Northwest Atlantic Fisheries Organization

Serial No. N5536 **NAFO SCR Doc. 08/035**

SCIENTIFIC COUNCIL MEETING – JUNE 2007

Assessment of the Greenland Halibut Stock Component in NAFO Subarea 0 + Division 1A Offshore + Divisions 1B-1F

O.A. Jørgensen
DTU-Aqua, Technical University of Denmark,
Charlottenlund Slot, DK 2920 Charlottenlund, Denmark

Abstract

The paper presents the background and the input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut stock component in NAFO Subarea 0 + Div. 1A offshore + Div. 1B-1F. Catches peaked at 18,000 tons in 1992 but have been stable around 10,000 tons during 1993-2000. Catches increased to 13,184 tons in 2001 and further to 19,954 tons in 2003 primarily due to increases in catches in Div. 0A and 1A. Catches have stayed at that level in 2004 and 2005. Catches increased to 24,155 tons due to increased effort in 0A and 1AB and stayed at that level in 2007 (23,416 tons). Survey trawlable biomass in Div. 1CD increased between 2003 and 2005 to 80.800 tons but decreased to 74,357 tons which still is above the average for the time series. The biomass in the Greenland shrimp survey decreased slightly between 2006 and 2007 but is still above average for the time series. The recruitment of age one has been above average in resent years for the time series, which dates back to 1988. Length distributions in the commercial fishery have men stable in recent years. Standardized CPUE indices from SA0 decreased slightly between 2006 and 2007 while CPUE in Div.1CD have showed an increasing trend since 2002. The combined CPUE Div. 0B - Div 1CD series showed a minor decline compared to 2006 but is still at a high level.

TAC, description of the fishery and nominal catches.

TAC

Between 1979 and 1994 a TAC was set at 25,000 tons for SA 0+1, including Div. 1A inshore. In 1994 it was decided to make separate assessments for the inshore area in Div. 1A and for SA 0 + Div. 1A offshore + Div.1B-1F. From 1995-2001 the advised TAC for the latter area was 11,000 tons. In 2000 there was set an additional TAC of 4,000 tons for Div. 0A+1AB for 2001. This TAC was in 2002 increased to 8,000 tons for 2003. Total advised TAC for 2004 and 2005 remained at 19.000 tons. In 2006 the advised TAC in Div. 0A+1AB was increased with further 5,000 tons to 13,000 tons. Total advised TAC remained at that level. - 24,000 tons - in 2007.

Catches in SA 0 + Div. 1A offshore + Div.1B-1F

During the period 1982-1989 nominal catches of Greenland halibut in SA 0 + Div. 1A offshore + Div.1B-1F fluctuated between 300 and 4,500 tons. Catches increased from 2,200 tons in 1989 to 10,500 tons in 1990. Catches stayed at that level in 1991 but increased again in 1992 to 18,100. During 1993-2000 catches have fluctuated between 8,300 and 11,400 tons. Catches increased to 13,315 tons in 2001 and increased further to 19,680 tons in 2005. In 2006 catches increased to 24,155 tons but decreased slightly to 23,416 tons in 2007 (Fig. 1).

The increase in catches from 1989 to 1990 was due to a new trawl fishery by Canada and Norway and increased effort by Russia and Faeroe Islands in Div. 0B, while the increase from 1991 to 1992 was caused by a further increase in effort by Russia in Div. 0B and an increase in fishing activity in SA 1. The increase in catches between

2000 and 2003 and from 2005 to 2006 was primarily due to an in increase in effort in Div. 0A and Div. 1A. The distribution of catches between 0A+1AB and 0B-1C-F has been stable in recent years.

Catches in SA 0

In 1983 annual catches in SA 0 were about 4,500 tons. Catches then dropped to a level of 1,000 tons or lower, where they remained until they increased from 907 tons in 1989 to 9,498 tons in 1990. Catches decreased in 1991 to 8,606 tons, to increase again in 1992 to 12,358 tons. Catches then decreased gradually to 3,233 tons in 1995 and fluctuated between 4,000 and 5,400 tons between 1996 and 2000. Until 2000 almost all catches in SA 0 were taken in Div. 0B. In 2001 a commercial fishery started in Div. 0A. Catches in SA 0 increased to 7,662 tons in 2001 and further to 9,201 tons in 2003 and stayed at that level in 2004 and 2005. Catches increased to 12,168 in 2006 but decreased slightly to 11,472 tons in 2007 (Table 1).

The increase in catches seen since 2000 was mainly due to an increased effort in Div. 0A where catches increased from a level of about 300 ton, where they have stayed since 1996, to 2,628 tons in 2001 and further to 4,142 tons in 2003. Catches stayed at that level in 2004 and 2005. In 2006 catches increased to 6,635 tons due to increased effort, but decreased slightly to 6,150 tons in 2007

The catches in Div. 0A in 2007 were taken by trawl (681 tons) and twin trawl (2,698 tons), while 2,771 tons was taken by gill net. The distribution of catches by gear is almost the same as in 2006. The long lines fishery in the area has apparently stopped. The fishery was prosecuted by Canadian vessels.

Catches in Div. 0B 2007 amounted to 5,322 tons which is at the level seen in recent years. Offshore, longliners took 58 tons and gillnetters 1,750 tons while single- and double trawlers took 3,514 tons. All catches were taken by Canadian vessels.

Catches in SA1

The catches in Subarea 1 (Div. offshore 1A Div. + 1B-1F) were below 1,600 tons during 1982-1990. In 1991 catches increased to 2,376 tons and were around 5,500 tons during 1992-1994, but decreased to 4,500- 5,000 tons during 1995-1999. Catches increased to 5,741 tons in 2000 and increased further to 9,524 tons in 2003 and stayed at this level in 2004 and 2005. Catches increased to 11,987 tons in 2006 due to increased effort by Greenland in Div. 1AB. and stayed at that level in 2007 (11,886 tons). Almost all catches have been taken offshore (Table 2). The inshore catches in 2007 in Div. 1B-1F amounted to 154 tons.

Catches in Div. 1AB (mainly in Div. 1A) increased gradually from 575 tons in 2001 to 3,558 tons in 2003 and stayed at that level in 2004-2005. Catches increased again in 2006 to 6,220 tons. Catches in 2007 were 6,238. All catches were taken off shore by trawlers from Faeroe Islands, Russia (SCS 08/6), and Greenland (SCS 08/11).

Catches in Div 1CD have been stable around 5,600 tons in recent years and was 5,603 tons in 2007. Catches were taken by vessels from Greenland (SCS 08/11), Norway, EU-Germany (SCS 08/08), Russia (SCS 08/6) and Faeroe Islands. Almost all catches offshore were taken by trawl except about 14 tons taken by a longliner. 154 tons were taken inshore in Div. 1B-1F, mainly by gill net.

2. Input data

2.1 Research trawl survey

Div. 1C-1D GHL-survey

Since 1997 Greenland has conducted stratified random bottom trawl surveys in September-October for Greenland halibut in NAFO Div. 1C-D at depth between 400 and 1500 m. In 2007 a total 50 hauls were made (SCR 08/17). The biomass and abundance of Greenland halibut in Div. 1C-D decreased slightly form 77,010 tons and $70.715*10^6$ to 74 357 tons and $67.427*10^6$ individuals in 2007 (Fig. 2a). The reduction in biomass and abundance was mainly due to slightly lower aerial coverage in 2007. The mean catch per km^2 swept was the same, 1.47 tons, as in 2006 (Fig. 2b).

Both the biomass and the abundance were above average for the time series. The highest densities were found at 1000-1200 m in Div. 1C and 1000-1400 m in Div. 1D. The overall length distribution in Div. 1CD was dominated by a mode at 47-49 cm and the age distribution was dominated by a mode at age 7.

Canadian deep sea survey in Baffin Bay (Div. 0A)

Canada has conducted surveys in the southern part of Div. 0A in 1999, 2001, 2004 and 2006. The biomass has increased gradually from 68,700 tons via 81,000 tons to 86, 200 tons in 2004. The biomass decreased to 52,271 t in 2006 (Fig. 2c). However, the survey coverage was not complete and two of the four strata missed fell within the depths 1001-1500 m and accounted for 11,000 – 13,000 tons of biomass in previous surveys. Therefore, the current estimates are considered to be lower than the most recent surveys but comparable to the estimate from 1999. The mode in the catches was at 39 cm compared to 45 cm in 2004. The decrease in mode might reflect the poor coverage of deeper depths where fish generally are larger (SCR 07/41). There was no survey in 2007.

Greenland shrimp-survey

Since 1988 annual trawl surveys with a shrimp trawl have been conducted off West Greenland in July-September. The survey covers the area between 59°N and 72°30'N (Div. 1A-1F), from the 3-mile limit to the 600-m depth contour line. The survey area was restratified in 2004 based on better information about depths and all biomass and abundance indices have been recalculated. The recalculation did not change the trends in the development of the different stocks.

Estimated total trawlable biomass of Greenland halibut in the offshore areas (not including Disko Bay) has fluctuated between 9,258 and 31,100 tons during 1992 – 2006.

In 2007 the biomass was estimated as 18,882 tons which is a gradual decrease from 31,103 in 2004 but is still above the average (16,972 tons) for the time series which dates back to 1992. The abundance was estimated at 293 mill. Which is at the level generally seen since 1999? The highest abundance was seen in Div. 1B-north. As in recent years most of the abundance was comprised of one-year-old fish (SCR (08/28).

In the inshore Disko Bay the biomass was estimated at 12,166 tons compared to record high 28,229 tons estimated in 2004. The biomass estimates from 2003-2006 are by far the largest in the time series, but the 2007 estimate is the 5th highest in the time series. The abundance was estimated as $145*10^6$ which is an increase compared to $106 *10^6$ in 2006.

The biomass in the nursery area (1AS and 1B) was estimated at 10,236 tons compared to 12,522 in 2006. The abundance was estimated at 200 compared to 207 mill. in 2006.

Recruitment

A recruitment index was provided from the Greenland shrimp trawl survey. By means of the Petersen-method ages 1, 2 and 3+ were separated in the survey catches. The number of one-year-old fish in the total survey area including Disko Bay increased gradually from 1996 to a peak of 500 million in 2001. The number of one-year old fish estimated in 2007 was 337 mill. which is a slight increase from 303 mill in 2006 and above the average for the time series (Fig. 3).

Further, a recruitment index was provided from the off shore nursery area in Div. 1AS-1B. Catches were standardized as catch in number per hour as described in Bech (1995). Data were plotted by year classes to visualize the relative year class strength and development in relative abundance (Fig. 4). In recent years the allocation of stations in the shrimp trawl survey has been changed in order to minimize the variance in the estimation of biomass and abundance of shrimp. To minimize the effect of that the CPUE index has been recalculated using stations > 300 m only. This generally increases the mean number per tow but not the trend in the index.

The recruitment index declined since the relatively large 1991 year-class, but the recruitment has been above the level in the 1980'. The recruitment increased again with the 1995-year class, which was the largest on record. The 1996

year-class seemed to be small but the recruitment has increased gradually until the 2000 year-class. Since then the recruitment has been around average. The recruitment of the 2006 year-class was estimated as 706 age-one caught per hour, some what above the average for the time series. In Disko Bay the recruitment has been good in recent years although the recruitment of year classes 2002-2005 has been gradually decreasing. The recruitment increased again in 2007 and the 2006 year class was the third largest on record.

Generally there is a steep decline between CPUE at age 1 and age 2 and 3+ which also was observed in the 2007 survey. Further, it has been noted, that the year-classes estimated to be a very strong year-class at age 1 have not shown up in as a particularly strong year-classes at 5-8 in the fishery catches or in the 1CD survey for Greenland halibut.

In order to get better information about age groups 2-5 (approx. 20-42cm), and hence better information about recruitment to the fishery, 11 stations at depths between 669 and 958 m in Div. 1AB were fished during the 2006 survey. In total 848 fish in the length range 12-98 cm were caught with a dominance of fish between 20 and 45 cm. This corresponds to ages 3-5, the ages, which generally speaking, are missing in the shrimp survey and the survey for Greenland halibut in Div. 1CD. In 2007 8 stations (n=1048) at depths between 659 and 765 m were fished in Div. 1AB. The length ranged between 13 and 89 cm with a dominance of fish between 22 and 50 cm and ages 3-5. Neither the length distributions nor the age distribution showed any clear trends in recruitment. Fishing took place at night. Catches are standardized to number at length per km^2 swept and converted to number at age using an age length key from the 1CD survey.

SSB/Recruitment

The relation between the spawning stock in numbers (age 10+) in Div. 1CD, estimated from the joint Japan/Greenland survey and the Greenland halibut survey and recruitment, given as the number of fish age 1 in the total survey area, estimated from the Greenland shrimp trawl survey, is shown in Fig. 5. The over all recruitment of the 2006 year-class was well above average. Note that there was no survey in 1996.

2.2 Commercial fishery data.

Length distribution

SA 0

Length distributions were available from the gill net fishery in Div. 0A and the gill net single trawl and twin trawl fishery in Div.0B.

The catch in the gill net fishery in Div. 0A was dominated by a modes at 63 cm, similar to that seen last year (Fig. 6a).

The length distribution in the trawl fishery in Div. 0B was dominated by a mode around 49 cm, for both types of gear, as seen in recent years (Fig. 6b). The length distribution for gill net showed a mode at 65 cm. The mode has been around the mid 60' s in recent years.

SA1

Length frequencies were available from Greenland and Russian trawl fisheries in Div. 1A (SCS 08/06), from EU and Greenland fisheries in Div. 1C, and from EU, Greenland, Russian (SCS 08/06) and Norwegian trawl fisheries and the Norwegian long line fishery in Div. 1D.

In Div. 1A the Russian catch composition showed a mode at 48 cm, while the mode was at 50-52 cm in the Greenland fishery. In 2006 the mode in the Russian fisheries was 42 cm, but generally the trawl catches have been dominated by fish on 48-52 cm (Fig 7).

In Div. 1C trawl catches by EU and Greenland were dominated by fish between 45 and 50 cm (Fig 8).

In Div. 1D the catches by Russia, Norway and Greenland showed clear modes between 50 and 52 cm (Fig. 9a). The mode in catches has been within this range for several years. The catches in the EU fishery was dominated by lengths of 44-46 cm. The reason for this difference is not clear. The mean fishing depth was the same as in the Greenland fishery, about 1100 m, while the fishing took place about a month earlier than the Greenland fishery. Fish are known to migrate into deeper water during winter.

The catches in the small (14 tons) Norwegian longline fishery in Div. 1D was dominated by fish between 50 and 80 cm similar to lengths seen as in 2006 (Fig. 9b).

Age distribution

Catch at age was available from the Russian trawl fishery in Div. 1A and 1D. Based on a combined Div. 1A+1D key, with the majority of the samples from Div.1D. Age readings were based on scales. Bothe in Div. 1A and Div. 1D ages 6 and 7 were dominating (Fig. 10). In Div. 1A the ages the percentage of age 6 and 7 was equal, while age 7 was slightly more dominating than age 6 in Div. 1D as was seen in most of the recent years.

No catch-at-age information was available from SA0, and the catch-at-age and mean-weight-at-age, in Table 3 and 4, respectively, has not been updated.

Analysis of commercial catches

Analysis of the Russian catches of Greenland halibut in 2003-2007 in Div. 1A and 1D showed a mean length of males and females of 49.6 cm and 55.1 cm, respectively (SCS Do 08/15). Ages 5-7 and 7-9 predominated for males and females, respectively. The sex ratio was 1.6 males : 1 females. The fishery took place in autumn and more than 70% of the males and in recent years 25-35% of the females were mature. Gonads developed during autumn and early winter indicating spawning during mid-winter.

Catch rate

Div. 0A
As in Div. 0B very few of the vessels operating in the fishery in 2007 have been in the fishery for more than 3 years. The General Linear Model used to standardize trawl catch rates for Div. 0B was applied to data from Div. 0A in 2008. Vessel/gear classes with fewer than 5 occurrences in the database were removed as were records where catches (t) and hours fished were less than 10. The standardized CPUE index declined slightly in 2007 (Fig. 12a) (SCS 08/12). This decline could also be seen in the un-standardized catch rates for both single and twin trawl gears (Fig. 11a). Trawl gear catch rates have been relatively stable over the past 7 years (Fig. 12a) (Appendix 1).

The un-standardized CPUE for the 0A gillnet fleet has remained relatively un-changed over the last 3 years.

Div. 0B
A CPUE index for the offshore trawl fleet was updated in 2007. There have been frequent vessel changes in this fishery over the years and the catch from single and double trawl gear was often aggregated as “otter trawl” catch when this gear was first introduced to the fishery in the early 2000s. Very few of the vessels operating in the fishery in 2007 have been in the fishery for more than 3 years. A standardized catch rate is produced using a General Linear Model. The model was updated in 2007; two vessel/gear classes were removed due to fewer than 5 occurrences in the database while one vessel/gear class was added due to the introduction of two Class 5 vessels to the fishery in 2006. Also, catches (t) and hours fished with values less than 10 were removed. The overall CPUE index declined slightly in 2007 (Fig. 12b) despite an observed increase in the un-standardized double trawl rate (Fig. 11b) for catches taken in Jan and late fall. The catch rates for vessels fishing both trawl gear during May-September declined from 2006 to 2007 and this decline influenced the overall estimate for 2007. The un-standardized catch rate index shows similar rates for single and double trawl catches in 2000 and 2002, this would not be expected and is likely due to the combining of catches from these two gear types in reported landings. The

standardized catch rates for the past 3 years are higher than those seen in the early 2000s and have returned to levels observed in the early-mid 1990s (Fig. 12b). (Appendix 2).

SA1
Un-standardized catch rates were available for the Greenland trawl fishery in Div. 1A and 1D (SCS 08/11), and the EU-German fishery in Div. 1D (SCS 08/08). Further, catch rates were available from logbooks submitted to the Greenland authorities. Standardized catch rates were available from the trawl fishery in Div. 1CD. In the GLM model catches (t) and hours fished with values less than 10 were removed.

Div 1AB
Un-standardized catch rates from Greenland twin trawlers in Div 1A were relatively stable between 2001 and 2004 around 1.0 ton/hr. Catch rates decreased slightly from record high 1.11 tons per hour in 2005 to 1,06 ton/hr in 2006 and further to 0.96 tons/hr in 2007. The catch rate for small trawlers in Div. 1A decreased form 0.68 tons/hr to 0.56 tons/hr in 2007 and was back at the 2005 level. The Russian catch rates in Div 1.AB, small and large trawlers combined, have been stable around 0.4 tons/hr in recent years (Fig.11c).

Div. 1CD
The un-standardized catch rates from the Greenland fishery in Div. 1CD decreased slightly while the Russian and EU-German catch rates were stable and the Norwegian catch rates increased between 2006 and 2007 (Fig.11d).

Standardized catch rate series, based on logbook data from the Greenland authorities, were available for the offshore trawl fishery in Div. 1CD for the period 1988-2007.

Standardized catch rates in Div. 1CD decreased gradually from 1989-1996 but have been stable since then with an increasing trend and the catch rates also increased slightly between 2006 and 2007, due to an increase in the Norwegian catch rates (Fig. 12c) (Appendix 3).

Combined Div. 0B-1CD
The combined (Div. 0B+1CD) standardized CPUE series has been stable in the period 1990-2001, decreased somewhat in 2002 but has increased again since then, and was in 2006 at the highest level seen since 1989. CPUE decreased very slightly in 2007, - a combination of the decrease seen in Div. 0B and the increase seen in Div. 1CD (Fig. 12d) (Appendix 4).

Due to the frequency of fleet changes in the fishery in both SA0 and SA1 and change in fishing grounds in Div. 0A and 1A, both the un-standardized and the standardized indices of CPUE should, however, be interpreted with caution.

3. **Assessment**

3.1 Yield per Recruit Analysis.

The level of total mortality has in 1994-1996 been estimated by means of catch-curves using data from the offshore longline fishery in Div. 1D. Z was estimated from regression on ages 15-21. A relative F-at-age was derived from the catch curve analysis, where the trawl, longline and gillnet catches were weighed and scaled to the estimated stock composition. In all three years STACFIS considered that the estimation of Z was based on too limited samples and represented too small a part of the fishery and that the outcome of the catch curve analysis was too uncertain to be used in the yield per recruit analysis. No age frequencies were available from the longline fishery in Div. 1D in 2007 fishery, and the catches only represented < 1 % of the total catches in the assessment area, hence no catch-curve analysis were made.

3.2 XSA.

Extended Survivors Analysis
An XSA has been run unsuccessfully several times during the 1990'ies, using a survey series covering 1987-1995 as tuning. STAFIS considered the XSA's unsuitable for an analytic assessment due to high log-catchability residuals and S.E.'s and systematic shift in the residuals by year. Further, a retrospective plot of F_{bar} showed poor convergence. In 1999 the XSA analyses was rerun including the latest two years surveys (1997-1998, new vessel and gear) but the outcome of the analysis did not improve.

An XSA analysis was run using the stock data for SA 0+1, calibrated with trawl survey data (age 5-15) from the Greenland deep sea surveys (1997-2001) in Div. 1CD. The assessment results are considered to be provisional due to problems with the catch-at-age data and the short time series, the assessment is, however, considered to reflect the dynamics in the stock. The rate of exploitation has been relative stable in recent years between 0.2-0.3 (F_{bar} 7-13). The input parameters to the analysis and the outcome of the analysis is given in (SCR 02/68)

The XSA was run again in 2003 with the 2002 survey and catch data and updated catch data from 2001 (very small changes). The assessment results are considered to be provisional due to problems with the catch-at-age data and the short time series. The assessment is, however, considered to some extend to reflect the dynamics in the stock. The rate of exploitation has been relatively stable in recent years between 0.2-0.3 (F_{bar} 7-13). The summary of the XSA is given in SCR (03/54).

The XSA was not run this year as no catch-at-age data were available for 2003-2007.

3.3 Spawning stock/recruitment relations.

A spawning stock/recruitment plot based on the available observations from the joint Japan/Greenland survey and the Greenland survey is shown in Fig.5. No further analysis of spawning stock recruitment relationships have been made due to few observations distributed on two different surveys, poor estimate of spawning stock biomass (survey trawls only take a very small proportion of the mature fish, poor estimates of ages of old fish, the survey covers only a restricted part of the area covered by the assessment, and knife edge maturity ogive was applied). Further, the age of the recruits is poorly estimated (the Petersen method).

3.4 ASPIC

ASPIC was run in 1999 with standardized CPUE data and a biomass index as inputs. Three CPUE series were available, one series covering Div. 0B during the period 1990-1998, one covering Div. 1CD during the period 1987-1998 and a series combining the two data sets. The biomass index was from 1CD and covered the period 1987-1995 and 1997-1998. Several runs showed that the combined CPUE series from Div. 0B+1CD fitted the total catch data best in terms of r^2 and "total objective function". Runs with biomass alone gave relatively bad fits in terms of "total objective function" and r^2 and the modeled population trajectory declining drastically over the period. Runs with the CPUE series from 0B gave unrealisticly high B_{msy} and negative r^2. The run with the combined CPUE series showed, however, that sensitivity analysis should be run, because "the B1-ratio constraint term contributed to loss". Several runs with different realistic values for the constraint did not solve the problem. Further, the coverage index and nearness index was equal in all runs. Several runs with different constraints on r and MSY were tried but it did not changes the outcome of the analysis. Removing the three first years from the input data gave negative r^2. To get measures of variance the run with the combined CPUE series was bootstrapped (500 re-samplings).

The results showed that estimated fishing mortalities 1987-1998 have been less than the (bias-reduced) estimate of F_{msy} (0.22) except for one year (1992). A number of essential parameters are quite imprecisely estimated (r, q, F_{msy}), and it is considered that the estimates of MSY and F_{msy} were not precise enough to be used.

The input parameters from 2000-2006 (catches, survey biomass index, and CPUE index) have varied little compared to 1999. An ASPIC was run in 2007, but the outcome of the analysis did not change significantly from the analysis in 1999.

4. **Prognosis**

Since catches peaked with 18,000 tons in 1992 they have been stable at around 10,000 tons until 2000. Since then catches have gradually increased to 19,954 tons in 2003 and they stayed at that level during 2004-2005. The TAC was increased by 5,000 tons in 2006 and catches increased to 24,155 and the TAC has hence been taken. The increase in catches has been due to increased effort in Div. 0A and Div. 1A. Catches stayed at that level in 2007, - 23,416 tons.

The biomass in Div. 1CD increased between 2003 and 2005, but decreased slightly during 2006-2007 but is still well above the average for the period 1997 – 2005.

The biomass in the Greenland shrimp survey decreased between 2006 and 2007 but was above average both in the off shore area and overall for the period 1992-2005.

The recruitment of age one in the entire survey area has been above average the last five years, and a recruitment index for the off shore nursery areas showed that the 2006 year class was well above average.

Length compositions in the commercial catches have been stable in recent years.

Un-standardized and standardized catch rates in 0A decreased between 2006 and 2007.
Un-standardized catch rates in Div. 0B decreased for single trawlers and increased for twin trawlers between 2006 and 2007. Standardized catch rates in Div. OB decreased between 1995 and 2002, but has been increasing until 2006. In 2007 catch rates decreased slightly.

In Div 1CD standardized catch rates have been increasing slightly since 1996. The combined catch rate for Div. 1CD+0B has showed very little variation during the period 1988-2006, but with an increasing trend in recent years. Combined CPUE decreased slightly between 2006 and 2007, but is still among the highest in the time series.

5. **Biological reference points**

Yield per recruit analysis or other age-based methods are not available, for estimating biological reference points. Biomass indices and CPUE series are relatively short and show little variability and are not useful for estimating reference points.

6. References

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

Jørgensen O.A.. 2008. Survey for Greenland Halibut in NAFO Divisions 1C-1D, 2007. NAFO SCR Doc. 08/17.

M. Stein and H. Fock. 2008. German research report for 2007. SCS Doc. 08/08.

Richards E.D. 2008. Canadian Research Report for 2007. NAFO SCS Doc. 08/12.

Siegstad, H. 2008. Denmark/Greenland Research Report for 2007. SCS Doc. 08/11.

Skryabin I and O. Smirnow. 2007. Length-age composition and sexual maturation rate of Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) from the commercial catches in the area of the West Greenland (Divs. 1AD) in 2003-2007. NAFO SCS Doc 08/15. Serial No. N5508.

Nygaard R., K. Sünksen O.A. Jørgensen. 2008. Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated from the Greenland shrimp survey, 1988-2007. NAFO SCR Doc. 08/28.

Treble M. A.. 2007. Analysis of Data from the 2006 Trawl Surveys in NAFO Division 0A. NAFO SCR Doc. 07/41.

Vaskov A.A., M.V. Pochtar and I.A. Skryabin. 2008. Russian Research Report for 2007. NAFO SCS Doc. 08/06.

Table 1. Greenland halibut catches (metric tons) by year and country for Subarea 0 (Split on Div. 0A and 0B) from 1987 to 2005. Minor (300 ton or less) catches from Div. 0A are included in some of the 0B catches prior to 2001.

Year																					
Count.	87	88	89	90	91	92	93	94	95	96	97	98	99	00[e]	01[c]	02[d]	03[f]	04	05	06	07
0A																					
CAN															2183	3561	4142	3751	4182	6635	6150
POL															445						
0B																					
CAN		2		589	256	2194	883		1941	2354	3871	3924	4784	5438	5034	3910	5059	5771	5780	5533	5322[g]
EST							631														
FRO	388	963	596	2252	2401	463	1038			839	452										
JAP				113	232	337	252	600	1031	500											
LAV							83														
NOR			282	5016[b]	3959		373														
RUS		59	29	1528	1758	9364	4229[a]	3674	261	915											
TOT	388	1024	907	9498	8606	12358	7489	4274	3233	4608	4323	3924	4784	5438	7662	7471	9201	9522	9962	12168	11472

[a] The Russian catch is reported as area unknown, but has previously been reported from 0B
[b] Double reported as 10031 tons
[c] Excluding 445 tons double reported, and 2 tons reported by error
[d] Excluding 782 tons reported by error
[e] STACFIS estimate
[f] excluding 2 tons reported by error
[g] Including 353 tons from Can-MQ

Table 2. Greenland halibut catches (metric tons) by year and country for Subarea 1 (Split on Div. 1AB and Div. 1CD) from 1987 to 2005. The Greenland catches are excl. inshore catches in Div. 1A. Offshore catches in Div. 1A prior to 2001 are negligible.

Coun.	87	88	89	90	91	92	93	94	95	96	97	98	99[a]	00	01	02	03[g]	04	05	06	07
1AB																					
GRL															340[c]	1619[c]	3558[c]	3500[c]	3363[bc]	5530[bc]	5596[bc]
RUS															85	279	259	241	549	565	575
FRO														96	150	150	146[b]	153	125	125[b]	125
NOR														15							
EU																	73[e]	141[e]			
1CD																					
GRL					965	227	213	885	1405	1880	2312	2295	2549	2657[b]	2012	2284	2059	2102	2380[b]	2430[b]	1805[b]
FRO				54	123	151	128	780			127	242	116	147	150	150	135	150	149	150[b]	150
JPN	907	1581	1300	988	677	2902	1198	820	337												
NOR					611	2432	2344	3119	2472	1785	1893	1338	1360	1590	1550	1734	1423	1364	1456[b]	1421[b]	1429
RUS							5		296	254		543	552	792	829	654	1328	1214	1147	1222	689
EU							46	266	527	455	446	350	330	444[b]	537[b]	536	543[d]	665[f]	549	544	1575
Total	907	1581	1300	1042	2376	5712	3934	5870	5037	4374	4778	4769	4907	5741	5653	7408	9524	9530	9718	11987	11944

[a] Excluding 7603 tons reported by error
[b] Reported to the Greenland authorities
[c] Offshore catches
[d] Including 2 tons taken in an experimental fishery
[e] Spanish research fishery
[f] Includes 131 tons taken in Spanish research fishery
[g] Excludes 1366 tons reported from Div. 1A by error

Table 3. Catch-at-age in numbers. Not updated for 2003 - 2007.

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE																
5	2	1	1	4	20	53	241	254	152	151	41	71	262	415	69	570
6	31	29	36	87	318	678	651	862	522	530	311	372	1092	1106	978	1975
7	182	190	244	592	1742	2967	2422	2472	1628	1818	1556	677	1759	1677	3212	4252
8	296	354	409	1711	2679	4311	2356	1692	940	1575	2110	1187	1174	1144	1802	1791
9	193	245	212	1356	1418	2604	1048	954	558	660	1042	900	672	772	1154	617
10	77	115	75	711	533	951	590	294	259	306	438	572	375	501	776	476
11	40	80	47	359	221	398	224	183	228	160	232	422	234	443	503	347
12	18	61	48	195	144	231	130	159	188	127	118	205	184	291	273	149
13	10	58	44	189	108	158	72	125	104	64	96	153	172	178	101	209
14	9	46	42	115	60	85	59	58	80	57	21	98	95	68	50	75
15	6	35	26	67	36	45	37	55	85	39	13	19	61	75	21	168
16	3	15	12	17	6	23	26	34	41	36	12	4	37	17	10	74
17	4	4	1	3	2	1	4	10	18	13	0	0	18	4	5	23
+gp	2	1	0	0	0	0	2	7	10	22	0	0	7	6	3	49
TOT	873	1234	1197	5406	7287	12505	7862	7159	4813	5558	5994	4688	6166	6717	8957	10917
TONS	1295	2605	2207	10540	10982	18070	11423	10144	8270	8982	9101	8693	9691	10689	13184	15136

Table 4. Catch weights at age (kg) Not updated for 2003-2007.

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE																
5	0.29	0.29	0.29	0.33	0.34	0.33	0.58	0.43	0.49	0.52	0.36	0.50	0.54	0.53	0.48	0.48
6	0.51	0.51	0.51	0.54	0.54	0.56	0.72	0.62	0.66	0.69	0.55	0.74	0.70	0.72	0.67	0.70
7	0.74	0.74	0.74	0.79	0.79	0.80	0.96	0.91	0.94	0.94	0.86	1.00	0.98	1.00	0.91	0.96
8	1.08	1.08	1.08	1.10	1.12	1.13	1.26	1.26	1.34	1.38	1.27	1.24	1.28	1.29	1.30	1.30
9	1.41	1.42	1.42	1.52	1.57	1.59	1.80	1.72	1.81	1.91	1.83	1.54	1.66	1.71	1.76	1.85
10	1.97	2.05	2.00	2.11	2.27	2.28	1.43	2.19	2.37	2.48	2.38	2.22	2.25	2.26	2.29	2.20
11	2.58	2.80	2.68	2.94	3.22	3.02	3.25	2.73	2.89	3.18	3.01	3.08	2.74	2.84	2.91	2.82
12	3.52	3.88	3.73	3.90	4.24	4.02	4.10	3.43	3.62	4.04	3.84	3.84	3.68	3.59	3.51	3.32
13	4.64	5.01	4.87	4.96	5.50	5.33	5.26	4.48	4.44	5.05	4.93	4.74	4.73	4.23	4.31	3.93
14	5.79	6.16	6.20	6.26	6.82	6.76	6.17	5.75	5.61	5.95	5.69	6.04	5.58	5.19	5.60	5.20
15	6.61	7.44	7.65	7.96	8.33	7.76	7.42	6.58	6.65	7.34	6.79	6.60	6.68	5.85	6.09	5.38
16	7.99	8.88	9.36	9.90	9.89	8.58	8.04	7.36	7.77	8.64	8.00	13.45	7.75	7.32	7.08	7.02
17	9.56	9.86	9.56	11.86	9.56	11.95	9.24	9.42	10.19	9.18			9.08	5.60	8.94	8.61
+gp		11.33					10.25	11.15	11.00	11.10			11.10	9.00	11.22	10.97

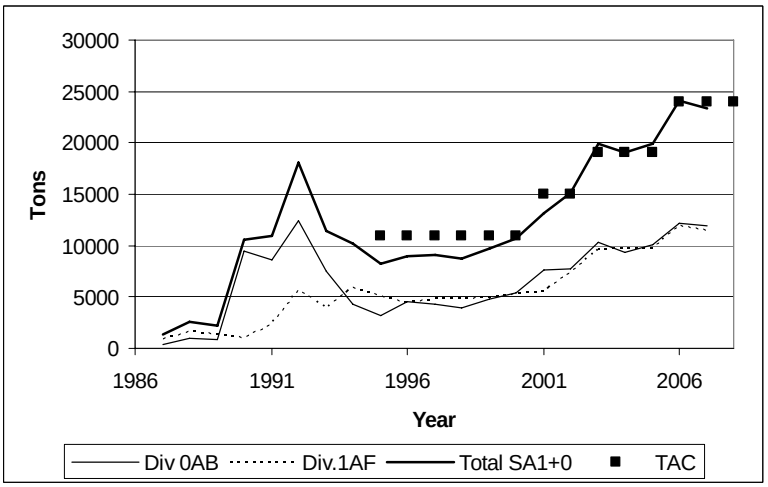

Fig. 1. Catches in SA0 and Div. 1A offshore + Div. 1B-1F and recommended TAC. For TAC before 1995 see text.

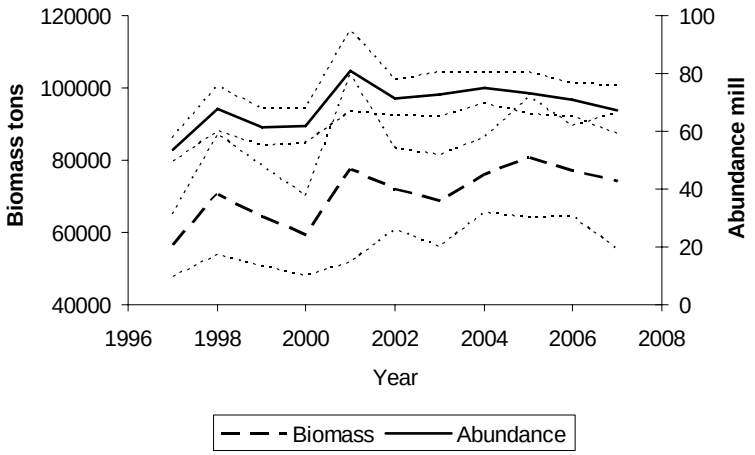

Fig 2b. Biomass and abundance with +/- 2*S.E. from the Greenland deep sea survey in Div. 1CD.

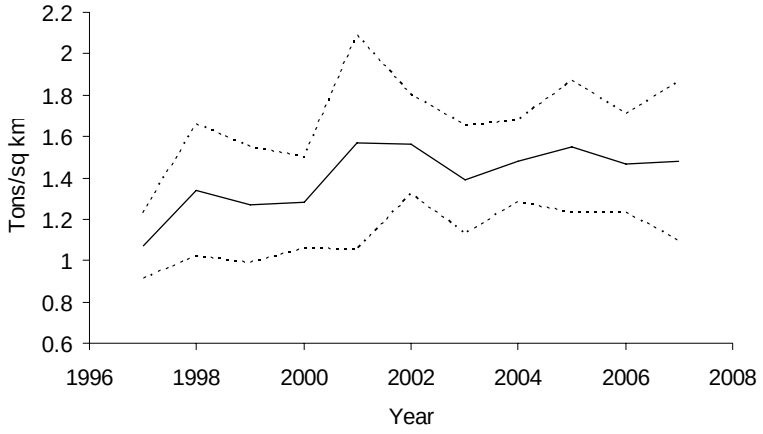

Fig 2b. Mean catch per km^2 swept with +/- 2*S.E. in the Greenland deep sea survey in Div. 1CD.

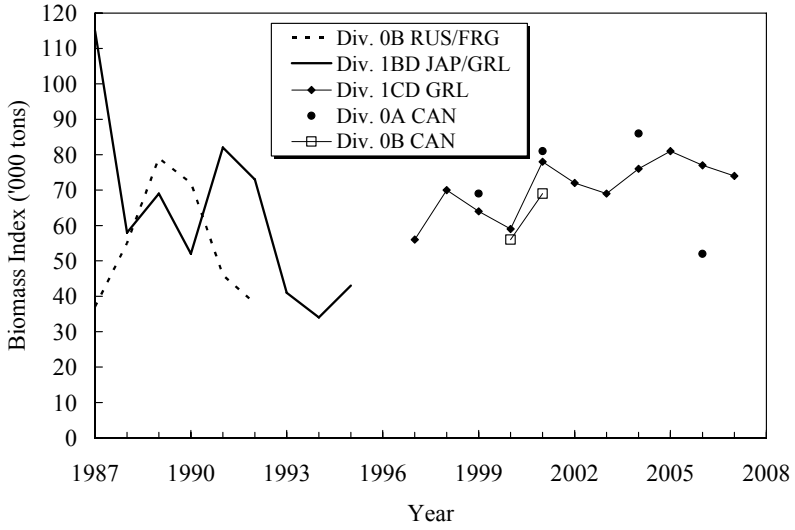

Fig. 2c. Biomass estimates from various surveys in SA 0 and 1. Note that the survey in Div. 0A in 2006 had incomplete coverage (see text).

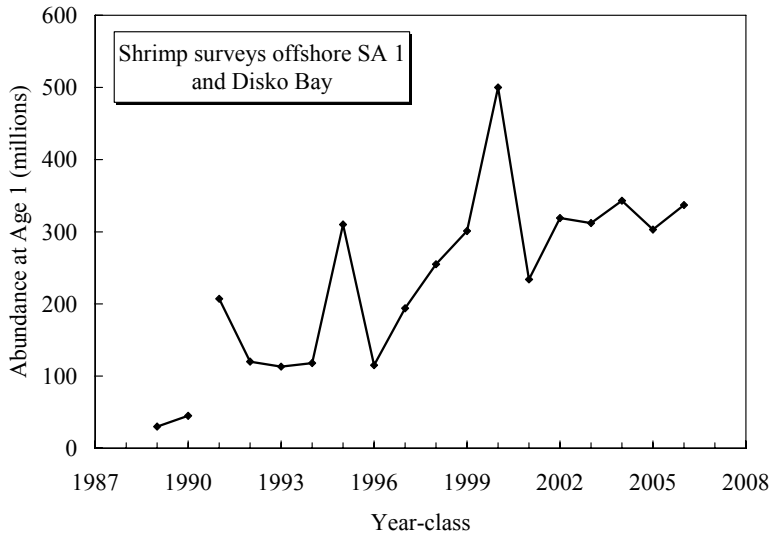

Fig.3. Abundance of age one Greenland halibut in the entire area covered by the Greenland shrimp survey including inshore Disko Bay and Div. 1AN (North of 70°N)

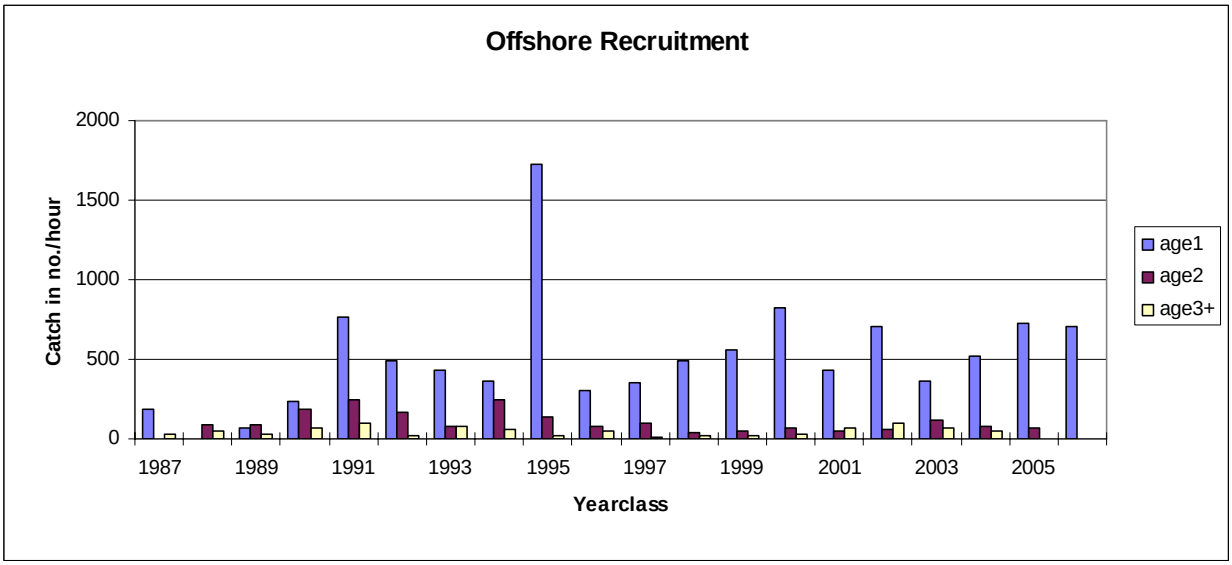

Fig. 4. Year-class strength of Greenland halibut of ages 1-3+ in number per hour trawled in the offshore nursery area (Div 1AS-1B, depths 300-600 m).

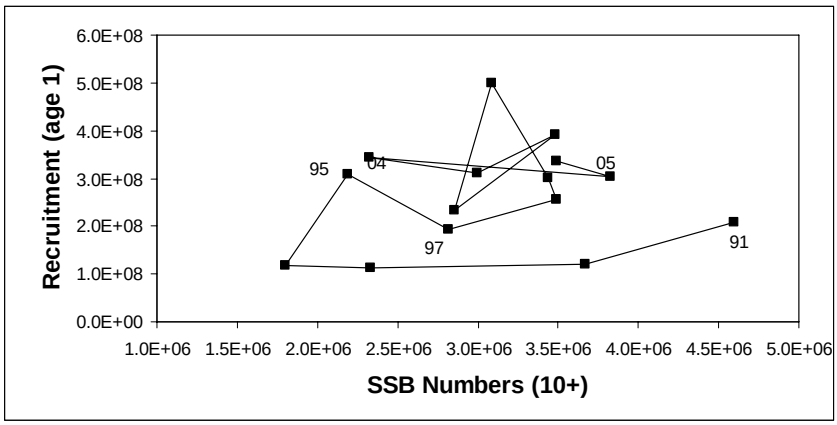

Fig. 5. Spawning stock in numbers (ages 10-18 in Div.1CD from the joint Japan/Greenland survey and the Greenland survey (1997-2006) plotted vs. number of fish age 1 the following year estimated from the Greenland shrimp trawl survey including the Disko Bay. Figures denote year class. Note there was no deep sea survey in 1996.

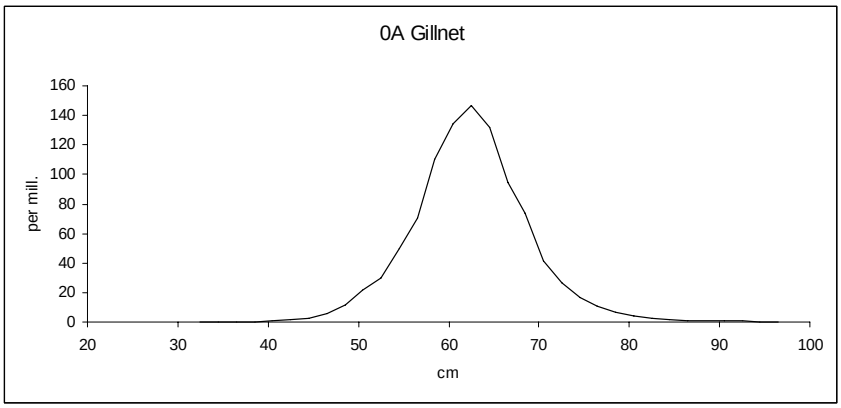

Fig.6a. Length distribution from the gill net fishery in Div 0A in 2007 in per mill ., 2 cm groups

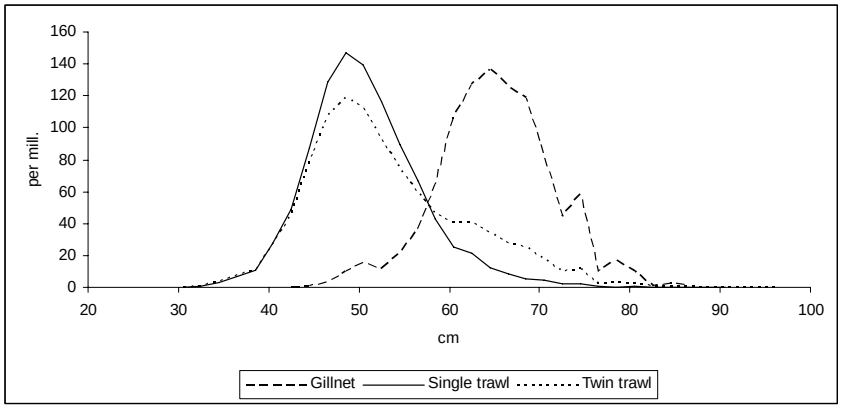

Fig.6b. Length distribution by gear from the fishery in Div 0B 2007 in per mill ., 2 cm groups

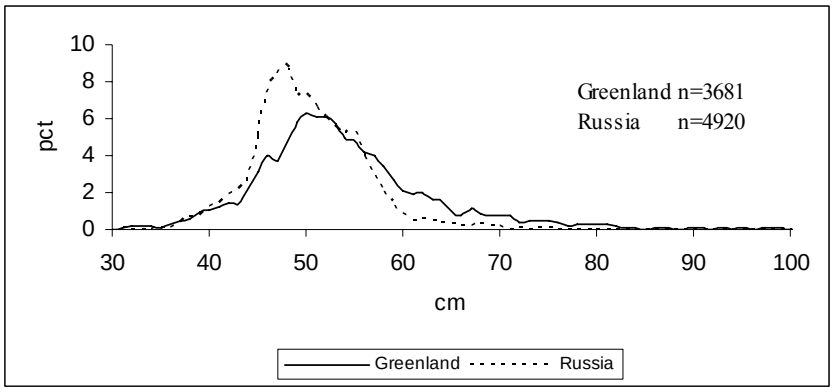

Fig. 7. Length distribution in the Russian and Greenland trawl fishery in Div. 1A in percent.

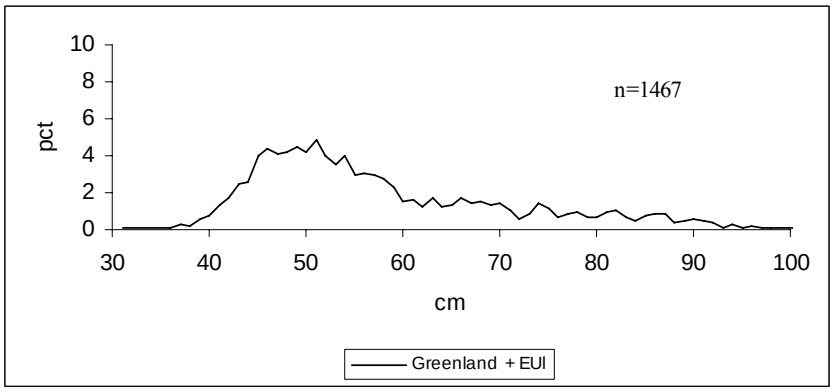

Fig. 8. Length distribution in the Greenland and EU-Germany trawl fishery in Div. 1B in 2007 in percent.

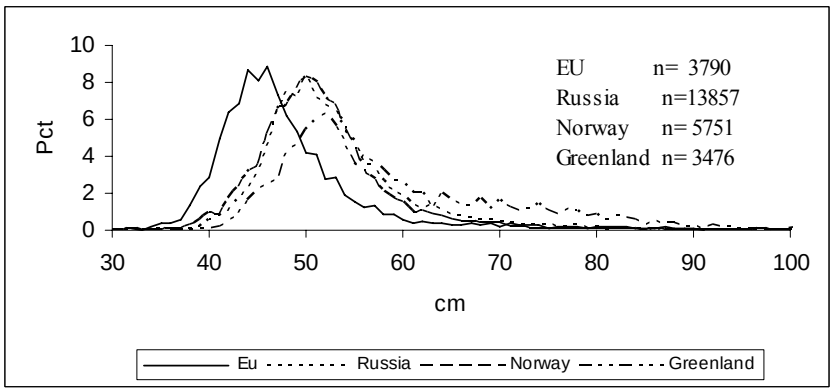

Fig. 9a. Length distribution in the EU-Germany, Russia, Norway and Greenland trawl fishery in Div. 1D in 2007.

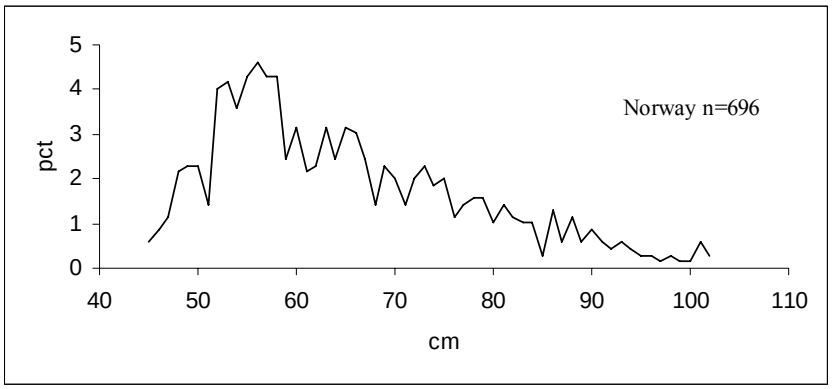

Fig. 9b. Length distribution in the small Norwegian longline fishery in Div. 1D in 2007.

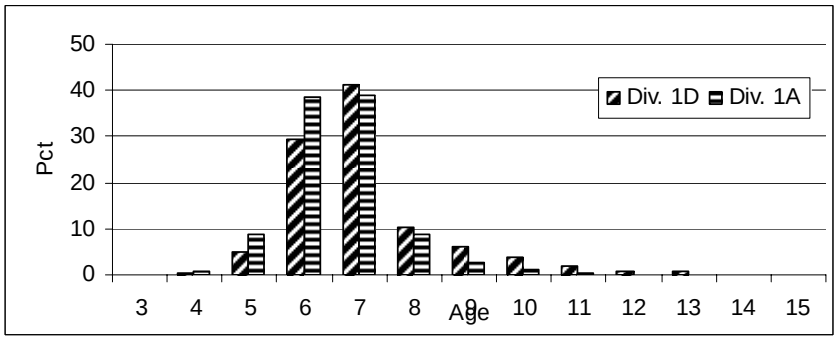

Fig. 10. Age distribution in the Russian trawl fishery in Div. 1A and 1D in 2007 in percent..

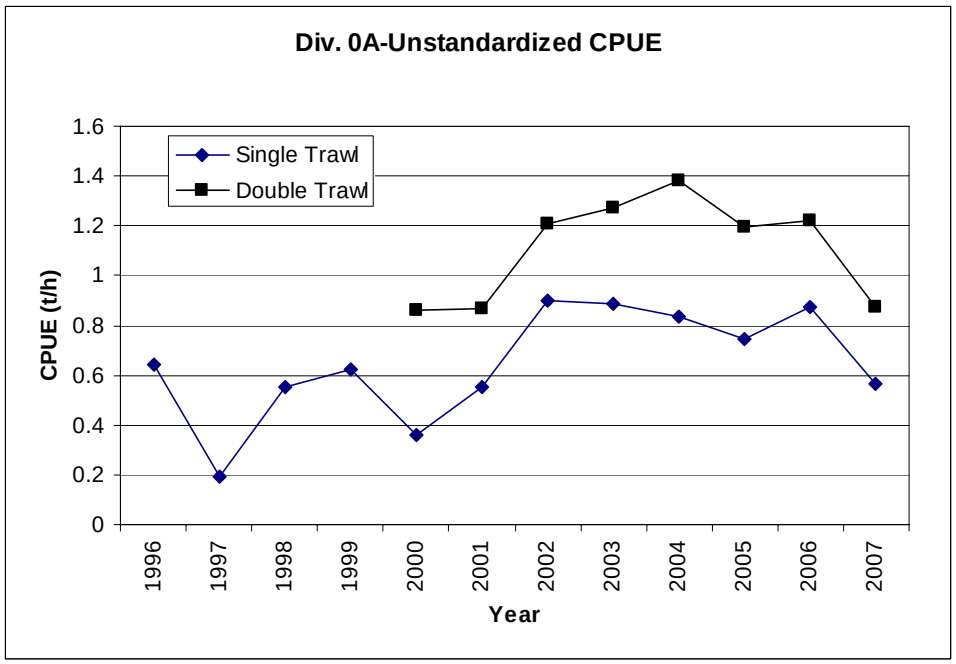

Fig. 11a. Un-standardized CPUE from the trawl fishery in Div. 0A

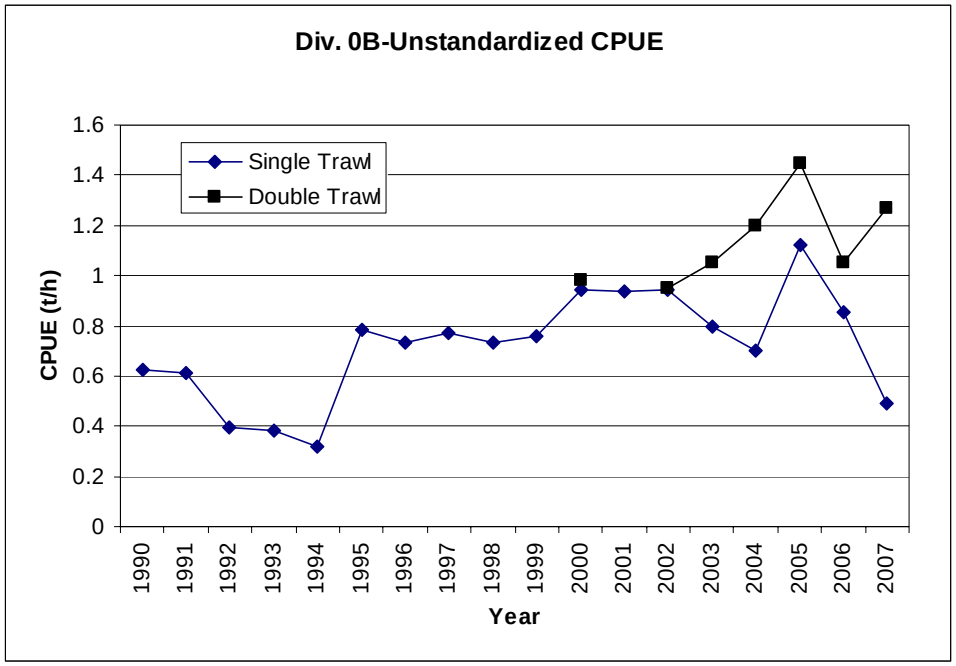

Fig. 11b. Un-standardized CPUE from the trawl fishery in Div. 0B

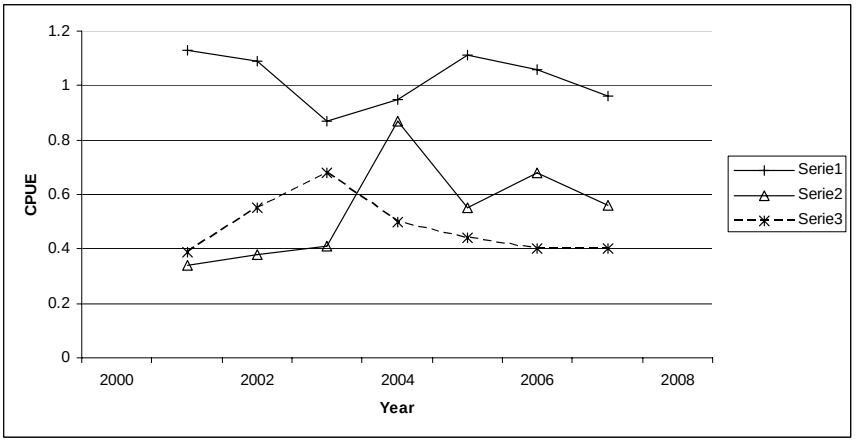

Fig. 11c. Unstandardized trawl CPUE series from Div. 1AB. Name of fleets not shown due to very few vessels in some of the series.

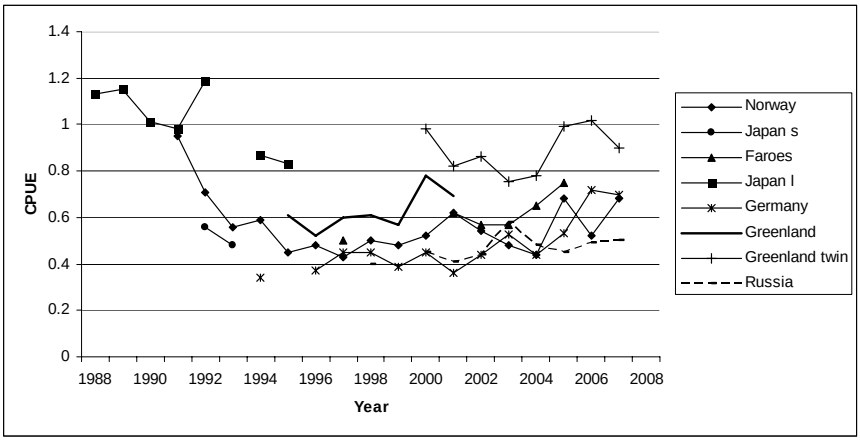

Fig. 11d. Unstandardized catch rates from different fleets fishing in Div. 1CD.

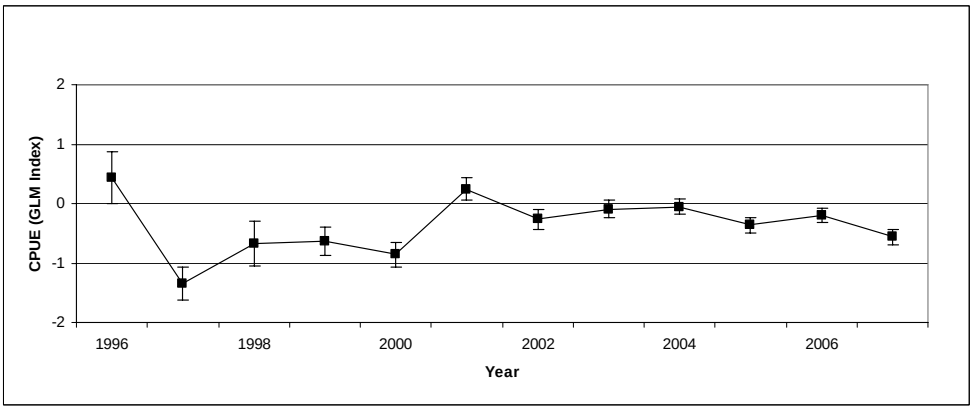

Fig 12a. Standardized CPUE series from trawlers in Div. 0A with +/- S.E.

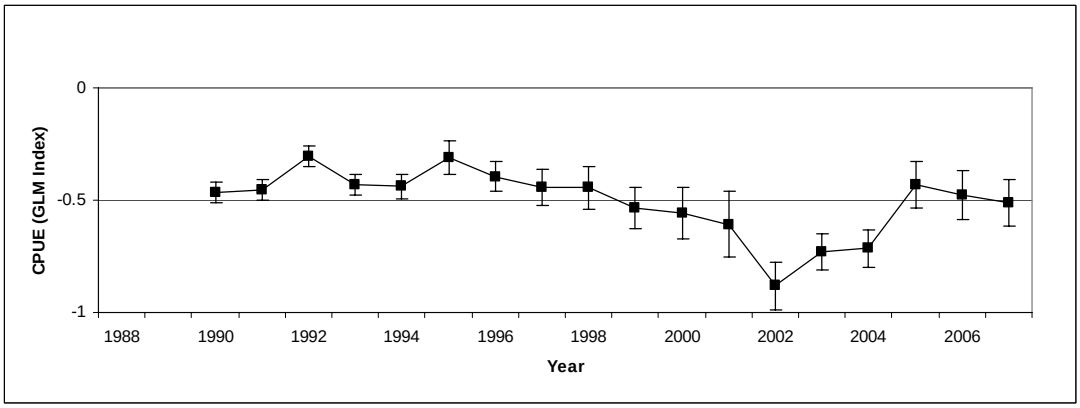

Fig 12b. Standardized CPUE series from trawlers in Div. 0B with +/- S.E.

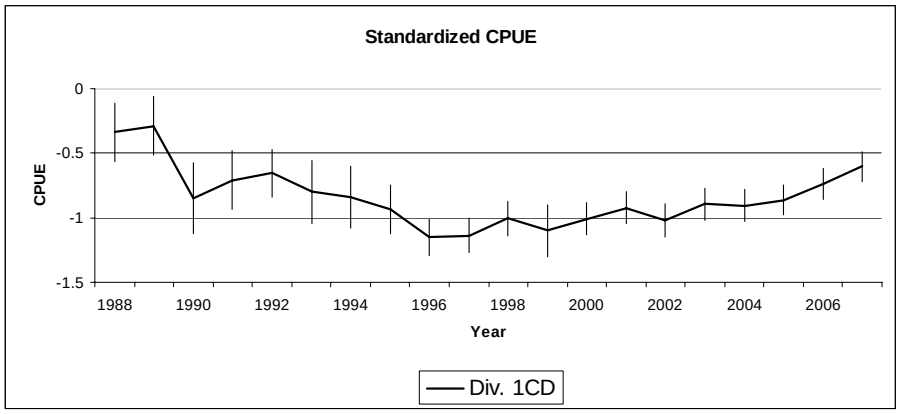

Fig. 12c. Standardized trawl CPUE index from trawlers in Div. 1CD with +/- S.E.

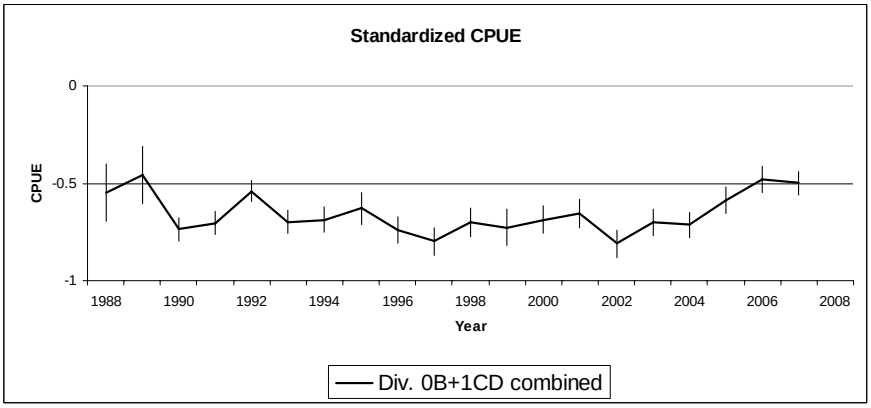

Fig. 12d. Combined standardized trawl CPUE index from trawlers in Div. 0B +1CD with +/- S.E.

Appendix 1. Standardized CPUE index from trawlers in Div. 0A

Greenland halibut, 0A trawlers 46
18:44 Sunday, June 8, 2008

The GLM Procedure

Class Level Information

Class	Levels	Values
Year	12	1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Month	6	7 8 9 10 11 12
CGT	5	2126 2127 5127 21926 21927

Number of Observations Read 103
Number of Observations Used 103

Greenland halibut, 0A trawlers 47
18:44 Sunday, June 8, 2008

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	20	15.17770503	0.75888525	6.00	<.0001
Error	82	10.36679905	0.12642438		
Corrected Total	102	25.54450407			

R-Square	Coeff Var	Root MSE	lcph Mean
0.594167	-304.3857	0.355562	-0.116813

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	11	8.76141467	0.79649224	6.30	<.0001
Month	5	2.68189864	0.53637973	4.24	0.0018
CGT	4	3.73439171	0.93359793	7.38	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	11	6.71551247	0.61050113	4.83	<.0001
Month	5	1.98103433	0.39620687	3.13	0.0122
CGT	4	3.73439171	0.93359793	7.38	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		-0.766104765	B	0.38427535	-1.99	0.0495
Year	1996	0.965873374	B	0.50542281	1.91	0.0595
Year	1997	-0.800495697	B	0.27745409	-2.89	0.0050
Year	1998	-0.132282048	B	0.37506280	-0.35	0.7252
Year	1999	-0.080881298	B	0.23006310	-0.35	0.7261
Year	2000	-0.296601469	B	0.20615472	-1.44	0.1540
Year	2001	0.801065994	B	0.22810797	3.51	0.0007
Year	2002	0.295888090	B	0.16860030	1.75	0.0830
Year	2003	0.461970239	B	0.15487200	2.98	0.0038
Year	2004	0.503740501	B	0.14575036	3.46	0.0009
Year	2005	0.195422843	B	0.14320819	1.36	0.1761
Year	2006	0.356296024	B	0.12438822	2.86	0.0053
Year	2007	0.000000000	B	.	.	.
Month	7	0.848450583	B	0.40489188	2.10	0.0392
Month	8	0.529454584	B	0.39029123	1.36	0.1786
Month	9	0.582263473	B	0.38197990	1.52	0.1313

18:44 Sunday, June 8, 2008

The GLM Procedure

Dependent Variable: lcph

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Month	10	0.687771989	B	0.37760920	1.82	0.0722
Month	11	0.373701796	B	0.37954406	0.98	0.3277
Month	12	0.000000000	B	.	.	.
CGT	2126	-0.393149542	B	0.11944164	-3.29	0.0015
CGT	2127	-0.290012464	B	0.09351561	-3.10	0.0026
CGT	5127	-1.295966220	B	0.42169978	-3.07	0.0029
CGT	21926	0.027285648	B	0.12846526	0.21	0.8323
CGT	21927	0.000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

The GLM Procedure
Least Squares Means

Year	lcph LSMEAN	Standard Error	Pr > |t|
1996	0.31300716	0.43498288	0.4738
1997	-1.45336191	0.27907512	<.0001
1998	-0.78514826	0.38192137	0.0430
1999	-0.73374751	0.24152015	0.0032
2000	-0.94946768	0.21866757	<.0001
2001	0.14819978	0.19832136	0.4570
2002	-0.35697812	0.18303604	0.0546
2003	-0.19089597	0.16218076	0.2426
2004	-0.14912571	0.12957518	0.2531
2005	-0.45744337	0.14338487	0.0020
2006	-0.29657019	0.13113045	0.0264
2007	-0.65286621	0.14553124	<.0001

Appendix 2. Standardized CPUE index from trawlers in Div. 0B

```
                    Greenland halibut, 0B trawlers                    34
                                              18:44 Sunday, June 8, 2008

                            The GLM Procedure

                         Class Level Information

Class       Levels  Values

YR              18  1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
                    2001 2002 2003 2004 2005 2006 2007

md              10  1 4 5 6 7 8 9 10 11 12

CGT             11  2126 2127 3125 5126 5127 14124 15126 15127 20126 20127
                    31927


                  Number of Observations Read         455
                  Number of Observations Used         455

                      Greenland halibut, 0B trawlers                   35
                                              18:44 Sunday, June 8, 2008

                            The GLM Procedure

Dependent Variable: lcph

 Source                     DF       Sum of Squares   Mean Square  F Value  Pr > F

 Model                      36   102.4181458     2.8449485    52.99  <.0001

 Error                     418    22.4424210     0.0536900

 Corrected Total           454   124.8605667


            R-Square     Coeff Var      Root MSE     lcph Mean

            0.820260     -31.97944      0.231711     -0.724562


 Source                     DF     Type I SS   Mean Square  F Value  Pr > F

 YR                         17   55.39946844    3.25879226    60.70  <.0001
 md                          9    6.74096955    0.74899662    13.95  <.0001
 CGT                        10   40.27770777    4.02777078    75.02  <.0001


 Source                     DF   Type III SS   Mean Square  F Value  Pr > F

 YR                         17    3.05619419    0.17977613     3.35  <.0001
 md                          9    5.59622400    0.62180267    11.58  <.0001
 CGT                        10   40.27770777    4.02777078    75.02  <.0001


 Parameter                Estimate             Standard Error    t Value    Pr > |t|

 Intercept             0.214370264 B      0.11283561       1.90      0.0581
 YR         1990       0.053340705 B      0.10009574       0.53      0.5944
 YR         1991       0.063865827 B      0.10121000       0.63      0.5284
 YR         1992       0.213397619 B      0.09775223       2.18      0.0296
 YR         1993       0.088623038 B      0.10075204       0.88      0.3796
 YR         1994       0.079826908 B      0.10482749       0.76      0.4468
 YR         1995       0.207058204 B      0.11788783       1.76      0.0798
 YR         1996       0.123836689 B      0.11075621       1.12      0.2642
 YR         1997       0.075287029 B      0.11149227       0.68      0.4999
 YR         1998       0.073087551 B      0.11624163       0.63      0.5299
 YR         1999      -0.016035048 B      0.11328947      -0.14      0.8875
 YR         2000      -0.041284348 B      0.13193546      -0.31      0.7545
 YR         2001      -0.089433292 B      0.16091965      -0.56      0.5787
 YR         2002      -0.361516996 B      0.12530088      -2.89      0.0041
 YR         2003      -0.214520888 B      0.10453926      -2.05      0.0408
 YR         2004      -0.194514819 B      0.10527768      -1.85      0.0654
 YR         2005       0.088138932 B      0.12302141       0.72      0.4741
```

YR	2006	0.037262490	B	0.10861031	0.34	0.7317
YR	2007	0.000000000	B	.	.	.
md	1	-0.050188197	B	0.11304776	-0.44	0.6573
md	4	0.095663901	B	0.09995532	0.96	0.3391
md	5	0.300505895	B	0.07868752	3.82	0.0002
md	6	0.062428217	B	0.08077350	0.77	0.4400
md	7	-0.300713098	B	0.06058436	-4.96	<.0001
md	8	-0.203915006	B	0.05496375	-3.71	0.0002
md	9	-0.290816422	B	0.05245200	-5.54	<.0001
md	10	-0.329152197	B	0.04966710	-6.63	<.0001
md	11	-0.175389680	B	0.05033380	-3.48	0.0005
md	12	0.000000000	B	.	.	.
CGT	2126	-0.818523983	B	0.11530403	-7.10	<.0001
CGT	2127	-0.382872959	B	0.07575559	-5.05	<.0001
CGT	3125	-1.261391803	B	0.11996784	-10.51	<.0001
CGT	5126	-0.547319780	B	0.13120987	-4.17	<.0001
CGT	5127	-0.353060799	B	0.09856942	-3.58	0.0004
CGT	14124	-0.913003218	B	0.10447445	-8.74	<.0001
CGT	15126	-0.143901439	B	0.10547443	-1.36	0.1732
CGT	15127	-0.173761167	B	0.12004562	-1.45	0.1485
CGT	20126	-1.227584519	B	0.09590563	-12.80	<.0001
CGT	20127	-1.243668107	B	0.10169569	-12.23	<.0001
CGT	31927	0.000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

The GLM Procedure
Least Squares Means

YR	lcph LSMEAN	Standard Error	Pr > |t|
1990	-0.46372740	0.04730883	<.0001
1991	-0.45320227	0.04650554	<.0001
1992	-0.30367048	0.04167741	<.0001
1993	-0.42844506	0.04606437	<.0001
1994	-0.43724119	0.05295651	<.0001
1995	-0.31000990	0.07721997	<.0001
1996	-0.39323141	0.07313708	<.0001
1997	-0.44178107	0.07809881	<.0001
1998	-0.44398055	0.09049924	<.0001
1999	-0.53310315	0.08990613	<.0001
2000	-0.55835245	0.11371561	<.0001
2001	-0.60650139	0.14432519	<.0001
2002	-0.87858510	0.10339081	<.0001
2003	-0.73158899	0.07842170	<.0001
2004	-0.71158292	0.08034081	<.0001
2005	-0.42892917	0.09959101	<.0001
2006	-0.47980561	0.09313752	<.0001
2007	-0.51706810	0.08245350	<.0001

Appendix 3. Standardized CPUE index for trawlers in Div.1CD.

Greenland halibut, 1CD trawlers 4172
09:25 Monday, June 2, 2008

The GLM Procedure

Class Level Information

Class	Levels	Values
YR	20	1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
CGT	9	2 3 4 5 6 7 8 9 10

Number of Observations Read 227
Number of Observations Used 227

Greenland halibut, 1CD trawlers 4173
09:25 Monday, June 2, 2008

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	38	28.16935209	0.74129874	9.10	<.0001
Error	188	15.31196277	0.08144661		
Corrected Total	226	43.48131487			

R-Square	Coeff Var	Root MSE	lcph Mean
0.647850	-50.18354	0.285389	-0.568689

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	19	11.97876572	0.63046135	7.74	<.0001
MD	11	8.71806530	0.79255139	9.73	<.0001
CGT	8	7.47252107	0.93406513	11.47	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	19	4.92166898	0.25903521	3.18	<.0001
MD	11	7.38456163	0.67132378	8.24	<.0001
CGT	8	7.47252107	0.93406513	11.47	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.275201223	B	0.09676788	2.84	0.0049
YR	1988	0.267306796	B	0.30179253	0.89	0.3769
YR	1989	0.315076594	B	0.29343197	1.07	0.2843
YR	1990	-0.244785256	B	0.33036006	-0.74	0.4596
YR	1991	-0.103771996	B	0.29422494	-0.35	0.7247
YR	1992	-0.052082014	B	0.25746264	-0.20	0.8399
YR	1993	-0.195105186	B	0.31553090	-0.62	0.5371
YR	1994	-0.235218357	B	0.30507972	-0.77	0.4417
YR	1995	-0.327856789	B	0.24502543	-1.34	0.1825
YR	1996	-0.548407772	B	0.11239998	-4.88	<.0001
YR	1997	-0.532900077	B	0.10658211	-5.00	<.0001
YR	1998	-0.403171390	B	0.10480431	-3.85	0.0002
YR	1999	-0.496084057	B	0.18295231	-2.71	0.0073
YR	2000	-0.406209743	B	0.09466680	-4.29	<.0001
YR	2001	-0.319911756	B	0.09612700	-3.33	0.0011
YR	2002	-0.415988482	B	0.09725550	-4.28	<.0001

Greenland halibut, 1CD trawlers 4174
09:25 Monday, June 2, 2008

The GLM Procedure

Dependent Variable: lcph

Parameter		Estimate		Standard Error	t Value	Pr > |t|
YR	2003	-0.290632639	B	0.09815063	-2.96	0.0035
YR	2004	-0.301689683	B	0.09800776	-3.08	0.0024
YR	2005	-0.261549485	B	0.09162065	-2.85	0.0048
YR	2006	-0.133415729	B	0.09294422	-1.44	0.1528
YR	2007	0.000000000	B	.	.	.
MD	1	-0.585502521	B	0.18502096	-3.16	0.0018
MD	2	-1.176667843	B	0.20198406	-5.83	<.0001
MD	3	-1.241467978	B	0.30317038	-4.09	<.0001
MD	4	-0.505068826	B	0.32962881	-1.53	0.1271
MD	5	-0.471904338	B	0.16886388	-2.79	0.0057
MD	6	-0.731805140	B	0.13037828	-5.61	<.0001
MD	7	-0.560872549	B	0.10461571	-5.36	<.0001
MD	8	-0.326488631	B	0.09167579	-3.56	0.0005
MD	9	-0.128567065	B	0.08011061	-1.60	0.1102
MD	10	-0.158034309	B	0.07581668	-2.08	0.0385
MD	11	-0.150891312	B	0.07621027	-1.98	0.0492
MD	12	0.000000000	B	.	.	.
CGT	2	-0.488408411	B	0.07114287	-6.87	<.0001
CGT	3	-0.395384820	B	0.28225502	-1.40	0.1629
CGT	4	-0.527430515	B	0.07603601	-6.94	<.0001
CGT	5	-0.644852249	B	0.30697442	-2.10	0.0370
CGT	6	-0.502966883	B	0.10487166	-4.80	<.0001
CGT	7	0.006481380	B	0.26352778	0.02	0.9804
CGT	8	-0.547988670	B	0.07178093	-7.63	<.0001
CGT	9	-0.280990089	B	0.07814406	-3.60	0.0004
CGT	10	0.000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

Greenland halibut, 1CD trawlers 4175
09:25 Monday, June 2, 2008

The GLM Procedure
Least Squares Means

YR	lcph LSMEAN	Standard Error	Pr > |t|
1988	-0.33632455	0.22698566	0.1401
1989	-0.28855475	0.22458800	0.2004
1990	-0.84841660	0.27428513	0.0023
1991	-0.70740334	0.22672755	0.0021
1992	-0.65571336	0.18228717	0.0004
1993	-0.79873653	0.24342966	0.0012
1994	-0.83884970	0.24078219	0.0006
1995	-0.93148814	0.18778126	<.0001
1996	-1.15203912	0.13894695	<.0001
1997	-1.13653143	0.13234197	<.0001
1998	-1.00680274	0.13132353	<.0001
1999	-1.09971541	0.20037365	<.0001
2000	-1.00984109	0.12286158	<.0001
2001	-0.92354310	0.12466979	<.0001
2002	-1.01961983	0.12480687	<.0001
2003	-0.89426399	0.12564793	<.0001
2004	-0.90532103	0.12634714	<.0001
2005	-0.86518083	0.11613898	<.0001
2006	-0.73704708	0.12296876	<.0001
2007	-0.60363135	0.11361307	<.0001

Appendix 4. Combined Standardized CPUE index for trawlers in Div. 1CD and Div. 0B.

Greenland halibut, 1CD+0B trawlers 38
18:44 Sunday, June 8, 2008

The GLM Procedure

Class Level Information

Class	Levels	Values
YR	20	1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
CGT	20	2 3 4 5 6 7 8 9 10 2126 2127 3125 5126 5127 14124 15126 15127 20126 20127 31927

Number of Observations Read 682
Number of Observations Used 682

Greenland halibut, 1CD+0B trawlers 39
18:44 Sunday, June 8, 2008

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	49	126.9914301	2.5916618	36.37	<.0001
Error	632	45.0299990	0.0712500		
Corrected Total	681	172.0214290			

R-Square	Coeff Var	Root MSE	lcph Mean
0.738230	-39.68106	0.266927	-0.672681

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	19	50.30652557	2.64771187	37.16	<.0001
MD	11	15.43774953	1.40343178	19.70	<.0001
CGT	19	61.24715496	3.22353447	45.24	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	19	4.50347805	0.23702516	3.33	<.0001
MD	11	7.08627781	0.64420707	9.04	<.0001
CGT	19	61.24715496	3.22353447	45.24	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.400822300	B	0.09876124	4.06	<.0001
YR	1988	-0.049233248	B	0.16253332	-0.30	0.7621
YR	1989	0.043251901	B	0.16164649	0.27	0.7891
YR	1990	-0.236866046	B	0.08487835	-2.79	0.0054
YR	1991	-0.206117285	B	0.08600684	-2.40	0.0168
YR	1992	-0.040384333	B	0.08238919	-0.49	0.6242
YR	1993	-0.199453155	B	0.08615390	-2.32	0.0209
YR	1994	-0.187281397	B	0.09121787	-2.05	0.0405
YR	1995	-0.128945812	B	0.09910673	-1.30	0.1937
YR	1996	-0.239395982	B	0.07914745	-3.02	0.0026
YR	1997	-0.297989175	B	0.07733587	-3.85	0.0001
YR	1998	-0.200039162	B	0.07772399	-2.57	0.0103
YR	1999	-0.226734521	B	0.09561891	-2.37	0.0180
YR	2000	-0.188736856	B	0.07411446	-2.55	0.0111
YR	2001	-0.156583590	B	0.07827733	-2.00	0.0459
YR	2002	-0.310193527	B	0.07570438	-4.10	<.0001
YR	2003	-0.200219429	B	0.07135977	-2.81	0.0052

YR	2004	-0.213759849	B	0.07156617	-2.99	0.0029
YR	2005	-0.087437749	B	0.07161524	-1.22	0.2226
YR	2006	0.018330812	B	0.07013816	0.26	0.7939
YR	2007	0.000000000	B	.	.	.
MD	1	-0.294469960	B	0.10044642	-2.93	0.0035
MD	2	-0.985878993	B	0.16740337	-5.89	<.0001
MD	3	-0.988742656	B	0.27754733	-3.56	0.0004
MD	4	-0.075554636	B	0.09933123	-0.76	0.4472
MD	5	0.066812123	B	0.07490672	0.89	0.3728
MD	6	-0.255204855	B	0.07259621	-3.52	0.0005
MD	7	-0.354935108	B	0.05517464	-6.43	<.0001
MD	8	-0.225617133	B	0.04956975	-4.55	<.0001
MD	9	-0.231494380	B	0.04602336	-5.03	<.0001
MD	10	-0.255323768	B	0.04372259	-5.84	<.0001
MD	11	-0.153267478	B	0.04436991	-3.45	0.0006
MD	12	0.000000000	B	.	.	.
CGT	2	-0.777224062	B	0.09062396	-8.58	<.0001
CGT	3	-0.454086910	B	0.15585959	-2.91	0.0037
CGT	4	-0.781029049	B	0.09579999	-8.15	<.0001
CGT	5	-0.721150871	B	0.14845456	-4.86	<.0001
CGT	6	-0.721345215	B	0.11571946	-6.23	<.0001
CGT	7	-0.071632716	B	0.12453369	-0.58	0.5654
CGT	8	-0.791212668	B	0.09140635	-8.66	<.0001
CGT	9	-0.659336488	B	0.09111963	-7.24	<.0001
CGT	10	-0.255400328	B	0.09284999	-2.75	0.0061
CGT	2126	-0.780855893	B	0.12505377	-6.24	<.0001
CGT	2127	-0.353352562	B	0.08120884	-4.35	<.0001
CGT	3125	-1.310878884	B	0.12366342	-10.60	<.0001
CGT	5126	-0.419684532	B	0.13599592	-3.09	0.0021
CGT	5127	-0.256187049	B	0.10047795	-2.55	0.0110
CGT	14124	-0.853324454	B	0.11142532	-7.66	<.0001
CGT	15126	-0.089061980	B	0.11269408	-0.79	0.4296
CGT	15127	-0.123258353	B	0.13062007	-0.94	0.3457
CGT	20126	-1.157432491	B	0.10089010	-11.47	<.0001
CGT	20127	-1.180762947	B	0.10805882	-10.93	<.0001
CGT	31927	0.000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

The GLM Procedure
Least Squares Means

YR	lcph LSMEAN	Standard Error	Pr > |t|
1988	-0.54907822	0.14725416	0.0002
1989	-0.45659308	0.14723999	0.0020
1990	-0.73671102	0.05939551	<.0001
1991	-0.70596226	0.05920836	<.0001
1992	-0.54022931	0.05395690	<.0001
1993	-0.69929813	0.05836127	<.0001
1994	-0.68712637	0.06502113	<.0001
1995	-0.62879079	0.08052512	<.0001
1996	-0.73924096	0.06869453	<.0001
1997	-0.79783415	0.07002771	<.0001
1998	-0.69988414	0.07348499	<.0001
1999	-0.72657950	0.09152995	<.0001
2000	-0.68858183	0.07079702	<.0001
2001	-0.65642857	0.07507314	<.0001
2002	-0.81003850	0.07119920	<.0001
2003	-0.70006440	0.06611658	<.0001
2004	-0.71360483	0.06667528	<.0001
2005	-0.58728273	0.06635567	<.0001
2006	-0.48151416	0.06746036	<.0001
2007	-0.49984498	0.06065379	<.0001