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An Assessment of the Greenland Halibut Stock Component in NAFO Division 1A Inshore

by

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Abstract

This paper presents the assessment of Greenland halibut in the inshore part of NAFO Div. 1A. The area covers the fjords in the three distinctive geographical areas, Disko Bay, Uummannaq and Upernavik. Information from the commercial fishery (only landings, no effort information) and research survey (longline survey in Uummannaq and a newly initiated gillnet survey in Disko Bay) was available for the assessment. The state of the stocks were as follows. **Disko Bay**: In the recent two decades annual landings increased from about 2 000 tons in 1987 to 10 500 tons in 1998 and 1999. Since then landings increased again from 2002 to 2004 to record high of nearly 13 000 tons. Recruitment indices from Disko Bay and offshore areas suggest high 1997 and onward year-classes, which the fishery might benefit in these years. Both gillnet and the longline surveys supported abundant incoming year-classes. In the winter and summer fishery mean lengths has decreased for the past three years. A newly established gillnet survey (since 2001) shows a slight increase in catch rates since 2002 The longline survey shows higher catch rates in 2001 and 2004 compared to the 1990s. **Uummannaq:** Catches have been increasing from less than 2 000 tons before 1987 to a record high of 8 425 tons in 1999, but have since stabilized at about 5 000 tons in recent three years. Development in mean length in the summer fishery has showed an overall negative trend until 1999. Since then mean length in catches has increased slightly. In the winter fishery the mean length has been has been relatively stable except for the winter 2002 and 2005 where mean length decreased. Survey results from 1993 to 1999 indicated an increase in abundance until 1998. In 2001 and further in 2003 survey abundance index decreased significantly to the lowest observed, but the 2004 index is at about average of the time series. Catch composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age groups, but has stabilized in recent decade. **Upernavik:** Landings increased from about 1 000 tons prior to 1992 to highest on record, 7 012 tons in 1998. Since then landings have decreased continually by more than 50% to 3 000 tons in 2003. In 2004 landings increased again the about 4 500 tons. Little recent information is available on the commercial fishery and no surveys have been carried out. Apart from total catches there is thus no information to evaluate present stock status. New fishing grounds in the northern part of the district (Kullorsuaq) are being exploited, individual weights from winter fishery 2002 to 2005 show a slightly declining trend.

Introduction

The Greenland halibut stock component in Div. 1A inshore is considered to be recruited from the Davis Strait stock, but the adults appear resident in the fjords and thus isolated from its origin spawning stock (Riget and Boje, 1989). As a result, the component does probably not contribute to the spawning stock in the Davis Strait (Boje, 1994). In samples from Disko Bay <10% of females in the reproductive age, were assigned mature during the assumed peak spawning period in spring (Gundersen *et al.*, 2004). Also in former times only sporadic spawning is observed in the inshore area (Jørgensen and Boje, 1994) and the inshore component is therefore not assumed to be self-sustainable,

but dependent on recruits and immigration from the offshore area (Bech, 1995). Evidence that supported this stock structure resulted in 1994 NAFO to disconnect the assessment and advice on the inshore stock components from the offshore component in the Davis Strait and Baffin Bay.

Description of the fishery and nominal catches

The main inshore fishing grounds for Greenland halibut in Greenland are in Div. 1A (Fig. 1), where the total landings amounted to 22 947 tons in 2004, and constitute far the majority (~99%) of inshore landings in Greenland. The inshore landings were around 7 000 tons in the late 1980s and increased until the late 1990s to a maximum of about 24 600 tons in 1998.

The inshore fishery in Div. 1A is located in three main areas: Disko Bay, Uummannaq and Upernavik (Fig. 1). The fishery is not quota regulated, but since 1998 regulations have restricted effort increase by means of licenses to conduct fishery. New license issues have since been limited and the total number of licenses is around 1 300. There are no landing limitations on the fishery licenses. Therefore, in reality the effort is more or less unregulated.

The fishery is traditionally performed with longlines from small open boats or by dog sledges. In recent 10-15 years bigger vessels (>25 feet) have entered the fishery. Typically the fishery is carried out in the inner parts of the ice fjords at depths between 500 to 800 m. In the middle of the 1980s gillnets were introduced to the inshore fishery, and were used more commonly in the following years. In the late nineties authorities introduced regulations limiting areas of gillnet fishery in order to limit effort. A total ban for gillnets has been in force since 2000. However, derogations have been given to this ban. Most recently is a re-opening of an all year gillnet fishery in Ilulissat in front of the icefjord. Also in Upernavik and Uummannaq, in areas outside the icefjords, the gillnet ban has been discontinued in periods of 2004. However competence to lay down local rules have been given to Uummannaq and Upernavik municipalities in 2004, and areas where gillnet fishery is allowed has been expanded in all three municipalities. The gillnet fishery is regulated by a minimum mesh-size of 110 mm (half meshes), while there are no gear regulations on the longline fishery.

Disko Bay

Disko Bay is the area where Greenland halibut fishery developed in Greenland in the beginning of the 1900, and the major part of the catches in Greenland have traditionally been taken here. The landings in Disko Bay have increased continually until the late 1990'ies to about 10 500 tons (Fig. 2). After a decline in 2001 to 7 052 tons landings has increased again in 2002 and further in 2004 to a historic high of 12 857 tons. The Greenland halibut fishery is conducted in, and in front of an ice fjord (Kangia) in the immediate vicinity of Ilulissat town, and in an icefjord north of Ilulissat, Torssukattak (Fig. 1). The winter fishery in Ilulissat Icefjord, Kangia, is a traditional fishery from the ice using longlines. The fishery near Ilulissat is conducted within a small area (2 nm^2) and consist of a mixture of gillnet and longline fishery. However, the gillnet fishery is restricted to areas further from the icefjord than the longline fishery. The majority of the landings in Disko Bay are caught within this area. The fishery in Ilulissat is carried out in all seasons but most often peak in summer (Fig. 3). It has been observed that the fish disappear from the area in mid July, where after the fishery move to Torssukattak north of Ilulissat (Simonsen and Roepstorff, 2000). The fishery in Torssukattak is almost exclusively carried out in the period July - August. Fishery in this fjord is restricted by sea ice in spring.

Uummannaq

The landings in Uummannaq were stable around 3 000 tons prior to 1992, but has increased with some fluctuations until 1999 where 8 425 tons were landed. After a decline to 5 039 tons in 2003, landings again increased to 5 248 tons in 2004 (Fig. 2 and Table 1).

The fishery in Uummannaq area is conducted in a large system of icefjords. The main fishing grounds are in the southwest part of the fjord system. In previous times the southernmost icefjord, Qarajaqs Icefjord was the main fishing area but during the last decade the fishery has spread further north to include Sermilik and Itiviup Icefjords (Fig. 1). Use of gillnets is prohibited in the inner parts of the fjords in Uummannaq.

Upernavik

The northernmost area consists of a large number of ice fjords. Fishery in this are started in the 1980s. The main fishing grounds are Upernavik Ice fjord and Giesecke Ice fjord. New fishing grounds around Kullorsuaq in the northern part of the area are exploited these years (Fig. 1). Use of gillnets have been prohibited in Upernavik but derogations have been given for a fishery outside the Icefjords in 2002.

The landings in the Upernavik area have increased steadily from about 1 000 tons in the late 1980s to about 3 to 4 000 tons in 1993 to 1995 (Fig. 2 and Table 1). The total landings in 1998 were the highest on record 7 012 tons. Since then landings declined to 3 019 tons in 2002 followed by an increase to 3 884 tons in 2003 and 4 573 in 2004.

Input data

Research Fishery

Longline survey

Prior to 1993 various longline exploratory fisheries were conducted with research vessels. Due to variable survey design and gear, these surveys are not comparable. In 1993 a longline survey for Greenland halibut was initiated for the inshore areas of Disko Bay, Uummannaq and Upernavik. The survey was conducted annually covering two of three areas alternately, with approximately 30 fixed stations in each area (for further details see Simonsen *et al.* (2000)). This survey has recently been evaluated and the main conclusions drawn are that the survey does not generate sufficient data for proper statistical analyses; this in combination with an almost unknown selectivity of the gear as well as catch efficiency, prevents the use of survey results as more than indicative of overall stock trends, e.g. no information on year-class strength and population in absolute numbers. Therefore, a pilot study on using gillnet (multi-meshed) as surveying gear have been performed since 2001. Parallel with the new gillnet survey the aim was to continue the longline survey in Uummannaq and Upernavik and in Ilulissat only to use as calibration tool with the gillnet survey. In 2004 longline survey was conducted in Disko Bay and in Uummannaq. In order to take account for varying area coverage the survey catch rates are standardized with respect to depth and area effects by means of a GLM to generate mean catch rates.

Gillnet survey

The main objective for using gillnets is a well-estimated selectivity and the possibility for targeting pre-fishery sized Greenland halibut, i.e. lesser than 40 cm. Experience with the gear so far, indicate that catch rates are sufficient to allow proper statistical analyses, and the strategy is therefore to continue this survey as a monitoring tool for the inshore Greenland halibut populations in Disko Bay.

The gillnet survey was initiated in 2001 and takes place only in Disko Bay with the research vessel 'Adolf Jensen'. The location, Disko bay, is chosen due to the known presence of pre-fishery recruits in the entire area in combination with a bottom topography (approx. 3-400 m depth of flat clay ground) that allows fishing with gillnets. Both northern areas, Uummannaq and Upernavik, have tough rock bottom grounds not suitable for gillnet fishing. Only 8 stations were fished in the starting year 2001, but since between 51 and 58 stations have been fished annually (see Table 2). The surveyed area covered the proposed young fish areas in Disko Bay, off Ilulissat and the Icefjord and off the northern icefjord Torssukattak (Fig. 4). Mesh sizes 45, 52, 60 and 70 mm (knot to knot) with twines 0.28, 0.40, 0.40 and 0.50 mm correspondingly, were used to target the fish size groups approximately 30-50 cm. Multi-gang gillnets being approx. 300 m were composed of 4 sections, one of each meshsize, with 2 m space between each section to prevent catchability interactions between sections. Soaktime is approx. 10 hours and fishing occurred both day and night. Stations were paired two and two, close to each other to analyse for within station variability. The survey uses fixed positions of stations, but occasionally stations are to be moved due to icebergs.

The gillnets are selecting Greenland halibut in the length range 30-50 cm. Greenland halibut larger than 50 cm are abundant in the area, but seem mostly concentrated at the commercial fishing grounds in the immediate vicinity of Ilulissat and in the Icefjords, Kangia (Ilulissat Icefjord) and Torsukattak in the north. The gillnet survey do not cover those commercial fishing grounds. Greenland halibut smaller than 30 cm are occasional abundant in the area, but are

mostly recruited from offshore areas off Disko Bay and are supposed to perform a stepwise migration towards the commercial fishing grounds near the icefjords.

Recruitment indices.

Greenland Institute of Natural Resources conducts annual surveys with R/V "*Pamiut*" in 3rd quarter for shrimp and demersal fish as described in Storr-Paulsen and Jørgensen (SCR Doc. 05/39). The CPUE for Greenland halibut (number per age per hour of ages 1-3) is estimated for the Disko Bay, since 1997 indices have been at a level above that of previous years. The index is assumed indicative for recruitment to the Disko Bay fishable stocks only. Recruitment dynamics for the northern areas, Uummannaq and Upernavik are unknown.

Commercial Fishery Data

Landings data

Data on the inshore landings of Greenland halibut for Disko Bay and Uummannaq in 2004 was obtained from Greenland Statistics (GS). Data from Upernavik was obtained from Upernavik Seafood. Only a part of the data from 2004 was allocated to gear, and the remaining catches were allocated according to these available data. Season is defined in relation to type of fishery, i.e. open water fishery versus fishery from sea ice. Thus June-November are assigned as summer, remaining months are assigned as winter.

Processed fish is normally converted to whole fish weight using conversion factor set by the authorities. In 1998 and 1999 a new set of conversion factors was introduced based on updated information. The conversion factor for gutted fish with head and tail was multiplied by a factor 1.10 (previously 1.05). The conversion factor for gutted fish without tail and tail fin was 1.35 (previously 1.52).

In order to obtain length distributions for the commercial catches/landings random samplings from gillnet and longline fishery are carried out annually in the three main areas in February/March and July/August. Sampling intensity from the commercial fishery in recent years is given in text table below. From the landings in Upernavik and Kullorsuaq, both in the Upernavik area, individual weights were obtained from samples done by Upernavik Seafood.

Effort

In 1999 logbooks were introduced in the inshore fishery on a voluntary basis. The reporting has been very limited in both 1999 to 2001 (Simonsen 2001), and no logbooks were available from the fishery in 2002 and 2003. Greenland authorities introduced in 2005 an initiative to make logbooks mandatory for vessels larger than 30 feet. This has not yet been implemented but is expected to be so within 2005. As at least 50% of the effort is conducted by the larger vessels this implementation will improve the information on effort as input to the assessment considerably.

ampling	**2004**	**Disko Bay**			
Nos length measurements					**Nos otoliths**
Gear \Season	Summer	Winter	**Total**	% sampled	
Longline	2948	2665	5.613		
Gillnet		5072	5.072		
All	2.948	7.737	10.685	0,453	547

Sampling	**2004**	**Uummannaq**			
Nos length measurements					**Nos otoliths**
Gear \Season	Summer	Winter	**Total**	% sampled	
Longline	3666	745	4.411		
Gillnet	1424	95	1.519		
All	5.090	840	5.930	0,419	382

Catch at age

Catch at age data were compiled for the 2004 fishery, based on otolith sampling in summer, both from the gillnet and longline surveys and from the commercial fishery (Table 5). For 2004 the Age-Length-Key (ALK) for Disko Bay was based on otoliths from older fish in Uummannaq in addition to sampling from Disko Bay in 2003 and 2004, due to incomplete coverage of the older age groups in Disko Bay. For Uummannaq in 2004 an ALK, with 2003 and 2004 readings, from Uummannaq was used (Table 7). Otoliths in the inshore part of Div. 1A had been read by the same otolith reader from GINR in the entire period. No reliable maturity data were available.

The gillnet fishery in summer was not sampled in 2004. Catch composition from this fishery was assumed equal to the winter gillnet fishery.

Analytic Assessment

Due to a short time series with consistent fishery independent data (survey) and a discontinuous time series, it is presently not possible to carry out a reliable age disaggregated analytical assessment based on the present catch at age data. Available logbooks from the fishery as suggested by authorities in 2005 will improve the possibilities of running such an assessment in the future.

Assessment

Gillnet Survey

The gillnet survey uses 4 different mesh sizes, 46, 55, 60 and 70 mm, for which is assumed a modified uni-modal selection curve as shown in Fig. 5. The curvature takes account of larger fish caught (by other means than being gilled) by a constant low selectivity for those fish, i.e. the right leg of the curve. In last years assessment a bi-modal approach was used. The difference in the resulting estimated population is insignificant. The mesh sizes 46, 55, 60 and 70 mm was chosen in order to select fish in the length range 30-50 cm, i.e. pre-fishery recruits. From the selection curves in Fig 5, it is obvious that selection is nearly 100% in that length interval, thus the catches in this length range will reflect the fished population.

Most catches in the survey was obtained in the area just north of Ilulissat (stat. sq. LH028) and off the northern Ice fjord Torssukattak (Fig. 6). Fig. 7 summarizes the overall development in catch rates since 2001; from 2001 to 2002 both CPUE and NPUE decreased, but since then catch rates seem to have increased. However, the increase is not significant. The catches have been expressed as catch or numbers per 6 hours of setting, assuming that catch rates are linear positive related to soak time. This has, however, not been proved, and since soak time is on average twice as high in 2002 as compared to 2001 and 2003, the trend in catch rates between years is dependant on this assumption. Disaggregating the CPUE and NPUE into length groups, shows that CPUE for smaller fish (<35cm) have increased significantly from 2003 to 2004.

Length distributions from the gillnet survey 2001 to 2004 are shown by mesh size in Fig. 7b.

Assuming a modified uni-modal selection curve as given in Fig. 5 will result in relative underlying populations as provided in Fig. 8b. The fit of the assumed selection curve to the data is given in Fig. 8a as residual plots by The residuals seem reasonably well distributed for each mesh size, however only the 60 mm mesh size do seem to have mostly positive residuals meaning that the mesh size catch less than expected from the model. This is probably associated with the fact that 60 mm nets are sewed by two sections at the horizontal axis and thus not as flexible as the other sections. The resulting relative population (Fig. 8b) shows that since 2003 young fish <35 cm have become more abundant in the survey.

Longline Survey

Since 2001 when the gillnet survey was initiated, the longline survey has been restricted and the aim is to cover the areas Uummannaq and Upernavik only. In 2004 a survey was carried out in Uummannaq and Disko Bay. In order to further establish the calibration key between gillnet and longline surveys, longline settings will be conducted in Disko Bay in 2005. This will allow an extension of the newly initiated gillnet survey index back in time. A

povisional calibration analysis between the two surveys (SCR Doc 05/57, Boje and Lyberth) suggest that catchability within the length range 30 -50 cm, where gillnets are considered fully selective, is constant.

Survey CPUE

Disko Bay

Mean length in the survey in lulissat has generally increased in the past 5 years. It was stable from 1993 to 1999, but has since increased by more than 10 cm to 2001. In the 2004 survey mean length declined to about 50 cm, which is above average. Mean length in the northern area of Disko bay, Torsukkataq has remained stable over the surveyed period.

Catch rates in the survey has increased over the period, and especially in 2001 and 2004. The increase is however, not significant. Catch composition (Fig. 11) shows that this increase is especially due to more abundant large fish in catches. In 2003 abundant fish less than 45 cm suggest strong incoming year-classes. This strong recruitment is also possible to track in 2004.

Using the relation between total catches and the survey index as an approximation for exploitation level, suggest that exploitation of the populations in Disko bay have decreased in recent years compared to the mid-1990s (Fig.12).

Uummannaq

In Uummannaq mean size have been very stable in the time series of the longline survey. Mean length increased from 57 cm to 62 cm in 1998 and has since decreased to 59 cm in 2004 (Fig. 9, Table 4). Catch rates have, however, showed a considerable decrease from 1999 to 2003. The 2004 estimate is about average for the time series (Fig.10). The length composition in the survey have varied considerably since 1993 and does not allow to track any strong year-classes (Fig. 11).

Using the relation between total catches and the survey index as an approximation for exploitation level, suggest that exploitation of the populations in Uummannaq have increased since the late 1990s up to 2003. The 2004 value is however about the lowest in the time series (Fig.12).

Upernavik

Since 2000 no survey has been carried out in Upernavik.

Commercial Fishery

Size distribution

Mean lengths from the longline landings in the period 1993 to winter 2005 in Disko Bay and Uummannaq are showed in Fig. 13. In Upernavik no sampling had been conducted from the commercial fishery from 2002 until winter 2005. Fish caught in summer are generally smaller than fish caught during winter.

In Disko Bay mean length in the winter fisheries have fluctuated considerably during time, with a slight increasing overall trend. The variation could be due to inadequate sampling. In recent 3 years mean length decreased from a high of about 80 cm to 66 cm in 2004. Fishing at the traditional winter fishing grounds in the icefjord has been impeded in the recent years due to lack of land-fast sea-ice (the fishery is conducted from the sea-ice) and an open-water fishery developed on alternative fishing grounds. This change in fishing grounds may have affected mean size in landings. Mean lengths in the summer fishery have fluctuated between 1993 and 2001 with a slightly increasing trend, and have thereafter been decreasing from 63 cm in 2001 to 59 cm in 2004.

In Uummannaq mean sizes in the winter fishery have been stable throughout the period at about 66 cm. Mean size in landings from the summer fishery decreased in the early period from 1993 to 1997, but have thereafter remained stable at about 64 cm, mean size in landings from winter fishery have been relatively stable around 66 cm until 2004 but have decreased in 2005 to 63 cm.

Individual weights Upernavik area

As no sampling has been conducted from the commercial fishery in Upernavik, individual weights measured at landing can be used as a rough measure of size distribution. Since 2002 Upernavik Seafood has weighed each individual fish from the first landing of the day in Upernavik and Kullorsuaq. Mean individual weights from the winter fishery in Kullorsuaq has decreased from 6.7 kg in 2003 to 5.9 kg in 2005, corresponding to a decrease in mean length of about 0.5 cm (Fig. 14.), which could be expected as the area have been exploited for less than 10 years.

Catch at age

For all three areas there has been a shift in exploitation pattern through the time series (Fig. 15). While the younger age groups comprised between 25% and 50% of the catches in the late 1980s and early 1990s, they now constitute about 60-80% of the catches. However, in Disko Bay and Uummannaq exploitation of the younger age groups seem to decrease somewhat in recent years to about 50-60%. In Upernavik, exploitation of the younger age groups have increased considerably in the period from less than 25% to more than 80% in 1999-2001. No catch-at-age is available for Upernavik since then.

Mean weight-at-age

Mean weight at age for Greenland halibut in the three fishing areas are shown in Fig. 16. The outliers in 1994 are considered to be due to errors in age readings. For the younger fish mean weight at age have varied in the sampled time series, but recent values are overall at same level as those in the beginning of the period. For the older fish (>age 12) there is a clear trend of a decline in mean weight at age in the entire period since 1993, while for ages 9 to 12 mean weights are stable.

Recruitment

Recruitment indices were available for Disko Bay (inshore). Since 1997 recruitment (age 1) have been considerably higher than from 1989 til 1996. Recruitment index of age 1 fish was high in 2003 and 2004; in 2003 the index was the second highest in the time series (1989-04), 1705 nos/hour *vs* 800 nos/hour. The strong 2000 year-class gives a high age 2 index but is below average as age 3. The relative strong 2001 year-class are found as age 3 fish in 2004 as the highest in the time series (Fig. 17). So far, there is no relation between the recruitment strength in these surveys and strength of corresponding age groups in the fishery in Disko Bay.

State of the stock components

The abrupt decline in landings in the most recent years that raised concern by NAFO in 2002, have reversed for all three areas since 2002. Exploitation of younger age groups has increased considerably for all areas in the past 10-15 years. The lack of information on fishing effort makes it difficult to evaluate trends in landings relative to stock biomass or fishing effort. Since no surveys and sampling has been conducted in Upernavik area since 2001, there is no basis to evaluate the state of Greenland halibut stocks in that area in recent years.

Disko Bay

Since the beginning of the fishery for Greenland halibut in Greenland early in the 1900 in this area, landings have increased continuously. In the recent two decades annual landings increased from about 2 000 tons in 1987 to 10 500 tons in 1998 and 99. Since then landings declined to 7 000 tons in 2001, but increased again from 2002 to 2004 to a record high of more than 12 000 tons. The reason for this high variation is unknown, and no effort measures are available. Ice and weather conditions are known to influence use of gear type in the fishery and can also limit the total fishery. Favourable weather conditions (warmer) have obviously endorsed the fishery in this period and consequently resulted in the high catches the last three years.

Recruitment indices from Disko Bay and offshore areas suggest high 1996 and onward year-classes, which the fishery

might benefit in these years. This could explain the increase in catches in recent years. High abundance of these year classes are confirmed by the surveys.

In the commercial fishery mean length in catches are quite variable for the entire time series. In the winter and summer fishery mean lengths has decreased for the past three years.

A newly established gillnet survey (since 2001) shows a slight increase in catch rates from 2002 to 2004. The longline survey show high catch rates in 2001 and 2004 compared to the 1990s,

Uummannaq

Landings have been increasing from less than 2 000 t before 1987 to a record high of 8 425 tons in 1999. Since then landings have declined to about 5 000 tons in 2002-2004. The seasonal distribution of landings has been constant for the recent years.

Development in mean length in the summer fishery has showed an overall negative trend until 1999. Since then mean length in catches has increased slightly. In the winter fishery the mean length has been relatively stable except for the winter 2002 and 2005. Age composition in catches from the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age groups, but has stabilized in recent decade.

Survey results from 1993 to 1999 indicate an increase in abundance until 1999. In 2001 and further in the 2003 survey abundance index decreased significantly to the lowest observed. The 2004 survey index is higher and at average for the series. Mean lengths from the survey are relatively stable in the entire period and survey length compositions do not indicate any strong incoming year-classes

Upernavik

Fishery in Upernavik developed in the mid-1980s and thus constitutes the youngest inshore fishery in West Greenland. Landings increased from about 1 000 tons prior to 1992 to about 5 000 tons in 1996 and 1997. In 1998 landings were the highest on record, 7 012 tons. Since then landings have decreased continually by more than 50% to 3 019 tons in 2002, though followed by an increase to 4 573 tons in 2004.

No sampling from the commercial fishery has been conducted since 2001 and there have been no survey since then. Apart from total catches there is thus no information to evaluate present stock status.

General Comments

The lack of reliable landing data for recent years and incomplete data release from the Greenland authorities hampers the assessment of the inshore stock components in Div. 1 A. Official data on landings allocated on area (field-code), fishing gear and effort is a prerequisite for disaggregating catches and compiling catch in numbers, thereby allowing any analytical approaches to determine stock status. Improvement of the current assessment is entirely dependent upon this. In 2002, no information has been provided on gear types in the fishery. For a number of years, the catch statistics are preliminary and frequent changes to the database creates confusion on its reliability

Beginning from 1 June 2005 vessels larger than 30 feet are obligated to use logbooks. A voluntary logbook was introduced in 1999 for parts of the inshore Greenland halibut fishery. However, the reporting rate has been to low to allow any analyses on the material.

An earlier study of the by-catch of Greenland halibut in the commercial shrimp fishery (Jørgensen and Carlsson, 1998) suggest that the by-catch is considerable and could have a negative effect on recruitment to the inshore stock component. However, sorting grids have since then been made mandatory in the shrimp fishery (since October 2000), but for the entire inshore shrimp fishery derogations have been given until recently.

References

Bech, G., 1995. Recruitment of Greenland halibut at West Greenalnd. NAFO Scr.Doc. 95/19.

Boje, J. (1994). Migrations of Greenland halibut in Northwest Atlantic based on tagging experiments in Greenland waters 1986-92. NAFO Scr.Doc. 94/18

Gundersen A.C., Simonsen C.S., Jørgensen O.A., Fossen I., Lyberth B., and Boje J. 2004. Sexual maturity and spawning of Greenland halibut, R. hippoglossoides, in West Greenlad waters. ICES CM 2004 / K: 72

Jørgensen, O. A. and D. M. Carlsson (1998). An estimate of by-catch of fish in the West Greenland shrimp fishery based on survey data. NAFO Scr.Doc. 98/41(N3030)

Jørgensen, O.A. and Boje, J., 1994. Sexual maturity of Greenland halibut in NAFO Subarea 1. NAFO Scr.Doc., 94/42(No. N2412).

Riget, F. and J. Boje (1989). Fishery and some biological aspects of Greenland halibut (Reinhardtius hippoglossoides) in West Greenland waters. Sci.Council Studies(13): 41-52.

Simonsen, C.S. and Roepstorff, A., 2000. Udvikling og adfærd af fisk & fiskere i Diskobugt området. In: H. M. and O.R. Rasmussen (Editors), Innusuk - Arktisk Forsknings Journal. Direktoratet for Kultur, Uddannelse og Forskning, Nuuk, Grønland, pp. 29-43. *In danish*

Simonsen, C.S., Boje, J. and Kingsley, M.C.S., 2000. A Review Using Longlining to Survey Fish Populations with Special Emphasis on an Inshore Longline Survey for Greenland Halibut (Reinhardtius hippoglossoides) in West Greenland, NAFO Division 1A. NAFO Scr.Doc., 00/29

Simonsen, C.S. 2001. Logbook in the inshore fishery for Greenland halibut in NAFO Div. 1A. NAFO Scr Doc. 01/26.

Storr-Paulsen, M. And O.A. Jørgensen (2004). Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated from the Greenland Shrimp survey, 1988-2003. NAFO SCR. Doc. 04/18.

Table 1. Landings and Greenland halibut (tons) in Div. 1A distributed on the main fishing areas: Disko Bay, Uummannaq and Upernavik. Conversion factor 1.1 for gutted fish with head, 1.50 for gutted fish without head, 1.52 for gutted fish without head and tail fin.

Area/year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Disko Bay	2258	2670	2781	3821	5372	6577	5367	5201	7400	7837	8601	10671	10593	7574	7072	11718	11571	12857
Uummannaq	2897	2920	2859	2779	3045	3067	3916	4004	7234	4579	6293	6912	8425	7568	6558	5339	5039	5248
Upernavik	1634	777	1253	1245	1495	2156	3805	4844	3269	4846	4879	7012	5258	3764	3239	3019	3884	4573
Unknown/other	407	636	599	507	17	133	0	0	0	0	0	0	55	2239				45
Total in Div. 1A inshore:																		
STATLAN 21A	6696	6384	6927	7465	9243	11932	13204	14067	17046	17271	20835	19669	24333				21482	22947
STACFIS	7196	7003	7492	8352	9929	11933	13088	14049	17037	17262	19774	24595	24332	21144	16869	20076	20494	22723

[1] Unofficial data from the fishing industry (Royal Greenland, NUKA, Upernavik Seafood and Uummannaq Seafood.

Table 2. Number of gillnet settings by stat. square in gillnet survey in Disko Bay since 2001.

	Year			
Statistical square	2001	2002	2003	2004
LA027				3
LB027				1
LD027			2	
LE027			2	
LF027			2	1
LF028			2	1
LG024			2	1
LG026				3
LG027	4	3	6	6
LG028	2	3	2	5
LH027		11	4	6
LH028	2	8	7	9
LH030		2		2
LH038			1	
LJ026			2	1
LJ028			4	
LJ030		5		
LK024		2		1
LK026		2		1
LK027		3		1
LK028		4		
LK029			4	
LK030		1		
LK031		3		
LL024				1
LL026		2		2
LL027		2		2
LL028				4
LL029			1	
LL031		1		
LM029			2	
LM030			2	
LM031			2	
LN024			2	
LN025			3	
LN026			2	
LN027			2	
LN028			2	
LP024		2		
Total	8	54	58	51

Table 3. Landings of Greenland halibut allocated on area, season and gear. Allocation on gear was obtained from 28.7% of Ilulissat, 30.5% of Uummannaq and 99.8% of Upernavik catches.

		summer		winter		Total
		longline	gillnet	longline	gillnet	
Disko	Ilulissat	6546	17	4055	1357	
	Torssukataq	729	0	120	33	12857
Ummannaq		2738	700	1413	398	5249
Upernavik		1167	700	1309	398	3574

Table 4. Mean length (cm) from catches taken in inshore longline surveys. Standardized survey since 1993

Area/year	1962	1985	1986	1987	1993	1994	1995	1996	1997	1998	1999	2000	2001	2003	2004
Disko bay	-	62.4	53.5	62.2	55.9	56.5	-	53.6	57.0	-	56.7	54.3	56.1	-	51.0
Uummannaq	67.8	70.5	-	61.8	56.6	-	57.6	59.5	-	61.9	61.7		59.7	57.6	58.6
Upernavik	-	-	-	-	-	64.6	60.8	-	-	57.1		58.4			

Table 5. Catch at age of Greenland halibut. - indicates insufficient or missing sampling.

A) Disko Bay

	Catch in numbers (thousands)																
age/year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
4	0	0	0	5	34	7	0	0	0	0	0	1	0	1	0	0	0
5	0	0	0	5	92	15	3	0	8	0	0	4	9	15	2	2	2
6	1	0	0	11	122	62	15	0	1	21	74	41	98	33	54	64	56
7	9	0	1	279	332	280	112	45	47	132	397	360	535	224	283	425	409
8	59	14	24	806	476	479	281	459	323	646	775	619	729	390	561	722	691
9	182	106	141	535	390	339	539	639	941	1113	944	836	780	521	771	1.187	1083
10	173	121	185	333	451	280	396	798	651	1168	1248	1028	636	450	421	610	634
11	132	94	188	238	532	240	190	463	454	607	754	786	478	485	575	847	730
12	73	49	126	76	309	122	91	185	273	185	346	426	223	280	393	422	311
13	63	33	80	45	140	91	50	127	145	69	132	136	52	78	398	158	144
14	65	39	59	67	92	112	45	27	75	19	68	72	28	33	175	146	130
15	38	31	42	57	18	75	41	36	44	10	27	29	12	31	112	135	152
16+	33	41	44	44	0	86	36	27	69	6	6	2	1	16	0	89	89
Total	828	528	890	2501	2988	2188	1799	2806	3031	3976	4770	4340	3583	2557	3745	4808	4431

B) Uummannaq

	Catch in numbers (thousands)																
age/year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
4	0	0	0	-	-	0	0	0	1	0	0	8	0	0	-	0	0
5	0	0	0	-	-	0	0	0	0	0	0	70	19	65	-	3	1
6	1	0	1	-	-	9	24	6	6	0	0	218	86	113	-	21	10
7	5	2	3	-	-	45	105	217	76	69	0	554	357	674	-	127	105
8	20	9	15	-	-	200	226	564	308	377	235	596	441	507	-	360	197
9	52	35	47	-	-	202	271	601	279	793	566	690	543	315	-	321	249
10	121	98	108	-	-	142	346	413	286	702	657	789	669	492	-	235	198
11	143	120	121	-	-	138	139	414	232	460	586	526	487	303	-	220	163
12	121	99	101	-	-	104	105	219	142	206	355	295	311	178	-	158	118
13	96	76	82	-	-	158	34	138	69	75	138	131	170	121	-	78	82
14	49	38	42	-	-	93	12	49	28	32	39	42	68	60	-	145	103
15	23	19	20	-	-	28	0	28	11	10	15	12	24	28	-	150	78
16+	17	20	21	-	-	20	3	22	15	6	5	4	8	12	-	94	59
Total	648	516	561	-	-	1139	1265	2671	1453	2732	2595	3935	3184	2868	-	1911	1364

Table 6. Age-length keys used for 2004 catch in numbers.

2003 +2004 age readings Ilulissat + older fish (age 15+) from Uummannaq																			
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
25-29	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-34	#	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35-39	0	49	35	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40-44	0	2	57	29	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45-49	0	0	4	52	24	6	0	0	0	0	0	0	0	0	0	0	0	0	0
50-54	0	0	0	8	50	20	1	0	0	0	0	0	0	0	0	0	0	0	0
55-59	0	0	0	0	12	35	19	3	1	0	0	0	0	0	0	0	0	0	0
60-64	0	0	0	0	0	6	37	22	9	1	0	0	0	0	0	0	0	0	0
65-69	0	0	0	0	0	0	2	4	13	4	2	0	0	0	0	0	0	0	0
70-74	0	0	0	0	0	0	0	0	2	5	2	4	2	0	0	0	0	0	0
75-79	0	0	0	0	0	0	0	0	0	1	1	1	2	2	1	0	0	0	0
80-84	0	0	0	0	0	0	0	0	0	0	0	1	4	1	0	0	0	0	0
85-89	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0
90-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
95-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100-104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
105-109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110-114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

2003 + 2004 age readings Uummanaq																			
winter	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**Sum**
30-34	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
35-39	9	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
40-44	1	16	17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
45-49	1	1	31	24	4	0	0	0	0	0	0	0	0	0	0	0	0	0	
50-54	0	0	0	38	21	0	0	0	0	0	0	0	0	0	0	0	0	0	
55-59	0	0	0	6	32	15	3	1	1	0	0	0	0	0	0	0	0	0	
60-64	0	0	0	0	4	31	17	7	2	0	0	0	0	0	0	0	0	0	
65-69	0	0	0	0	0	4	13	11	7	3	0	0	0	0	0	0	0	0	
70-74	0	0	0	0	0	0	0	3	3	3	4	2	0	0	0	0	0	0	
75-79	0	0	0	0	0	0	0	0	1	2	4	1	2	1	0	0	0	0	
80-84	0	0	0	0	0	0	0	0	0	0	1	4	2	0	0	0	0	0	
85-89	0	0	0	0	0	0	0	0	0	0	1	3	1	1	0	0	0	0	
90-94	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	
95-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
100-104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
105-109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
110-114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	

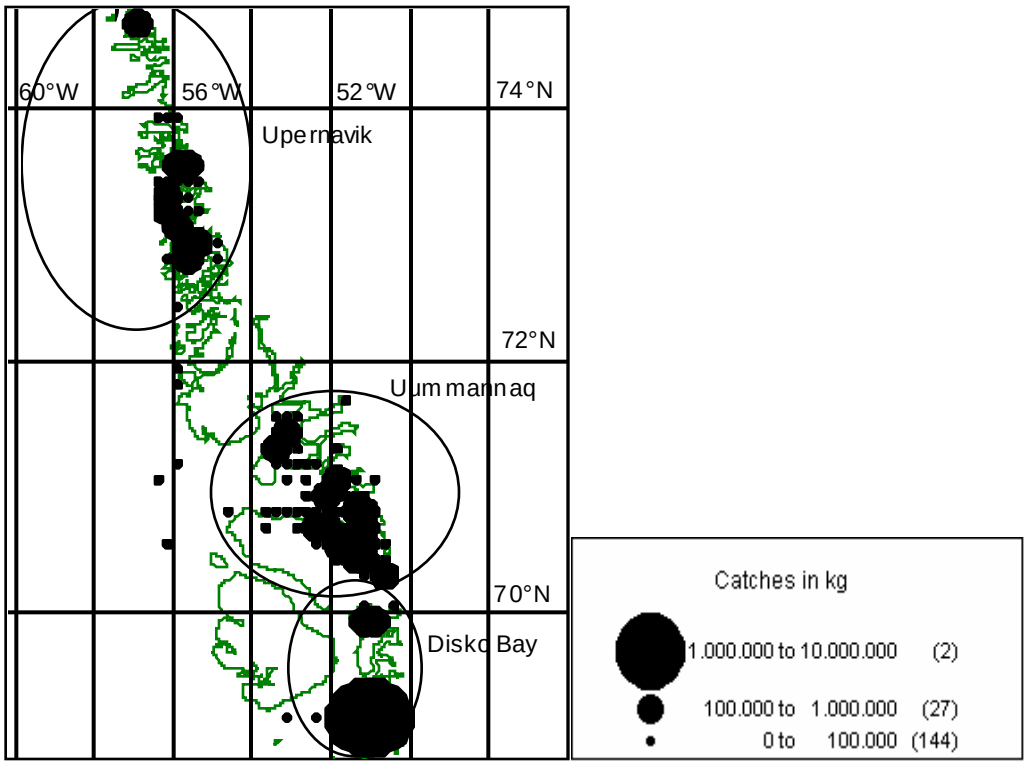


Fig. 1. Distribution of the inshore fishery for Greenland halibut in Div.1A in 2003. Landings is shown in tons per. Square (field-code). Catch statistics are provisional.

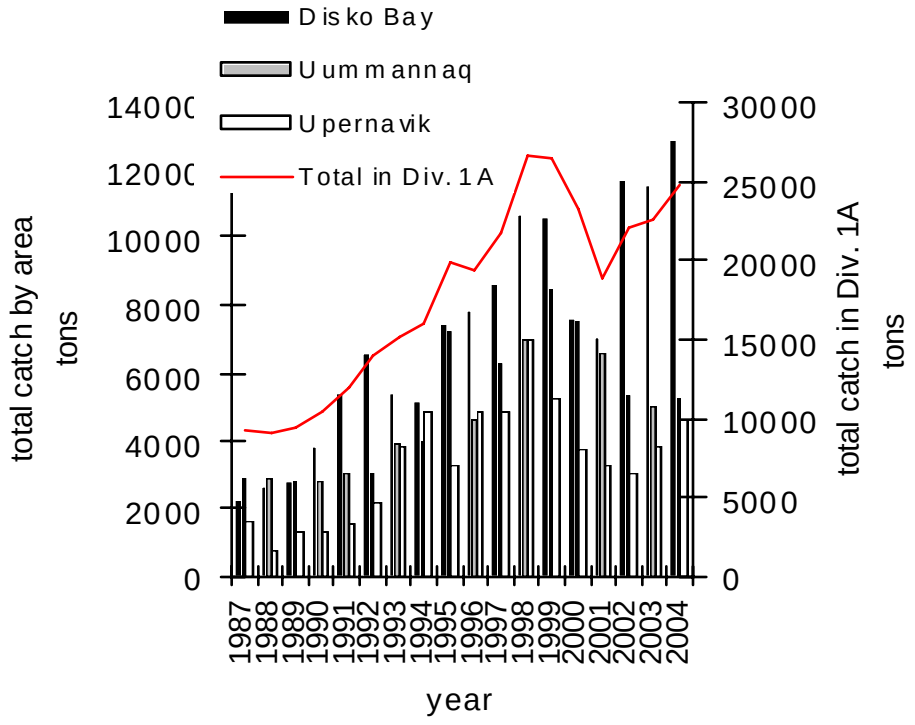


Fig. 2. Landings in NAFO Div. 1A since 1987 for the 3 main fishing areas. Landings from 2000-2001 are provisional. See also Table 1.

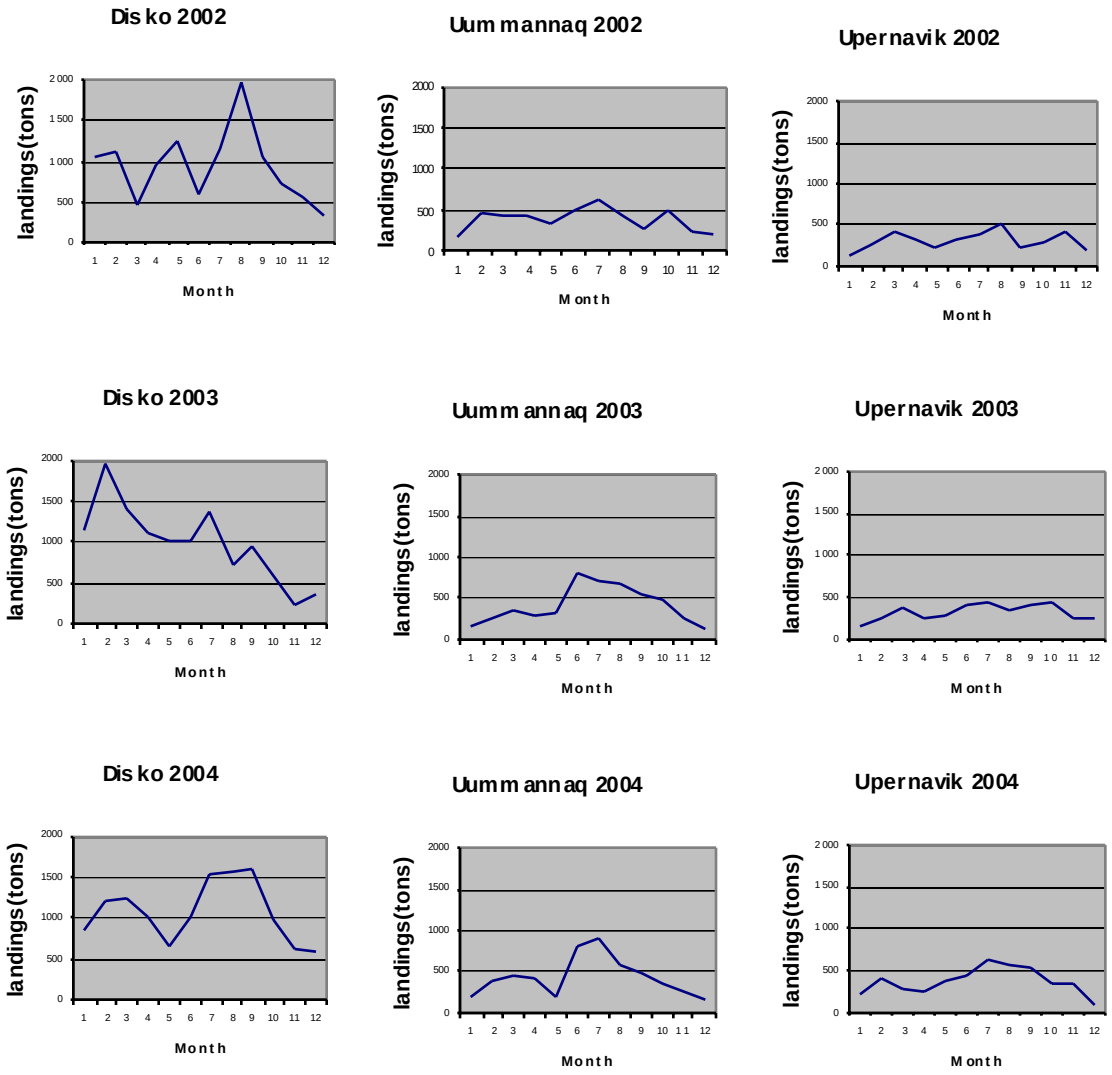


Fig. 3. Landings in NAFO Div.1A inshore by month and area for the years 2002-2004.

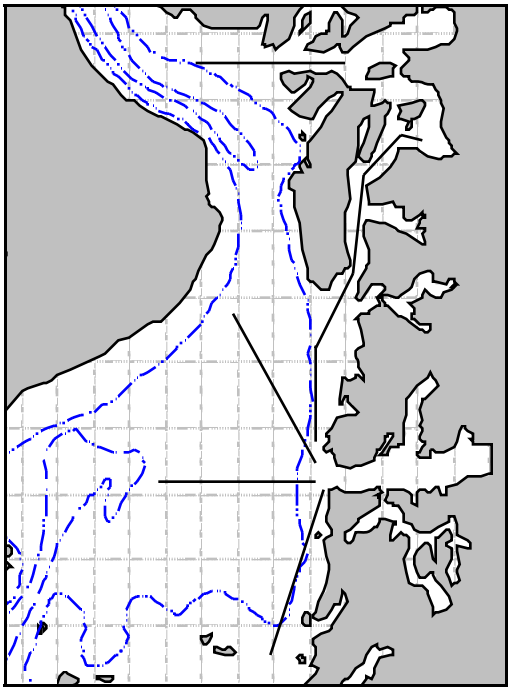


Fig. 4. Map of area in Disko Bay for gillnet survey. Lines are transects along which fixed stations are positioned.

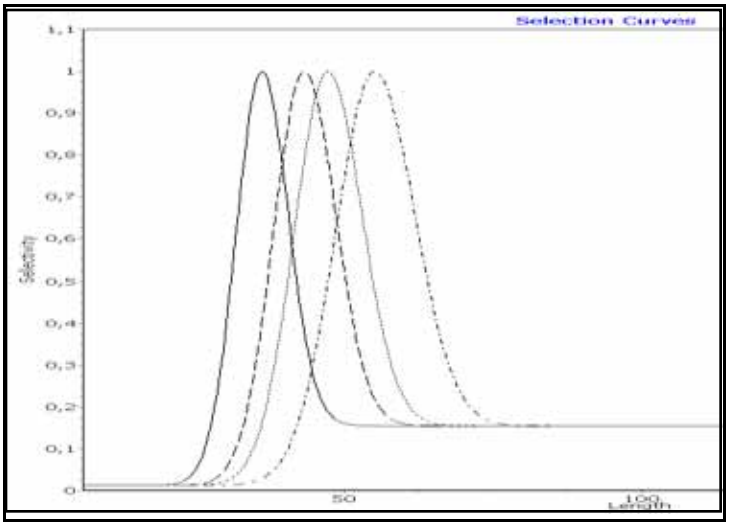


Fig. 5. Assumed selectivity curve applied to gillnet survey catches (Wileman's wings).

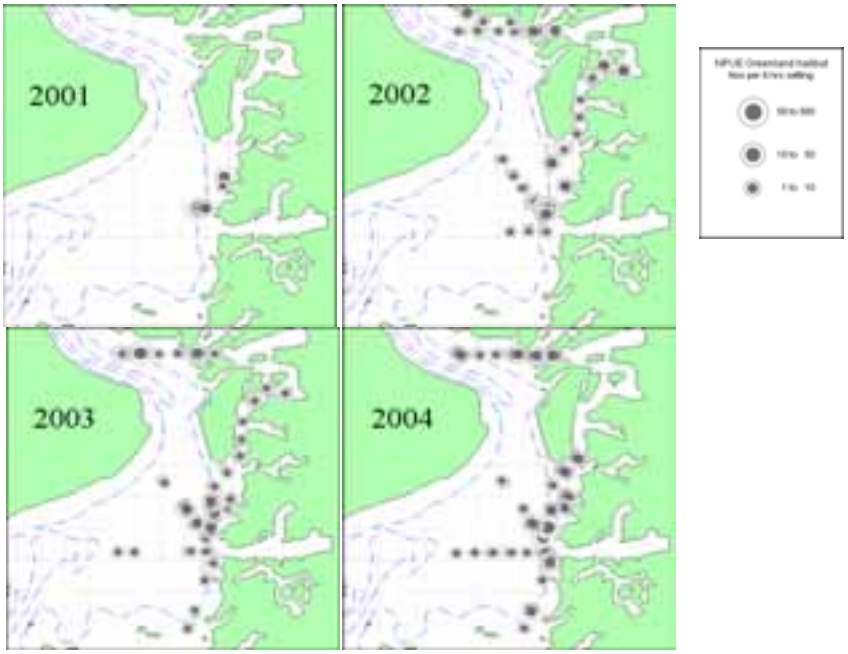


Fig. 6. Gillnet survey in Disko Bay 2001-2004. NPUE distribution (Nos per 6 hrs of setting).

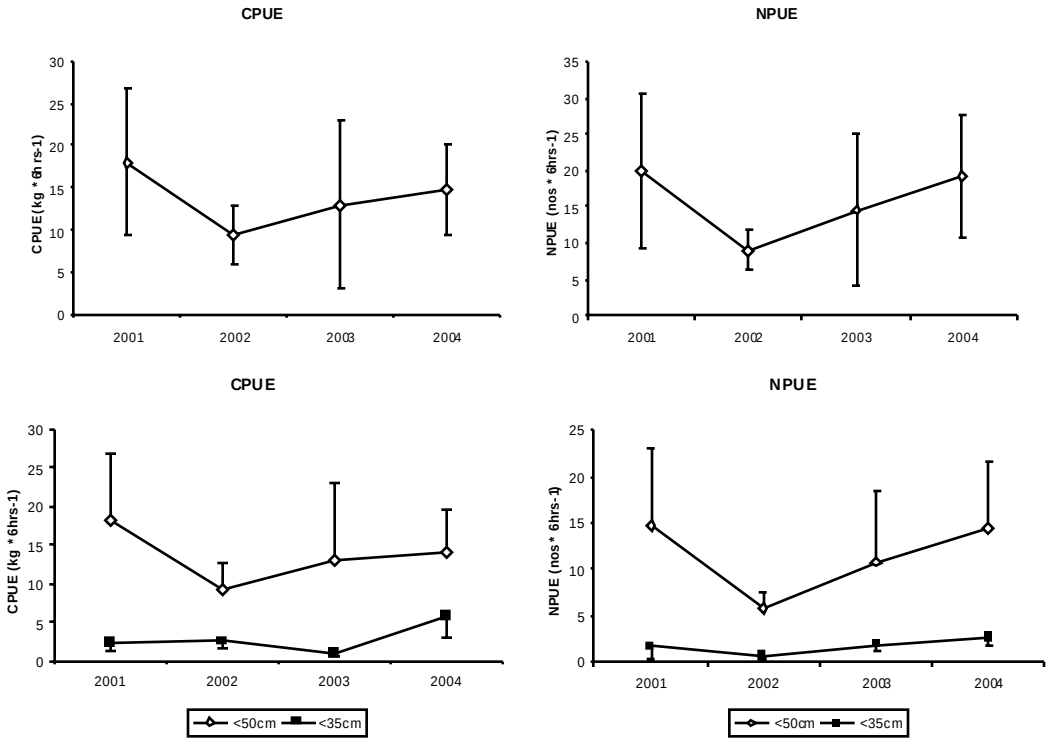


Fig. 7a. Gillnet survey indices, CPUE (kg*6hrs^{-1}) and NPUE (nos*6hrs-1). Lower figures are shown by length groups. 95% CI indicated.

.

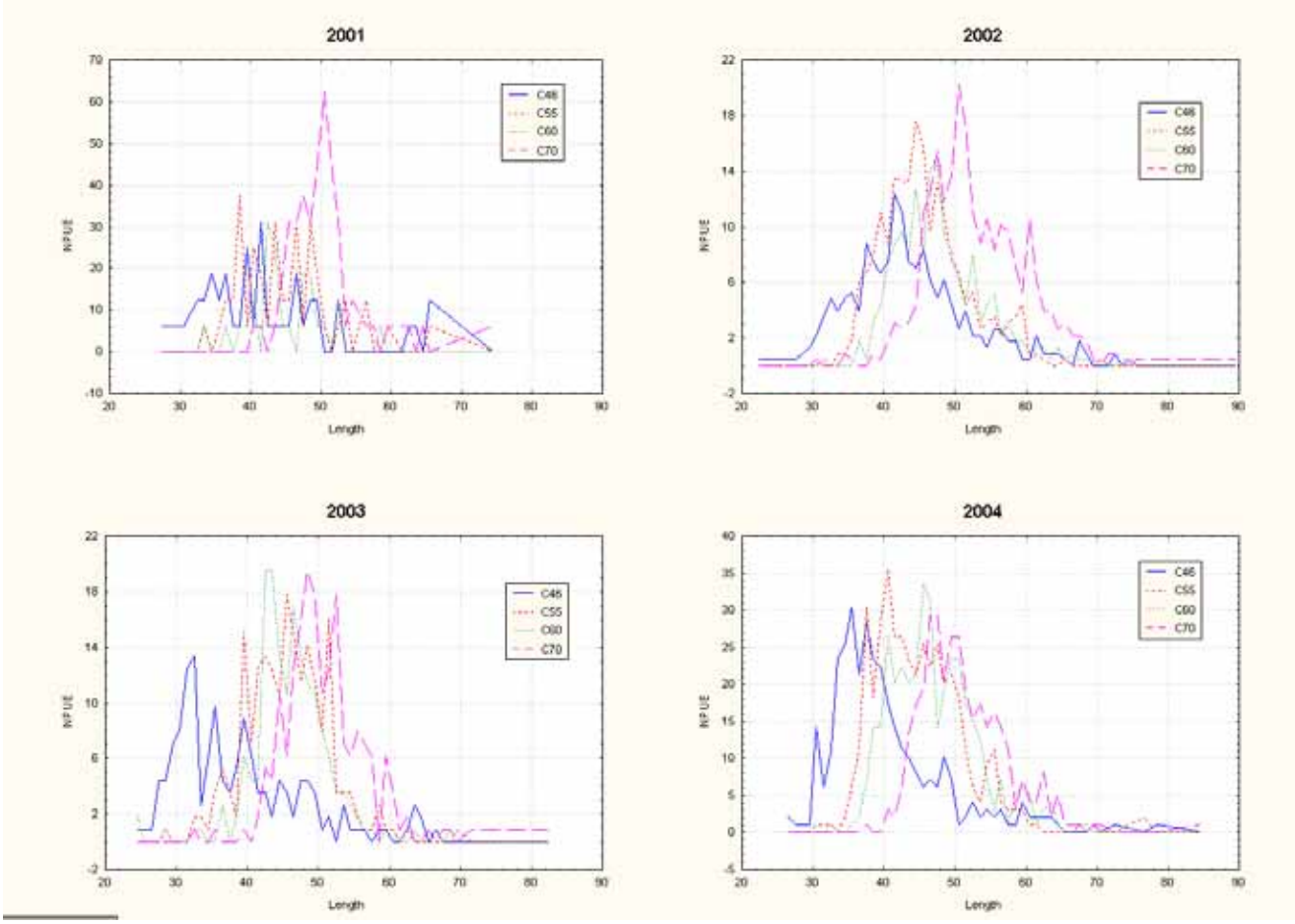
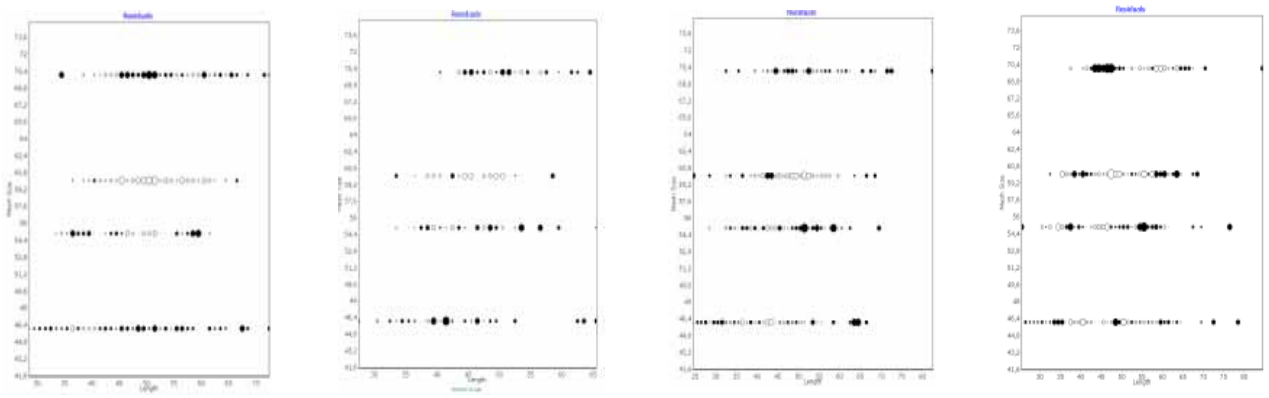


Fig. 7b. NPUE (nos per setting per 6 hours) per mesh size in the gillnet survey in 2001-2004.



2001 2002 2003 2004

Fig. 8a. Residuals for each mesh size (y-axis) by length (x-axis) from the selectivity model (bi-modal) 2001-2004.

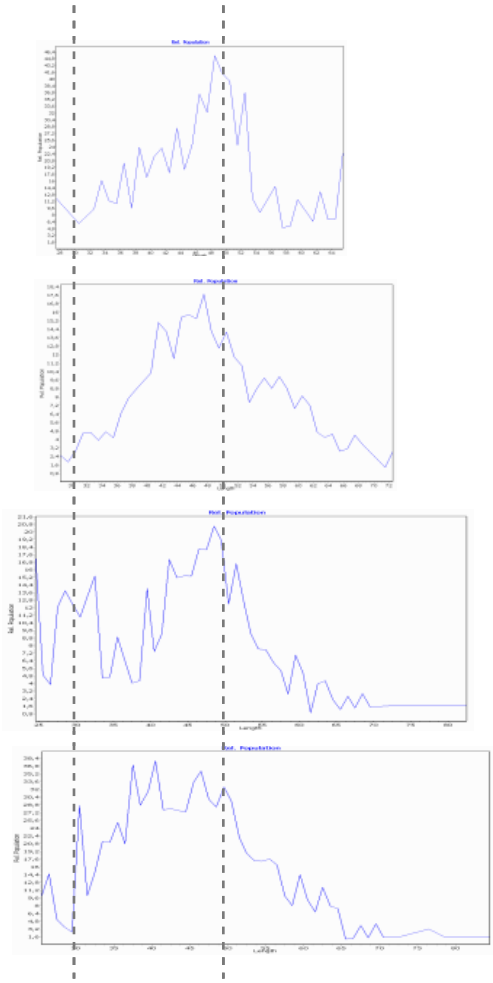


Fig. 8b. Estimated relative population assuming a bi-modal selectivity curve in 2001 to 2004 (from top to bottom): the dashed lines indicate the length interval 30-50 cm where fully selection is assumed.

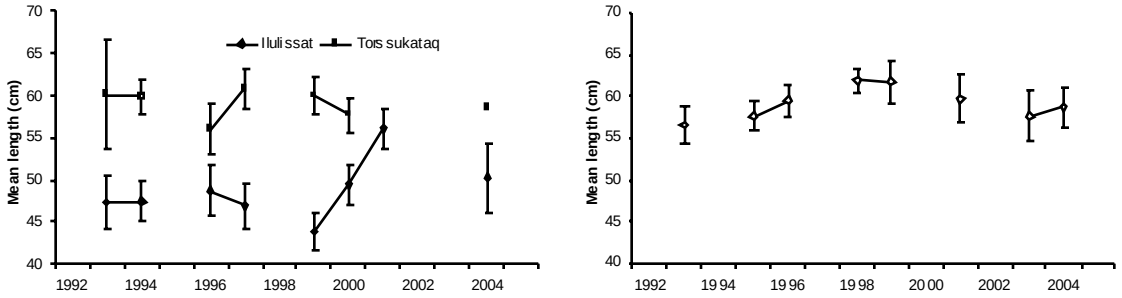


Fig. 9. Mean length for longline surveys conducted since 1993. 95% CI indicated. Left: Ilulissat, Right: Uummannaq.

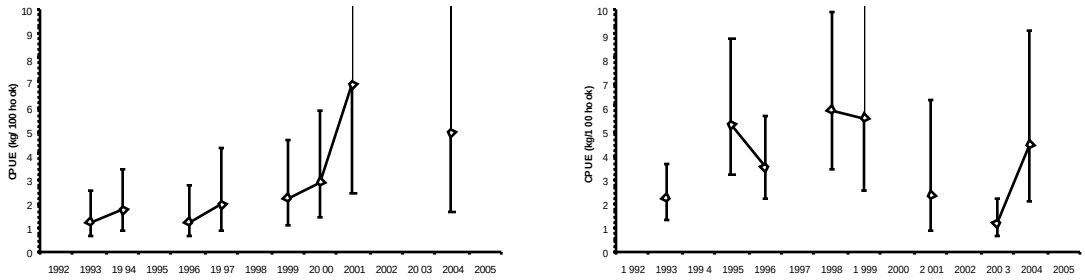


Fig. 10. Longline survey index (standardised CPUE) for Ilulissat (left) and Uummannaq (right) 1993-2004. 95% CI indicated.

.

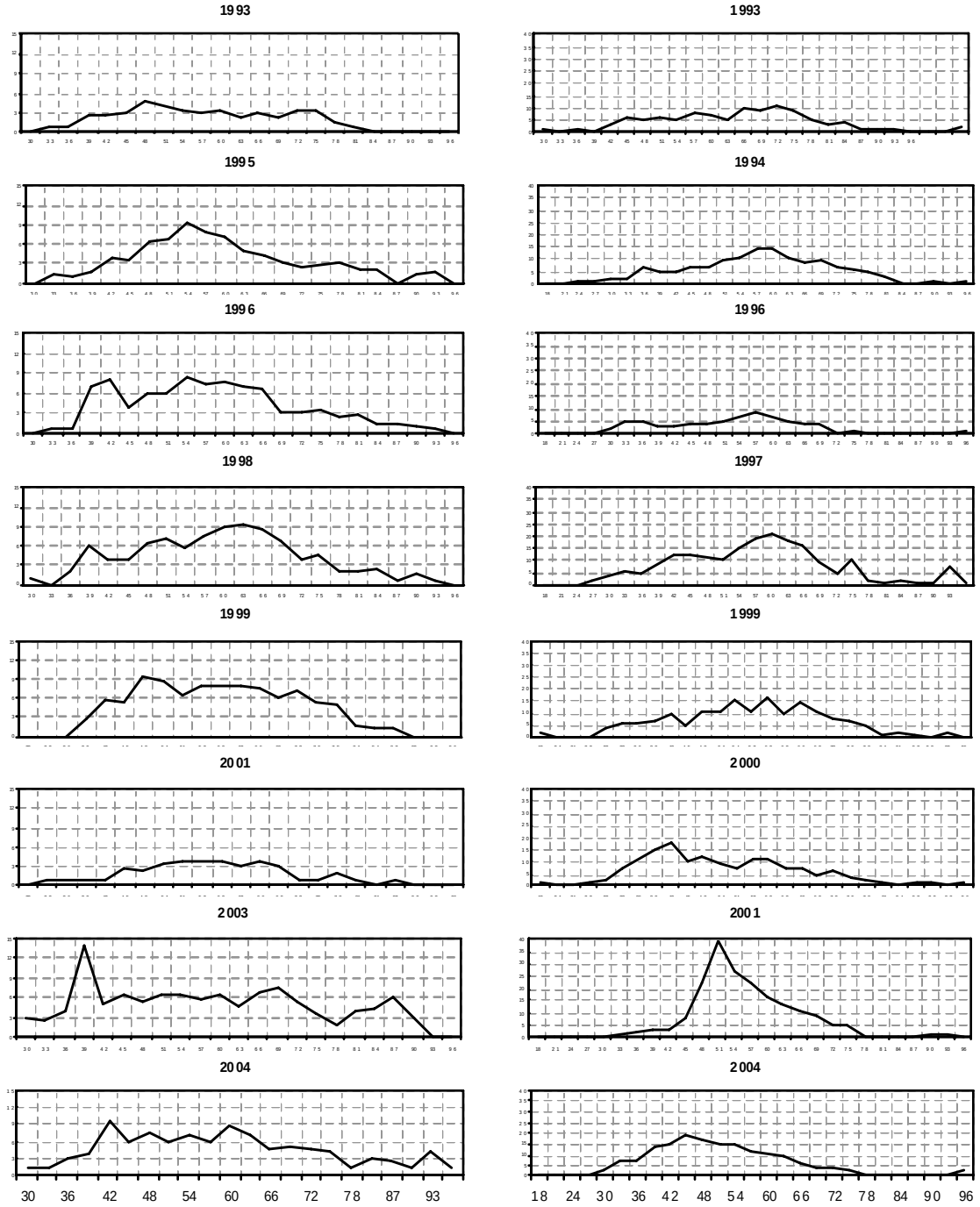


Fig. 11. NPUE (nos/1000 hooks) by length group (3 cm) of Greenland halibut from longline surveys. **Left:Uummannaq, Right: Ilulissat**

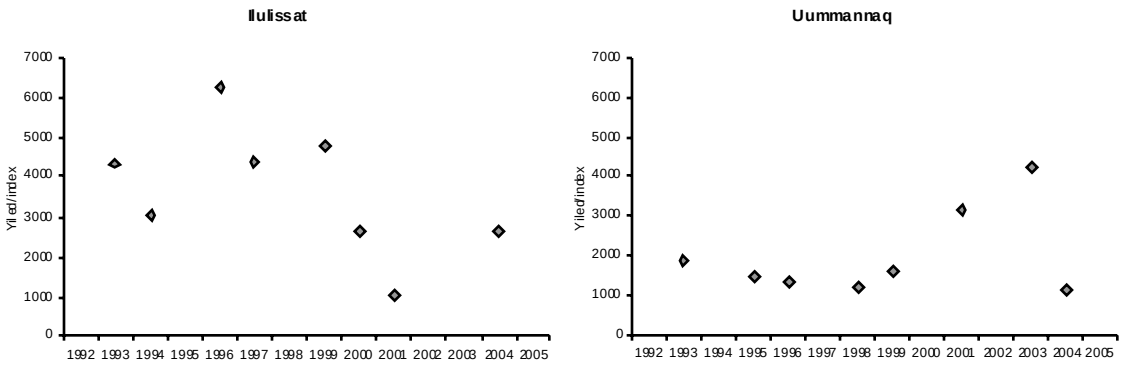


Fig. 12. Exploitation proxy (Landings/standardized survey index) for Ilulissat and Uummannaq.

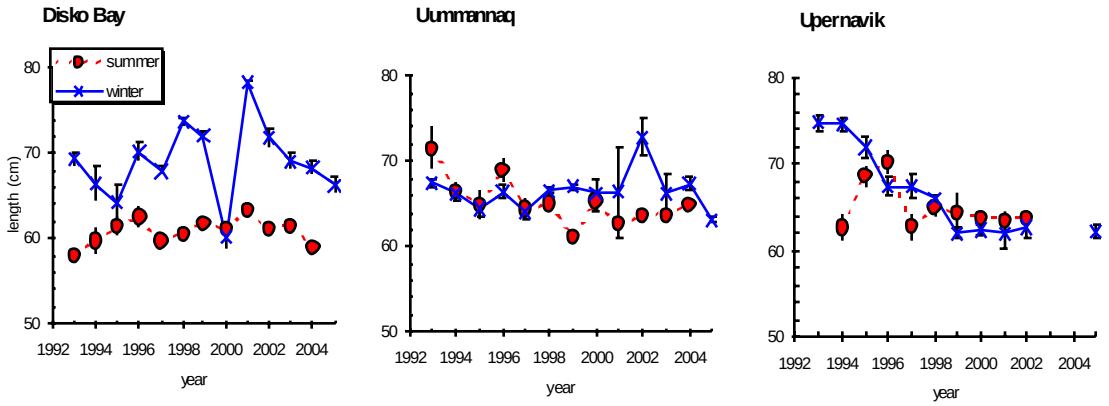


Fig. 13. Mean length of Greenland halibut in commercial longline catches from Ilulissat, Uummannaq and Upernavik with 95% conf. Int.

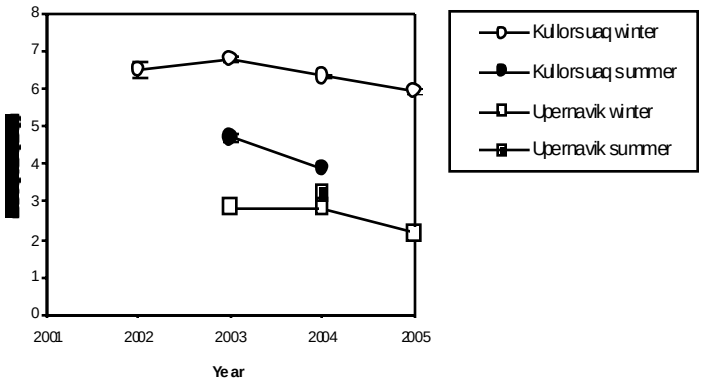


Fig. 14. Individual weights of Greenland halibut landed in Kullorsuaq and Upernavik

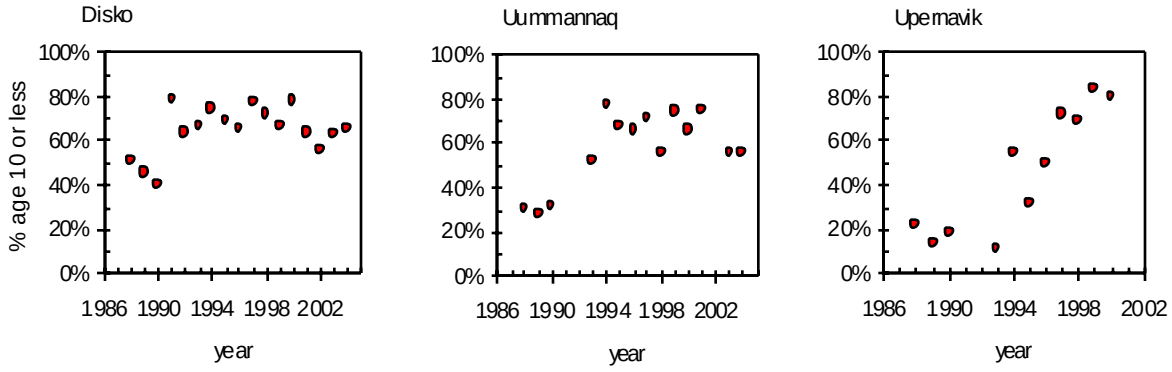


Fig. 15. The development in exploitation of the *age 10 and younger* expressed as percentages of those age groups in commercial landings by year.

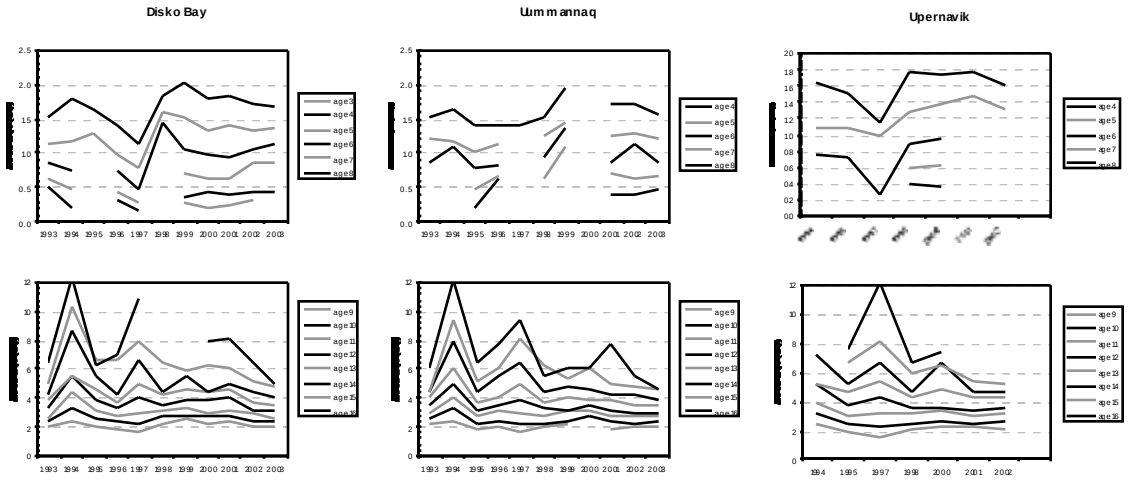


Fig. 16. Weight at age for the three areas Disko Bay, Uummannaq and Upernavik.

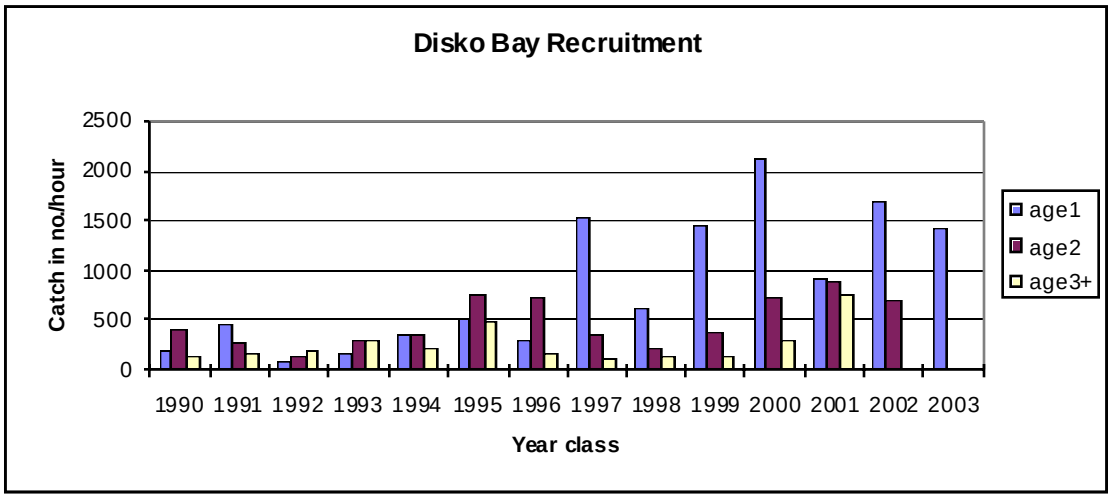


Fig. 17. Catch in number per hour of Greenland halibut at age 1, 2 and 3+ in the in the inshore Disko Bay (from SCR 05/39).