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

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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 2003 primarily due to increases in catches in Div. 0A and 1A. Catches dropped slightly in 2004 to 19,098 tons. Survey trawlable biomass in the southern part of Div. 0A increased between 2001 and 2004 when it was estimated at 86,000 tons. In a new Canadian survey in the northern part of Div. 1A the biomass was estimated as 46,000 tons. Survey trawlable biomass in Div. 1CD increased between 2003 and 2004 to 76.000 tons which is above the average for the time series. The biomass in a new Greenland survey in the northern part of Baffin Bay (Div. 1A) was estimated as 54 000 tons. The recruitment of age one has been above average in resent years for the time series, which dates back to 1988. A standardised CPUE index from Div. 1CD has been stable since 1990.

1. 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 has been 11 000 tons. In 2000 there was set an additional TAC on 4 000 tons for Div. 0A+1AB for 2001. This TAC was in 2002 increased to 8 000 tons for 2003. The total advised TAC for 2004 remained at 19 000 tons.

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 13 184 tons in 2001 and increased further *via* 15 236 in 2002 to record high 19 954 tons in 2003. The catches decreased slightly to 19 098 tons in 2004 (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 was primarily due to an in increase in effort in Div. 0A and Div. 1A but there was also seen an increase in the catches in Div. 0B between 2002 and 2003. The decrease in catches between 2003 and 2004 was due to a decrease in catches in SA0

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 5 300 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 10 355 tons in 2003. In 2004 catches dropped to 9 367 tons (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 about 300 ton, where they have stayed since 1996, to 2 628 tons in 2001 and further to 4 278 tons in 2003. Catches in Div. 0A dropped to 3 740 tons in 2004.

The catches in Div. 0A in 2004 were mainly taken by trawl and twin trawl, while 15 tons was taken by gill net. The long lines fishery in the area has apparently stopped. The fishery was prosecuted by Canadian vessels.

Catches in Div. 0B 2004 amounted to 5 527 which is a decrease from 6 077 in 2003. The 2004 catches include 63 tons from Cumberland Sound taken on longlines. Offshore, longliners took 300 tons and gillnetters 1 413 tons while single and double trawlers took 3 851 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 in the period 1992-1994, but decreased to 4 500-5 300 in the period 1995-2000. Catches increased from 5 522 in 2001 further to 7 368 tons in 2002 and 9,598 tons in 2003. The catches in 2004 were 9,731 tons. Almost all catches have been taken offshore (Table 2). The inshore catches in 2004 in Div. 1B-1F amounted to 174 tons.

Catches in Div. 1AB (mainly in Div. 1A) increased gradually from 573 tons in 2001 to 4 153 tons in 2004. The 2004 catches included 141 tons taken in a Spanish trial fishery for squids (SCR Doc. 05/33) and 66 tons taken inshore in Div. 1B. All offshore catches in Div. 1AB was taken by trawl by vessels from Faeroe Islands, Russia (SCS Doc. 05/5), EU-Spain and Greenland (SCS Doc. 05/14). The inshore catches were taken primarily by gill nets.

Catches in Div 1CD amounted to 5 578 tons compared to 5 567 tons in 2003. Catches were mainly taken by vessels from Greenland (SCS Doc. 05/14), Norway, EU/Germany (SCS Doc. 05/9), Russia (SCS Doc. 05/5) and Faeroe Islands. 131 tons was taken in a Spanish trial fishery for squid in Div. 1CD (SCR Doc. 05/33). Almost all catches off shore were taken by trawl except 87 ton which was taken by gill net. 108 tons were taken inshore in Div. 1C-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 1 500 m. In 2004 in total 51 hauls were made (SCR Doc. 05/13). The biomass and abundance Greenland halibut in Div. 1C-D was estimated at 75 869 tons and $74.859*10^6$ individuals compared to 68 717 tons and $72.556 *10^6$ individuals in 2003. The mean catch per km^2 swept increased from 1.39 tons to 1.48 tons. Both the biomass and the abundance were above average for the time series. The highest densities were found at 1 000-1 200 m in Div. 1C and 1 000-1 400 m in Div. 1D. The overall length distribution in Div. 1C-D was dominated by a mode at 48 cm and the age distribution was dominated by a mode at age 6 as in previous years.

Greenland deep sea survey in the northern part of Baffin Bay (Div. 1A)

In 2004 Greenland conducted a bottom trawl survey aimed at Greenland halibut in the Greenland part of the Baffin Bay between 73ºN and 77ºN at depths down to 1 500 m. In total 62 valid hauls were conducted and the swept area biomass and the abundance was estimated as 53 867 tons and 77.948*10^6 individuals, respectively. At shallow water (400-800 m) the length distribution was dominated by modes at 30 and 45 cm, while the length distribution at depths >800 m was dominated by a mode at 48-51 cm. The over all age composition was dominated by fish between 3 and 7 years (SCR Doc. 05/14).

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

Canada has conducted surveys in the southern part of Div. 0A in 1999, 2001 and 2004. The biomass has increased gradually from 68 700 tons *via* 81 000 tons to 86, 200 tons in 2004. The mode in the catches increased from 42 cm in 2001 to 45 cm in 2004. In 2004 Canada also conducted a survey in the northern part of the Baffin Bay. The biomass was estimated as 45 878 tons. The length frequencies in the catches showed a mode at 48 cm (SCR Doc. 05/56).

Deep sea surveys in SA0+1

Most of SA 0 and SA 1 has been covered by deep sea surveys in the period 2001-2004. Div. 0A was surveyed in 2004, Div. 0B in 2001, the northern part of Div. 1A in 2004, the southern part of Div. 1A and Div. 1B in 2001 and Div. 1CD in 2004 (Fig. 2). The only part of the area that has not been covered is Div. 1EF, which, due to the steep continental shelf, has little area at depths relevant for commercial fisheries. Div. 1EF has, however, been surveyed down to 600 m by the Greenland shrimp survey, see below.

Biomass estimated from various deep sea surveys, all conducted by same vessel and gear.

SA 0		SA 1	
Div. 0A north	45 877	Div. 1A N of 73°	53 867
Div. 0A south	86 176	Div. 1B-1A S of 73°	36 416[1)]
Div. 0B	68 917[1)]	Div. 1CD	75 896
Total	200 970		166 179
Grand total			367 149

1) Latest estimate 2001, other estimates are from 2004.

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 restratificated 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 (- Disko Bay) has fluctuated between 9 258 and 23 413 tons during 1992-2003. In 2004 the biomass was estimated as 31,100 tons which was an increase compared to 19 112 tons in 2003 and by far the highest in the time series. The abundance was estimated at 269 mill, which is a decrease compared to 317 mill in 2003. The highest abundance was seen in Div. 1AN (north of 70°N). As in recent years most of the abundance was comprised of one-year-old fish, but there were more older fish in the catches compared to previous years (SCR Doc. 05/39).

In the Disko Bay the biomass was estimated at record high 28 229 tons compared to 16 556 tons in 2003. The abundance was estimated at 199*10^6, which is a slight decrease compared to 227*10^6 specimens in 2003. There was a relatively higher proportion of two- and three-year-old fish in the catches compared to previous years.

The biomass in the nursery area (1AS and 1B) was estimated at 14 981 tons compared to 9 579 tons in 2003 and the highest in the time series. The abundance was estimated at 107 mill. compared to 157 mill in 2003.

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 450 million in 2001. The estimate was 196 million one-year-old specimens in 2002, which is above the recruitment of the 1989 to1994 year-classes but below the recruitment levels since then, except the 1996 and 1997 year-classes. The number of one-year-olds increased in 2003 to 317 million and stayed at that level in 2004 (314 million) which is above 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 has been declining since the presumably large 1991 year-class, but the recruitment has been above the level in the 1980s. 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. The 2001 year-class was estimated to be a little below average for the last decade, while the 2002 year-class was above average. The recruitment of age one (2003 year-class) decreased again in 2004 to somewhat below average, but the 2001 year- class could still be detected as age 3+. In Disko Bay the recruitment have been good in recent years and the 2003 year- class was well above average.

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 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 2003 year-class was well above average. Note that there was no survey in 1996.

2.2. **Biological investigations**

An assessment of age determination methods with age validation of Greenland halibut from the Northwest Atlantic (SCR Doc. 05/43) was presented in STACREC. See STACREC report for summary.

2.3. **Commercial fishery data**

Length and age distribution

SA 0

Length distributions were available from the trawl fishery in Div. 0A and Div. 0B and gill net fishery in Div. 0A. The length frequencies in the trawl fishery had modes at 48 cm for the twin trawl fishery and 51 cm for the single trawl fishery, respectively. Modes around 48-51 cm were also seen in previous years in Div. 0A (Fig. 6). The catches in the gill net fishery was dominated by fish between 50 and 70 cm with modes at 57 and 63 cm.

The length distribution in the single trawl fishery in Div. 0B was dominated by a mode around 48 cm as in

previous years.
SA1

Length frequencies were available from the Greenland trawl fishery in Div.1ABD and the Russian (SCS Doc. 05/05) and Norwegian trawl fishery in Div. 1D. Further, length frequencies from Div.1A-1D were available from a Spanish trial fishery directed against squid (SCR Doc. 05/33).

The length frequency in the trawl fishery in Div. 1AB showed a mode at 48-51 cm and there were generally more large fish in the catches compared to Div. 1D, as seen in the previous years.

The catch composition in the Russian, Norwegian and the Greenland trawl fishery in Div. 1D showed modes at 49, 50 and 52 cm, respectively (Fig. 7).

The catches in the Spanish research fishery in 1A and B mainly comprised of fish 30 between 50 cm while the length composition from Div. 1C and 1D showed modes at 46 and 48 cm, respectively (Fig. 8).

Catch at age was available from the Russian trawl fishery in Div. 1D. Ages 6 and 7 dominated the catches (Fig. 9).

The Greenland trawl length frequencies in Div. was converted to age frequency using an age length key sampled during the Greenland deep sea survey in Div 1CD. The catches were dominated by fish age 6 to 8 (Fig. 10)

No catch-at-age information was available from SA 0 and the catch-at-age and mean-weight-at-age, in Table 3 and 4, respectively, has not been updated.

Catch rate

Unstandardized catch rates were available from the Greenland trawl fishery in Div. 1A and 1D (SCS Doc. 05/14). The catch rates were stable in Div. 1A between 2001 and 2002 (1.09 ton/hr) but decreased to 0.87 ton/hour in 2003 to increase again in 2004 to 0.95 ton/hr. The catch rates in Div. 1CD decreased from 0.87 to 0.71 ton/hr between 2002 and 2003 but increased again in 2004 to 0.78 ton/hr (Fig. 11).

Unstandardized catch rates were estimated from logbooks from the trawl fishery in Div. 1CD submitted to the Greenland authorities and for EU/German trawlers during 1996-2004 (SCS Doc. 05/9) (Fig. 11). The catch rates from vessels from Faeroe Island and Greenland twin trawlers increased slightly while the CPUE from EU/Germany and Russia and Norway decreased slightly between 2003 and 2004.

Unstandardized catch rates from the Spanish trial fishery for squid showed catch rates from Div. 1A-1D on 320, 248, 482 and 321 kg/hr for the four divisions, respectively (SCR Doc. 05/33).

Standardized catch rate series, based on available logbook data and data from the EU-German trawl fishery (SCS Doc. 05/9), were available for the offshore trawl fishery in Div. 1CD for the period 1988-2004.

The standardized catch rates in Div. 1CD dropped from 1989-1990 but has been stable since then but showed a small increase between 2002 and 2003 but dropped slightly between 2003 and 2004. The CPUE is however the second highest seen since 1993 (Fig. 12) (Appendix 1). In 2004 the logbooks represented 80 percent of the catches in Div. 1CD. The Spanish catches have not been included in the analysis because the trial fishery is a one year event and the fishery was directed towards squids.

The combined catch rate from 0B and 1CD could not be updated in 2004 due to lack of data from 0B (Fig. 12). There are, however added a few logbooks from 1CD, 1996. But this has not changed the trend in the series.

Due to the frequency of fleet changes in the fishery in both SA0 and SA1 both the unstandardized 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 age 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 2004 fishery hence no catch-curve analysis were made made.

3.2. XSA

Extended Survivors Analysis

An XSA has been run unsuccessful 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 Doc. 02/68)

The XSA was run again in 2003 year 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 relative stable in recent years between 0.2-0.3 (F_{bar} 7-13). The summary of the XSA is given in SCR (Doc. 03/54).

The XSA was not run this year as no catch-at-age data were available for 2003-2004.

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 trawl only take a very small proportion of the mature 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 relatively poor 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 unrealistic 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 changesthe 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 resamplings).

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 2000-2004 (catches, survey biomass index, and CPUE index) have only varied little compared to 1999, and it was not expected that the outcome of an ASPIC analysis would change significantly, hence the analysis was not attempted.

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 in 2003. Catches decreased slightly to 19,098 in 2004. The increase in catches have primarily been due to increased effort in Div. 0A and Div. 1A

Standardized catch rates in Div. 1CD have been stable during the last decade and decreased slightly compared to 2003 which was the highest seen since 1993. The combined catch rate for Div. 1C-D+0B has showed very little variation during the period 1988-2000 (not updated in since then). Unstandardized catch rates for Div. 0A increased from 2001 to 2002 and further in 2003 (no update for 2004). Catch rates from one-two trawlers in Div. 1A was stable between 2001 and 2002, dropped in 2003 but increased again in 2004.

Survey biomass has been increasing gradually in 1999, 2001 and 2004 in Div 0A.

A new survey in the northern part of 0A estimated a biomass on 46 000 tons.

The biomass in Div. 1CD increased between 2003 and 2004 and is above the average for the period 1997-2004.

A new survey in the northern part of Div. 1A estimated a biomass on 54 000 tons.

Most of SA 0 and SA 1 has been covered by deep sea surveys in 2001 and 2004 and the total trawlable biomass has been estimated at around 360 000 tons.

Off shore biomass in the Greenland shrimp survey has been relatively stable since 1996 but increased between 2003 and 2004 to the highest level in the time series, that dates back to 1992. The recruitment of age one, in the entire survey area has been above average the last three years, but an recruitment index for the off shore nursery areas showed that the 2003 year-class was below average.

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 relative short and show little variability and are not useful for estimating reference points.

6. References

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TABLE 1. Greenland halibut catches (metric tons) by year and country for Subarea 0 (Split on Div. 0A and 0B) from 1987 to 2004. 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[a]	01[ad]	02[ae]	03[af]	04[a]
0A																		
CAN															2183	3800	4278	3740
POL															445			
0B																		
CAN		2		589	256	2194	883		1941	2354	3871	3924	4784	5438	5034	3186	4709	5627
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[c]	3959		373									782		
RUS		59	29	1528	1758	9364	4229[b]	3674	261	915							1368	
TOT	388	1024	907	9498	8606	12358	7489	4274	3233	4608	4323	3924	4784	5438	7662	7768	10355	9367

[a] Provisional data.
[b] The Russian catch is reported as area unknown, but has previously been reported from 0B.
[c] Dobbel reported as 10 031 tons.
[d] Excluding 445 tons double reported, and 2 tons reported by error.
[e] Excluding 370 tons double reported and 782 tons reported by error.
[f] Excluding 1 366 tons double reported.

TABLE 2. Greenland halibut catches (metric tons) by year and country for Subarea 1 (Split on Div. 1AB and Div. 1CD) from 1987 to 2003. 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	00[a]	01[a]	02[a]	03[a]	04[a]
1AB																		
GRL															340[d]	1571[d]	3476[d]	3621
RUS															85	279	259	241
FRO														96	148	150	146[c]	150[c]
NOR																	77	
EU																	73	141[f]
1CD																		
GRL					965	227	213	885	1405	1880	2312	2295	2549	2657	2657	2294[c]	2199	2185
FRO				54	123	151	128	780			127	242	116	147	150	150	152[c]	150[c]
JPN	907	1581	1300	988	677	2902	1198	820	337									
NOR					611	2432	2344	3119	2472	1785	1893	1338	1360	1360	1419	1734	1345	1364
RUS							5		296	254		543	552	792	829	654	1328	1214
EU							46	266	527	455	446	350	330	444	537	536	543[e]	665[g]
Total	907	1581	1300	1042	2376	5712	3934	5870	5037	4374	4778	4769	4907[b]	5251	5522	7368	9598	9731

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

TABLE 3. Catch-at-age in numbers. Not updated for 2003 and 2004.

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
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.NUM	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	19953	19098

TABLE 4. Catch weights at age (kg) Not updated for 2003-2004.

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YEAR	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

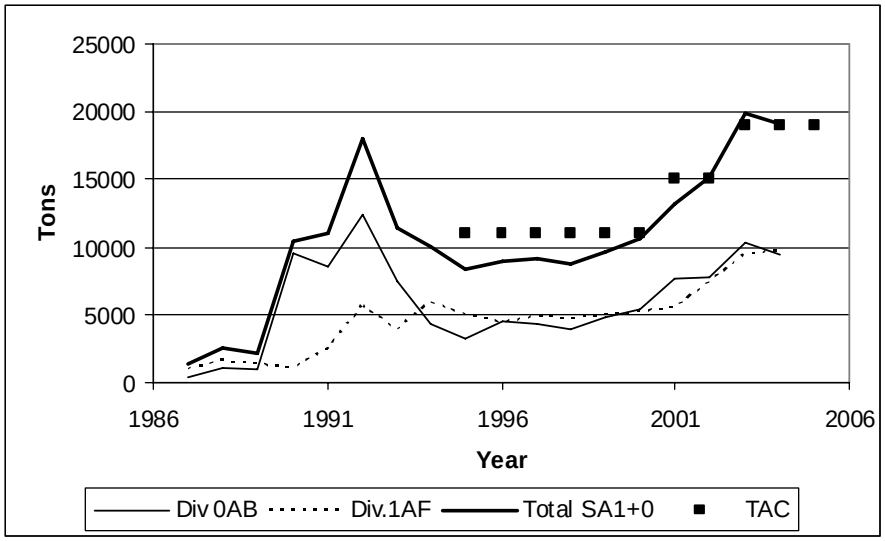


Fig. 1. Catches in SA0 and Div. 1A offshore + Div. 1B-1F and recommended TAC. For TAC before 1995 see text.

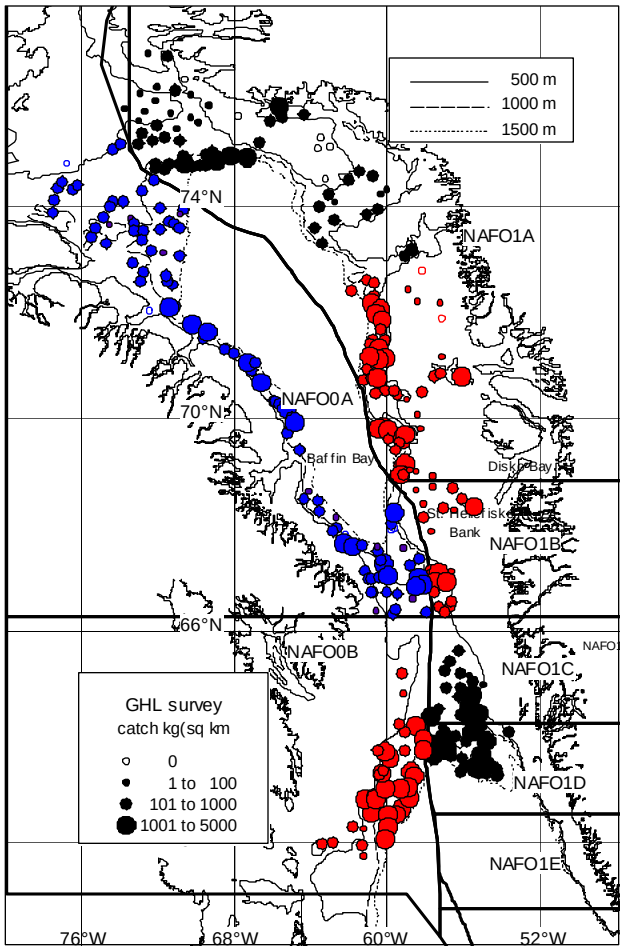


Fig. 2. Distribution of catches of Greenland halibut during surveys in 2001 and 2004.

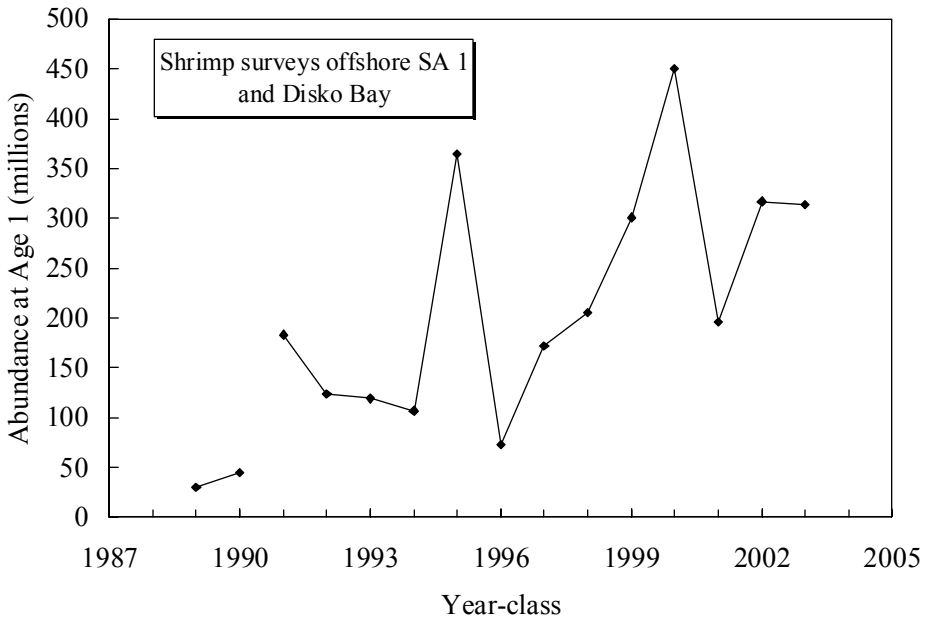


Fig.3. Abundance of age one in the entire area covered by the Greenland shrimp survey including inshore Disko Bay and Div. 1AN (North of 70°N).

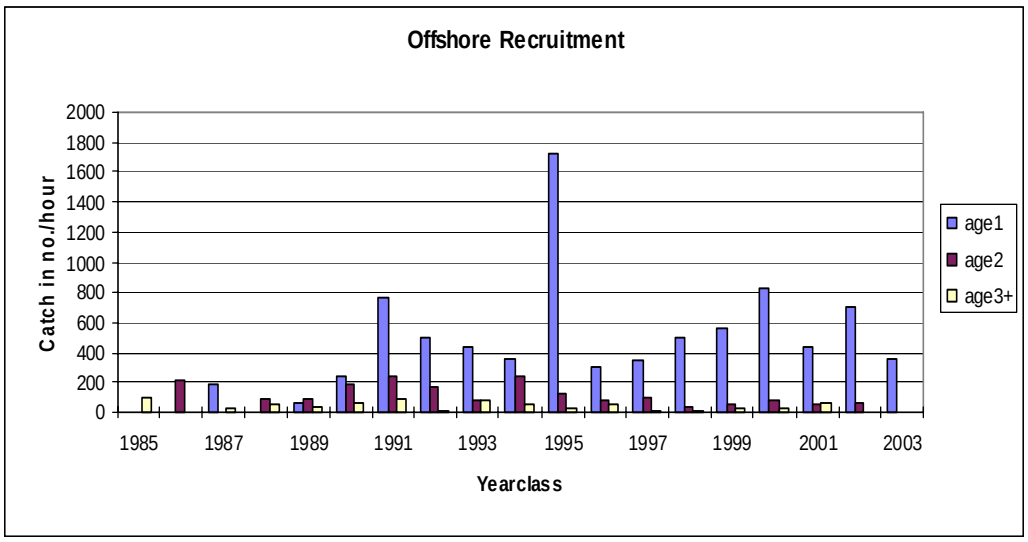


Fig. 4. Year-class strength of Greenland halibut of ages 1-3+ in number per hour trawled in the offshore nursery area (Div. 1AS-1B, depths > 300 m).

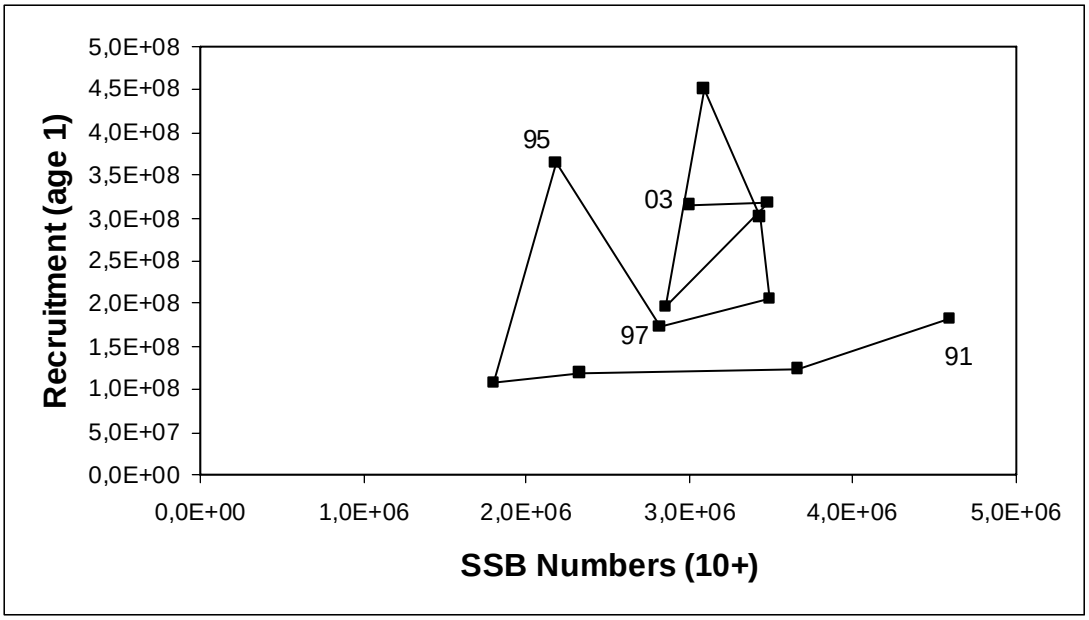


Fig. 5. Spawning stock in numbers (ages 10-18 in Div.1CD from the joint Japan/Greenland survey and the Greenland survey (1997-2001) plotted *vs* number of fish age 1 the following year estimated from the Greenland shrimp trawl survey including the Disko Bay. Figures denotes year-class. Note there was no deep sea survey in 1996.

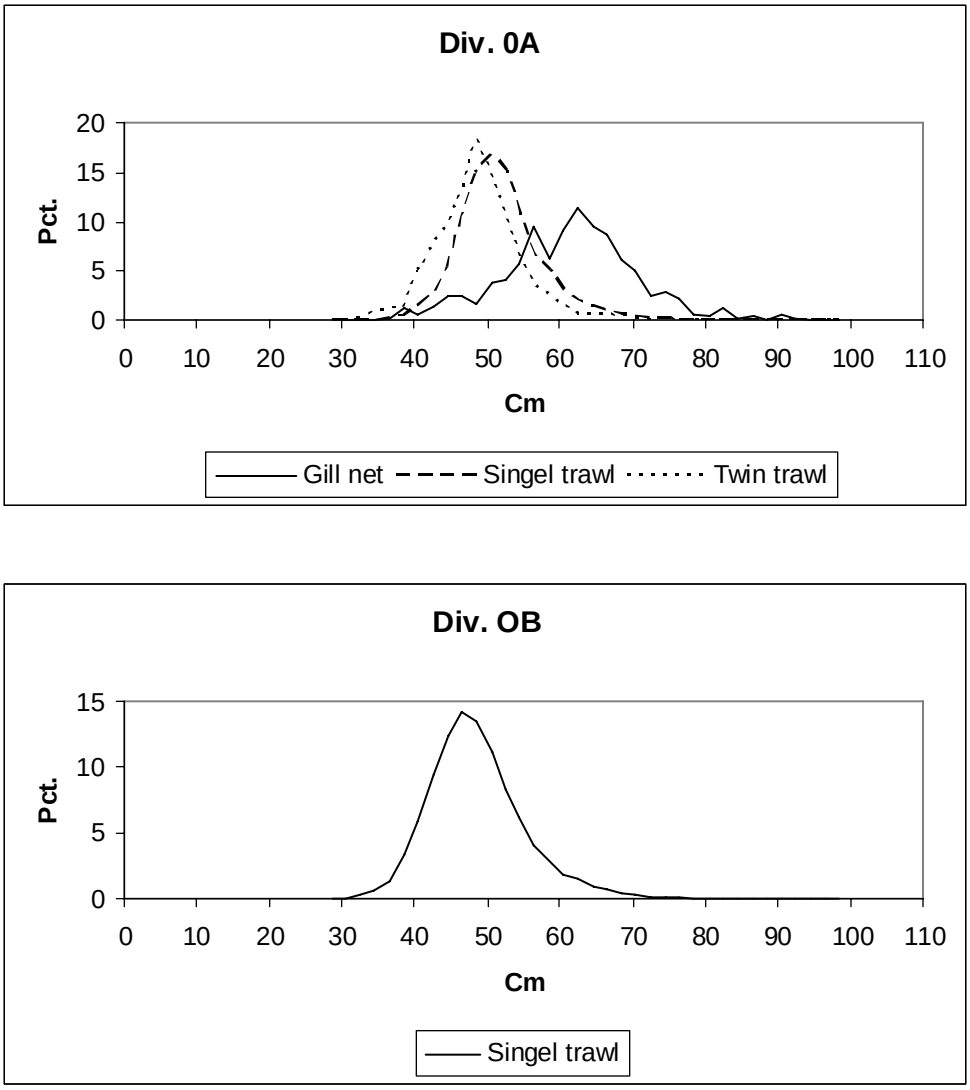


Fig 6. Length distribution from the fishery in Div 0AB in 2004.

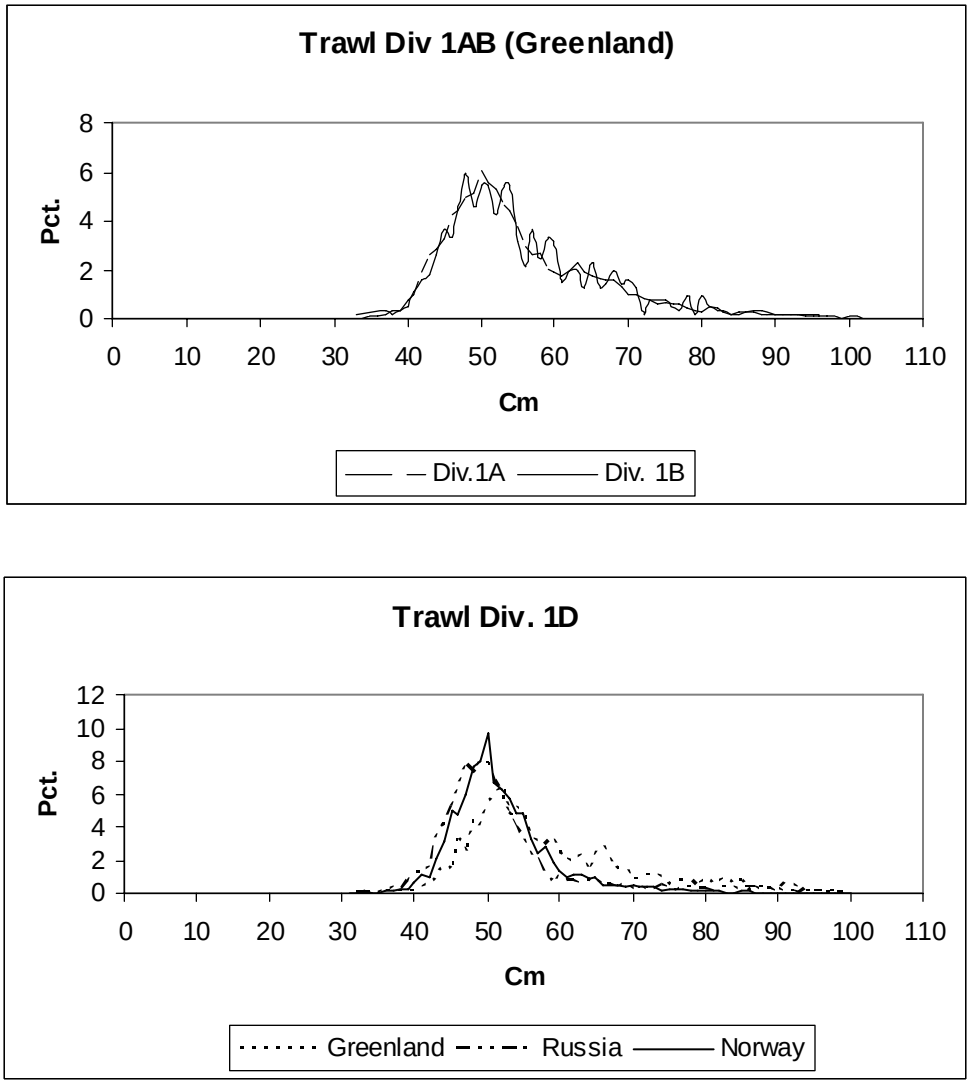


Fig. 7. Length distribution in the trawl fishery in Div. 1AB and 1D in 2004.

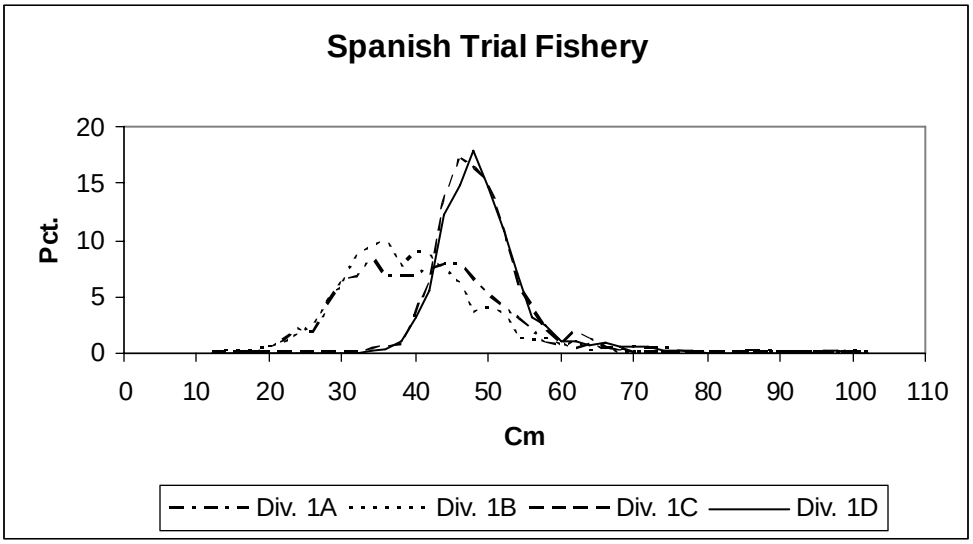


Fig. 8. Length distribution from the Spanish trial fishery for squids in 2004.

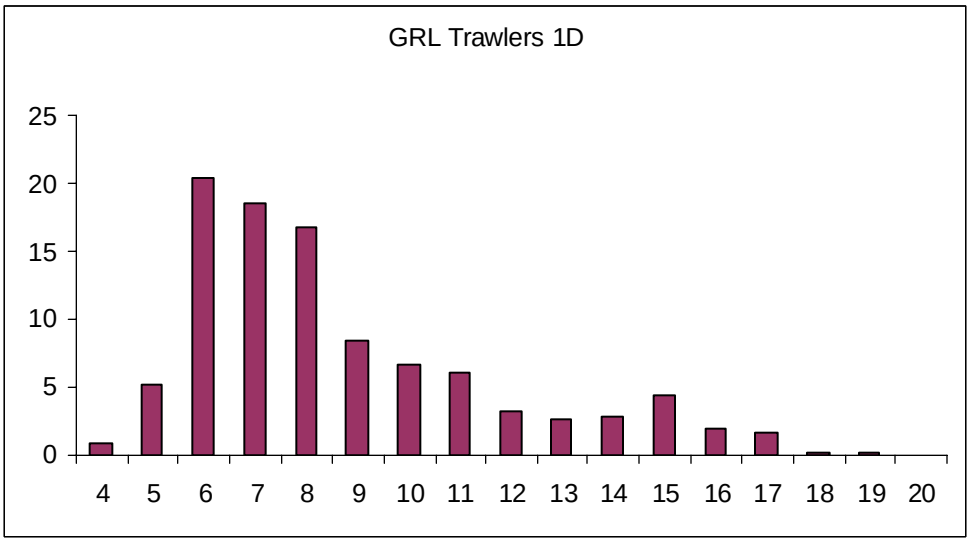


Fig. 9. Age distribution in the Greenland trawl fishery in Div. 1D

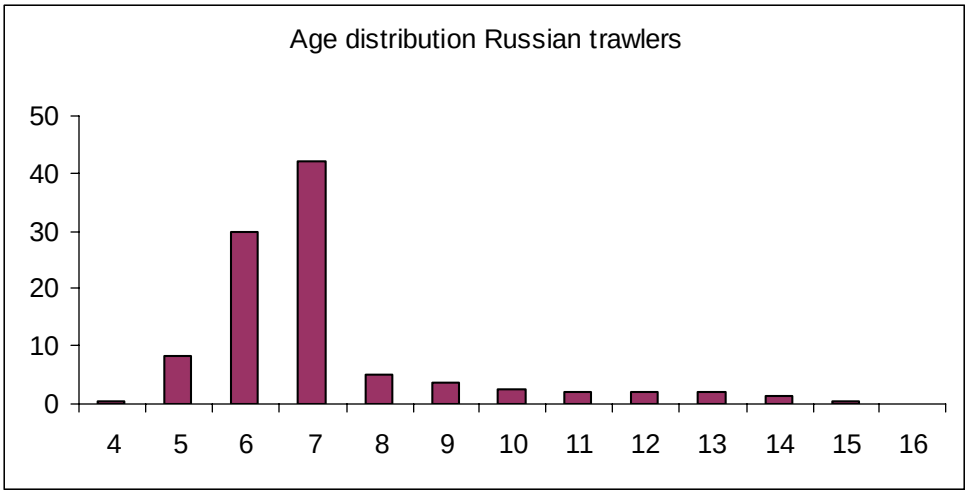


Fig. 10. Age distribution in the Russian trawl fishery in 1D in 2004,

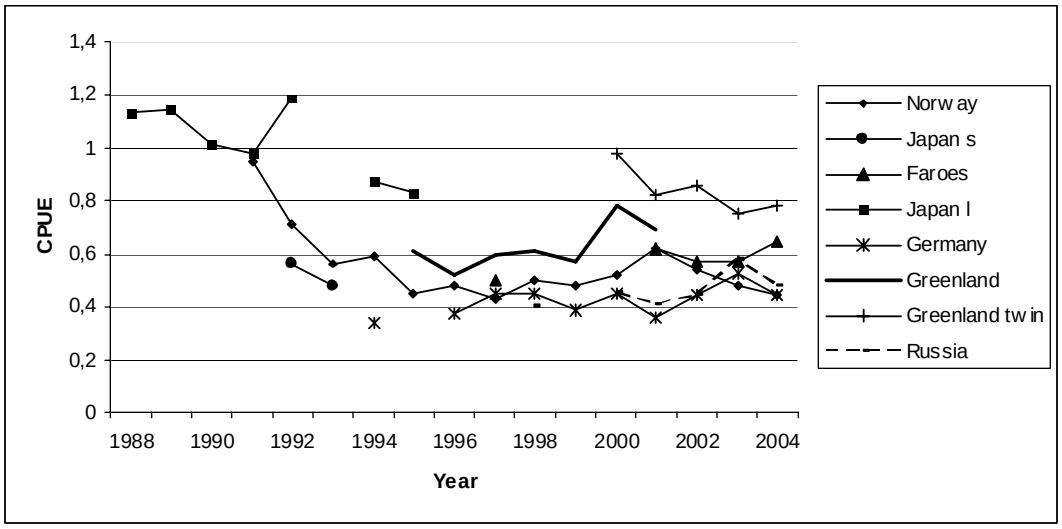
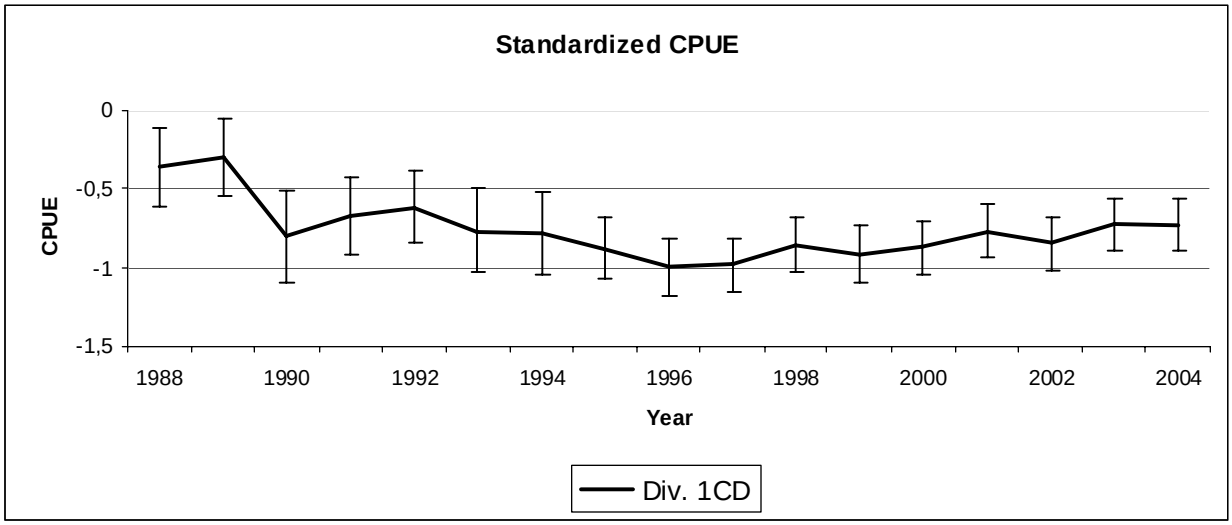


Fig. 11. Unstandardized trawl CPUE series from Div. 1CD.



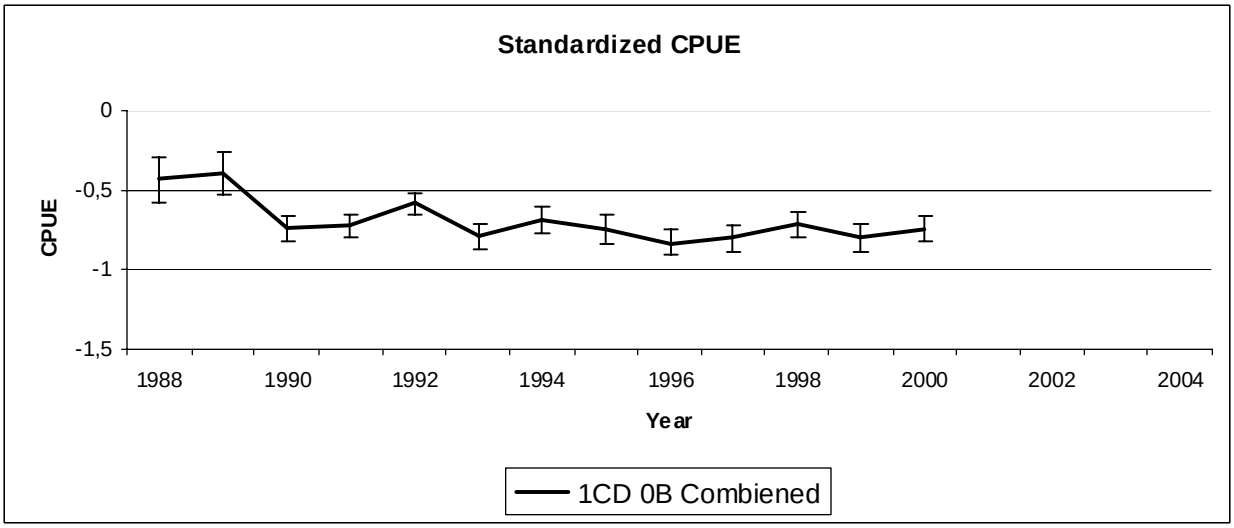


Fig. 12. Standardized trawl CPUE indices from SA1 (Div. 1CD) and SA0+1 combined with +/- S.E.

APPENDIX 1. Standardized CPUE index Div.1CD.

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The GLM Procedure

Class Level Information

Class	Levels	Values
YR	17	1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
MD	11	1 2 4 5 6 7 8 9 10 11 12
CGT	9	2 3 4 5 6 7 8 9 10

Number of observations 172

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The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	34	22.45190913	0.66035027	8.54	<.0001
Error	137	10.59662667	0.07734764		
Corrected Total	171	33.04853580			

R-Square	Coeff Var	Root MSE	lcph Mean
0.679362	-47.01689	0.278114	-0.591520

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	16	11.25859233	0.70366202	9.10	<.0001
MD	10	4.75189459	0.47518946	6.14	<.0001
CGT	8	6.44142220	0.80517778	10.41	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	16	1.78405212	0.11150326	1.44	0.1313
MD	10	3.68164153	0.36816415	4.76	<.0001
CGT	8	6.44142220	0.80517778	10.41	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		-0.007752475	B	0.10449892	-0.07	0.9410
YR	1988	0.364134077	B	0.38206493	0.95	0.3422
YR	1989	0.430385535	B	0.37482781	1.15	0.2529
YR	1990	-0.071281310	B	0.39574370	-0.18	0.8573
YR	1991	0.056429272	B	0.36911777	0.15	0.8787
YR	1992	0.107605583	B	0.36528175	0.29	0.7688
YR	1993	-0.037027146	B	0.39749259	-0.09	0.9259
YR	1994	-0.057212839	B	0.37590156	-0.15	0.8793
YR	1995	-0.153482364	B	0.29937362	-0.51	0.6090
YR	1996	-0.270811558	B	0.11530022	-2.35	0.0203
YR	1997	-0.258765087	B	0.11045721	-2.34	0.0206
YR	1998	-0.133076501	B	0.10678183	-1.25	0.2148
YR	1999	-0.186707754	B	0.12106799	-1.54	0.1253
YR	2000	-0.145002039	B	0.09581694	-1.51	0.1325
YR	2001	-0.037120942	B	0.09735840	-0.38	0.7036
YR	2002	-0.119154139	B	0.09739917	-1.22	0.2233

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The GLM Procedure

Dependent Variable: lcph

Parameter		Estimate		Standard Error	t Value	Pr > |t|
YR	2003	0.002443608	B	0.09664213	0.03	0.9799
YR	2004	0.000000000	B	.	.	.
MD	1	-0.356215343	B	0.21919362	-1.63	0.1064
MD	2	-1.110324219	B	0.45280980	-2.45	0.0155
MD	4	-0.442603527	B	0.32793168	-1.35	0.1793
MD	5	-0.212648979	B	0.23944147	-0.89	0.3760
MD	6	-0.764128073	B	0.16955333	-4.51	<.0001
MD	7	-0.590815548	B	0.13009374	-4.54	<.0001
MD	8	-0.356063923	B	0.10208978	-3.49	0.0007
MD	9	-0.148353795	B	0.08598952	-1.73	0.0867
MD	10	-0.166670312	B	0.08085343	-2.06	0.0412
MD	11	-0.119326539	B	0.08206957	-1.45	0.1482
MD	12	0.000000000	B	.	.	.
CGT	2	-0.482981401	B	0.08207636	-5.88	<.0001
CGT	3	-0.269864488	B	0.35940310	-0.75	0.4540
CGT	4	-0.499689988	B	0.09282003	-5.38	<.0001
CGT	5	-0.511370446	B	0.39253250	-1.30	0.1948
CGT	6	-0.523594587	B	0.11103210	-4.72	<.0001
CGT	7	0.130142498	B	0.34411310	0.38	0.7059
CGT	8	-0.599257039	B	0.08495931	-7.05	<.0001
CGT	9	-0.214021600	B	0.09671332	-2.21	0.0286
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.

The GLM Procedure
Least Squares Means

YR	lcph LSMEAN	Standard Error	Pr > |t|
1988	-0.36161193	0.24842992	0.1478
1989	-0.29536047	0.24593276	0.2318
1990	-0.79702732	0.28803705	0.0064
1991	-0.66931674	0.24651634	0.0075
1992	-0.61814043	0.22814340	0.0076
1993	-0.76277316	0.27033939	0.0055
1994	-0.78295885	0.25854832	0.0029
1995	-0.87922837	0.19142120	<.0001
1996	-0.99655757	0.17591787	<.0001
1997	-0.98451110	0.17056449	<.0001
1998	-0.85882251	0.17131198	<.0001
1999	-0.91245376	0.17646561	<.0001
2000	-0.87074805	0.16505584	<.0001
2001	-0.76286695	0.16670473	<.0001
2002	-0.84490015	0.16842560	<.0001
2003	-0.72330240	0.16962883	<.0001
2004	-0.72574601	0.17078226	<.0001