Northwest Atlantic Fisheries Organization

Serial No. N4997 **NAFO SCR Doc. 04/45**

SCIENTIFIC COUNCIL MEETING – JUNE 2003

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 13,1284 tons in 2001 and further to 15,136 tons in 2002, primarily due to increased effort in Div. 0A and 1A. Catches increased again in 2003 to 19,954, primarily due to increases in catches in Div. 0B and 1A. Survey trawlable biomass in Div. 1CD was in 2003 estimated at 69,000 tons compared to 72,000 tons in 2002 and a little above the average for the time series The recruitment of age one has been increasing during the latest years but decreased in 2002 to a level a little below average. Recruitment increased again in 2003 to a level above average for the time series, which dates back to 1988. A standardised CPUE index from Div. 1CD has showed a minor increase between 2002 and 2003 to a level a little above average for the 1990-2002 period. An unstardardized CPUE from the single-trawl and twin trawl fishery in Div 0A showed a further increase compared to 2001 and 2002.

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 (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.

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 via 7,768 tons in 2002 to 10,355 in 2003 (Table 1). (SCR Doc. 04/44)

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 3,800 tons in 2002 and 4,278 tons in 2003.

The catches in Div. 0A in 2003 were taken by trawl, twin trawl and long lines in approximately equal proportions. The fishery was prosecuted by Canadian vessels and vessels from a number of different countries fishing on a Canadian license

Catches in Div. 0B 2003 amounted to 6,077 which is an increase from 3,968 tons in 2002 tons. The 2003 catches includes 244 tons from Cumberland Sound taken on longlines. Offshore, longliners took 641 tons and gillnetters 1,168 tons while single and double trawlers took 4,024 (SCR Doc. 04/44). The increase in the catches in Div. 0B between 2002 and 2003 was due to an increase in trawl catches. All catches were taken by Canadian vessels.

(Poland has in STATLANT 21A reported 445 tons taken in Div. 0A in 2001, but these catches are included in the Canadian catches. In 2002 Russia has reported 370 tons form 0A that are included in the Canadian catches and Norway and Faeroe Island has reported 782 and 2 tons, respectively, from Div. 0B by error. In 2003 Norway reported 1,366 tons from Div. 0B that are included in the Canadian catches).

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 7368 tons in 2002 and 9598 tons in 2003. Almost all catches have been taken offshore (Table 2). The inshore catches in Div. 1B-1F in 2003 amounted to 73 tons.

Catches in Div. 1AB (almost exclusively Div. 1A) increased from 573 tons in 2001 and further to 2,000 tons in 2002 and 4,031 in 2003. Most of the catches in Div. 1AB in 2003 was taken by trawl, but gillnets were also employed. Vessels from Faeroe Islands, Russia (SCS 04/3), Norway, EU-Spain (SCR Doc. 04/23, SCS Doc. 04/9) and Greenland (SCS Doc. 04/14) participated in the fishery.

Catches in Div 1CD amounted to 5,447 tons which was mainly taken by trawlers from Greenland (SCS 04/14), Norway, EU/Germany (SCS 04/10), Russia (SCS 04/3 and Faeroe Islands. Minor catches were taken by gillnet, < 300 tons.

When catch data from research reports and STATLANT 21 catches have been conflicting the 21 A catches have been used unless anything else has been stated.

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 2003 in total 35 hauls were made (SCR Doc.

04/19). The biomass and abundance Greenland halibut in Div. 1C-D was estimated at 68,717 tons and 72,556 $\times 10^6$ individuals compared to 71,932 tons and 71.510×10^6, respectively in 2002. Both the biomass and the abundance is a little above average for the time series. The highest densities were found at depths 1000-1400 m in Div. 1D.

The over all length distribution in Div. 1C-D was dominated by a mode at 48 cm. The age distribution was dominated by a mode at age 6 as in previous years.

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. Estimated total trawlable biomass of Greenland halibut in the offshore areas (- Disko Bay) has fluctuated between 6,800 and 15,339 tons during 1992 – 2002. In 2003 the biomass was estimated at 16,090 tons, which is a slight increase compared to the previous two years and the highest in the time series. The abundance was estimated at 250 mill., which is a slight increase compared to 207 mill in 2002 and about average for the time series. The highest abundance was seen in Div. 1BN (north of 67°N). As in recent years most of the abundance was comprised of one-year-old fish (72%)

In the Disko Bay the biomass was estimated at 16,171 tons compared to 8,838 tons in 2002 and the highest in the time series. The abundance was estimated at 190×10^6, close to the record high 201×10^6 specimens in 2001. There was a relatively high proportion of two-year-old fish in the catches compared to previous years.

The biomass in the nursery area (1AS and 1B) was estimated at 7,603 tons compared to 6,847 tons in 2002 and above average for the time series. The abundance was estimated at 142×10^6, a little below average for the time series.

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 in the nursery area (Div. 1AS-1B) for the period 1988 to 2002. Catches at 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. 2). In recent years the allocation of stations in the shrimp trawl survey have 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 numbers 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 the above average. In Disko Bay catches of one year old fish was estimated as 1,705 specimens per hour, the second highest estimate in the time series

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 3. The over all recruitment of the 2002 year-class was, as the fourth highest in the time series, above average. Note that the coverage in 1989 and 1990 was incomplete and that there was no survey in 1996.

2.2. Biological Investigations

No biological investigations were presented in 2004.

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 the longline fishery in Div. 0A (SCR 04/44 The length frequencies in the trawl fishery were almost identical with a mode around 47 cm (3 cm groups) as also seen in Div. 0A in 2002. In 2003 there was tendency towards more large fish in the catches in Div. 0A compared to Div. 0B (Fig. 4). In 2002 the length frequencies in the longline fishery in Div. 0A vas dominated by a broad mode around 47 cm. This mode shifted to 50 cm (3 cm groups) in 2003 (Fig. 5). There were generally more large fish in the longline catches compared to the trawl catches.

SA1

Length frequencies were available from the Russian trawl fishery in 1A and 1D (SCS Doc. 04/3) and from an experimental trawl fishery in 1A (and 1B-1D but they represented a total catch of about 10 tons and is not considered further). The length frequency in the Russian trawl fishery peaked at 44 and 50 cm in Div. 1A and Div. 1D, respectively. In 2002 the modes were around 42 and 48 cm, respectively. The length frequency in the Spanish experimental fishery in Div. 1A showed two modes at 44 and 48 cm, respectively (Fig. 6) Further, length frequencies were available from the Greenland gillnet fishery in Div. 1A and 1C. The length frequency showed board modes around 68-72 cam and 72-78 cm in Div. 1A and 1C, respectively (Fig. 7).

Catch at age was available from the Russian trawl fishery in Div. 1A and 1D. Catches peaked at age 6 in Div. 1A and at age 7 in Div. 1D (Fig. 8.)

No catch-at-age information was available from SA 0 or gill net catches from SA1 and the catch-at-age and weight-at-age, in Table 3 and 4, respectively, has not been updated.

The age distribution in Div. 0A+1AB and Div. 0B+1CD, respectively, are given in Fig. 8 for 2002 (Not updated for 2003).

Catch rate

Unstandadized catch rates were available from the trawl fishery in Div. 0A from 1996-2003 (SCR Doc. 04/44. The catch rate for single trawlers have fluctuated during the years but increased from 2000 to 2003 to an above average level. The catches prior to 2001 were, however, small. The catch rates for twin trawlers were stable between 2000 and 2001, increased in 2002 and increased further in 2003. (Fig. 9)

Unstandardized catch rates were available from the Greenland gill net fishery in Div. 1A where catch rates dropped from 0.25 ton to 0.23 tons between 2002 and 2003 while it increased in Div. 1CD from 0.18 ton/hr to 0.21 ton/hr (SCS Doc. 04/14 GRL). Further, catch rates were available from the trawl fishery in Div. 1A and 1D (SCS Doc. 04/14 GRL). 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 (Fig. 10). The catch rates in Div. 1CD decreased from 0.87 to 0.71 ton/hr between 2002 and 2003. The Div. 1CD trawl catch rates are included in the analyses mentioned below.

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 1996-2003 (SCS 04/10) (Fig. 10). The catch rates from vessels from Norway, and Greenland twin trawlers dropped somewhat, while catch rates from EU/Germany and Russia increased. The catch rates from Faeroe Islands trawlers remained unchanged between 2002 and 2003

Standardized catch rate series, based on available logbook data and data from the EU-German trawl fishery (SCS Doc. 04/10), were available for the offshore trawl fishery in Div. 1CD for the period 1988-2003 (Appendix 1).

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 and is now the highest seen since 1993 (Fig. 11).

The combined catch rate from Div. OB and 1CD could not be updated in 2003 due to lack of data from 0B (Fig. 11).

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 were too uncertain to be used in the yield-per-recruit analysis. No age frequencies were available from the longline fishery in 2003 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) (not presented) 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.

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. 2. 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 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 resamplings).

The results showed that estimated fishing moralities 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 2000-2003 (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. The increase in catches have primarily been due to increased effort in Div. 0A and Div. 1A, in 2003 there was, however, also seen an increase on about 2000 tons in Div. 0B. Standardized catch rates in Div. 1CD have been stable during the last decade and increased slightly in 2003 and is now 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. Catch rates from one-two trawlers in Div. 1A was stable between 2001 and 2002 but dropped in 2003.

Survey biomass have increased between 1999 and 2001 in Div 0A, between 2000 and 2001 in 0B and 1CD, where it was the highest seen in the five year long survey series. The biomass in Div. 1CD dropped between 2001 and 2003 but is still above average for the period 1997–2002. Off shore biomass in the Greenland shrimp survey has been relatively stable since 1996 and increased slightly in 2003 to the highest level in the time series, that dates back to 1992. The recruitment of age one, which has been increasing in recent years, dropped in 2002 but increased again in 2003 to a level above average from 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 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 2003. Minor (300 ton or less) catches from Div. 0A are included in some of the 0B catches prior to 2001.

	Year																
Country	87	88	89	90	91	92	93	94	95	96	97	98	99	00[a]	01[ad]	02[ae]	03[af]
0A																	
CAN															2628	3800	4278
0B																	
CAN	-	2	-	589	256	2194	883	-	1941	2354	3871	3924	4784	5438	5034	3968	6077
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	-	-	-	-	-	-	-	-	-	
RUS	-	59	29	1528	1758	9364	4229[b]	3674	261	915	-	-	-	-	-	-	
TOTAL	388	1024	907	9498	8606	12358	7489	4274	3233	4608	4323	3924	4784	5438	7662	7768	10355

[a] Provisional data.
[b] The russian catch is reported as area unknown, but has previously been reported from 0B
[c] Dobbel reported as 10031 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 1366 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.

	Year																
Country	87	88	89	90	91	92	93	94	95	96	97	98	99	00[a]	01[a]	02[a]	03[a]
1AB																	
GRL															340[d]	1571[d]	3476[d]
RUS															85	279	259
FRO														96	148	150	146[e]
NOR																	77
EU																	73
1CD																	
GRL	-	-	-	-	965	227	213	885	1405	1880	2312	2295	2549	2657	2657	2294[c]	2199
FRO	-	-	-	54	123	151	128	780	-	-	127	242	116	147	150	150	152[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
RUS	-	-	-	-	-	-	5	-	296	254	-	543	552	792	829	654	1328
EU	-	-	-	-	-	-	46	266	527	455	446	350	330	444	537	536	543[e]
Total	907	1581	1300	1042	2376	5712	3934	5870	5037	4374	4778	4769	4907[b]	5251	5522	7368	9598

[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

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

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.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

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

.

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

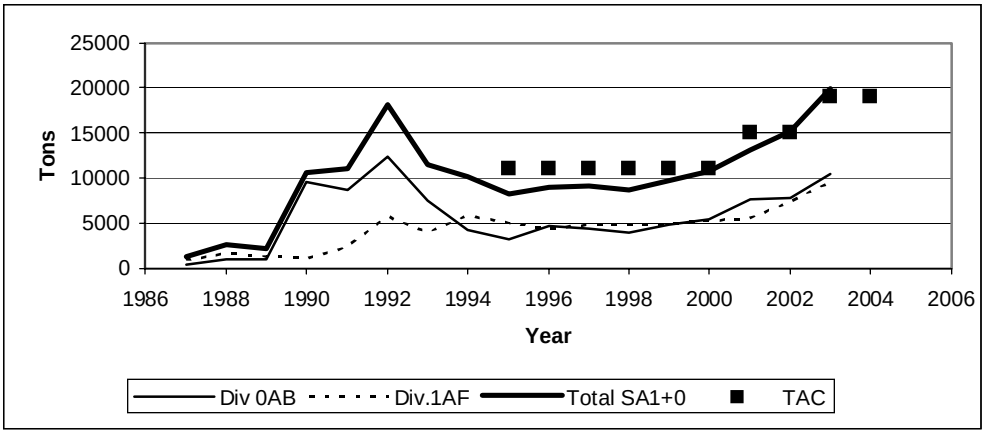


Fig. 1. Catches in SA0 and Div. 1A offshore + Div. 1B-1F and recommented TAC. For AC before 1995 see text.

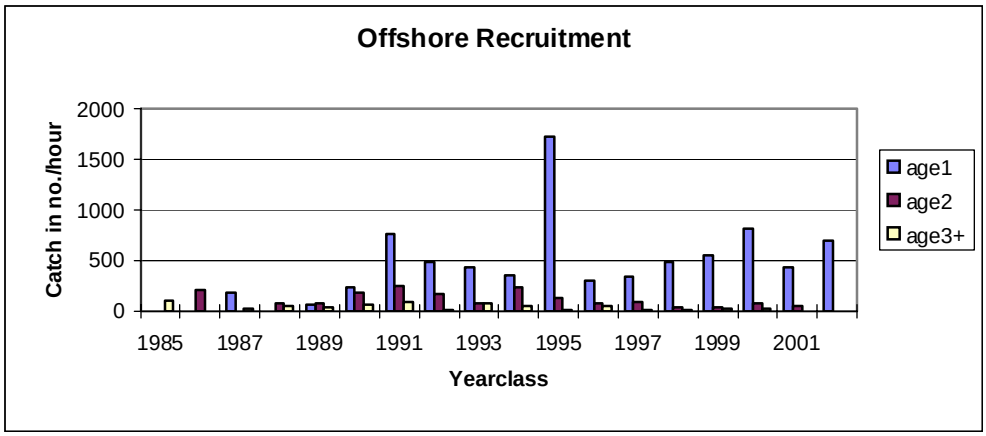


Fig. 2. Year-class strength of Greenland halibut of ages 1-3+ in number per hour trawled in the offshore nursery area.

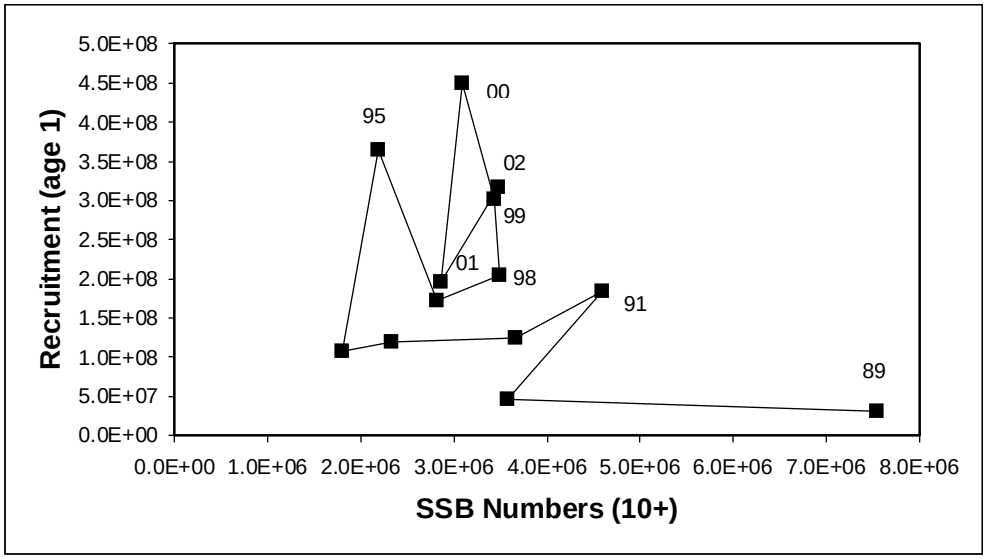


Fig. 3. Spawning stock in numbers (ages 10-18 in Div.1CD from the joint Japan/Greenland survey and the Greenland survey (1997-2001) plotted vs number of fish age 1 the following year estimated from the Greenland shrimp trawl survey including the Disko Bay. Note pure coverage in 1989 and 1990 and that there was no survey in 1996.

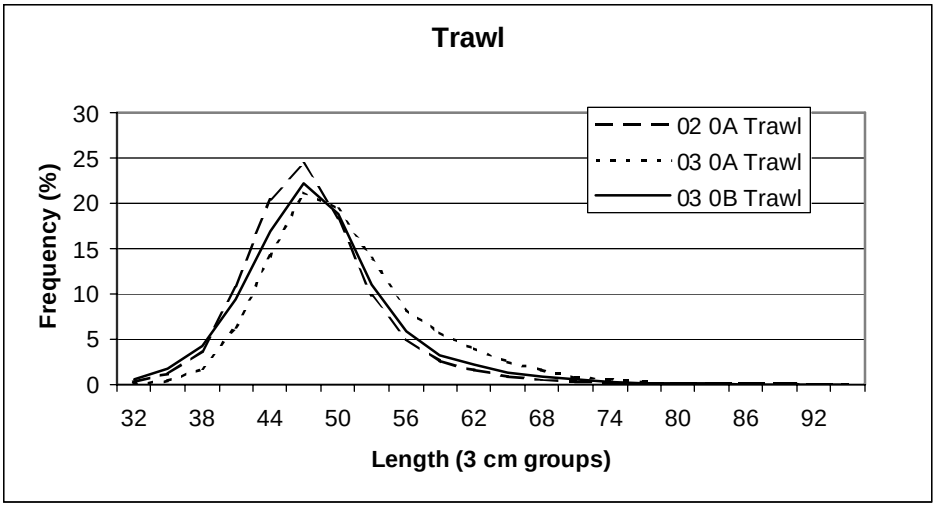


Fig 4. Length distribution from the trawl fishery in Div 0AB in 2002 and 2003.

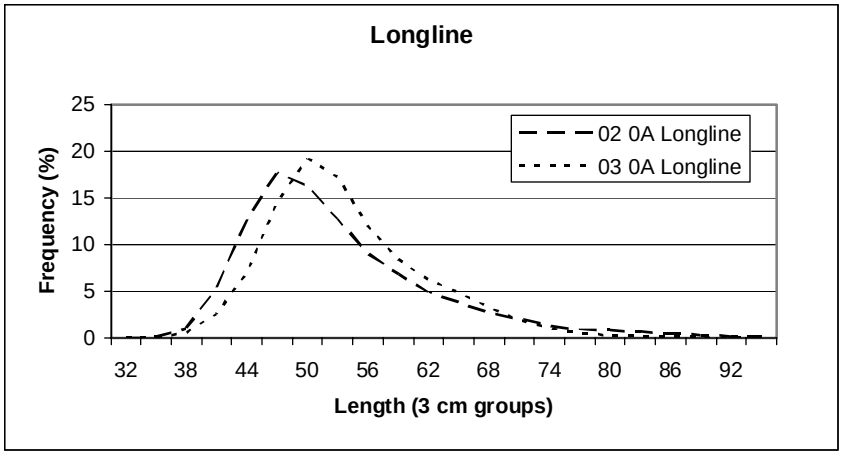


Fig. 5. Length distribution from the longline fishery in Div. 0A in 2002 and 2003.

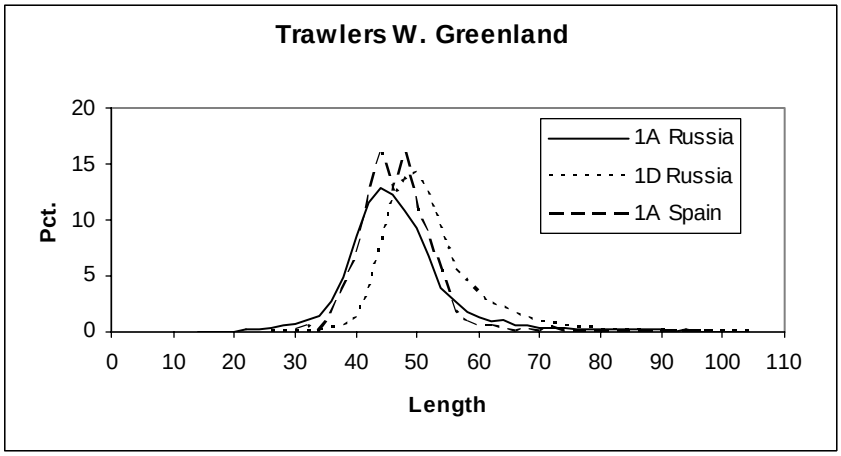


Fig. 6. Length distribution in the trawl fishery in Div. 1A and 1D in 2003.

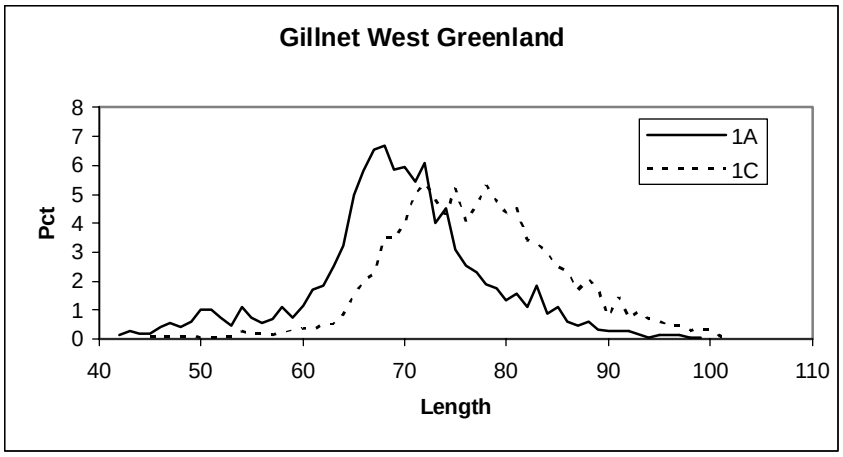
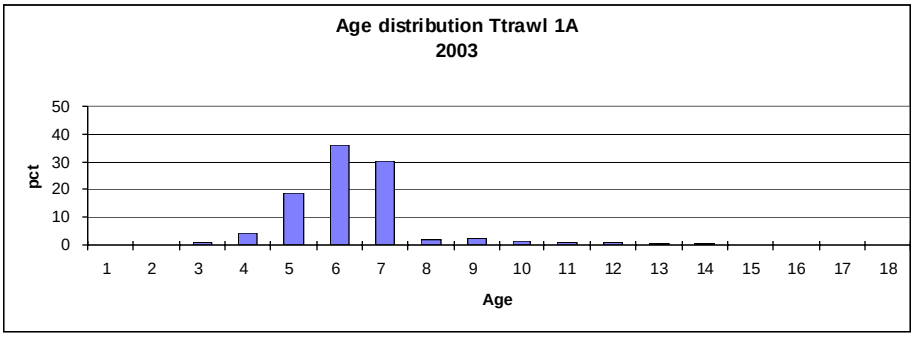
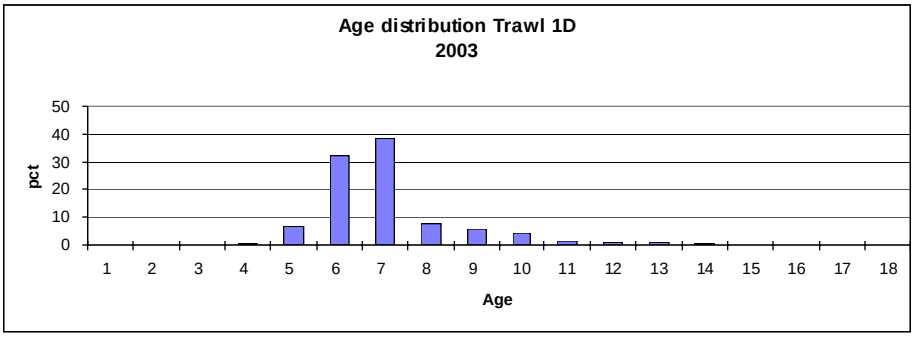
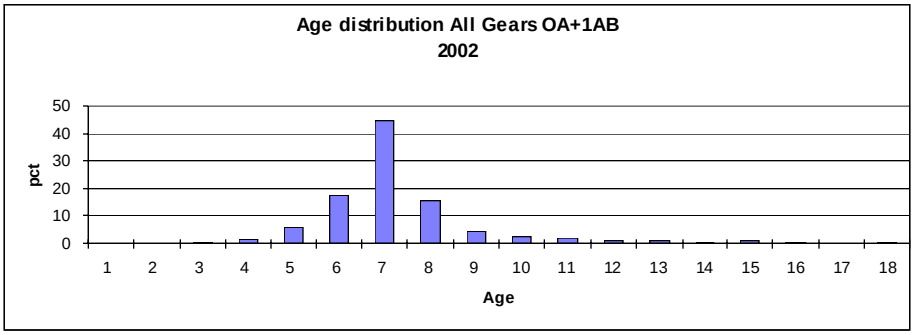


Fig. 7. Length distribution form the gill net fishery in Div. 1A and 1C in 2003







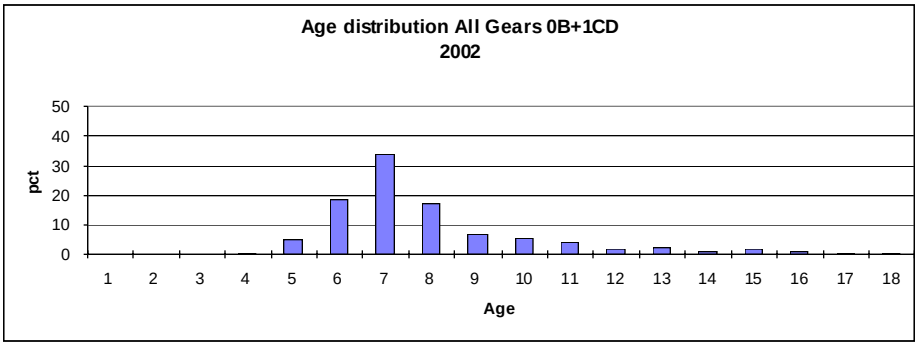


Fig. 8. Age distribution in the Russian trawl fishery in Div.1A and 1D in 2003, and in all gears combined (longline (gillnet and trawl) in Div. 0A and Div. 1AB and 0B and 1CD, respectively in 2002.

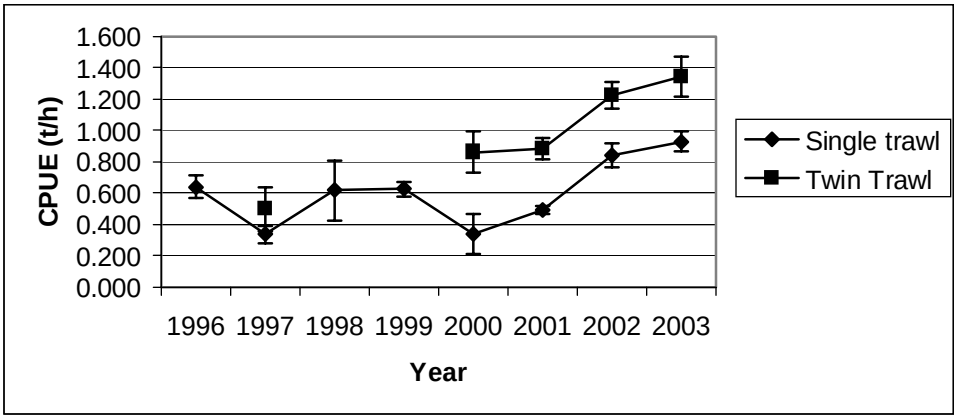


Fig. 9. Unstandardized CPUE for single and twin trawl in Div. 0A during 1996-2003.

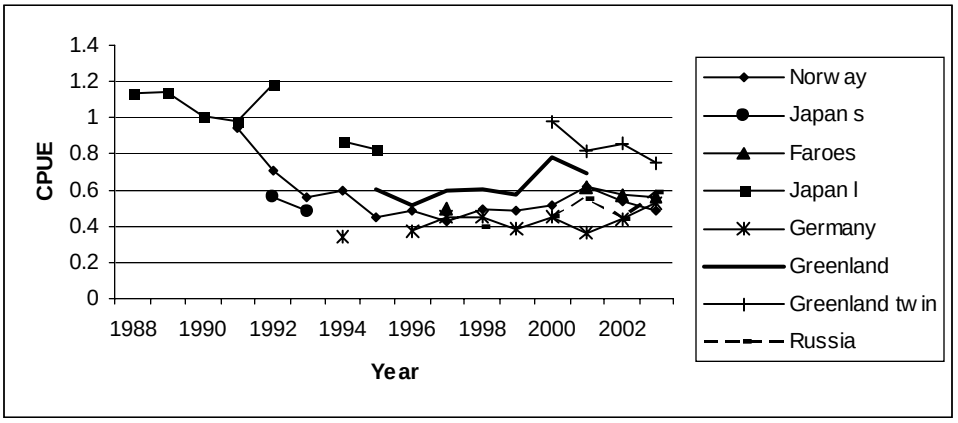


Fig. 10. Unstandardized trawl CPUE series from Div. 1CD.

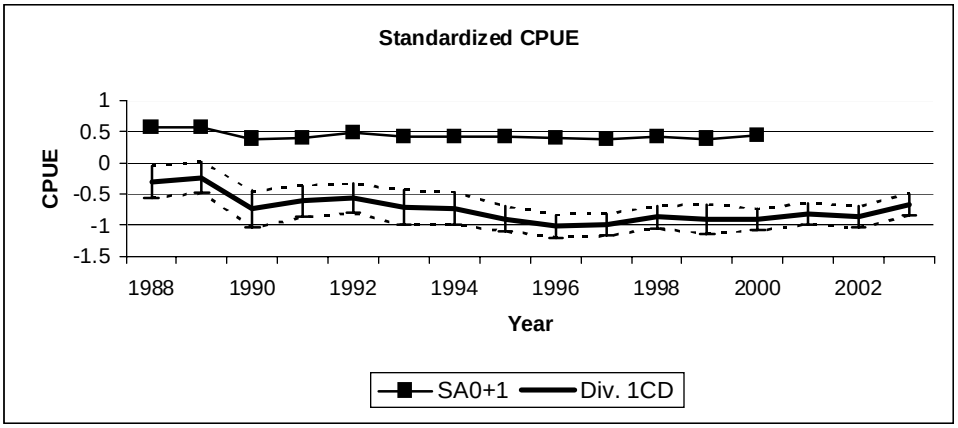


Fig. 10. Standardized trawl CPUE indices from SA1 (Div. 1CD) with +/- S.E. and SA0+1 combined.

Appendix 1. Standardized CPUE index Div.1CD.

The GLM Procedure

Class Level Information

Class	Levels	Values
YR	16	1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003
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 145
Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	33	21.79414994	0.66042879	8.16	<.0001
Error	111	8.98576278	0.08095282		
Corrected Total	144	30.77991272			

R-Square	Coeff Var	Root MSE	lcph Mean
0.708064	-48.44097	0.284522	-0.587358

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	15	11.39075016	0.75938334	9.38	<.0001
MD	10	4.26951328	0.42695133	5.27	<.0001
CGT	8	6.13388650	0.76673581	9.47	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	15	1.89221292	0.12614753	1.56	0.0973
MD	10	3.04925656	0.30492566	3.77	0.0002
CGT	8	6.13388650	0.76673581	9.47	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.122094567	B	0.11397055	1.07	0.2864
YR	1988	0.367699062	B	0.39169948	0.94	0.3499
YR	1989	0.436894047	B	0.38465210	1.14	0.2585
YR	1990	-0.075986185	B	0.40571971	-0.19	0.8518
YR	1991	0.051957183	B	0.37859503	0.14	0.8911
YR	1992	0.100353573	B	0.37462283	0.27	0.7893
YR	1993	-0.045730925	B	0.40825049	-0.11	0.9110
YR	1994	-0.063604831	B	0.38724517	-0.16	0.8698
YR	1995	-0.225779830	B	0.30755776	-0.73	0.4644
YR	1996	-0.341212533	B	0.12141355	-2.81	0.0059
YR	1997	-0.320420006	B	0.11562100	-2.77	0.0065
YR	1998	-0.203103974	B	0.11122082	-1.83	0.0705
YR	1999	-0.228007168	B	0.19038463	-1.20	0.2336
YR	2000	-0.243038747	B	0.10027902	-2.42	0.0170
YR	2001	-0.142007328	B	0.10223269	-1.39	0.1676
YR	2002	-0.194537404	B	0.10196196	-1.91	0.0590
YR	2003	0.000000000	B	.	.	.
MD	1	-0.150227832	B	0.30768568	-0.49	0.6263
MD	2	-1.178910984	B	0.46482565	-2.54	0.0126
MD	4	-0.438364959	B	0.33737275	-1.30	0.1965
MD	5	-0.209882173	B	0.24773619	-0.85	0.3987
MD	6	-0.757462712	B	0.17759130	-4.27	<.0001
MD	7	-0.601294612	B	0.15504264	-3.88	0.0002
MD	8	-0.355057746	B	0.12365145	-2.87	0.0049
MD	9	-0.134400355	B	0.09702319	-1.39	0.1688
MD	10	-0.155606894	B	0.09104611	-1.71	0.0902
MD	11	-0.122867849	B	0.09172510	-1.34	0.1831
MD	12	0.000000000	B	.	.	.
CGT	2	-0.554873268	B	0.09902290	-5.60	<.0001

CGT	3	-0.390951481 B	0.37190797	-1.05	0.2954
CGT	4	-0.569529699 B	0.10954250	-5.20	<.0001
CGT	5	-0.640914062 B	0.40540910	-1.58	0.1167
CGT	6	-0.666558143 B	0.13054780	-5.11	<.0001
CGT	7	-0.007508098 B	0.35614032	-0.02	0.9832
CGT	8	-0.671164765 B	0.10019155	-6.70	<.0001
CGT	9	-0.268029866 B	0.10999160	-2.44	0.0164
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	-0.30214080	0.25613154	0.2407
1989	-0.23294581	0.25380721	0.3607
1990	-0.74582604	0.29611577	0.0132
1991	-0.61788268	0.25400961	0.0166
1992	-0.56948629	0.23534093	0.0172
1993	-0.71557078	0.27832235	0.0115
1994	-0.73344469	0.26641670	0.0069
1995	-0.89561969	0.19794225	<.0001
1996	-1.01105239	0.18200919	<.0001
1997	-0.99025987	0.17623083	<.0001
1998	-0.87294383	0.17738176	<.0001
1999	-0.89784703	0.23720078	0.0002
2000	-0.91287861	0.16979549	<.0001
2001	-0.81184719	0.17291082	<.0001
2002	-0.86437726	0.17406875	<.0001
2003	-0.66983986	0.17622949	0.0002