

## NOTES

### Cycle 100 and its Influence on Renewable Resources and Economic Conditions in Greenland - and other countries as well?

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*Fluctuations in the populations of various animal species living in Greenland are known to us. Closer scrutiny of these variations has revealed interesting correlations that arouse curiosity. The climatic influence on living resources, and hence on our Arctic economy, and the way in which nature functions in our part of the world offer an explanation to many questions that must be of interest far beyond our own country. The present article is a brief presentation of the conditions observed, offered in the hope that others have made similar observations. These phenomena cannot be specific to Greenland. They must be Arctic and, as a consequence, part of the global system.*

We have known about the fluctuating populations of certain animal species in Greenland for a long time. Short-term cycles are very obvious. Fluctuations occurring over longer intervals are less conspicuous, and cycles surpassing the span of a human life-time are difficult to observe. Several researchers have investigated these matters, including Christian Vibe in his article "Arctic Animals In Relation To Climatic Fluctuations" from the year 1967. Since the 1970s, I have been collecting material with a view to shedding better light on the mechanisms underlying these phenomena.

#### OBSERVATIONS

Greenlandic animal species are either Arctic or Atlantic. It is interesting to see whether the populations of other species fluctuate like the stock of the Atlantic cod.

#### A) The Case of Cod: an Atlantic Species

##### i) Its Presence in the 20th Century

Fig. 1 shows cod occurrences in Greenlandic waters since the time of the Egede family, i.e. from about the year 1721 until the present day. Taking our own twentieth century as our starting point, we find that the turn of the century saw some occurrences of cod in West Greenland, but in certain fjords only, as shown in Figures 2b and 2c. The great invasion of cod from Iceland began between the years 1915-20 so that subsequently cod occurred in the fjords, between the coastal islands, and on off-shore banks. The migratory habits of cod revealed a distinct, annual pattern. In May and June intercoastal fishing would begin. Outward bound from the end of June, the cod would reach the outer coast during the course of August. This rhythm was so predictable that the fishermen knew exactly where to find the cod each summer. The cod would spawn in certain fjords and banks.

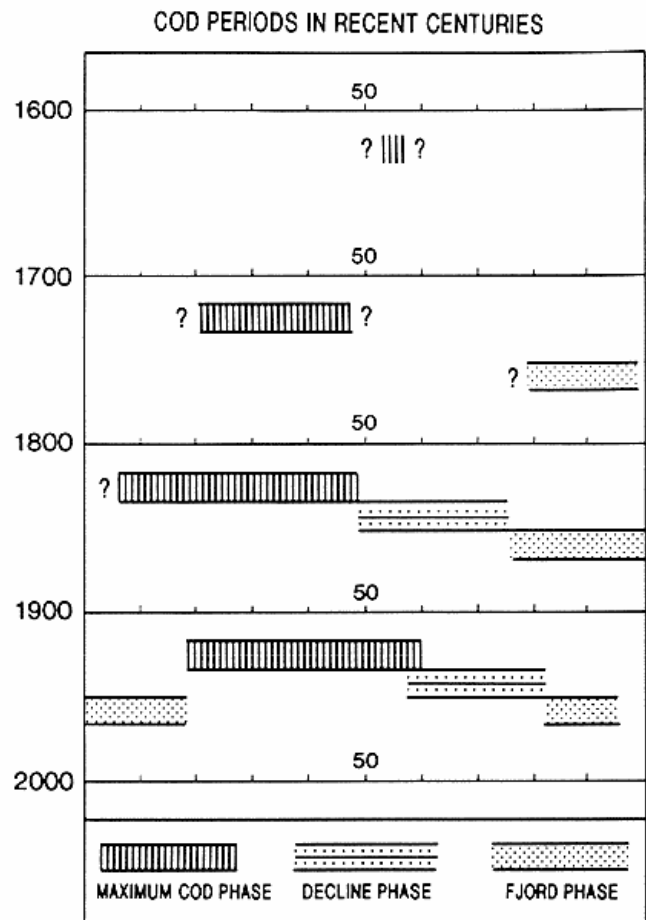


Fig 1. In summary, Figure 1 shows three distinct cod phases which reoccur each century and which support the hypothesis of the existence of a phenomenon called "Cycle 100". During the maximum phase, the cod are found on offshore banks, along the coast and in the fjords. During this phase, they are also characterized by having a large body size. During the decline phase, the cod are found only on offshore banks and in the fjords. Their body size is generally small. The fjord phase is synonymous with the minimum cod phase, during which the cod are only found in specific fjords where the waters are too deep too freeze down to the bottom. The cod in these fjords may grow very large, and may well be native and therefore might represent the evolution of a resident Arctic cod species in contrast to the more common, migrant Atlantic species?

Towards 1960 the stable rhythm was disturbed. The occurrence of cod became more and more unpredictable. In time, emigration from the banks and the coast began. The cod became smaller and smaller, that is ever younger. Eventually no cod was to be caught from the offshore banks or in the coastal waters. At present, there are only

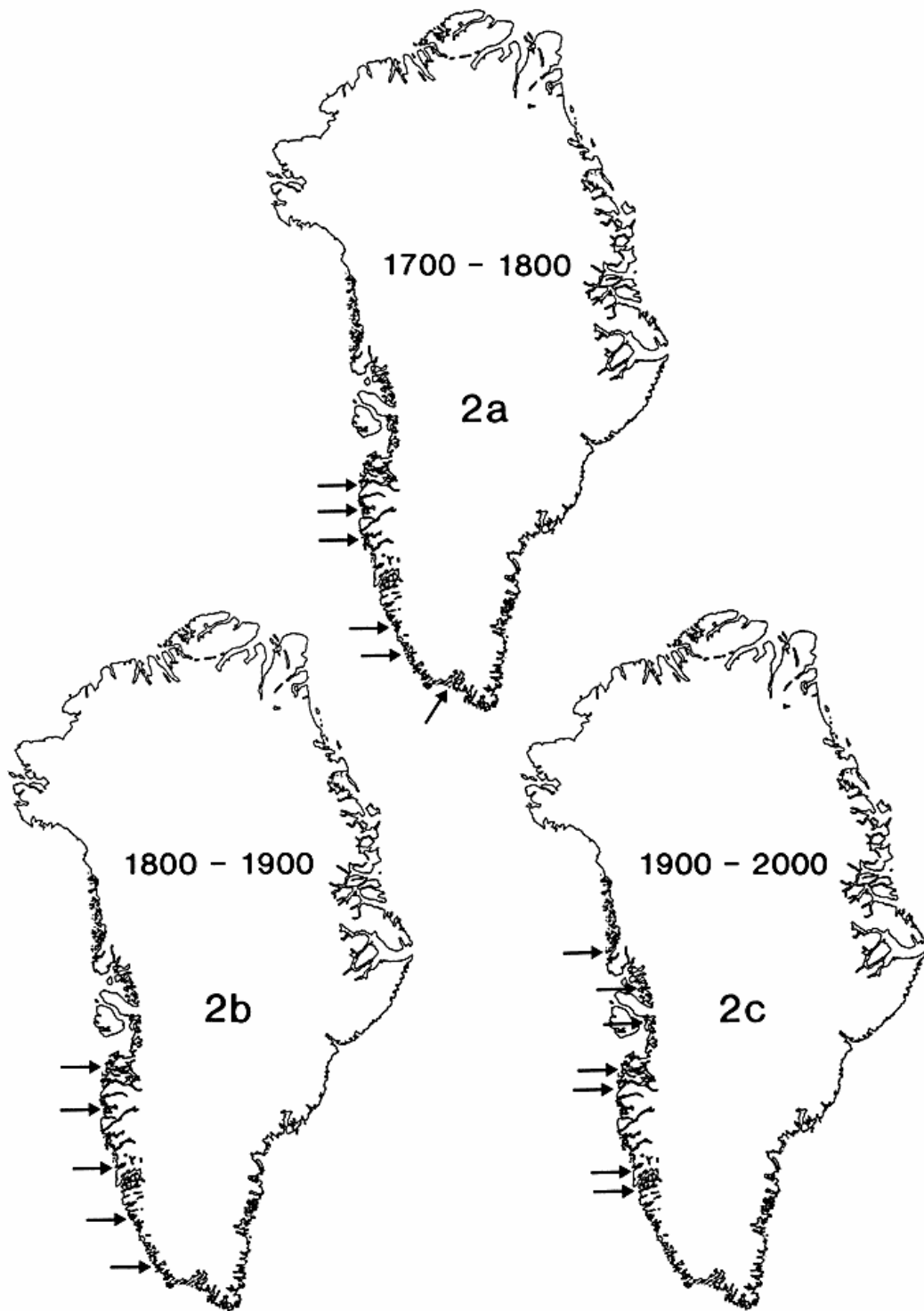


Fig. 2. Fjord phases. Fjords with cod during the stages (Fjord Phase) of Cycle 100.

small, scattered, unpredictable occurrences near the coast or within certain fjords. Finally, only certain fjords were left with permanent stocks of non-migratory cod, Fig. 2c. This is the story of our own century.

*ii) Its Presence in the 19th Century*

Cod occurred in the fjords, off the coast, and on the banks all year round before the year 1810. This plentiful period seemed to last till the 1840s. Then the presence of cod became unpredictable as to time and place. Eventually only certain fjords retained shoals of non-migratory cod all year round, from about 1880 until the great invasion of about 1915-20. Accounts of cod occurrences dating from the first half of the 19th century, as compared to the first stage of the 20th century, call for closer analysis.

*iii) Its Presence in the 18th Century*

We have only limited knowledge of 18th century cod occurrences. According to "Perlustration", missionary Hans Egede's diaries from the year 1741, cod would frequent the waters of southern Greenland in the summertime. Hans Egede lived on Greenland from 1721-36. Poul Egede's "News", 1788:257, mentions that American cod fishers came over from Boston to fish on the banks off Frederikshaab. The missionary and zoologist, Otto Fabricius, wrote in his book "Fauna Groenlandica", 1 80:145, that there were no cod off the coast of Greenland. Only certain fjords had a non-migratory cod population, fig. 2a.

*iv) Earlier Records of Occurrences*

We can actually proceed further back in time. The David Danell, an English vessel visiting the Nuuk/Godthaab fjord in late July, 1653, was codfishing on the Fylla Bank (J. Matthiessen, 1852:146). This stock must have been a population dating from the end of the first part of the 17th century. Taking archaeology into account, we find two old settlements (fig. 3), complete with thick kitchen middens, located halfway up the west coast, one in the southern part of the Disko Bay (A) and the other at Vaigat (B). Horizons from the time before the Danish colonization (1721) and the European whaling period (from 1650 onward) revealed layers with bones of big cod, separated by other layers without cod bones. I have personally seen the layers in (A). The information on (B) derives from Pavia Nielsen, former President of the Hunters' and Fishermen's Association. Is this evidence of Cycle 100 in these centuries?

*v) Concluding Points on the Case of Cod*

We have seen three cod periods since the Egede era. A cod period will last for about 100 years and comprise three phases (see also comments in fig. 1):

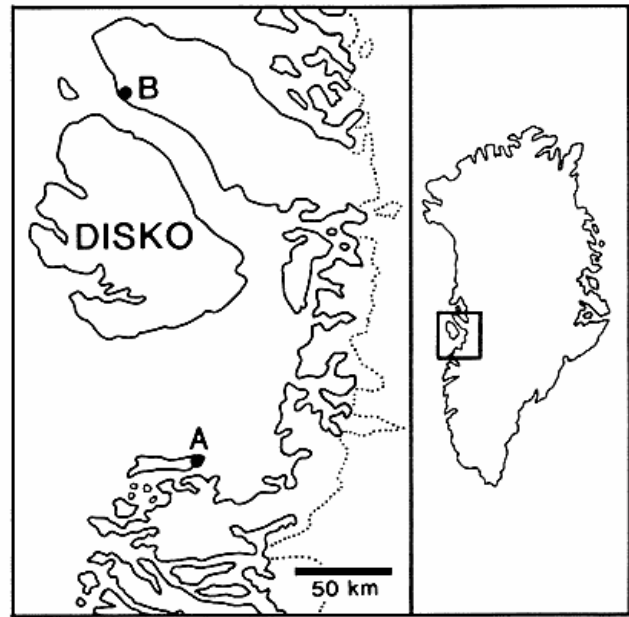


Fig. 3. Evidence of Cod Periods before the year 1650.

Phase 1: Large cod shoals invade Greenland from Iceland and reach a certain latitude along the west coast. There are cod stocks on the banks, between the islands, and in the fjords. They spawn on certain banks off the coast and in the fjords. The cod follow a fixed seasonal rhythm.

Phase 2: The seasonal rhythm is disturbed. Migration to Iceland has started. Occurrences of fry on the banks decline and finally disappear.

Phase 3: The cod have now disappeared from the banks and the archipelago. Only certain fjords have non-migratory cod stocks spawning within the habitat area.

After Phase 3, the cycle reverts very rapidly, for some reason, to Phase 1.

We therefore call this cyclic phenomenon "Cycle 100". The actual length of the alleged centennial period has not yet been conclusively determined. The lengths of individual periods may vary from one cycle to another. The validity of this hypothesis will not be established till a later date when the mapping of the cycles has been completed. Then we will be able to see if we can maintain the designation "Cycle 100", or whether we shall have to find an alternative name for the phenomenon.

**B) The Case of other Marine Species**

*i) Atlantic Species*

Let us turn to another Atlantic species, the pilot whale

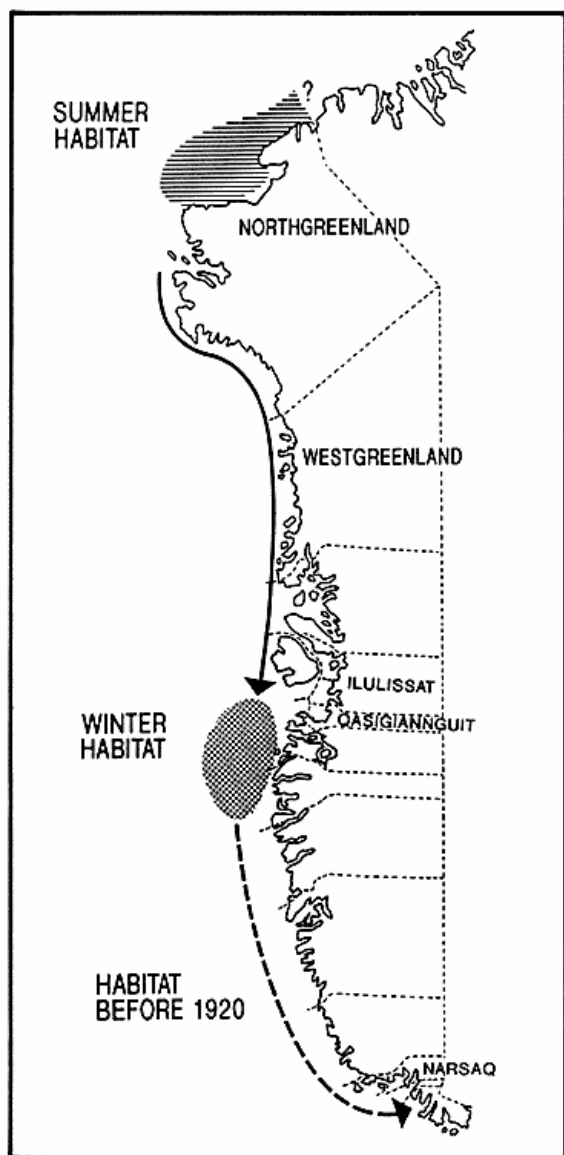


Fig. 4. The annual migratory routes of the beluga (white whale).

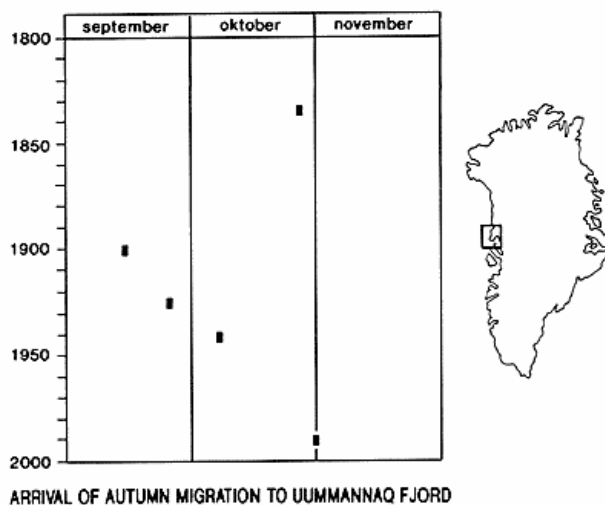


Fig. 5. The fluctuating migratory periods of the beluga (white whale).

(*Globicephala melaena*). An article by the editor of the *Atuagagdliutit*, volume 1932/33:146, says "Pilot whales have now become more common in these parts. Formerly we heard but little of them. Nowadays they arrive every fall at the northern coast of South Greenland." Interviews with local people along the coast from Frederikshåb to Holsteinsborg have confirmed this statement, but in the wake of the declining cod populations today, pilot whales have again become rarer.

#### ii) Arctic Species

We may now consider the cases of two Arctic species; the beluga (*Delphinapterus leucas*) also known as the white whale, and the ringed seal (*Phoca hispida*).

The beluga of the Davis Strait area have an annual rhythm, fig. 4. In spring the whales move north to the Kane Basin waters, where they spend the summer. Towards autumn they migrate south along the west coast of Greenland, and their winter quarters are the northern part of the Davis Strait, subject to the relevant Cycle 100 phase. During the peak of the warm spell of the cycle, they

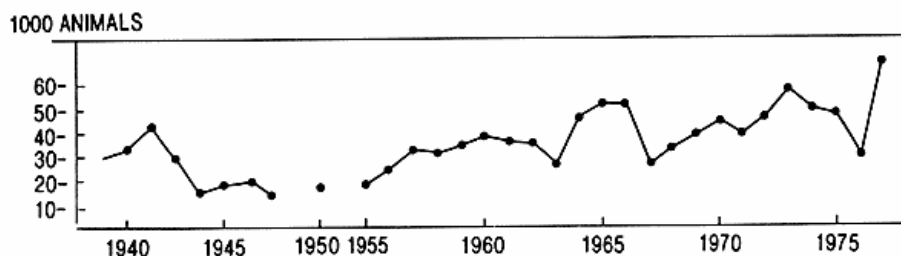


Fig. 6. Ringed seal hunting in North Greenland.

Year	Population	Alteration (pct.)	Year	Population	Alteration (pct.)
1779	5,122	4.0 11.3 13.9 19.5	1850	9,417	2.5
1805	6,046		1860	9,648	- 0.6
1820	6,286		1870	9,586	1.4
1830	6,699		1880	9,720	5.5
1840	7,877		1890	10,254	

Table 1. Population statistics in West Greenland: Cape Farewell to Melville Bay.

do not appear south of Sisimiut/Holsteinsborg on the Greenland side. During the coldest spell they go as far south as Cape Farewell although I have no information to confirm this happening through lack of information on the Canadian side. Due to the decreasing temperatures of the latter half of the 19th century, belugas came as far south as Cape Farewell in the two decades of the 1870s and 1880s. At the time of the cod invasion they yielded to the warmer current, and towards 1930 they disappeared from the Nuuk/Godthaab area which they used to visit regularly every winter. They reappeared with the onset of decreasing sea temperatures after the year 1980. The times of spring and autumn migrations also tend to fluctuate throughout the ages, (Fig. 5).

The ringed seal is an Arctic species heavily dependent on fjord ice. It spends the winter months in the fjords where there is normally ice from October until the end of May. By summer it has left the fjords as ice does not form at this time of the year. It will return to the fjords towards the end of October. As would be expected, the falling temperature curve so characteristic of Cycle 100 during the period of decreasing temperatures shows a converse increase in the volume of ringed seal catches, fig. 6. From about 1960, a marked rise in the population numbers has been observed.

#### C) The Case of Terrestrial Species (including human beings)

The numbers of several species, or their absence, can be correlated with the cycle of climatic change. The caribou

is one of the species whose number fluctuates very recognizably over the years. The populations of birds, and terrestrial species and certain marine mammals also fluctuate. At this point in time, research is still in progress, and therefore the results cannot be included in this article.

As yet, we cannot tell whether these fluctuations are a coincidence or related to the cycle. But Greenlandic population statistics do show a very interesting development from the 19th century onwards (table 1). Colonizers introduced illnesses hitherto unknown to the closed country of Greenland. The Greenlanders themselves were sorely afflicted, and epidemics took a heavy toll.

From about the year 1820, public health improved considerably. The epidemic rates dropped. For a 30-year period, 1820-50, population figures soared by 50%. Then the increase stopped abruptly. Epidemics returned. When the dates are compared, it appears that the population boom occurred during the warm phase of Cycle 100. This coincided with the peak of the cod and caribou periods, and seal hunting was good. Spring came early. About the year 1850, the prosperous period came to an end and misery returned. Is there a connection, or are we looking at mere coincidence?

#### D) Identifying Climatic Patterns: Apparent Springtime Fluctuations

During the 1930s and 1940s, the winter used to end early in April (table 2). April heralded the spring thaw. As the years went by, the spring thaw became increasingly delayed. With reference to what is happening today (the

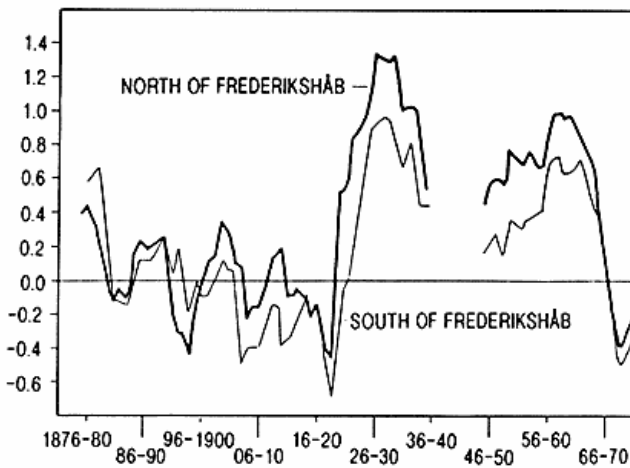


Fig. 7. Sea surface temperature measurements off West Greenland.

early 1990s) snow exposed to direct sunlight melts in April and May, but in the shade it remains frozen. Once the sun sets, the surface everywhere freezes again. The spring thaw does not start until the transition from May to June. Temperature differences are most significant in spring. There is no corresponding delay in autumn. We are faced by a continuous shortening of summer owing to the prolongation of springtime.

We have a great deal of information on the changes in climatic conditions during the course of the first half of the 20th century, as from Uummanaq Fjord. Formerly, April used to be the peak season for uuttoq hunting i.e. the hunting of the ringed seal at the time when it basks in the warm spring sunshine on the surface of the sea-ice. But during the warmer phase of Cycle 100, during the middle of this century, the following statement was made on the pitiful hunting situation, "Now the ice is rotten or has floated away during the peak season. This is because a warm current has come up from the south" (Avangnámioq, 1942:58). 50 years later, the situation has reversed

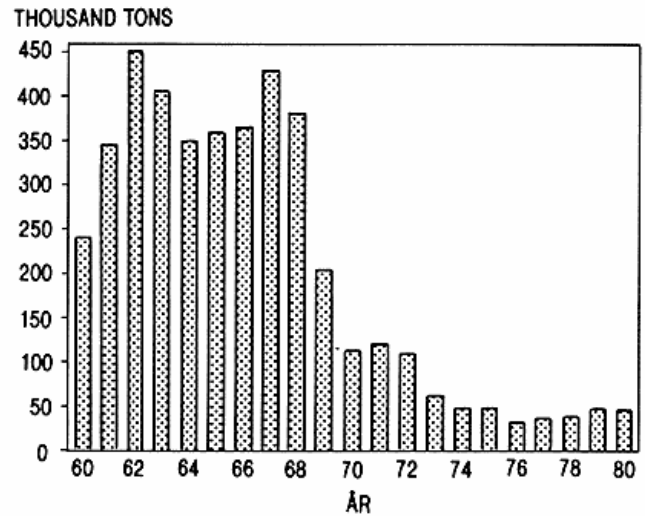


Fig. 8. Cod Fishing Off West Greenland 1960-1980. Source: NAFO Annual Statistics. Various volumes. (Work report on the development of South Greenland fisheries, RUC).

again as the ice no longer disappears from the fjord until the end of June, or an even later! Hydrographic measurements show this development quite clearly, fig. 7. A comparison between the climatic curve and the cod catch figures leaves no doubt either (fig. 8).

We have information on the climate of Greenland during the 1820s and 1830s. Winter was over and spring began by late March or early April (Atuagagdliutit 1874:18). Reference to the occurrence of various animal species confirms this report. We possess continuous information on annual events from the 1880s, by which time the start of springtime was already two months retarded. But, once again, by about the turn of the century, the onset of the spring thaw period was much earlier.

We lack recordings for periods earlier than the 19th century. We know that Hans Egede wrote of families leaving their winter settlements for the spring hunting

Period	Number of years	April	May	Sept.	October
1876-1920	44	-3.9	0.7	3.2	-0.9
1932-41	10	2.0	2.3	4.4	-0.4
1951-60	10	2.7	2.3	4.2	0.1
1979-88	10	-4.4	0.6	3.6	-1.3

Table 2. Mean temperatures for April, May, September, and October in Nuuk/Godthåb (°C).

camps in the course of April. May this, therefore, be interpreted as being early spring?

## CONCLUSION

Research is still in progress. A good deal of work remains to be done. Among other things, changes of humidity and pressure within the course of the cycle call for closer investigation. There are indications that this is where we should seek the reason for the fluctuations in Greenland's caribou population.

There is clear evidence that climatic conditions control the occurrence of various species in our Arctic area. They are of vital importance, not only to the animals but also to the economic conditions of Arctic social structure.

We know that there have also been changes in the occurrence of certain animal species in the transition from an arctic to a more temperate climate. Areas with occurrences of cod such as; the Barent Sea, Iceland, and Newfoundland, are also influenced. My knowledge of biological balances in these areas is too limited to pursue these subjects in further detail. It is the aim of this article to invite others to come forward with their information on similar observations based on other regions.

When this cross-disciplinary phenomenon has been clarified, we shall be able to employ better protective measures in keeping with the requirements of native and migratory animals and adapt our economies to the course of nature. We shall also be better qualified to make more reliable prognoses for politicians and administrative planners, and we shall have acquired a better understanding of this our home, planet Earth.