam, A., Elvestad, K., Krogh, H. V. & Thing, H. 1980. Summer mortality among caribou calves in West Greenland. – Nord. Vet.-Med. 32: 291–300.
Dalager, L. 1752. Grønlandske relationer: indeholdende grønlændernes liv og levnet. – In: Bobé, L. (ed.) Det Grønlandske Selskabs Skrifter 2, 1915: 87 pp.
Dawes, P., Elander, M. & Ericson, M. 1985. The wolf (Canis lupus) in Greenland. A historical review and present status. – Arctic 39(2).
Davis, C. H. 1876. Narrative of the North Polar Expedition. – Government Printing Office, Washington: 696 pp.
Davis, J. L., Valkenburg, P. & Reynolds, H. V. 1980. Population dynamics of Alaska's Western Arctic Caribou Herd. – In: Reimers, E. et al. (eds.) Proc. 2nd Int. Reindeer/caribou Symp., Røros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim: 595–604.
Degerbøl, M. 1929. Animalbones from the norse ruins at Gardar, Greenland. – Meddr Grønland 76: 183–192.
– 1931. Animalbones from the Sukkertoppen District. – Meddr Grønland 91: 134–137.
– 1934a. Animalbones from the norse ruins at Brattahlid. – Meddr Grønland 88(1): 149–155.
– 1934b. Animalbones from the eskimo settlement in Dødemandsbugten, Clavering Island. A contribution to the immigration history of musk ox and reindeer in East Greenland. – Meddr Grønland 102(1): 173–180.
– 1935. Animalbones from King Oscar Fjord region in East Greenland. Meddr Grønland 102(2): 93–97.
– 1936a. Bones from Julianehaab District. – Meddr Grønland 118(1): 131–133.
– 1936b. Animal remains from the West Settlement in Greenland with special reference to livestock. Researches into Norse Culture in Greenland. – Meddr Grønland 88(3): 1–55.
– 1936c. The former eskimo habitation in the Kangerdlugssuak district, East Greenland. – Meddr Grønland 104(10): 47 pp.
– 1937. A contribution to the investigation of the fauna of the Blosseville Coast, East Greenland, with special reference to zoogeography. – Meddr Grønland 104(19): 1–36.
– 1941. The osseus material from Austmannadal and Tungmeralik, West Settlement, Greenland. – Meddr Grønland 89(1): 345–354.
– 1943. Animalbones from inland farms in the East Settlement. – Meddr Grønland 90: 113–119.
– 1957. The extinct reindeer of East Greenland. – Acta Arctica 10: 57 pp.
Degerbøl, M. & Krog, H. 1959. The reindeer (Rangifer taran-

dus L.) in Denmark. – Biol. Skr. Dan. Vid. Selsk. 10(4): 165 pp.
Doerr, J. G. 1980. Modeling the population decline of two alaskan caribou herds. – In: Reimers, E. et al. (eds.) Proc. 2nd. Int. Reindeer/Caribou Symposium, Røros, Norway, 1979. Direktorate for vilt og ferskvannsfisk, Trondheim: 611–623.
Driesch, A. von den, 1976. A guide to the measurement of animal bones from archaeological sites. – Peabody Museum Bulletin 1, Harvard University: 137 pp.
Edwards, G. 1743. A natural history of uncommon birds and of some other rare and undescribed animals. – College of Physicians, Warwick-Lane, London: 52 plates.
Egede, H. 1741. Relationer fra Grønland 1721–36 og det gamle Grønlands ny perlustration 1741. – In: Bobé, L. (ed.) 1925, Meddr Grønland 54: 442 pp.
Egede, N. 1744. Tredie continuation af relationerne betreffende den grønlandske missions tilstand og beskaffenhed. – In: Osterman, H. (ed.) Poul og Niels Egede: continuation af Hans Egedes relationer fra Grønland samt Niels Egede: beskrivelse over Grønland, 1939. – Meddr Grønland 120: 128–206.
– 1770. En kort og udførlig beskrivelse over Grønland. – In: Ostermann, H. (ed.) Poul og Niels Egede: continuation af Hans Egedes relationer fra Grønland samt Niels Egede: Beskrivelse over Grønland, 1939. – Meddr Grønland 120: 233–269.
Elton, C. 1942. Voles, Mice, and lemmings. – The Clarendon Press, Oxford: 496 pp.
Fabricius, O. 1780. Den grønlandske fauna. – In: Helms, O. (ed.) Otto Fabricius' Fauna Groenlandica, pattedyr og fugle, 1929. – Det Grønlandske Selskabs Skrifter 6: 166 pp.
Feilden, H. W. 1877. The Post-tertiary beds of Grinnell Land and North Greenland. – Ann. Mag. Nat. Hist. 4(20): 483–494.
– 1878. Notes on the natural history. – In: Nares, G. S. (ed.) Narrative of a voyage to the Polar Sea. – Sampson Low, Marston, Searle & Rivington, London, vol. 2, 187–361.
Fitzhugh, W. W. 1979. Les modes d'adaptation basés sur le caribou dans les régions centrale et septentrionale du Labrador. – Recherches Amérindiennes au Quebec 9(1–2): 55–70.
– 1981. A prehistoric caribou fence from Williams Harbour, Northern Labrador. – In: Wilson, M., Road, K. L. & Hardy, K. J. (eds.) Megaliths to medicine wheels: boulder structures in archaeology. – Proceedings of the Elleventh Annual Chacmool Conference, Calgary: 187–206.
Fredskild, B. 1973. Studies in the vegetational history of Greenland. – Meddr Grønland 198(4): 1–245.
Freuchen, P. 1911. Om rener og moskusokser i Kap York Distriktet. – Geografisk tidsskrift 21(4): 144–146.
– 1915. Report of the First Thule Expedition. Scientific work. – Meddr Grønland 51(12): 389–411.
– 1927. Grønland, Land og Folk. – Kultur og Videnskab. Studentersamfundets Oplysningsforening, København: 96 pp.
Freuchen, P. & Salomonsen, F. 1958. The arctic year. – Putnam, New York: 438 pp.
Funder, S. 1978. Holocene (10.000–0 years BP) climates in Greenland, and North Atlantic atmospheric circulation. – In: Frydendahl, K. (ed.) Proceedings of the Nordic Symposium on Climatic Changes Related Problems, Copenhagen 1978. – Danish Meteorological Institute, Climatological Papers 4: 175–180.
– 1982. Plante refugierne i Grønland. – Naturens Verden 7: 241–255.
Gaare, E. 1978. Ecological modeling. – In: Klein, D. R. & White, R. G. (eds.) Parameters of caribou population ecology in Alaska. Proceedings of a symposium and workshop. – Biological Papers of the University of Alaska, Special Report 3: 27–30.
Gad, F. 1976. Grønlands historie 3. 1782–1808. – Nyt Nordisk Forlag, Arnold Busck, København: 615 pp.
Glahn, H. C. 1768. Dagbøger for Aarene 1763–64, 1766–67 og 1767–68. – In: Ostermann, H. (ed.) Missionær i Grønland Heinrich Christopher Glahns Dagbøger. – Det Grønlandske Selskabs Skrifter 4, 1921: 1–239.
Glob, P. V. 1935. Eskimo settlements in Kempes Fjord and King Oscar Fjord. – Meddr Grønland 102(2): 1–92.
– 1946. Eskimo settlements in Northeast Greenland. – Meddr Grønland 144(6): 1–40.
Grønnow, B. 1985. Recent archaeological investigations of West Greenland caribou hunting. – Arctic Anthropology, in press.
Grønnow, B. & Meldgaard, M. 1980. Archaeological investigations. – In: Jacobsen, N. K. (ed.) Report of activities at Tugtuligssuaq, Melville Bugt, 1978–79. – Geografisk Tidsskrift 80: 41–44.
– 1982. Arkæologiske recognosceringer i Paamiut, Nuuk og Sisimiut kommuner, 1982. – Field report on file at Kalaallit Nunaata Katersugaasivia (Grønlands Landsmuseum), Nuuk.
Grønnow, B., Meldgaard, M. & Nielsen, J. B. 1983. Aasivissuit–The Great Summer Camp. Archaeological, ethnographical and zoo-archaeological studies of a caribou hunting site in West Greenland. – Meddr Grønland, Man & Soc. 5: 96 pp.
Gulløv, H. C. 1983. Nuup kommuneani qangarnitsanik eqqaassutit inuit-kulturip nunaqarfii. Fortidsminder i Nuuk kommune- inuit-kulturens bopladser. – Kalallit Nunaata Katersugaasivia & Nationalmuseet, Nuuk: 240 pp.
Gunn, A., Miller, F. L. & Thomas, D. C. 1980/81. The current status and future of Peary caribou Rangifer tarandus pearyi on the arctic islands of Canada. – Biological Conservation 19: 283–296.
Gynther, B. & Meldgaard, J. 1983. 5 kapitler af Grønlands Forhistorie. – Pilersuiffik, Nuuk: 113 pp.
Haber, G. & Walters, C. 1980. Dynamics of the Alaska-Youkon caribou herds and management implications. – In: Reimers, E. et al. (eds.) Proc. 2nd Int. Reindeer/Caribou Symposium, Røros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim: 645–663.
Hansen, J. 1885. Dagbogsnotater 1883–1885. – In: Thalbitzer, W. (ed.) Den grønlandske kateket Hanseraks dagbog om den Danske Konebådsexpedition til Ammassalik i Østgrønland 1884–85. – Det Grønlandske Selskabs Skrifter 8, 1933: 9–184.
Harrington, C. R. 1964. Remarks on Devon Island muskoxen. – Canadian Journ. Zoology 42: 79–86.
– 1971. Ice age mammals in Canada. – The Arctic Circular 22(2): 66–89.
Hartz, N. 1902. Beretning om skibsexpeditionen til Grønlands østkyst. For tidsrummet fra d. 18. juli til d. 12. september. – Meddr Grønland 27(3): 153–181.
Hasholt, B. 1981. Hydrologi i Buksefjordsområdet. – Report on file at Geografisk Institut, University of Copenhagen and Grønlands Tekniske Organisation, unpublished: 70 pp.
Hasholt, B. & Søgaard, H. 1978. Et forsøg på en klimatisk-hydrologisk regionsinddeling af Holsteinsborg kommune (Sisimiut). – Geografisk Tidsskrift 77: 72–92.
Hay, P. O. 1923. The Pleistocene of North America and its vertebrated animals. – Carnegie Institution of Washington, Washington: 499 pp.
Hayes, I. I. 1867. The open polar sea. – Sampson Low, Son & Marston, London: 454 pp.
Helle, T. & Säntti, V. 1982. Vinterkatastrofer inom renskötseln i Finland: förluster och deras förebygande (winter-catastrophies in the reindeer husbandry of Finland). – Rangifer 2(1): 2–8.
Hemming, J. 1975. Population growth and movement patterns of the Nelchina Caribou Herd. – Proceedings of the First International Reindeer and Caribou Symposium. Biological Papers of the University of Alaska, Special Report 1: 162–169.

Henshaw, J. 1968. The activities of the wintering caribou in northwestern Alaska in relation to weather and snow conditions. – Int. J. Biometeor. 12(1): 21–27.
Hjarnø, J., Jørgensen, J. B. & Vesely, M. 1974. Archaeological and anthropological investigations of late heathen graves in Upernavik district. – Meddr Grønland 202(1): 1–36.
Hjort, C. 1981. Studies of the Quaternary in Northeast Greenland. – Thesis 9, Lund Universitet: 29 pp.
Holm, G. 1887. Ethnologisk skizze af angmagsalikerne. – Meddr Grønland 10: 43–182.
– 1888. Den Østgrønlandske Expedition. – Meddr Grønland 10: 42 figures.
– 1911. Ethnological sketch of the angmagsalik eskimo. – Meddr Grønland 39(1): 1–147.
Holm, G. & Petersen, J. 1885. Østgrønlandske sagn og fortællinger. – In: Thalbitzer, W. (ed.) Østgrønlandske sagn og fortællinger. Samlede af Gustav Holm ved Angmagssalik (Ammattalik) og straks oversat til dansk af tolken Johan Petersen kaldet "Ujuât", Østgrønland 1884–85. – Det Grønlandske Selskabs Skrifter 19, 1957: 219–318.
Holt, S. 1980. Vegetation patterns and effects of grazing on caribou ranges in the Søndre Strømfjord area, West Greenland. – In: Reimers, E. et al. (eds.) Proc. 2nd. Int. Reindeer/Caribou Symp., Røros, Norway 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim: 57–63.
Holthe, V. & Lassen, P. no date. Bestandsundersøgelser over den vestgrønlandske vildren (Rangifer tarandus groenlandicus Gmlin). – Report on file at Vildtbiologisk Station, Kalø, unpublished: 41 pp.
– 1984. Vækst, Kondition og dødelighed hos vildren (Rangifer tarandus groenlandicus) i Sisimiut-bestanden, Vest Grønland. – Rangifer 4(1): 35–42.
Holtved, E. 1944a. Archaeological investigations in the Thule district, I. descriptive part. – Meddr Grønland 141(1): 1–308.
– 1944b. Archaeological investigations in the Thule district, II. Analytical part. – Meddr Grønland 141(2): 1–184.
– 1954. Archaeological investigations in the Thule district, III. Nûgdlît and Comers midden. – Meddr Grønland 146(3): 1–135.
Ingold, T. 1980. Hunters, pastoralists and ranchers. – Cambridge University Press, Cambridge: 326 pp.
Jacobi, A. 1931. Das rentier. – Zoologischer Anzeiger 96: 264 pp.
Janssen, C. E. 1913. En grønlænderpræsts optegnelser 1844–49. – In: Clausen, J. & Rist, P. F. (eds.) Memoirer og breve 19, Nordisk Forlag, København: 223 pp.
Jeffreys, G. 1877. The Post-tertiary fossils procured in the late Arctic Expedition, with notes on some of the recent or living Mollusca from the same expedition. – The Annals and Magazine of Natural History 20(4): 229–242.
Jennov, J. G. 1953a. Något om vildrenens och myskoxens förekomst på Nordostgrönland. – Svensk Faunistisk Revy: 13–27.
– 1953b. Nogle betraktninger over forskellige forhold i Nordøstgrønland. – Naturen 14: 427–445.
Jensen, A. S. 1928. Grønlands Fauna, et forsøg på en oversigt. – Festskrift udgivet af Københavns Universitet i anledning af Hans Majestæt Kongens Fødselsdag, Bianco Lunos Bogtrykkeri, København: 87 pp.
Jensen, J. A. D. 1879. Expeditionen til Holstenborgs og Egedesmindes distrikter i 1879. Beretning om rejsen og de geografiske forhold. – Meddr Grønland 2(5): 113–149.
Jensen, S. 1909. Mammals observed on Amdrup's journeys to East Greenland 1898–1900. – Meddr Grønland 29(1): 1–62.
Johnsen, P. 1953. Birds and mammals of Peary Land in North Greenland. – Meddr Grønland 128(6): 1–135.
Kane, E. K. 1856. Arctic explorations. – Childs & Peterson, Philadelphia, vol. 1: 464 pp., vol. 2: 467 pp.
Kelsall, J. P. 1968. The migratory barren-ground caribou of Canada. – Department of Indian Affairs and Northern Development, Canadian Wildlife Service. Queen's Printer, Ottawa: 340 pp.
Klein, D. R. 1968. The introduction, increase, and crash of reindeer on St. Matthew Island. – Journ. of Wildl. Manage. 32(2): 350–367.
– 1980. Reaction of caribou and reindeer to obstructions – a reassessment. – In: Reimers, E. et al. (eds.) Proc. 2nd. Int. Reindeer/Caribou Symp., Røros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim: 519–527.
Klein, D. R., Meldgaard, M. and Fancy, S. G. in prep. Selective factors in the determination of leglength in Rangifer tarandus.
Knuth, E. 1942. Dansk Nordøstgrønlands Ekspedition 1938–39. Report on the expedition. – Meddr Grønland 126(1): 1–157.
– 1967. Archaeology of the Musk-ox Way. – Cont. Cent. Etud. arct. finno-scand. Paris 5: 70 pp.
– 1981. Greenland news from between 81 and 83 north. – Folk 23: 91–111.
– 1982. Jordens nordligste ruinpladser/Nunarssuarme nunakarfikut avangnardlersât. – Forskning i Grønland/ilisimatût misigssuinerinik Kalâtdlit Nunâne 1: 17–28.
– 1984. Reports from the Musk-ox Way. – Privately printed, Copenhagen: 173 pp.
Koch, L. 1926. Report on the Danish Bicentenary Expedition north of Greenland 1920–23. – Meddr Grønland 70(1): 5–232.
– 1928. Contributions to the glaciology of North Greenland. – Meddr Grønland 65 (15): 191–464.
– 1930. Report on the geological expedition to East Greenland 1926–27. – Meddr Grønland 76(6): 225–282.
Koldewey, K. 1873. Küsten fahrt der Germania nach Süden. Die Jackson Insel. Kap Broer Roys. Bootfahrt. Entdeckung des Keiser-Franz-Josephs-Fjords. – In: Hartlaub, G. & Lindeman, M. (eds.) Die Zweite Deutsche Nordpolarfahrt in den Jahren 1869 und 1870, 1, Erzählender Theil. – F. A. Brockhaus, Leipzig: 644–661.
Koldewey, K. et al. 1873. Einsegelung in den Fjord. Besteigung der Payerspitze. Entdeckung der Peterman-Spitze. Rückreise beschlossen. – In: Hartlaub, G. & Lindeman, M. (eds.) Die Zweite Deutsche Nordpolarfahrt in den Jahren 1869 und 1870, 1, Erzählender Theil. – F. A. Brockhaus, Leipzig: 661–680.
Kolthoff, G. 1901. Till Spitsbergen och Nordöstra Grönland. – Fr. Skoglunds Förlag, Stockholm: 227 pp.
Krebs, C. J. 1978. Ecology. The experimental analysis of distribution and abundance. – Harper & Row, Publishers, New York: 678 pp.
Larsen, H. 1934. Dødemandsbugten. An eskimo settlement on Clavering Island. – Meddr Grønland 102(1): 1–185.
Lassen, P. & Aastrup, P. 1981. Undersøgelser over tamrenbestanden (Rangifer tarandus tarandus L.) ved Itivnera, Vestgrønland. – Danske vildtundersøgelser 35: 1–36.
Lindroth, C. H. 1957. The faunal connection between Europe and North America. – Almqvist & Wiksell, Stockholm: 344 pp.
Lönnberg, E. 1909. Om renarne och deras lefnadsvanor. – Bilaga till "Förhandlingarna inför Skiljedomstolen af 1909 i renbetesfrågann, Afdeling I, Svensk Inlaga No. 3". – Almqvist & Wiksells Boktryckeri-A. – B. Uppsala: 198 pp.
MacMillann, D. B. 1925. Four years in the white north. – The Medici Society of America, Boston and New York: 428 pp.
MacPherson, A. H. 1965. The origin of diversity in mammals of the canadian arctic tundra. – Systematic Zoology 14: 153–173.
Manniche, A. L. V. 1910. The terrestrial mammals and birds of Northeast Greenland. Biological observations. – Meddr Grønland 45(1): 1–199.
Manning, T. H. 1960. The relationship of the Peary and Barren-ground caribou. – Arctic Institute of North America,

Technical Paper 4: 52 pp.
Manning, T. H. & MacPhearson, A. H. 1961. A biological investigation of Prince of Wales Island, N. W. T. – Transactions of the Royal Canadian Institute 33(2): 116–239.
Mathiassen, T. 1928. Eskimo relics from Washington and Hall Land. – Meddr Grønland 71(3): 183–216.
– 1930. Inugsuk, a mediaeval eskimo settlement in Upernavik district, West Greenland. – Meddr Grønland 77(4): 147–342.
– 1931. Anciant eskimo settlements in the Kangâmiut area. – Meddr Grønland 91(1): 1–149.
– 1933. Prehistory of the Angmassalik eskimos. – Meddr Grønland 92(4): 1–158.
– 1934a. Contributions to the archaeology of Disko Bay. – Meddr Grønland 93(2): 1–192.
– 1934b. Eskimo finds from the Kangerdlugssuaq region. – Meddr Grønland 104(9): 1–22.
– 1958. The Sermermiut excavations 1955. – Meddr Grønland 161(3): 1–52.
Mathiassen, T. & Holtved, E. 1936. The eskimo archaeology of Julianehaab district. With a brief summary of the prehistory of the greenlanders. – Meddr Grønland 118(1): 1–138.
Matthews, J. V. Jr. 1979. Tertiary and Quaternary environments: historical background for an analysis of the canadian insect fauna. – In: Danks, H. V. (ed.) Canada and its insect fauna. – Mem., Enthmological Society of Canada 108: 31–86.
McGovern, T. 1979. The paleoeconomy of Norse Greenland: adaptation and extinction in a tightly bounded ecosystem. – Unpublished Ph. D. dissertation, Columbia University: 395 pp.
– 1981. The economics of extinction in Norse Greenland. – In: Wigley et al. (eds.) Climate and history. – Cambridge University Press: 404–434.
Meldgaard, J. 1961. Sarqaq-folket ved Itivnera. Nationalmuseets undersøgelser i sommeren 1960. – Grønland: 15–23.
– 1982. Aron. En af de mærkværdigste billedsamlinger i verden/Silarsuarmi assilissat katersugaatit eqqumiinersaasa ilaat. – Nationalmuseet: 112 pp.
– 1983. Qajâ, en køkkenmødding i dybfrost. Felt rapport fra arbejdsmarken i Grønland. – Nationalmuseets Arbejdsmark: 83–96.
Meldgaard, M. 1983. Resource fluctuations and human subsistence. A zooarchaeological and ethnographical investigation of a West Greenland caribou hunting site. – In: Clutton-Brock, J. & Grigson, C. (eds.) Animals and archaeology. – British Archaeological reports, International Series 163: 259–272.
Mercer, W. E. & Kitchen, D. A. 1968. A preliminary report on the extension of moose range in the Labrador peninsula. – In: Anon (ed.) Proceedings of the Fifth North American Moose Workshop, Kenai, Alaska: 62–81.
Mikiassen, N. 1864. Nûngme piniatut ilâta univkâliai 1864me. – Atuagagdliutit 29 & 30, columns 447–457.
Miller, F. L. 1982. Caribou. – In: Chapman, J. A. & Feldhamer, G. A. (eds.) Wild mammals of North America, biology, management, and economics. – The Johns Hopkins University Press, Baltimore & London: 1147 pp.
Miller, F. L., Russel, R. H. & Gunn, A. 1977. Distribution, movements, and numbers of Peary caribou and muskoxen on Western Queen Elisabeth Islands, Northwest Territories, 1972–74. – Can. Wildl. Serv. Rep. Ser. 40: 55 pp.
Müller, R. 1906. Vildtet og jagten i Sydgrønland. – Universitetets Bogtrykkeri, København: 519 pp.
Møbjerg, T. 1983. An ethno-archaeological investigation of the Sermermiut settlement, West Greenland. – Folk 25: 23–51.
Møhl, J. 1979a. The bones from Hope Colony. – In: Gulløv, H. C. & Kapel, H. C. (eds.) Haabetz Colonie 1721–1728. Ethnohistorical studies of the meeting of eskimo and european cultures, I. – National Museum of Denmark: 215–230.
– 1979b. Description and analysis of the bonematerial from Nugarsuk: an eskimo settlement representative of the Thule Culture in West Greenland. – In: McCartney. A. P. Thule Eskimo Culture: an anthropological retrospektive. – National Museum of Man, Mercury Series 88: 380–394.
– 1982. Ressource udnyttelse fra norrøne og eskimoiske affaldslag belyst gennem knoglematerialet. – Grønland 8–9: 286–296.
Møhl, U. 1972. Animalbones from Itivnera, West Greenland. A reindeer hunting site of the Sarqaq Culture. – Meddr Gønland 191(6): 1–21.
Møller, J. 1907. Erhvervsforholdene i de grønlandske fjorde med særligt henblik paa fangerne i Godthaabsfjorden II. – In: Rasmussen, K. (ed.) Breve fra grønlændere og rapport til Indenrigsministeriet over Renbejte-Undersøgelses-Ekspeditionens rejse i Grønland, sommeren 1905. – Atlanten 37–39, 1907, København: 23–26.
Møller, S. 1936. No title. – In: Beretninger og kundgørelser vedrørende styrelsen af Grønland: 859–860.
Nares, G. S. 1878. Narrative of a voyage to the Polar Sea. – Sampson Low, Marston, Searle & Rivington, London, vol. I: 395 pp, vol. II: 378 pp.
Nathorst, A. G. 1900. Två somrar i Norra Ishafet. – Beijers Bokförlagsaktiebolag, Stockholm vol. II: 414 pp.
Nellemann, G. 1969/70. Caribou hunting in West Greenland. – Folk 11–12: 133–153.
NES. unpublished. Ethnographic investigations in Greenland by the National Museum of Denmark (NES). Questionnaires drawn up by K. Birket-Smith in 1948. Written answers collected in the period 1948–1958 by among others C. L. Vebæk 1948–1951 and G. Nellemann 1957–1958. 13 parts. Part 2 deals with caribou hunting. It is divided into 11 main questions. Kept at the Kalaallit Nunaata Katersugaasivia (Grønlands Landsmuseum), Nuuk and at the National Museum, IV. dept., Copenhagen. Informants cited in this publikation: Banjamin Benediktsen, b. 1880 (Narssaq distr.); Gedion Larsen, b. 18? (Aasiaat distr.); Hendrik Josefsen, b. 1884 (Nuuk distr.); Gerhardt Lyberth, b. approx. 1890 (Maniitsoq distr.). Andreas Petersen, b. 1888 (Upernavik distr.); Otto Sandgreen, b. 1884 (Disko Bay distr.); Enok Storch, b. 1880 (Aasiaat distr.).
Nichols, H. 1974. Arctic North American palaeoecology: the recent history of vegetation and climate deduced from pollen analysis. – In: Ives, J. D. & Barry, R. G. (eds.) Arctic and alpine environments, Methuen: 637–67.
Nieminen, M., Koskela, K. & Koivuperä, N. 1982. Rendödeligheten i Finnland under åren 1971–81 (reindeer mortality in Finnland during the years 1971–81). – Rangifer 2(1): 9–25.
Nielsen, A. 1907. Erhvervsforholdene i de grønlandske fjorde med særligt henblik paa fangere i Godthaabsfjorden I. – In: Rasmussen, K. (ed.) Breve fra grønlændere og rapport til Indenrigsministeriet over Renbejte-Undersøgelses-Expeditionens rejse i Grønland, sommeren 1905. – Atlanten 37–39, 1907, København: 4–22.
Oldendow, K. 1935. Naturfredning i Grønland. – Det Grønlandske Selskabs Skrifter 9: 389 pp.
Ostermann, H. 1938. Knud Rasmussens posthumous notes on the life and the doings of the East Greenlanders in olden times. – Meddr Grønland 109(1): 1–212.
Pansch, A. G. 1873. Excursionen nach der Sabine- und Clavering Insel zur Untersuchung der Reste von Eskimosiedlungen. – In: Hartlaub, G. & Lindeman, M. (eds.) Die Zweite Deutsche Nordpolarfahrt in den Jahren 1869 und 1870 1, erzählender theil. – F. A. Borckhaus, Leipzig: 587–624.
Parker, G. R. 1972. Biology of the Kaminuriak population of barren-ground caribou 1. – Can. Wildl. Serv. Rep. Ser. 20: 95 pp.
Parker, G. R., Thomas, D. C., Broughton, E. & Gray, D. R. 1975. Chrashes of muskox and Peary's caribou in 1973–74 on the Parry Islands, Arctic Canada. – Can. Wildl. Ser. Progr. Notes 56: 73–82.

Payer, J. & Copeland, R. 1873. Jagden und Thierleben in Ostgrönland. – In: Hartlaub, G. & Lindeman, M. (eds.) Die Zweite Deutsche Nordpolarfahrt in den Jahren 1869 und 1870 1, erzählender theil. – F. A. Brockhaus, Leipzig: 515–545.
Pearson, G., Pilcher, J. R. & Baillie, M. G. L. 1983. High-precision C-14 measurement of Irish oaks to show the natural athmospheric variations from 200 BC to 4000 BC. – Radiocarbon 25: 179–186.
Peary, R. E. 1898. Northward over the "Great Ice". – Methuen & Co, London, vol. 1: 521 pp, vol. 2: 625 pp.
– 1907. Nearest the Pole. – Hutchinson & Co, London: 410 pp.
Peters, W. 1874. Säugetiere und fische. – In: Hartlaub, G. & Lindeman, M. (eds.) Die Zweite Deutsche Nordpolarfahrt in den jahren 1869 und 1870 2, Wissenschaftliche ergebnisse. – F. A. Brockhaus, Leipzig: 157–174.
Petersen, A. 1926. Beiträge zur Kenntnis der Säugetier- und Vogelfauna der Ostküste Grönlands. – Meddr Grønland 68: 151–249.
– 1930. Fortgesetzte Beiträge zur Kenntnis der Säugetier- und Vogelfauna der Ostküste Grönlands. – Meddr Grønland 77(5): 343–506.
– 1934. Polardyr. – Gyldendalske Boghandel, Nordisk Forlag, København: 150 pp.
Petersen, O. 1970. Majorqaq. – Grønland: 180–189.
Piérard, J. 1979. Le caribou dans la préhistorie et la protohistoire du Québec. – Recherches amérindiennes au Québec 9(1–2): 9–16.
Porsild, M. P. 1916. Om nogle Vestgrønlandske pattedyr og fugle I–II. – Meddr Grønland 56(2): 31–54.
– 1920. On eskimo stone rows in Greenland formerly supposed to be of norse origin. – The Geographical Review 10(5): 297–309.
– 1921. Beskrivelse af distrikterne i Nordgrønland. – In: Amdrup, G. et al. (eds.) Grønland i tohundredeaaret for Hans Egedes landing. – Meddr Grønland 60(1): 1–516.
Pruitt, W. O. 1968. Synchronous biomass fluctuations of some northern mammals. – Mammalia 32: 172–191.
Rand, A. L. 1954. The ice age and mammal speciation. – Arctic 7(1): 31–35.
Rasmussen, K. 1905. Nye Mennesker. – Nordisk Forlag, København: 246 pp.
– 1907a. En grønlandsk jagtlov. Udtalelser af renjægeren Abia i Godthaabsfjorden III. – In: Rasmussen, K. (ed.) Breve fra grønlændere og rapport til Indenrigsministeriet over Renbejte-Undersøgelses-Ekspeditionens rejse i Grønland, sommeren 1905. – Atlanten 37.39, København: 26–28.
– 1907b. Rapport til Indenrigsministeriet over Renbejte-Undersøgelses-Ekspeditionens rejse i Grønland, sommeren 1905. – In: Rasmussen, K. (ed.) Breve fra grønlændere og rapport til Indenrigsministeriet. – Atlanten 37.39, København: 38–53.
– 1919. Grønland langs Polhavet. – Gyldendal, København: 596 pp.
– 1921. Beskrivelse af Thule distrikt. – In: Amdrup, G. et al. (eds.) Grønland i tohundredeaaret for Hans Egedes landing. – Meddr Grønland 60(1): 517–567.
– 1927. Report on the II. Thule-expedition for the exploration of Greenland from Melville Bay to de Long Fjord, 1916–18. – Meddr Grønland 65(1): 1–181.
Reimers, E. 1972. Growth in domestic and wild reindeer in Norway. – Journ. Wildl. Manage. 36(2): 612–619.
– 1977. Population dynamics in two subpopulations of reindeer in Svalbard. – Arctic and Alpine Research 9(4): 369–381.
– 1980. Rensdyrbestanden på Disko, Nûgssuaq, Frederikshåb- og Angmassalik-områderne. – Report on file at Vildtbiologisk Station, Kalø: 33 pp.
Rink, H. 1852. De danske handelsdistrikter i Nordgrønland 1. – København: 202 pp.
– 1855. De danske handelsdistrikter i Nordgrønland 2. – København: 218 pp.
– 1857. Grønland geografisk og statistisk beskrevet. Det Søndre Inspektorat. – København: 416 pp.
– 1877. Danish Greenland its people and products. – Henry S. King & Co., London: 468 pp.
Roby, D., Thing, H. & Brink, K. L. 1984. History, status, and taxonomic identity of caribou (Rangifer tarandus) in Northwest Greenland. – Arctic 37(1): 22–30.
Rosendahl, P. 1961. Grønlandsk jagt- og fangststatistik. – Geografisk Tidsskrift 60: 16–38.
Rosing, Jak. 1926/27. Kangâmiormiut asimiuisalo ingerdlausiánik. – Atuagagdliutit nos: 1, 2, 4, 6, 8, & 10: columns: 14–16, 30–32, 55–59, 87–91, 113–118, & 149–152.
Rosing, Jens, 1955. Norsk tamren på Vestgrønland. – Polarboken.
– 1958. Tanker ved et "viftested". – Grønland: 385–392.
Rousselière, G. M. 1976. The paleoeskimo in northern Baffinland. – Memoirs of the Society for American Archaeology 31: 40–57.
Ryder, C. 1895. Den Østgrønlandske Expedition udført i aarene 1891–92. – Meddr Grønland 17: 1–374.
Scheffer, V. B. 1951. The rise and fall of a reindeer herd. – Scientific Monthly 73(6): 356–362.
Scoresby, W. 1823. Journal of a voyage to the northern whalefishery. – A. Constable & Co., Edinburgh: 472 pp.
Semenov-Tian-Shanskii, O. I. 1975. The status of wild reindeer in the USSR, especially the Kola peninsula. – In: Luick, J. R. et al. (eds.) Proceedings of the First International Reindeer and Caribou Symposium, Fairbanks, Alaska 1972. – Biological Papers of the University of Alaska, Special Report 1: 155–161.
Sjøvold, T. 1977. Non-metrical divergence between skeletal populations. – Ossa 4(1): 1–133.
Skogland, T. & Mølmen, Ø. 1980. Prehistoric and present habitat distribution of wild mountain reindeer at Dovrefjell. – In: Reimers, E. et al. (eds.) Proc. 2nd. Int. Reindeer/Caribou Symp., Røros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim: 130–141.
Skoog, R. O. 1968. Ecology of the caribou (Rangifer tarandus granti) in Alaska. – Unpubl. Ph. D. thesis, Univ. of Berkeley: 699 pp.
Smith, M. & Rigby, B. 1981. Distribution of polynias in the Canadian Arctic. – In: Stirling, I. & Cleator, H. (eds.) Polynyas in the Canadian Arctic. – Can. Wildl. Ser., Occational Paper 45: 7–28.
Sondaar, P. Y. 1977. Insularity and its effect on mammal evolution. – In: Hecht, M. K. et al. (eds.) Major patterns in vertebrate evolution. – Plenum Press, New York and London: 671–707.
Steensby, H. P. 1910. Contributions to the ethnography and anthropology of the Polar Eskimos. – Meddr Grønland 34: 255–405.
Strandgaard, H. 1977. Rensdyrundersøgelser i Vestgrønland. – Dansk Vildtforskning: 1976–77: 24–27.
– 1980. Undersøgelser over Vestgrønlands rensdyr. – Grønland 5: 145–152.
Strandgaard, H., Holthe, V., Lassen, P. & Thing, H. 1983. Rensdyrundersøgelser i Vestgrønland 1977–1982. – Report on file at Vildtbiologisk Station, Kalø: 29 pp.
Stuiver, M. 1982. A high-precision callibration of the AD radiocarbon time scale. – Radiocarbon 24: 1–26.
Thalbitzer, W. 1912. Ethnographical collections from East Greenland (Angmagsalik and Nualik) made by G. Holm, G. Amdrup, and J. Petersen. – Meddr Grønland 39(7): 319–754.
Thing, H. 1982. Struktur og årlig tilvækst af vestgrønlandsk vildren (Rangifer tarandus groenlandicus). – Rangifer 2(2): 28–35.
– 1984. Feeding ecology of the West Greenland caribou (Rangifer tarandus groenlandicus) in the Sisimiut-Kangerlussuaq region. – Danish Review of Game Biology 12(3): 53 pp.

Thomas, D. C. & Everson, P. 1982. Geographic variation in caribou on the Canadian arctic islands. – Can. J. Zool. 60: 2442–54.
Thorhallesen, E. 1775. Beskrivelse over missionerne i Grønlands Søndre Distrikt, hvilke han som vice-provst visiterede i aarene 1774–1775. – In: Bobé, L. (ed.) Det Grønlandske Selskabs Skrifter 1, 1914: 108 pp.
Thostrup, C. B. 1911. Ethnographic description of the eskimo settlements and stone remains in Northeast Greenland. – Meddr Grønland 44(4): 183–351.
Vibe, C. 1948. Langthen og nordpaa. – Gyldendal, København: 199 pp.
– 1967. Arctic animals in relation to climatic fluctuations. – Meddr Grønland 170(5): 1–227.
– 1981. Pattedyr. In: Salomonsen, F. (ed.) Grønlands fauna. – Nordisk Forlag, København: 364–459.
– 1982. Micro-istider. – Naturens Verden 9: 297–320.
– 1984. Luna-nøglen til klima og økologi. – Naturens Verden 4: 145–160.
Walløe, P. O. 1753. Peder Olsen Walløes Dagbøger fra hans rejser i Grønland. – In: Bobé, L. (ed.) Det Grønlandske Selskabs Skrifter, 1927, 5: 13–119.
Weidick, A. 1976. Glaciation and the Quaternary of Greenland. – In: Escher, A. & Watt, W. S. (eds.) Geology of Greenland, The Geological Survey of Greenland: 430–460.
– 1984. Studies of glacier behaviour and glacier mass balance in Greenland – a review. – Geogr. Ann. 66A(3): 183–195.
Winge, H. 1895. Knogler fra nordboruinerne i Julianehaabs distrikt. – In: Bruun, D. (ed.) Arkæologiske undersøgelser i Julianehaabs distrikt. – Meddr Grønland 16: 210, 222, 291, 434–437.
– 1902. Grønlands Pattedyr. – Meddr Grønland 21: 319–521.
– 1911. Levninger af hvirveldyr fra køkkenmøddingen ved Kagsiarsuk. – In: Clemmensen, M. (ed.) Kirkeruiner fra nordbotiden i Julianehaab distrikt. – Meddr Grønland 47: 344.

Appendices

Appendix 1a.

C-14 dated caribou material from Greenland. All datings have been made on antler found in situ on the ground in non-cultural context. CN and ZMK-numbers refer to collections at the Zoological Museum, Copenhagen.

Region	Locality		Dating			K-no.	References	Catalogue references
	No.	Name	Conventional C-14 years BP	Calibrated age BC/AD	Calibrated according to:			
Region 16, North Greenland	I	Brønlund Fjord	7980±115			3865	Knuth 1984: 144	ZMK
	II	Brønlund Fjord	6240±100	5160 BC	Clark 1975	4348		CN 3800
	III	Brønlund Fjord	5470±95	4390 BC	Clark 1975	3866	Knuth 1984: 144	ZMK
	IV	Brønlund Fjord	3710±80	2045–2130 BC	Pearson 1983	4059	Knuth 1984: 144	ZMK
	V	Brønlund Fjord	2080±75	135 BC	Clark 1975	3867	Knuth 1984: 144	ZMK
	VI	Kap Morris Jesup	1830±70	135–210 AD	Stuiver 1982	3868		ZMK
	VII	Independence Fjord	740±65	1265–1280 AD	Stuiver 1982	4349		CN 2791
Region 19, Angmagssalik	I	Vahl Fjord	1680±70	355–385 AD	Stuiver 1982	4138		CN 3694
	II	Angmagssalik Fjord	1250±70	720–770 AD	Stuiver 1982	4343		CN 1007
	III	Sermilik Fjord	1110±70	900–975 AD	Stuiver 1982	4139		CN 3789
	IV	Kulusuk	990±70	1005–1020 AD	Stuiver 1982	4140		CN 2267
	V	Kulusuk	970±70	1025 AD	Stuiver 1982	4345		ZMK 11/1939
	VI	Angmagssalik Ø	940±70	1035–1150 AD	Stuiver 1982	4344		CN 1006
	VII	Angmagssalik Ø	870±65	1165–1190 AD	Stuiver 1982	4346		ZMK 14/1932
Region 20, Tingmiarmiut	I	Tingmiarmiut Fjord	1260±70	695–770 AD	Stuiver 1982	4350		CN 3390

Appendix 1b.

Archaeological sites in Greenland with caribou remains. The arrow in e.g. 1000→1500 AD indicates that caribou material occur throughout the time-interval, while e.g. 1000–1500 AD indicates that caribou material occur at some point within the time-interval. *"Bones measured"* are presented in Appendix 2b. *K-numbers* are registration numbers for C-14 datings produced by the C-14 Laboratory at the National Museum, Copenhagen. *ZMK-numbers* refer to collections at the Zoological Museum, Copenhagen. *KNK-numbers* refer to collections found either at the National Museum, Copenhagen or at Kalaallit Nunaata Katersugaasivia (Grønlands Landsmuseum), Nuuk.

Region	Locality		Dating	Context	Bones measured	References	Catalogue references	
	No.	Name						
Region 1, South West Greenland	1	Ø 2	1000–1500 AD	Norse	4	Winge 1895: 222	ZMK	5/1895
	2	Ø 17a			0	McGovern 1979	ZMK	104/1955
	3	Ø 20			2	Winge 1895: 434, 436	ZMK	4/1895
	4	Ø 29 Brattahlid			1	Degerbøl 1934a, McGovern 1979 Winge 1895: 434, 436	ZMK	3/1895 9/1932
	5	Ø 47 Gardar			6	Degerbøl 1929, Winge 1895: 434, 436–37	ZMK	1/1895 9/1926
	6	Ø 64a,c			1	Degerbøl 1943	ZMK	10/1939 11/1939
	7	Ø 66			0	Degerbøl 1943, Winge 1895: 434, 437, 1911: 344	ZMK	2/1895 16/1910 12/1939
	8	Ø 71			1	McGovern 1979	ZMK	106/1952
	9	Ø 78a			0	Degerbøl 1943	ZMK	13/1939
	10	Ø 149			0	McGovern 1979	ZMK	108/1952
	11	Ø 167			0		ZMK	109/1952
	12	Narssarssuaq	1350–1650 AD	Thule	0	Degerbøl 1936a, Mathiassen & Holtved 1936: 84	ZMK	
	13	Tugtutûp isuâ			0	Mathiassen & Holtved 1936: 84	KNK	60V1–I:60
	14	Ûnartoq			0	Mathiassen & Holtved 1936: 84	KNK	60V1–I:80
	15	Tugtutûp isuâ	1650–1800 AD		0	Degerbøl 1936a, Mathiassen & Holtved 1936: 90	ZMK KNK	 60V1–I:60
	16	Igdlutalik			0	Degerbøl 1936a, Mathiassen & Holtved 1936: 41, 90	ZMK	
	17	Narssarssuaq			0	Degerbøl 1936a, Mathiassen & Holtved 1936: 41, 90	ZMK	
	18	Ûnartoq			0	Mathiassen & Holtved 1936: 63, 90	ZMK KNK	 60V1–I:80

Region	Locality		Dating	Context	Bones measured	References	Catalogue references	
	No.	Name						
Region 2, Ivigtut	1	M 21	1000–1500 AD	Norse	0	McGovern 1979	ZMK	101/1955
Region 5, Nuuk	1	Itivnera	c. 1500 BC	Saqqaq	34	Degerbøl & Krog 1959, Meldgaard, J. 1961, Møhl, U. 1972, Pearson 1983, K-1192, 1193	ZMK	112/1958 114/1966
	2	V 16	1000–1400 AD	Norse	2	Degerbøl 1936b, McGovern 1979	ZMK	9/1934
	3	V 18			3	Bruun 1917: 78–79	ZMK	
	4	V 18 or 19			4	Bruun 1917: 78–79	ZMK	
	5	V 48 Niaqûssat			2	McGovern 1979, Møhl, J. 1982	ZMK	136/1977
	6	V 51 Sandnæs			42	Degerbøl 1936b, McGovern 1979	ZMK	10/1903 1/1917 10/1934
	7	V 52a Umiviarssuk			32	Degerbøl 1936b, McGovern 1979	ZMK	11/1934
	8	V 53 a, c, d and V 35			17	Degerbøl 1941, McGovern 1979	ZMK	9/1939
	9	V 54 Nipaitsoq	1000→1400 AD		5	McGovern 1979, Møhl, J. 1982	ZMK	110/1952 137/1977
	10	V 59 Eqaluit	1000–1400 AD		0	McGovern 1979, Møhl, J. 1982	ZMK	
	11	V 63			0	McGovern 1979	ZMK	153/1977
	12	Kangeq	c. 1375→1970 AD		1	Gulløv 1983, Møhl, J. unpubl., Stuiver 1982, K-3821, 3822	ZMK	
	13	Utorqait	1350–1500 AD		3	Degerbøl 1931, Mathiassen 1931	ZMK KNK	65V1–IV:23
	14	Qeqertarmiut	1500–1650 AD		2	Degerbøl 1931, Mathiassen 1931	ZMK KNK	65V1–IV:3
	15	Utorqait			1	Mathiassen 1931	KNK	65V1–IV:23
	16	Erssâ	1500–1700 AD		0	Gulløv 1983	ZMK	
	17	Midtvejspladsen	1600–1700 AD	Thule	4	Grønnow & Meldgaard, M. 1982, Stuiver 1982, K-4040, 4041	ZMK	
	18	'Knuths Plads'	1600→1900 AD		4	Grønnow & Meldgaard, M. 1982	ZMK	
	19	Utorqait	1650–1700 AD		0	Mathiassen 1931	KNK	65V1–IV:23
	20	Umanat	1700–1750 AD		0	Degerbøl 1931, Mathiassen 1931	ZMK KNK	65V1–IV:30
	21	Igdlorpait	1700–1800 AD		1	Gulløv 1983, Møhl, J. unpubl.	ZMK	
	22	Umîvît			0	Møhl, J. 1982	ZMK	
	23	'Frederik IV plads'			0	Gulløv 1983	ZMK	109/1978
	24	Håbets Koloni	1721–1728 AD	Colonial	2	Møhl, J. 1979a	ZMK	
	25	Ukîvinguaq	1750–1800 AD	Thule	0	Mathiassen 1931	KNK	65V1–IV:11
	26	Tuperdluk	1800–1900 AD		0	Møhl, J. 1982	ZMK	
Region 6, Sisimiut	1	Uluagordlit	2300–2000 BC	Saqqaq	0	Meldgaard, J. unpubl.	ZMK	
	2	Qajâ	c. 1900→900 BC		4	Meldgaard, J. 1983, Pearson 1983, K-3894, 3899, 1904, 1906	ZMK	
	3	Qeqertasugssuk	c. 2100→1500 BC		2	Grønnow unpubl. Pearson 1983, K-4168, 4171	ZMK	
	4	'Malmqvist Site'	c. 450 BC	Dorset	9	Meldgaard, J. unpubl. Pearson 1983, K-3055	ZMK	
	5	Aussivigssuit	c. 200 BC		0	Grønnow et al. 1983, Clark 1975, K-3152	ZMK	135/1978
	6		c. 1300 AD	Thule	0	Grønnow et al. 1983, Stuiver 1982, K-3153	ZMK	135/1978
	7		1400–1600 AD		5	Grønnow et al. 1983	ZMK	135/1978
	8		1650–1750 AD		38	Grønnow et al. 1983	ZMK	135/1978
	9		1800–1850 AD		12	Grønnow et al. 1983	ZMK	135/1978
	10		1900–1950 AD		0	Grønnow et al. 1983	ZMK	135/1978
	11	'Eqalungmiut aussive'	1910–1940 AD	Thule	251	Grønnow & Meldgaard, M. 1982	ZMK	
Region 8, Jakobshavn Isfjord to Torssukátaq	1	Sermermiut	c. 50 AD	Dorset	0	Mathiassen 1958, Stuiver 1982, K-515, 517	ZMK	
	2	Igdlutalik	1200–1400 AD	Thule	0	Mathiassen 1934a	ZMK KNK	69V2–I:17

Region	Locality No.	Name	Dating	Context	Bones measured	References	Catalogue references
	3	Sermermiut			0	Mathiassen 1958	KNK 69V2–II:13
	4	Igdlutalik	1500–1600 AD		7	Mathiassen 1934a	ZMK KNK 69V2–I:17
	5		1700–1750 AD		1	Mathiassen 1934a	KNK 69V2–I:17
	6	Sermermiut	1850–1900 AD		0	Møbjerg 1983	ZMK
Region 9, Nûgssuaq	1	Sarqaq Øst	c. 400 BC	Dorset	0	Pearson 1983, K-3770	ZMK
	2	Igdlorssuit	1200–1400 AD	Thule	0	Mathiassen 1934a	KNK 69V2–IV:15
	3	Qeqertaq	1200–1900 AD		0	Mathiassen 1934a	KNK 69V2–IV:16
	4	Igdlorssuit	1700–1800 AD		0	Mathiassen 1934a	KNK 69V2–IV:15
Region 11, Upernavik	1	Kûk	1200–1400 AD	Thule	0	Mathiassen 1930	KNK 73V1–I:7
	2	Inugsuk	1200–1500 AD		2	Mathiassen 1930	ZMK 4/1930 KNK 72V1–IV:22
	3	Ikerasârssuk	1200–1900 AD		1	Mathiassen 1930	KNK 73V1–I:4
	4	Ivnarssuit			0	Mathiassen 1930	KNK 73V1–II:9
	5	Qeqertaq			0	Mathiassen 1930	KNK 73V1–I:8
	6	'Kitsorsuaq'			0	Mathiassen 1930	KNK 73V1–I:12
	7	Inugsuk	1500–1850 AD		0	Mathiassen 1930	ZMK 4/1930
	8	Inugsuk	1650–1750 AD		1	Mathiassen 1930	KNK 72V1–IV:22
	9	Nûgârssuk	1650→1850 AD		7	Hjarnø et al. 1974, Møhl, J. 1979b	ZMK
	10	Inugsuk	1750–1850 AD		0	Mathiassen 1930	ZMK 4/1930
Region 12, Melville Bay	1	Igdluminerssuit	1200–1300 AD	Thule	0	Grønnow & Meldgaard, M. 1980	ZMK 80/1979
Region 13, Thule	1	Nûgdlît	c. 1000 AD	Thule	0	Holtved 1954, Stuiver 1982, K-1099	KNK 76V1–IV:4
	2	Ûmánaq	1200–1300 AD		0	Holtved 1944a, 1944b	ZMK
	3		1300–1400 AD		0	Holtved 1944a, 1944b	KNK 76V1–I:2
	4		1400–1500 AD		0	Holtved 1944a, 1944b	ZMK KNK 76V1–I:2
	5		1500–1600 AD		0	Holtved 1944a, 1944b	KNK 76V1–I:2
	6		1800–1900 AD		0	Holtved 1944a, 1944b	KNK 76V1–I:2
Region 14, Inglefield Land	1	Inuarfigssuaq	700–950 AD	Dorset	0	Holtved 1944a, 1944b	KNK F 2:1
	2	Ruin Ø	c. 1000 AD	Thule	0	Holtved 1944a, 1944b, Stuiver 1982, K-1505, 1506	KNK F 2:2
	3	Inuarfigssuaq	1100–1300		0	Holtved 1944a, 1944b	KNK F 2:2
	4		c. 1150 AD		3	Holtved 1944a, 1944b	KNK F 2:2
	5		1150–1200 AD		0	Holtved 1944a, 1944b	KNK F 2:2
	6		1200–1250 AD		2	Holtved 1944a, 1944b	KNK F 2:2
	7	Kap Russell	1200–1300 AD		0	Holtved 1944a, 1944b	KNK F 2:3
	8	Kap Kent	1200–1300 AD		0	Holtved 1944a, 1944b	KNK F 3:1
	9	Inuarfigssuaq	c. 1300 AD		0	Holtved 1944a, 1944b	KNK F 2:1
Region 15, Washington Land	1	Kap Webster	1200–1700 AD		0	Mathiassen 1928	KNK F 5:3 (in lit.)
Region 16, North Greenland	1	Portfjeldet	c. 2300 BC	Independence I	0	Knuth 1967, 1981, Pearson 1983, K-928, 930	ZMK
	2	'Pearylandville'	c. 2300 BC		0	Knuth 1967, 1981, Pearson 1983, K-939	ZMK
	3	Vendenæs	c. 2150 BC		0	Knuth 1967, 1981, Pearson 1983, K-1061	ZMK
	4	'Adam C. Knuth Site'	c. 2100 BC	Independence I	0	Knuth 1981, 1982, Pearson 1983, K-3531, 3532	ZMK
	5	'Pearylandville'	c. 2000 BC		0	Knuth 1967, 1984, Pearson 1983, K-4058	ZMK
	6	Delta-terrasserne	c. 1550 BC	Independence II	0	Knuth, 1967, 1981, Pearson 1983, K-150	ZMK
	7	Kap Tyson	700–950 AD	Dorset	0	Mathiassen 1928	KNK F 8:2 (in lit.)

Region	Locality No.	Locality Name	Dating	Context	Bones measured	References	Catalogue references
	8	Fældestrand	1200–1800 AD	Thule	0	Glob 1946, Thostrup 1911	ZMK KNK F 23:2
	9	Eskimonæsset			0	Thostrup 1911	ZMK KNK F 23:3
Region 17, North East Greenland	1	Sælsøen	1200–1800 AD	Thule	0	Thostrup 1911	ZMK
	2	Rypefjældet			1	Thostrup 1911	ZMK
	3	Syttenkilometer-næsset			0	Thostrup 1911	ZMK 9/1921 KNK F 31:36
	4	Snenæs			3	Thostrup 1911	ZMK
	5	Stormnæs			0	Thostrup 1911	ZMK KNK F 31:35
	6	Stormbugtens østkyst			3	Thostrup 1911	ZMK KNK F 31:34
	7	Danmarkshavn			0	Thostrup 1911	ZMK KNK F 31:5
	8	Bådskæret			0	Thostrup 1911	ZMK
	9	Maroussia			0	Thostrup 1911	ZMK KNK F 31:20
	10	Kap Helgoland			0	Thostrup 1911	ZMK
	11	Renskæret			0	Thostrup 1911	ZMK KNK F 31:29
	12	Gefion Havn			6	Knuth 1942: 109–24	ZMK
	13	'Kap Borlase Warren'			0	Amdrup 1909, Glob 1946	KNK 74Ø1–III:3
	14	Revet			1	Andersen, S. H. unpubl.	ZMK 32/75A KNK 74Ø2–II:13
	15	Ella Ø			0		ZMK 6/1933
	16	Kap Hope			0	Glob 1946, A. Petersen 1930: 358	ZMK
	17	Kap Stewart			0	Glob 1946, A. Petersen 1930: 358	ZMK
	18	Hurry Inlet			4	Vibe 1967: 159	ZMK 29/67A
	19	Harefjord			5	Vibe 1967: 159	ZMK 29/67A
	20	Hekla Havn			0	Ryder 1895	KNK 70Ø2–III:3 (in lit.)
	21	Gaasepynt			0	Ryder 1895	KNK 70Ø2–III:2 (in lit.)
	22	Sydkap			0	Ryder 1895	KNK 71Ø2–II:5 (in lit.)
	23	Dødemands-bugten	1350–1500 AD		5	Degerbøl 1934b, Larsen 1934	ZMK
	24		1600–1700 AD		7	Degerbøl 1934b, Larsen 1934	ZMK KNK 74Ø2–II:5
	25	Kap Harry			12	Degerbøl 1934b, Glob 1935	ZMK KNK 72Ø2–IV:3
	26	Kap Elisabeth			0	Degerbøl 1935, Glob 1935	KNK 72Ø2–IV:5
	27	Geographical Society Ø, II.			1	Degerbøl 1935, Glob 1935	ZMK KNK 72Ø2–I:3
	28	Konglomeratnæs			0	Degerbøl 1935, Glob 1935	KNK 73Ø2–III:3
	29	Suessland			0	Degerbøl 1935, Glob 1935	KNK 73Ø2–III:2
	30	Rypefjeldet	1600–1800 AD		0	Glob 1946, Thostrup 1911	KNK F 31:25
	31	Snenæs			0	Thostrup 1911	KNK F 31:30
	32	Dødemands-bugten	1700–1800 AD	Thule	4	Degerbøl 1934b, Larsen 1934	ZMK KNK 74Ø2–II:5
	33	Kap Elisabeth			3	Degerbøl 1935, Glob 1935	ZMK KNK 72Ø2–IV:5
	34	Kap Hedlund			8	Degerbøl 1935, Glob 1935	ZMK KNK 72Ø3–I:2
	35	Kap Harry			0	Glob 1935	KNK 72Ø2–IV:3
	36	Suessland			0	Glob 1935	KNK 73Ø2–III:2
	37	Renodde			0	Glob 1946, Ryder 1895	KNK 70Ø3–II:4
	38	Kap Stewart			0	Glob 1946, Ryder 1895	KNK 70Ø1–II:8
	39	Kap Tobin			0	Amdrup 1909, Glob 1946	KNK 70Ø1–II:3
	40	Kap Hope			0	Glob 1946, Koch 1930: 237	KNK 70Ø1–II:4
	41	'Perlehuset', Jameson Land	1800–1850 AD		0	Sandell, H. & B. pers. com.	

Region	Locality No.	Name	Dating	Context	Bones measured	References	Catalogue references
Region 19, Ammassalik	1	'Sukersit'	1350–1500 AD		0	Mathiassen 1933	KNK 66Ø2–III:1
	2	'Misigtoq'			0	Mathiassen 1933	KNK 65Ø1–IV:46
	3	Kangârtik			0	Mathiassen 1933	KNK 65Ø1–IV:55
	4	'Savanganeq'			0	Mathiassen 1933	KNK 65Ø1–IV:12

Appendix 2a.

Naturally deposited caribou remains found "in situ" on the ground. Only remains that add to the knowledge of caribou distribution and taxonomy are presented. CN and ZMK numbers refer to collections kept at the Zoological Museum, Copenhagen. Measurements have been taken as described by Driesch 1976 : Bd = greatest breadth of the distal end, A/P = greatest anterior-posterior thickness of distal end, DD = smallest bredth of diafysis, GL = greatest length. All bones measured had completely fused epifysis.

Region and locality		Humerus dist.epiph.		Metacarpus dist.epiph.				Metatarsus dist.epiph.				Other anatomical parts	Catalogue reference
		Bd	A/P	Bd	A/P	DD	GL	Bd	A/P	DD	GL		
Region 6,	Sarfartôq			38.0	18.9	13.6	165						CN
				38.2		12.9	167						CN
Region 12,	Tugtuligssuaq			41.2	21.6	13.9	178	42.4	22.0		260	Antler fragments	CN
	Naujaligssuaq											Antler	CN
Region 14,	Rensselaer Bugt	49.2	50.6					42.8	24.4	17.5	254		CN
Region 16,	Hall Land							43.0				Metatarsus (sub.ad.)	CN
	Nyboe Land						166						CN
	Warming Land											Antler	CN
	Nansen Land											Antler	CN
	Peary Land											Antler fragment	CN 2790
	Peary Land											Antler fragment	CN 2792
Region 17,	Danmark Havn							42.7	22.5	17.3	242		CN 1485
	Rypefjord			37.5	18.6	11.5	163	41.4	21.9	16.0	242		CN 3104, 3105
	No locality							41.1	21.6	16.0	237		CN 982
Region 19,	Kulusuk							35.1	18.9	13.0	191		ZMK
	Kulusuk											Distal tibia	ZMK
	Kulusuk											Four antler fragments	ZMK
	Kulusuk											One antler fragment	ZMK
	Kulusuk											Three cerv.vertebrae	ZMK
	No locality											Antler fragment	ZMK

Appendix 2b.

Caribou bones from archaeological sites in Greenland. Measurements have been taken as defined by Driesch 1976. All the bone-material is kept at the Zoological Museum, Copenhagen.

Region number	Locality No.	Name	Humerus dist.epiph. Bd	A/P	Metacarpus dist.epiph. Bd	A/P	DD	GL	Metatarsus dist.epiph. Bd	A/P	DD	GL
1	1	Ø 2	50.5	50.6								
			50.0	50.4								
			–	49.8								
			44.6	45.3								
	3	Ø 20			46.4	23.6			39.6	21.8		
	4	Ø 29							42.6			
	5	Ø 47	53.6	53.8	41.4	21.2						
			48.2			20.1						
			45.1	44.9								
				52.7								

Region number	Locality		Humerus dist.epiph.		Metacarpus dist.epiph.				Metatarsus dist.epiph.			
	No.	Name	Bd	A/P	Bd	A/P	DD	GL	Bd	A/P	DD	GL
	6	Ø 64 a, c			40.5	21.5	14.3	178.5				
	8	Ø 71	49.6	50.0								
5	1	Itivnera	38.6	41.1	37.2		14.7	160.8	41.4	22.3	17.8	
			42.2	42.4	38.3		13.5				15.8	221.3
					36.5		13.1		39.7	21.6	17.0	
					36.4	18.2			37.6	20.0	16.1	
					36.3		12.5		37.3	20.3		
							12.9		35.5		16.1	
					33.4	18.2	12.7		35.2	19.4	14.8	
							11.8		38.2	21.3	17.7	
					35.0	17.8	12.5		36.0			
					36.5	18.0	12.6				15.1	
									34.7	19.4	13.8	
									35.5	18.9	14.2	
									39.8	21.6		
									35.8	19.2	15.6	
									36.8	19.0		
									38.0	20.5	15.7	
									36.2		14.5	
									34.8	17.4	14.2	
									35.2			
											15.1	
											15.8	
											15.0	
	2	V 16	50.0	48.5					44.0	24.2		
	3	V 18			43.8	21.7	15.9		44.0	22.8	20.6	
									45.0	23.6		
	4	V 18 or 19			40.0	19.8			43.7	23.7		
									39.9	22.9		
									42.9	22.4		
	5	V 48	50.6	51.8								
			47.4	48.7								
	6	V 51	46.9	47.6	44.5	23.2			42.2	24.3		
				51.2	43.1	20.7			44.8	23.2		
			46.7	47.0	41.1	20.2	14.4		46.1	26.2		
			45.5	46.6	40.0	20.5			44.5	24.0	18.8	
			49.2	52.0	46.7	23.0			37.6	20.0	15.5	
			50.5	52.2	46.5	22.2			41.6	23.0		
			50.0	50.8	46.2	23.9			40.9			
			52.0	53.8			14.0	190	41.7	23.3		
			50.8	53.4	44.0	21.6			44.7	24.6		
			41.8	45.0					41.2			
			45.4	46.8								
			51.5	51.2								
			47.7	48.4								
			50.0	52.2								
				47.6								
			46.4	47.2								
			39.0	39.8								
			47.9	47.7								
			53.2									
			50.9									
			47.4	47.1								
			50.8	50.7								
			48.1	48.1								
	7	V 52 a	50.4	49.0	42.3	21.8	23.5		45.8	25.0	19.5	
			51.3	51.8	46.7	26.4			44.4	24.6		
			51.4	52.1	43.5	23.0			43.5	24.5		
			50.7	51.6	49.6	25.0			47.7	23.9		
			48.9	50.5					46.0	25.7	19.6	
			54.0						45.3			
			50.8	52.9					41.9			
			53.4	54.5					42.6	23.6		
			50.3	52.0					41.7	23.0	16.0	
			56.0	56.5								

Region number	Locality No.	Locality Name	Humerus dist.epiph. Bd	Humerus dist.epiph. A/P	Metacarpus dist.epiph. Bd	Metacarpus dist.epiph. A/P	Metacarpus dist.epiph. DD	Metacarpus dist.epiph. GL	Metatarsus dist.epiph. Bd	Metatarsus dist.epiph. A/P	Metatarsus dist.epiph. DD	Metatarsus dist.epiph. GL
			52.2	54.2								
			51.2	51.6								
			47.4	49.0								
			53.9	53.6								
			52.0	51.9								
			50.6	52.0								
			51.5	53.3								
			47.9	48.3								
			43.6	44.3								
	8	V 53 a, c, d	52.4	52.0	46.2	22.4	17.0		45.0	25.0		
		and V 35	51.3		44.8	23.3			43.1	24.1		
			49.2	49.6	40.0	20.8			45.7			
									44.0	25.0		
									40.0			
									41.3	21.6		
									42.9	22.5		
										24.0		
									40.7	22.7		
									43.1	22.0		
									38.8	22.0	15.0	
	9	V 54, lower							45.9	24.9	19.8	
		upper					17.0		43.9	24.6		
					47.2	23.6	16.6					
					43.9	24.6						
	12	Kangeq							43.9	22.0	14.0	
	13	Utorqait	49.0	50.4	44.7	22.7	16.1		43.0	24.0	21.0	280
	14	Qeqertarmiut			44.4							
					47.1	23.5	18.0					
	15	Utorqait			45.3	23.4	16.9	199				
	17	'Midtvejspladsen'		52.8	42.9	22.3			41.2	21.2	17.3	
									40.7	22.3	16.8	
	18	'Knuths Plads'			43.6	20.9	15.8		41.3	23.2	17.8	
					40.4	20.2	13.0					
					43.1	20.4	16.3					
	21	Igdlorpait							38.9	22.2		
	24	Håbets Koloni		46.2					40.0	22.2	17.1	
6	2	Qajâ (1900–1500 BC)									17.3	
									40.0	22.3		
		(c. 1500 BC)			41.1	21.0			43.5	23.0	19.0	
	3	Qeqertasugssuk	42.0	40.5								
			46.5	45.5								
	4	'Malmqvist Site'			41.2	21.3			43.7	24.5		
					46.0				45.6	25.8	20.8	
					44.5	21.3			42.0	23.0		
					45.8	23.0			47.2	25.7		
									42.6	23.2		
	7	Aussivigssuit	47.8	50.8	41.0							
					41.0	21.0	14.3					
					48.0	23.6	19.6					
					43.0		14.2					
	8	Aussivigssuit	47.8	47.7	47.0	24.8	19.6		44.2	25.2	19.6	
			42.0	44.9	45.0	23.1	16.7		46.6	26.2		
			49.6	50.5	41.7	21.0			43.9	24.7	17.5	
			45.5	46.8	39.1	21.0	15.1		42.2	23.2	17.5	
			48.5	48.1	45.6		17.1		44.2	24.2	19.4	
			46.4	48.0	45.8	23.4	17.2		41.9	22.4	16.8	
			50.6	50.2	43.8	22.4					16.7	
			49.0	51.4					41.7		18.1	
				48.2					46.4	25.2	19.6	
			48.6	48.4					41.4	23.2	17.8	
									40.3	22.7	16.7	
									45.7	25.6		
									45.7	24.8	21.6	
									42.4	23.5	18.6	
									41.0		20.1	

Region number	Locality No.	Name	Humerus dist.epiph. Bd	A/P	Metacarpus dist.epiph. Bd	A/P	DD	GL	Metatarsus dist.epiph. Bd	A/P	DD	GL
									43.7	24.5		
									40.5	23.0	17.7	
									42.5	23.8		
									43.2	24.0	19.6	
										22.4	17.5	
									42.3	23.5	16.9	
	9	Aussivigssuit	50.9	51.2	49.0	24.0	17.8		44.6	24.8		
			43.9	45.1	42.1	20.7	14.0		44.1	24.5	18.9	
			48.8	49.9	43.9	22.4	16.8		44.3	24.5	19.7	
					42.0	21.4	14.8					
					45.6	24.1	17.0					
					43.4	22.6	16.8					

Region number	Locality No.	Name	Metatarsus dist.epiph. Bd	A/P	DD	Metatarsus dist.epiph. Bd	A/P	DD	Metatarsus dist.epiph. Bd	A/P	DD
6	11	'Eqalungmiut aussive'	41.8	21.9	16.5	40.0	20.0	16.3	45.0	23.5	19.8
			44.0	24.2	20.5	39.5	20.4		43.6	23.1	19.3
			39.1	20.5	17.1	39.6	21.1		44.4	23.6	20.0
			45.4	25.6		43.8	23.0	18.9	43.4	22.6	17.4
			43.4	21.2	16.3	46.6	23.6	22.2	44.8	24.6	20.4
			39.7	19.0		44.2	23.2	19.5	41.4	19.3	13.6
			42.4	23.0	18.6	42.1	22.2	17.1	40.9	20.7	17.7
			42.5	22.1	17.4	40.6	20.0		45.4	24.6	
			42.1	22.3	18.8	41.3	22.5	16.5	42.4	23.0	19.0
			40.2	21.4	15.4	40.5	21.8		44.6	24.0	19.1
			40.7	22.0	16.4	42.4	23.0		44.7	23.0	19.5
			45.7	23.5	20.0	44.0	21.6	18.6	40.0	21.4	16.2
			41.1	23.2		42.2	22.8	18.0	44.2	24.1	20.0
			40.7	21.5	15.8	45.4	23.4	20.1	44.6	22.7	19.2
			43.6	22.0		40.0	21.0	16.1	44.8	23.0	18.8
			39.3	21.0	15.6	43.2	23.2	20.3	42.1	22.3	18.1
			45.0	24.0	21.2	39.4	21.0		44.1	22.3	19.5
			46.1	24.3	19.5	42.6	21.3	15.5	41.1	20.3	15.9
			43.1	21.3	17.6	42.5	21.6	17.5	38.5	21.3	15.5
			41.5	21.8	17.5	40.2	21.4	16.6	41.0	21.5	
			40.6	21.7	16.6	43.4	23.3	18.9	46.2	24.6	18.8
			42.4	23.5	19.2	42.8	21.2		40.3	22.1	16.8
			42.3	21.7	17.0	44.2	23.1		45.6	25.2	20.0
			41.0	22.3	18.3	44.0	23.0	20.6	45.1	23.5	20.1
			44.4	23.0	18.1	39.0	21.2	17.5	43.9	22.4	18.4
			42.0	22.4	18.5	41.6	23.0		44.4	23.6	19.1
			43.0	21.8	18.6	43.7	22.5	18.1	44.4	24.0	18.6
			43.7	24.0	19.4	40.1	22.0		38.6	21.2	15.5
			45.5	24.6	20.4	40.7	21.7		41.9	23.0	17.3
			43.0	24.7	20.6	46.0	24.1	20.4	40.1	22.8	16.3
			40.6	22.0	16.8	42.0	22.0	16.7	44.0	23.4	18.2
			39.1	20.1	17.0	44.0	24.2	19.9	43.6	22.8	18.1
			42.0	21.9		40.5	21.4		40.0	21.7	
			43.7	22.0	18.0	39.8	21.4	16.2	44.0	22.7	18.4
			44.7	23.8	19.4	41.9	22.6	18.8	44.3	22.2	
			39.6	20.8	16.6	42.8	22.0	17.7	43.6	21.8	
			39.0	19.9	15.5	45.0	23.2		44.4	24.6	19.8
			45.0	23.4		45.6	21.6	16.8	44.7	23.4	19.8
			43.0	22.8	18.3	40.9	20.7		44.3	23.0	18.5
			43.8	24.0		41.3	22.5		41.0	21.1	16.6
			38.8	19.6		40.0	21.7		41.4	22.4	18.0
			38.4	20.6		41.4			38.1	19.4	
			38.6	21.1	15.2	39.6	20.0	15.5	43.0	23.1	
			39.5	21.8	17.0	45.5	23.0		46.2	25.2	20.8
			44.3	24.0	19.5	42.7	21.4	16.7	38.3	21.0	
			44.7	23.9	21.2	39.3	20.6		40.8	21.2	
			41.0	22.3		41.4	22.3	18.9	43.5	23.1	

Region number	Locality		Metatarsus dist.epiph.			Metatarsus dist.epiph.			Metatarsus dist.epiph.		
	No.	Name	Bd	A/P	DD	Bd	A/P	DD	Bd	A/P	DD
			41.2	22.4		42.3	23.8	18.9	45.0	23.6	20.0
			43.0	23.2		46.0	24.9	21.4	42.6	22.5	18.0
			40.0	21.4	15.3	43.3	22.0	18.3	46.8	24.5	20.2
			44.6	21.0		41.6	23.0		40.1	20.3	18.1
			41.2	22.2		41.8	22.6	17.2	45.1	23.4	18.3
			42.9	22.7	17.2	41.8	23.4	18.6	41.6	22.4	15.6
			40.4	19.6	15.0	39.8	20.0	15.5	42.4	22.6	
			41.8	22.0	18.5	43.2	22.9	17.7	38.4	21.4	15.8
			40.9	22.3	16.0	44.4	24.2	19.3	38.2	20.3	15.0
			38.5	20.7	17.5	38.4	19.4	15.7	43.0	22.4	18.3
			42.3	22.3	18.0	44.2	23.7	18.2	44.0	22.2	
			42.6	22.4		44.3	22.7	18.4	40.2	21.0	16.4
			40.4	20.6	16.6	43.0	22.4		39.1	20.2	16.8
			39.2	21.4	16.1	41.2	22.0	17.6	39.9	21.8	
			40.3	21.4	17.0	44.7	24.4	19.7	42.7	23.8	18.3
			42.0	22.4		43.3	23.0	20.6	38.6	20.8	15.0
			42.0	22.4	16.4	38.6	21.0		42.4	22.7	
			43.5	23.6		40.5	20.2		39.0	21.3	17.5
			45.9	25.6		40.8	21.0		41.4	22.8	15.3
			40.9	23.0		38.6			43.0	22.7	
			45.2	24.1		41.1	21.7	16.2	41.4	21.0	
			39.2	20.5		46.4	19.0		39.4	20.8	15.6
			42.5	21.6	18.1	40.2			39.7	21.2	
			45.3	24.9		42.5	22.0		41.6	23.5	18.5
			45.0	23.9	20.9	42.8	20.8	17.8	39.0	21.2	
			41.0	22.4		36.7	19.8		39.0	20.5	
			48.2	24.8		44.6	23.2		40.6	22.4	
			41.4	21.8	16.0	43.7	23.1		38.2	18.6	
			43.6	24.2	19.8	40.3	21.8	17.4	40.6	22.5	16.0
			45.5	23.2	19.5	44.3	24.2	20.0	41.9	22.3	18.1
			40.3	21.9		42.0	23.6	18.0	39.4		15.3
			41.3	23.1	16.9	38.4	21.0	15.6	45.2	24.3	
			41.5	23.2	17.3	39.3	21.1	15.3	39.8	21.9	
			41.0	22.4		40.9	22.4		43.4	22.7	
			42.7	22.9		39.5	21.2		44.5	22.6	18.3
			45.0	24.2	20.3	40.0	22.0		42.3	23.0	16.9
			44.5	24.0		41.8	22.8				

Region number	Locality		Humerus dist.epiph.		Metacarpus dist.epiph.				Metatarsus dist.epiph.			
	No.	Name	Bd	A/P	Bd	A/P	DD	GL	Bd	A/P	DD	GL
8	4	Igdlutalik			45.1	23.3	16.9	193	39.5	22.6		
					45.7		17.4					
					44.0	22.9	15.8	189				
					45.5	23.0	16.7					
					41.0		14.0					
					43.5	22.3	16.7	194				
	5	Igdlutalik			40.8	22.1	13.8	182				
11	2	Inugsuk			46.3	24.0	16.2	203	42.0	24.5	17.1	
	3	Ikerasarssuk							42.7	23.8	17.7	
	8	Inugsuk			46.4	23.3	16.0	198				
	9	Nûgârssuk	47.7		40.3							
			48.0		45.1	22.4	15.3					
					41.6	22.8	14.6	184				
					41.0	21.0	14.4					
					45.5	22.1						
14	4	Inuarfigssuaq			42.6	22.4		186				
					40.0			174				
					38.4	20.5		168				
	6				37.4	20.1		174				
					45.0	23.1	15.5	190				

Region number	Locality No.	Name	Humerus dist.epiph. Bd	A/P	Metacarpus dist.epiph. Bd	A/P	DD	GL	Metatarsus dist.epiph. Bd	A/P	DD	GL
17	2	Rypefjeldet			40.6	19.3	14.4					
	4	Snenæs	43.6	46.4	38.9	19.8	11.8					
					36.9	17.9	11.5					
	6	Stormbugtens østkyst			41.2							
					38.6							
					38.2	19.1						
	12	Gefion Havn	41.5	43.4	38.6	19.5	12.7		37.8	20.0	15.0	
			43.9	47.4								
			42.7	43.8								
			39.7	44.8								
	14	Revet	43.0									
	18	Hurry Inlet			38.6				38.6	20.4		
					39.9		14.1					
					40.2		14.2					
	19	Harefjord	40.6		36.1	18.2	11.7		33.8	16.3	11.1	
			43.6	46.4	39.1	18.4	13.0					
	23	Dødemandsbugten		42.5					39.6	21.1	15.0	
				42.4					40.4	21.4	17.2	
									35.2		12.4	
	24	Dødemandsbugten	43.2	43.9	40.6	21.0	13.9				15.9	
			39.7	43.8	37.2		12.0		39.9	21.2		
					35.4	17.9	11.2					
	25	Kap Harry	46.7	48.4	41.0		14.0		42.5	23.0		
			39.9	43.2	37.7	19.5	12.6		40.0	21.2		
			40.7		38.0	19.7	13.0		38.8	21.0		
					38.1	20.0			42.0	22.0	16.9	
					37.5	19.4	12.0					
	27	Geogr. Society Ø, I	44.0	44.0								
	32	Dødemandsbugten					15.0		38.9	20.2	14.5	
					38.9	18.2						
						19.0						
	33	Kap Elisabeth			40.2	21.1						
					43.5	21.8						
					41.5	20.9						
	34	Kap Hedlund			39.9	19.9	12.6		40.2	21.3	16.2	
					39.2	20.0	12.4		39.7	21.0	14.3	
					42.3	21.0	14.8		38.5	19.6	14.5	
					38.3	19.5	12.3		39.6	20.8	13.3	

Appendix 2c.

Recently collected Greenland caribou. Only specimens with measurable longbones are presented. CN numbers refer to collections kept at the Zoological Museum, Copenhagen. Measurements have been taken as described by Driesch 1976.

Region and locality		Date of collection	Sex	Humerus dist.epiph. Bd	A/P	Metacarpus dist.epiph. Bd	A/P	DD	GL	Metatarsus dist.epiph. Bd	A/P	DD	GL	Catalogue references
Region 5,	Godthåbsfjord	1943	♀			41.6	22.0	14.0	173	40.0	23.0	16.5	239	CN 2718
			♂			48.4	24.8	17.6	195	46.7	25.4	20.2	278	CN 2726
			♀			41.3	21.6	14.4	178	41.4	22.4	22.9	250	CN 2719
			♀			46.0	23.5	15.5	192	45.0	25.0	18.0	264	CN 2720
			♂			45.9	23.4	16.5	191	43.4	24.2	19.6	267	CN 2727
Region 6,	Sisimiut	1899	♂	56.2	55.4	49.8	24.4	19.0	225	45.4	24.4	20.0	285	CN 886
		1913	♂	54.0	52.9	47.0	23.8	17.0		45.9	25.2	19.7		CN 1045
	Søndre Strømfjord	1955				41.2	21.4	15.0	173					CN 3344
						43.5	22.6	15.6	187					CN 3336
						41.9	21.2	14.2	180					CN 3341
						40.9	21.0	14.8	172					CN 3338
						48.7	24.0	18.6	200					CN 3333
						46.3	24.0	16.0	182					CN 3337
						45.4	23.0	16.7	186					CN 3332

Region and locality	Date	Sex	Humerus dist.epiph.		Metacarpus dist.epiph.				Metatarsus dist.epiph.				Catalogue reference
			Bd	A/P	Bd	A/P	DD	GL	Bd	A/P	DD	GL	
Sisimiut	1964	♂			44.0		16.5	187	43.0		18.0	268	CN
Søndre Strømfjord	1970	♂							43.4	23.3	18.5	254	CN 3687
		♂			45.8	22.6	15.9	179	43.6	23.7	18.1	257	CN 3688
		♂			46.2	23.0	17.0	189	44.1	23.4	19.0	262	CN 3689
	1978	♀	46.5	47.8	42.4	21.8	13.6	180	41.6	24.2	16.5	255	CN
		♀			39.5	20.3	13.4	170	38.9	21.6	15.0	238	CN 4035
		♂	51.3	51.4	45.8	24.2	16.2	186	44.8	25.4	18.9	262	CN 3946
		♀	44.8		42.1	21.5	13.4	173					CN 3940
		♀	43.4	43.4	41.2	21.4	13.4	178	39.9	22.4	15.4	249	CN 4033
		♂	49.8	49.5	45.1	22.8	17.6	185	43.8	23.7	20.0	262	CN 4029
		♀			41.8	21.5	14.5	174	40.0	23.0	16.7	242	CN 4034
		♀	45.3	45.6					41.7	23.8	16.9	257	CN 4039
		♀	45.6	47.2	43.1	21.1	13.4	172	42.5	23.0	16.2	245	CN 4036
			44.6	45.6	41.2	21.4	12.9	173	39.3	22.5	15.8	246	CN 3935
			51.0	51.0	47.0	23.6	16.7	184					CN 3930
			54.0	55.5									CN 3962
			45.3	48.0									CN 3963
			50.6	51.0									CN 3964
			51.4	50.5									CN 4031
					47.2	24.4	19.6	192					CN 3989
					47.3	24.3	18.0	192					CN 3943
					40.0	22.1	15.2	231					CN 3943
					41.4	21.0	13.4	173					CN 3936
					44.5	22.8	16.7	188					CN 4009
					48.2	23.8	18.4	194					CN 3938
					46.6	23.7	17.0	195					CN 4003
					44.6	22.1	15.0	182					CN 4002
					47.0	23.6	18.0	191					CN 3997
					44.0	22.8	15.4	182					CN 4008
					47.0	23.2	17.6	192					CN 4000
					48.6	24.6	18.0	191					CN 4010
					45.0	22.6	14.3	186					CN 4005
					44.3	23.2	14.6	188					CN 4001
					44.2	23.0	16.7	182					CN 4004
					42.0	21.0	17.2	175					CN 3998
					42.2	21.4	14.3	181					CN 4007
					45.0	23.0	16.2	181					CN 3996
					46.2	24.0	17.0	187					CN 3999
									40.0	22.5	16.6	240	CN 3947
									40.3	23.0	15.4	250	CN 3937
									44.8	25.0	20.4	269	CN 4013
									44.8	25.0	19.7	273	CN 4024
									44.9	24.8	19.4	265	CN 4015
									44.4	24.6	19.8	263	CN 4016
									45.3	25.0	20.0	270	CN 4017
									41.8	23.1	17.7	252	CN 4026
									40.8	22.9	17.0	243	CN 4023
									42.0	24.0	16.6	250	CN 4014
									41.9	23.4	17.0	251	CN 4021
									45.0	24.6	20.7	268	CN 4027
									41.2	23.6	16.7	258	CN 4020
									43.6	23.8	19.6	268	CN 4012
									42.3	23.8	17.0	250	CN 4019
									42.6	23.6	15.7	252	CN 4025
Nagssugtôq	1955				46.4	23.9	18.1	196					CN 2993
		♂			45.7	23.4	17.4	192					CN 2992
Region 9, Nûgssuaq	1955	♀	45.0	45.4	40.9	21.5	13.2	175	40.2	23.3	15.9	244	CN 2976
Region 9 or 11	1935	♂	51.1	52.7	45.5	23.3	16.8	186					CN 1611
Region 14, Marshall Bay	1939	♂			44.5	23.0	15.0	185	44.0	24.1	18.2	260	CN 2737
Region 17, Scoresby Sund	1892	♀			40.0	20.0	13.5	167	40.4	20.6	16.0	233	CN 592
		♂?			42.6	19.9	14.7	173					CN 591

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