

# Catch history and status of the harbour seal (*Phoca vitulina*) in Greenland

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## ABSTRACT

The number of harbour seals (*Phoca vitulina*) in West Greenland declined rapidly after the 1950s and the seals have now abandoned their traditional haulout locations along the Greenland west coast. However, in recent years, a previously undetected group of about 60-100 harbour seals has been observed approximately 80 km upstream in a large river, and some traditional haulout locations are still in use near the south-eastern tip of Greenland. A small number of harbour seals is caught annually far from any of these locations, indicating that other groups might live unnoticed. Catch statistics provide the best evidence of the presence and locations of these remnant harbour seals. Therefore efforts were made to validate the recent catch statistics and to describe the catch history for the past 60 years. The catch statistics were also used to estimate plausible ranges of past and present numbers of harbour seals based on the assumption that hunting has caused the observed decline. The total number of harbour seals in Greenland according to these estimates was about 3,000 in 1950 and fewer than 1,000 in 2007. The number of harbour seals caught in the southernmost part of Greenland has, unlike in the rest of Greenland, increased significantly in some of the recent years. This change seems to be related to changes in the amount of drift ice. Drift ice reduces the frequency of contact between hunters and harbour seals in South Greenland and above normal quantities of drift ice from the mid 1960s to the mid 1980s probably allowed these seals to increase in numbers. Record low inflow of drift ice in some of the recent years, however, has resulted in record high catches, which likely have reduced the seals again. The remaining harbour seals in Greenland are few and without protection these seals are potentially in danger of extinction.

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## INTRODUCTION

The harbour seal (*Phoca vitulina*) is distributed along the sections of the Greenlandic coast which have sub-arctic marine environments (south of 67°N on the east coast and south of 75°N on the west coast). Only a few sightings have been reported along the high-arctic part of the coast. The population structure of Greenland harbour seals has not been investigated (see Andersen and Tange Olsen 2010).

A breeding site once existed at 66°N near Ammassalik on the east coast (Teilmann and Dietz 1993) and harbour seals were common in the area by the start of the 20<sup>th</sup> century (Winge 1902). It is uncertain when this breeding locality was abandoned, but catch statistics indicate that harbour seals had become rare around Ammassalik by the 1950s. Today, the only area along the east coast where harbour seals are commonly seen is on the southernmost coast near Cape Farewell (south of 61°N).

On the west coast, harbour seals congregated at several breeding and moulting localities until the 1960s. Most of these localities were abandoned by the early 1990s (Teilmann and Dietz 1993) and harbour seals are now rarely seen in West Greenland.

Hunting is likely to have been the main reason for these changes. The hunt was unregulated until 1960 when adult harbour seals were given legal protection throughout Greenland between 1<sup>st</sup> May and 30<sup>th</sup> September (Anon. 1960). Protection of young animals and newborns has never been implemented and there has never been any quota or upper limit on the catch. Therefore, trends in the catch statistics should reflect changes in relative abundance (or catchability) and distribution of the seals, although trends also may be related to changes in the hunting effort or to changing reliability of the statistics.

Hunting statistics have been collected in Greenland through the so-called "Lists-of-Game" since the late 19<sup>th</sup> Century. Catch statistics were recorded by an appointed person from each settlement (Kapel and Rosing-Asvid 1996). The time series on harbour seal catches begins in Northwest Greenland in 1939 and in the rest of West Greenland in 1949 and on the east coast in 1953. The "Lists-of-Game" functioned relatively well up until 1975, but thereafter estimates were increasingly used to replace missing catch data from some settlements.

After 1983, official catch statistics were no longer published and a gap exists from 1983 until September 1992, when a new system for collecting catch information was initiated. The new system requires hunters to report their results by completing a form that lists all game species. A weakness of this system seems to be simple errors, such as putting ringed seal (*Phoca hispida*) catches in the column for harbour seals. Such errors might be infrequent, but with more than 3,000 people sending in a form these errors have a disproportionately large effect on species that are caught in small numbers. For example, a reporting error of a few hundred seals is a small percentage of the ringed seal catch number (50,000+), but even few extra animals can

dramatically affect the harbour seal catch number, which might be less than 100/yr. Catch statistics from recent years have therefore been validated by contacting some of the respondents.

The old statistics (prior to 1983) are likely to be fairly precise, at least until the mid 1970s. The statistics for most of the west coast show an initial increase in harbour seal catches during the 1940s and 1950s, followed by a strong decrease during the 1960s and 1970s. The availability of hunting equipment such as boats, nets, and rifles increased at a rapid rate during these four decades. The trends are therefore likely to reflect increased effort and over-harvest.

Several factors spurred the harbour seal hunt in the first decades after the Second World War. One factor was that the trousers used as a component of women's full-dress attire in West Greenland have to be made from harbour seal skin. The declining catches drove up the price until the late 1980s when relatively inexpensive harbour seal skins started to be imported from Iceland. A second factor contributing to the incentive to hunt harbour seals was the decline in the availability of harp seals (*Pagophilus groenlandicus*), which were an important food commodity, particularly in Central West Greenland (CW). Harp seals had historically been very abundant along the Greenlandic west coast, but commercial sealing off Newfoundland reduced the population significantly and the population reached a low around the late 1960s and early 1970s (Hammill and Stenson 2005). Similarly, Greenlandic catches of harp seals declined in CW from 2,186 in 1945 to 169 in 1967, despite a 3-fold increase in the human population during this period. As commercial sealing was reduced in Canada during the 1970s and 1980s, the population started to rebound, and harp seals reinvaded the Greenland coast. By the year 2000 the reported catch of harp seal in CW peaked at 31,788, and seal meat was no longer a strong incentive for hunting the more elusive harbour seal.

Any current field study of population size or trends is difficult to implement because harbour seals are wary of humans and are

dispersed along a vast coastline, no longer congregating at known haulout sites in West Greenland. The catch history, however, contains information about their past and present distribution and abundance and these data are described here and explored in order to come up with a status for the harbour seals in Greenland.

## MATERIALS AND METHODS

### Skin statistics

The harbour seal skin-purchase data from 1860 to 1939 are the same data presented by (Vibe 1967). Recent skin-purchase statistics 1988-2007 are from Anon. (2008). These statistics only refer to the purchase by the government-owned skin-trading company.

### Catch statistics

Catch statistics were summarized from the "Lists-of-Game" (Anon. 1939-83). Monthly data archived at the Greenland Institute of Natural Resources are only available for the periods 1949-50, 1950-51, 1952-53 and 1962-1983 (Fig. 4). Data from the new reporting system "Piniarneq" (Anon. 1993-2007) are also reported by month and have been provided by the Home Rule Government, Department for Fisheries and Hunting.

### The "Storis"-index

Drift ice, "storis", is transported to Southwest Greenland with the East Greenland Current and the index measures the monthly extent of "storis" up the southwest coast (Fabricius *et al.* 1995, Rosing-Asvid 2006). Ice maps produced by the Danish Meteorological Institute have been used to update the time series.

### Population size estimation

The number of harbour seals needed to sustain the present catch (or the catch in the early 1980s) was estimated by back-calculation of catch statistics and fixed values of replacement yield:

$$N_{t+1} = N_t + (\text{replacement yield } (N_t)) - \text{catch } t$$

The catch statistics are also used to back-calculate a plausible range of the number of har-

bour seals to the period when collection of catch statistics started (1939-1949). There are uncertainties about the population structure, and therefore the division into geographical units is inferred from the spatial distribution of haulout areas (Fig.1). There is also some uncertainty regarding the accuracy of the catch statistics, but the overall range or trends of the statistics are fairly well documented. Harbour seals had been hunted for centuries prior to recording of catch statistics. Back-calculations are, therefore, made under the assumption that density dependence not has influenced the stock(s) at any time during the years with catch statistics.

The replacement yields for harp and hooded seal populations, estimated by the ICES Harp and Hooded Seal Working Group, are typically between 3-8 % mainly depending on the age composition of the catches (ICES 2008). The replacement yield for harbour seals is likely to fall in the same range. Populations can, however, grow faster than that; and for example, without epizootics the mean population growth rate of harbour seals in Kattegat-Skagerrak is around 12 % in the exponential growth phase (Harding *et al.* 2002).

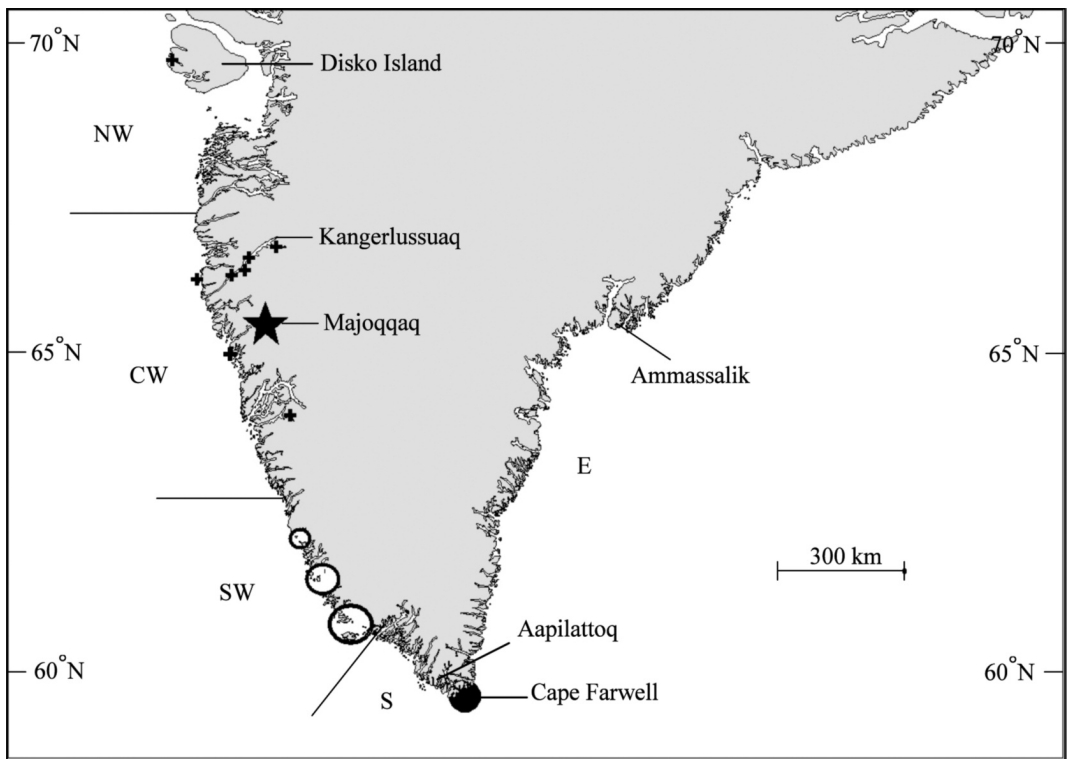
## RESULTS

### Catch history by region

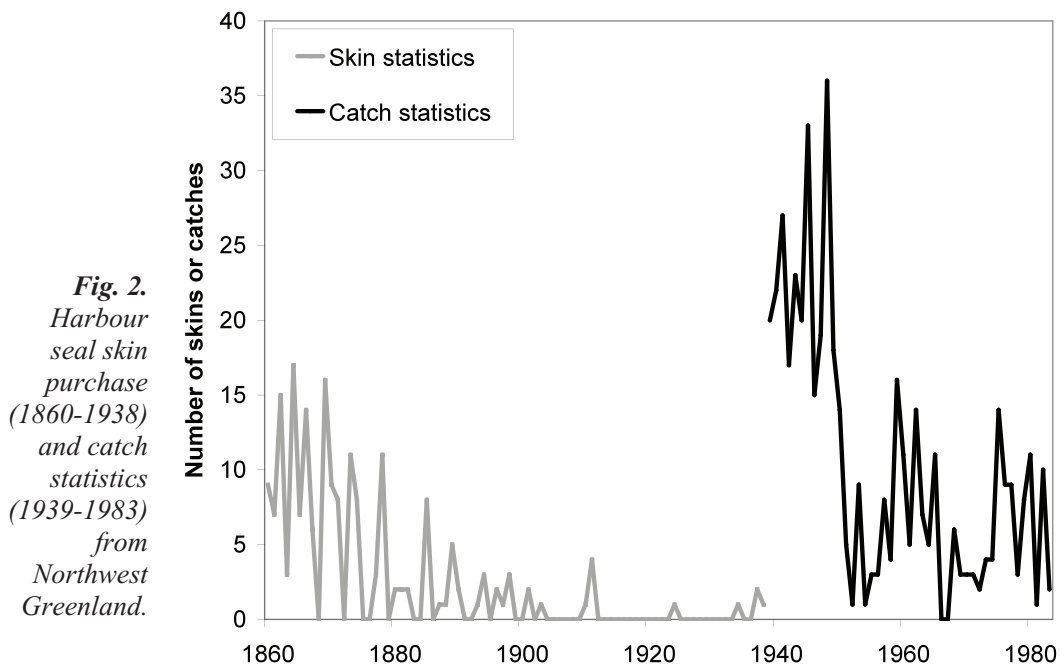
The skin-purchase and catch statistics are described by the regions delineated in Fig. 1.

#### *Northwest Greenland (NW)*

About 10 skins from harbour seals were purchased annually in the NW during the 1860s, but the number gradually dropped to less than one skin/yr during the following three decades. The catch-statistics for the NW region (1939-1983) show an average catch of one harbour seal/yr north of 70°N without any trend in this period. South of 70°N the catches declined from an average of 22 in the 1940s to an average of 5 during 1950-1983 (Fig 2). The catches from this area can be divided by month during 1962-1983. A large fraction (41%) of the catches south of 70°N was from June (the breeding season) during the 1960s, but after 1970 the catches were evenly distributed throughout the year.



**Fig. 1.** Map with names of areas mentioned in the text. + marks specific locations and o marks areas where harbour seals were breeding in the early 1960s. These breeding sites are now abandoned or occupied by only a few seals (less than 10 seals observed simultaneously in the recent decade). ● shows an area in south Greenland where higher numbers of harbour seals (100+) have been seen by hunters within the last 5 years. ★ is a recently discovered site where a group of 50-100 harbour seals has been seen by hunters several times in the last decade.



**Fig. 2.** Harbour seal skin purchase (1860-1938) and catch statistics (1939-1983) from Northwest Greenland.

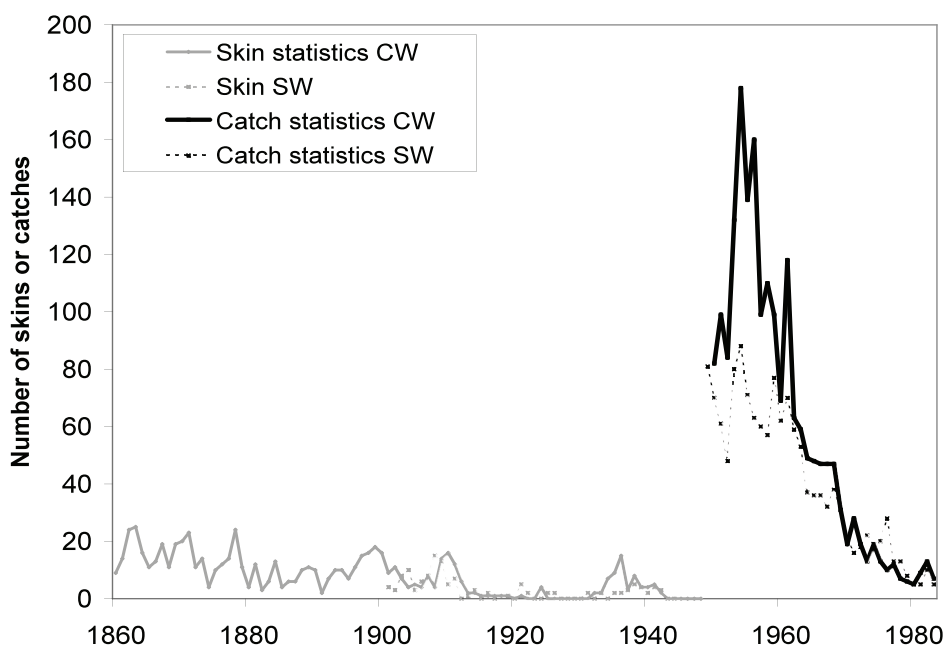
The northernmost known breeding site in West Greenland was located on the west coast of Disko Island at 69°52' N (Fig. 1) (Teilmann and Dietz 1993). Heide-Jørgensen (1986) reports that a few groups of 20-30 harbour seals were seen in a nearby fjord in April 1980, but since then there have been no reports of larger groups. Hunters living in the area also report that harbour seals have become rare, and large groups are no longer seen. The average annual catch by hunters living on Disko Island is less than 1/yr. Most of the harbour seal catches in NW are now conducted along the coast of the mainland. Recent statistics indicate that the catch still fluctuates in the same range as it did during 1950-1983.

From January 2006 to September 2007, the reported catch in NW was 29 harbour seals by 19 hunters. Six of these hunters were contacted and all except one hunter confirmed catching a harbour seal. One was by-caught in a net for lump sucker (*Cyclopterus lumpus*) and four seals were shot. Only one of the hunters was aware that the seal was a harbour seal when he was shooting. The others assumed they were shooting ringed seals, which are common. One hunter from NW had reported 8 harbour seals, but several attempts to contact this person were unsuccessful.

Two seals were caught close to the boundary between NW and CW (around 68°N) during winter (January-February), whereas 5 were taken further north (up to 70°50'N) during May-July. The catches included both pups and adults (adults are legally protected during May-September, but as mentioned above, some are by-caught in nets or mistaken for ringed seals).

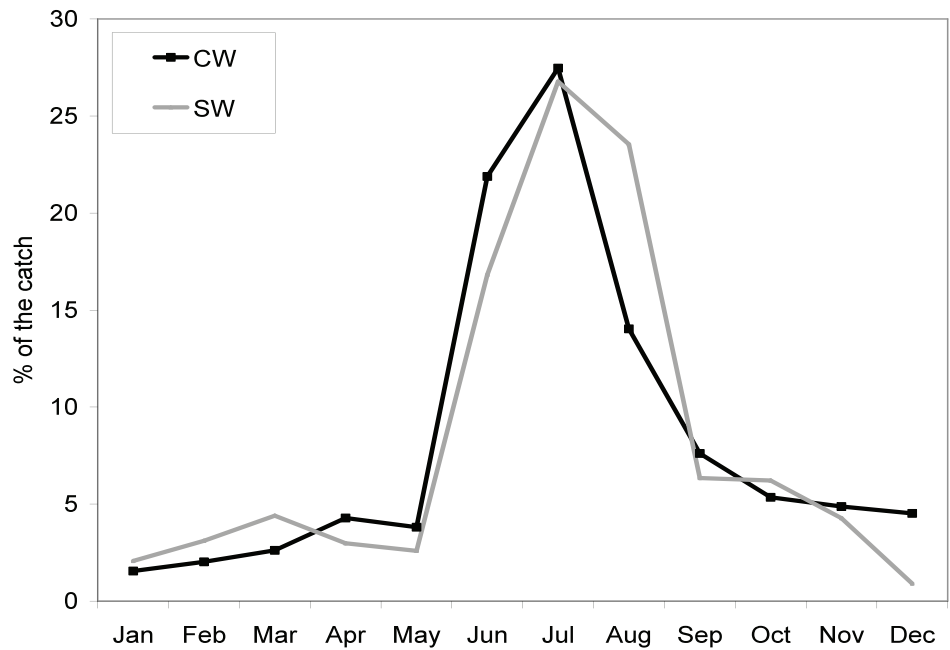
#### Central West (CW)

An important area for harbour seals in CW is Kangerlussuaq (Greenlandic for "the large fjord") (Fig. 1). An American military base established there in 1941 was later turned into a civil airport, and the main harbour seals breeding and moulting site is only a few kilometers from the airstrip. The number of harbour seals at this locality has declined significantly, but this happened many years after the establishment of the base. A resident from Kangerlussuaq stated that up to 500-600 harbour seals could be seen on the sandbanks next to the airstrip in the early 1960s, but in the early 1990s the number of basking seals was less than 20 (Teilmann and Dietz 1993). A study using video cameras to monitor haulout behaviour during August-October 1995-1997 never counted more than 7 seals simultaneously, and only one seal was considerably smaller than the others



**Fig. 3.**  
Harbour seal skin purchase (1860-1938) and catch statistics (1949-1983) from Central West and Southwest Greenland.

**Fig. 4.**  
Relative seasonal distribution of harbour seal catches in Central West and Southwest Greenland (1950-1983).



(indication of a pup) (Lisborg and Teilmann 1999). Presently, harbour seals are rarely seen on the sandbanks off Kangerlussuaq.

Five breeding sites existed in or near Kangerlussuaq during the 1960s and two sites were located further south in CW (Fig. 1). The two southernmost sites were in use during the mid 1970s (GTO 1976), but not in the early 1990s (Siegstad 1992, cited in Teilmann and Dietz 1993). Relatively high catches during the 1950s and 1960s in CW and in SW (Fig. 3) mainly occurred during summer (Fig. 4), indicating that these catches were from seals that used the local summer haulout sites. The catches dropped simultaneously in both areas during the 1960s and 1970s.

In 2001 and 2002 some hunters sailed upstream in a large meltwater river (Majoqqaq). This can only be done in some years when the conditions are right. They reported a group of about 60 harbour seals near the head of the river about 50 km from the coast. Another hunter reported he saw about 100 harbour seals in the same area in 2006. The seals were observed in August-September and they included both pups and adult seals. This river and the delta at its mouth were known to have many harbour seals in the last part of the 19<sup>th</sup> century, but they disappeared during the start of the 20<sup>th</sup> century (Petersen

1993). Other than the seals seen in this river, there are no recent reports of large concentrations of harbour seals in West Greenland.

A few harbour seals are still caught in CW every year. Their birthplace is unknown, but the area has a large archipelago with numerous small islands that are rarely visited. One recent reported catch (from July 2007) was a pup found together with its mother on the shore of an island just south of Kangerlussuaq. The reported catch in CW for January 2006 to September 2007 was 30 harbour seals caught by 10 hunters. Five hunters were contacted. Two of them stated that they never caught a harbour seal and they accounted for 3 and 4 of the reported seals. Three hunters confirmed a total of 4 catches. One hunter had reported 16 harbour seals, but it was not possible to contact that individual. CW is a densely populated area with many reports from non-professional hunters. This might be the reason for the high number of errors from this area. The actual catch during this period was more likely in the range of 5-10/year, similar to catch levels from the early 1980s.

#### *Southwest (SW)*

SW is defined as the southwest coast except the southernmost part as outlined in Fig 1. The catch statistics show the same declining trend and timing of the decline as in CW (Fig. 3).

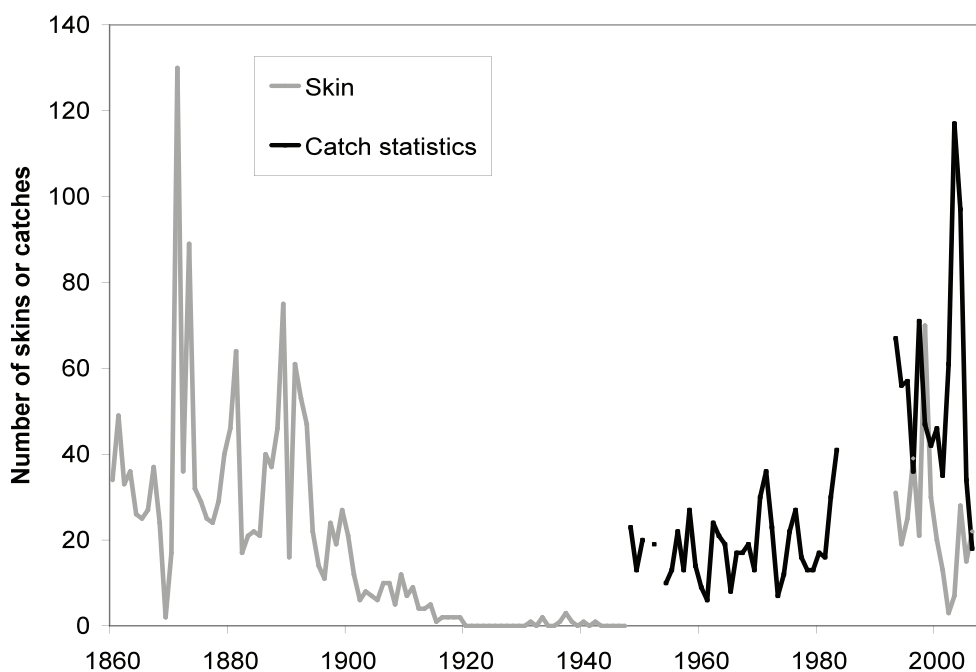
In 1960, people from SW were living in one main town (Paamiut) with 891 inhabitants and 6 small settlements with a total of 761 inhabitants. Five of the settlements were closed and abandoned during 1967-1982, including 3 settlements in close vicinity to harbour seal breeding areas. Hunters from those settlements accounted for most of the catches during the 1950s and early 1960s. The declining number of harbour seals was recognized locally and in 1973 the national regulation (protection of adult harbour seals during May-October) in SW was extended to year-round protection, and netting of harbour seals became illegal (Anon 1973). Further regulations in 1982 protected some of the haulout sites against both hunting and disturbance (Anon 1982a, b), but these efforts did not bring the seals back to the haulout sites. A wildlife officer has visited several former haulout sites in recent years without seeing any seals, and hunters from the SW tell him that they rarely see harbour seals. Some stragglers are, however, still in the area and a few (<10) are caught annually.

The reported catch in SW for January 2006 to September 2007 was 8 harbour seals reported by 7 hunters. Four of these hunters were contacted and they all confirmed catching a harbour seal. Two were by-caught in nets, one

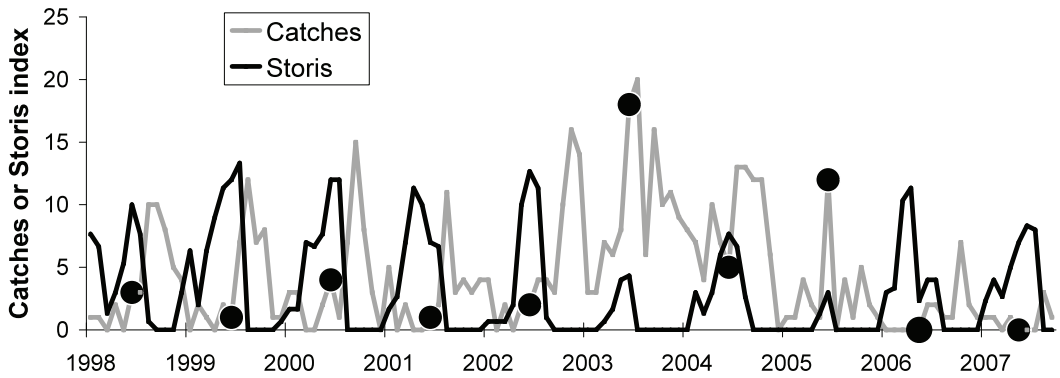
in a net for Atlantic cod (*Gadus morhua*) and one in a net for lumpsuckers, and 2 were shot. Again the data indicate that the catches are about 5/yr. as in the early 1980s.

#### South Greenland (S)

The catch from South Greenland is defined as the catch by hunters that live on the part of the southwest coast which is strongly influenced by “storis”. These hunters will hunt on the southwest and southeast coasts in late summer and fall when the ice disappears. The number of harbour seal skins purchased annually in South Greenland during the last part of the 19th century was higher than the annual recorded catches during 1949-1983. The catch statistics (up to 1983) did, however, show an increasing trend, which continued with the new statistics starting in 1993 (Fig. 5) and this trend is opposite that of all other areas in Greenland. Some of the catches might be reporting errors (as noted above). Most catches were reported by a few hunters that consistently report some catches every year, and since 1993 they have regularly sold skins to the government-owned tannery. These hunters live in Aappilattoq, a small settlement close to Cape Farwell (141 inhabitants in 2007). Thirteen persons from this settlement had reported two or more harbour seal catches during 2001-2004 and 12 of them



**Fig. 5.** Harbour seal skin purchase (1860-1938) and catch statistics (1949-1983) and (1993-2006) from South Greenland.

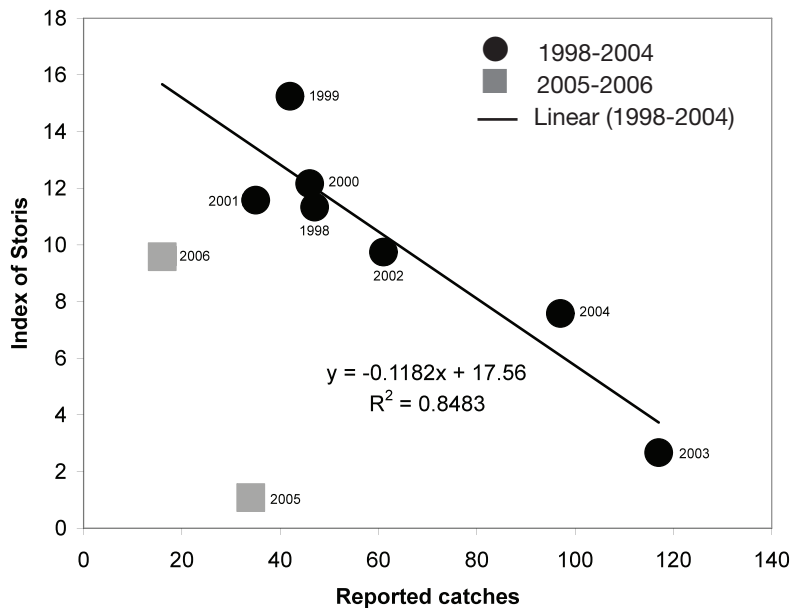


**Fig. 6.** The monthly reported catch of harbour seals in South Greenland (Anon. January 1998–September 2007) and a monthly index of drift ice “Storis” (Fabricius et al. 1995; Rosing-Asvid 2006). Catches in June are marked with a ●.

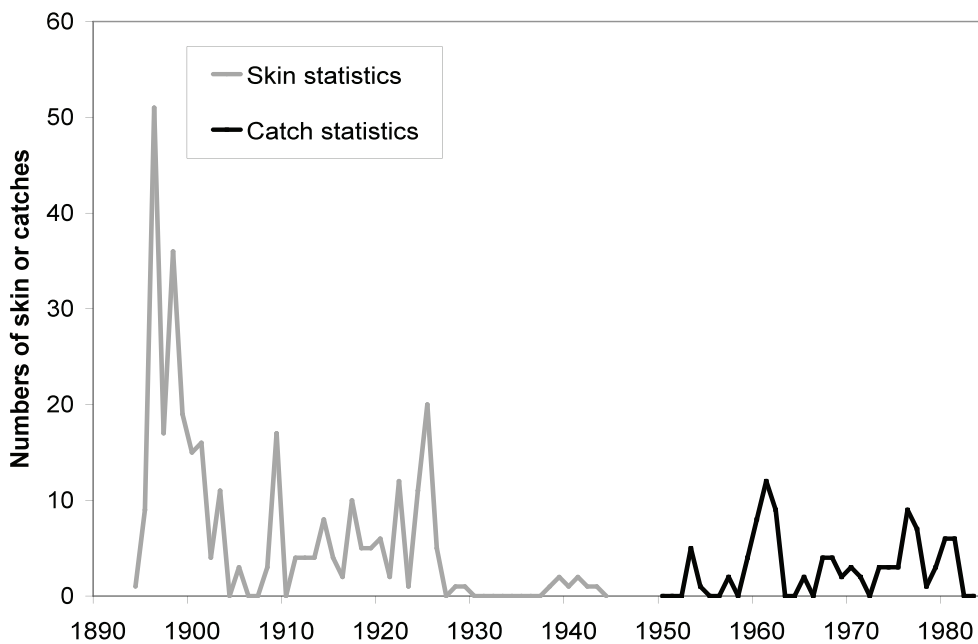
were interviewed in 2006 regarding their catches. They reported that most harbour seals were taken when they were out hunting other species, although one hunter sometimes went hunting with the main purpose to catch harbour seals. He stated that many young harbour seals seek shelter in the fjords during strong storms and after such storms he went to specific locations to catch these young seals. This individual reported more than 1/3 of the harbour seal catches from Aappilattoq during 2001–2004, with the highest catches in 2003 when he caught 25.

The hunters were questioned about the sex and age of the last harbour seal they had caught. The age categories were pups of the year (n=4) and juvenile seals (age 1+; n=8). Only eight hunters recalled the sex and all said that it was male. Two hunters had independently seen more than 100 harbour seals at the same location near the Cape in September 2003, and other hunters stated they regularly encountered groups of more than 10 harbour seals at certain locations on the southeast coast. In addition to these “hot spots”, single harbour seals could be encountered on rocks anywhere along the coast.

**Fig. 7.** Harbour seal catches in South Greenland plotted against an index of “Storis” (mean of all months) (1998–2006).







**Fig. 8.** Harbour seal skin purchase (1860-1938) and catch statistics (1953-1983) from Ammassalik.

None of the hunters felt that harbour seal numbers had declined during their years as hunters.

“Storis” will normally reach Cape Farwell around January, and during spring and early summer it extends 200-300 km up the west coast. This ice normally makes it impossible to visit the main harbour seal haulout sites by boat except in late summer and fall. The ice situation was, however, extraordinary during 2003-2006. The “storis” index goes back to 1820 for the months May-August and data for all months are available since 1900. The 2005 season had the lowest ice-index value in the entire time series (7% of mean), and 2003 had the third lowest (17%). The lack of “storis” allowed hunters to catch harbour seals throughout the summer, and catches were, therefore, extraordinarily high during 2003 and 2004 (Figs 6 and 7). Catches dropped again in 2005 despite a record low “storis” index, and only a few harbour seals were caught in 2006 despite light ice conditions during June-August.

Hunters from Aappilattoq accounted for 30% of the reported harbour seals from S during the last years under the old reporting system (1977-1983). During 1993-2006 their fraction of the reported catch was 39% and interviews confirmed these catches. The catch in Aappilattoq

during 1993-2006 is correlated ( $R^2 = 0.78$ ) with catches in the rest of S, and the timing by month is very similar. This implies that the reported catch in all S reflects the actual catch fairly well. A strong correlation also exists between the total catch in S and the “storis” index (estimated as an average of all months) during 1998-2004. The reported catch number in S averaged 54/yr during 1993-2006. There is a high level of confidence in this number and it is more than twice the catch level during 1949-83 (18/yr).

#### *East Greenland (Ammassalik)*

A high number of skins from harbour seals was purchased in Ammassalik during the first years following the establishment of a trading station in the area (Fig. 8). Several authors mention that harbour seals were relatively abundant around Ammassalik during the 1880s and 1890s (in Winge 1902) and a breeding site once existed not far from the town (GTO 1976). The catch was, however, only 3/yr during 1953-83 and no catches were reported from Ammassalik in 2006 or January-September 2007. One catch was reported from the more northerly Ittoqqortoormiit (at 70°30'N), but it was not possible to contact that hunter. The catches have apparently dropped in Ammassalik since the start of the 1980s when a few seals were caught every year. Several skins from harbour seals

have, however, been purchased in Ammassalik every year according to the statistics, most of them in the small settlement Kulusuk. Several hunters were contacted to learn more about these seals. None of the hunters recalled any harbour seals caught near the settlement in recent years and they all thought that this must be an error.

### Regional population estimates and changes

#### *Northwest Greenland*

With a 5% replacement yield the number of seals needed to support the present catch in NW (5/yr) would be around 100. The catches have fluctuated around 5/yr since the early 1950s and 240 seals would be needed when the statistics started in 1939 in order to end up with a population around 100 in the early 1950s. Using 3% or 10% as replacement yield gives a starting point in 1939 and a present population of 323-165 and 157-50 respectively. The number of seals in 1950 using 3% or 5% replacement yield is listed in Table 1.

#### *Central West Greenland*

To maintain the present catch which is similar to the catch level in the early 1980s, a population of approximately 100-200 seals would be required, assuming a replacement yield around 5%. This indicates that the seals observed in the river Majoqqaq are likely to constitute the majority of the remaining harbour

seals in this area. A population size of about 150 seals in the early 1980s requires back-calculated (5% replacement yield) population sizes of around 1,200 seals in the early 1950s and 500 in the early 1960s.

#### *Southwest Greenland*

Back-calculations based on a 5% replacement yield results in population estimates of around 800 seals in 1950 and 100 animals today.

#### *South Greenland*

The catch number in the southernmost part of Greenland was relatively stable, averaging 19/yr during 1950-1983. The catches increased significantly in the 1990s and very high catches were taken in 2003 and 2004. The reported catches during 1993-2006 would, under normal conditions, have required a population of at least 500-600 in 1993 in order to have any seals in 2007. The reported catch during 1950-1983 could, however, be sustained (with a replacement yield of 5%) by a population of 350 seals. It is therefore likely that the number of harbour seals in the area was increasing between the two periods.

The skin statistics indicate that harbour seals were more abundant in South Greenland during the last part of the 19<sup>th</sup> Century. Not all skins were purchased, but the quantity sold would have required a population of more than 600 in 1860 in order to have any seals left

**Table 1.** Estimated harbour seal numbers in 1950 and 2006 based on back-calculations ( $N_{t+1} = N_t + (\text{replacement yield } (N_t) - \text{catch}_t)$ ).

Area	Estimated numbers in 1950 and (2006)			Catch numbers used in years without statistics	Assumptions about present numbers of seals in the region
	3%	5%	10%		
NW	176 (166)	110 (100)	58 (50)	5/yr. (stable since 1983)	Stable
CW	1523-1587 (166-333)	1260-1280 (100-200)	878-880 (50-100)	5/yr. - 10/yr. (stable since 1983)	Stable
SW	1026 (166)	821 (100)	549 (50)	5/yr. (stable since 1983)	Stable
S	710-803 (100-600)	426-457 (100-600)	186-189 (100-600)	Interpolation during 1983-1992 (42-50/yr.)	100-600
Total	3435-3592 (598-1265)	2617-2662 (400-1000)	1671-1676 (250-800)		

by the turn of the century (assuming 5% replacement yield).

#### *East Greenland*

A small catch averaging 3 harbour seals/yr was reported by hunters from Ammassalik during 1953-83. Many of these seals were caught from outpost camps several hundreds of kilometers south of Ammassalik. Harbour seals are very rare near Ammassalik at this time and the few harbour seals occasionally caught in the area are most likely stragglers from the breeding sites near the southern tip of Greenland.

## DISCUSSION

The catch statistics provide information about changes in the relative abundance of harbour seals along the coast back to the mid 20<sup>th</sup> century. Skin-purchase data go back to the mid 19<sup>th</sup> century for some areas, but they only reflect an unknown fraction of catches, as many skins were not sold. The sharp decline in the skin-purchase data in some areas during the early part of the 20<sup>th</sup> century is therefore not necessarily an indication of fewer catches. However the data, show that the catches in S and E were higher during the last part of the 19<sup>th</sup> century than at any time in the 20<sup>th</sup> century.

The catch statistics are believed to be fairly accurate from the 1940s to the mid 1970s and they show an initial increase followed by a decrease in the catches in West Greenland. The hunting effort was sharply increasing during this period and it is now evident that the statistics reflect an over-harvest followed by a decline in the seal stock(s). What happened after this decline (after the early 1980s) is less clear due to a lack of reliable statistics. The hunt directed at harbour seals in West Greenland was declining and ceased in most areas, as this species became rare throughout the region. The incentive to hunt harbour seals also weakened as seal meat from harp seals and harbour seal skins from Iceland became easier to obtain during the 1980s.

Validation of the recent catch statistics shows that the catch number in West Greenland is

close to what it was in the early 1980s, but the remaining harbour seals are rarely seen in the traditional haulout areas.

Several haulout sites were in use simultaneously in CW during the 1960s. One of the sites (near Kangerlussuaq) was said to have up to 500-600 harbour seals resting simultaneously on the sandbanks during the early 1960s (Teilmann and Dietz 1993). This indicates that the total number of harbour seals in CW was at least around 1,000 back then. The catches in CW started to decline in the early 1960s, and declined rapidly after the 1960s. The decline in SW followed the trend and timing in CW. The population decline in CW cannot be explained solely by reported catches. Given an initial population of 1,000 seals in 1960 and a replacement yield as low as 2%, the population would have started increasing again in the late 1970s at the reduced catch levels.

One potential activity that could have influenced the decline in this period was a commercial fishery for arctic char (*Salvelinus alpinus*), which started up in the 1960s. This fishery peaked during the late 1960s and the 1970s (Anon. 1948-1968 and Anon. 1968-1986) and matches the period when the harbour seal catches dropped significantly and the seals started to abandon the traditional haulout sites. Some of the first literature on harbour seals in Greenland (Winge 1902 and Fabricius (1780) in Kapel 2005) states that arctic char is an important prey for harbour seals. These fish concentrate near the rivers during July-September, thus are available when harbour seal pups start to feed independently. The char is also important for human consumption and the commercial fishery, which mainly took place in CW, depleted char stocks, and likely impacted seal populations. This fishery has been regulated since 1997 (Anon. 1997). Alternative explanations for the decline could be that the catch statistics underestimated the real catch or that the 500-600 seals in Kangerlussuaq during the early 1960s were an overestimate.

The population increase in the south was probably due to a combination of hunters emigrating away from the settlements near Cape Farewell during the 1960s, and an inflow of "storis" that was well above average from the

late 1960s to the mid 1980s. “Storis” likely restricted human access to harbour seals. The very high catches during 2003 and 2004 coincide with a low “storis” index, thus allowing hunting throughout the summer. Increased hunting likely reduced the seal population again and this may explain the low catches during 2005-2006, despite relatively low “storis”.

At least 725 people immigrated to Southwest Greenland from East during the 19<sup>th</sup> century and they made up a considerable part of the total population in Southwest Greenland (Gulløv 1995). Strong family ties were established between eastern and western communities during the last part of the 19<sup>th</sup> century and people from the two areas met every year near Aluk (60°09'N) on the southeast coast (Gulløv 2000). The exchange of goods was also an important incentive for these meetings as there was no trading station on the east coast at that time. The meetings made people travel through areas near Cape Farwell and along the southeast coast, which likely brought them in contact with important harbour seal haulouts. This could explain the relatively high seal skin purchase in Southwest Greenland in the late 19<sup>th</sup> century (Fig. 5) and in Ammassalik during the first years after the establishment of skin trade in 1894 (Fig. 8). Regular contact with the outside world was established with the trading post in Ammassalik and after a few years the meetings in Southeast Greenland stopped completely. This is likely to have caused the concomitant large decline in harbour seal skin purchases in Southwest Greenland and Ammassalik.

The catch statistics indicate that harbour seals have never been very abundant in Greenland,

at least not in the period of the catch statistics. If hunting was the main reason for the observed decline, then the number of seals would not have been much higher than 3,000 in the 1950s and would be below 1,000 at present. Interviews with individuals responsible for 17 catches in NW, CW and SW during 2006 and 2007 confirm that 4 were by-caught in fishing nets, and 4 of the 13 shot seals were mistaken for ringed seals. This indicates that close to 50% of reported mortalities would have occurred even with a complete ban on harbour seal hunting.

The shy nature and the widespread distribution of the remaining harbour seals makes it very difficult to obtain a precise estimate of their current numbers. Furthermore, some seals give birth individually on the coast and some undetected breeding sites likely exist. However, seals have become rare at traditional haulout localities, and it is likely that few harbour seals remain in Greenland. Without protection these seals are in danger of extinction.

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*\* Just before the printing of this book, the Government of Greenland announced that by December 1, 2010 harbour seals will be protected from all kind of hunting until biological advice will warrant for the resumption of the harvest.*

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