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

by

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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 since then. The catch composition has been stable in recent years. Survey trawlable biomass in Div. 1CD was in 1999 estimated as 64,000 tons, which is a minor decrease from 70,000 tons estimated in 1998. In a new survey covering Div. 0A the biomass was estimated at 83,000 tons. Recruitment estimates at age 1 of the 1992-94 year-classes were lower than the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class was estimated to be the best in the series. The 1996 and 1997 year-classes were estimated to be slightly below the average of the last decade while the 1998 year-class is above. A combined standardised CPUE index from Div. 0B and Div. 1CD has showed a minor decline compared to 1998 but the index has been stable during 1990-99. Although the survey series from 1987-1995 not is directly comparable with the series from 1997-99 the decline in the stock observed in Subarea 1 until 1994 has stopped and the stock seems to be back at the level in the late-1980s and early-1990s.

1. TAC, description of the fishery and nominal catches.

Between 1979 and 1994 a TAC has been 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 SA 0 + Div. 1A offshore + Div.1B-1F. From 1995-2000 the adviced TAC for the latter area has been 11,000 tons.

In 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 in 1989 tons to 10,500 in 1990. Catches stayed at that level in 1991 but increased again in 1992 to 18,100, the highest in the time series. Since then catches have been about 10,000 tons. The catch amounted to 9 667 tons in 1999. 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.

In 1983 annual catches in Div. 0B 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 4,274 tons in 1994, but increased again to about 5,300 tons in 1995 and stayed at level until 1997. In 1998 catches dropped to 4,370 tons and they stayed at that level in 1999 where catches were 4,567 tons. (Table 1).

Canada took all catches. Trawlers took 1,872 tons (516 tons in 0A), 399 tons were taken by longliners and 1,900 tons by gill-netters while 306 tons was taken by unknown gear. In Cumberland Sound 35 tons were taken by longlines (not officially reported yet).

The catches in Subarea 1 (Div. offshore 1A Div. + 1B-1F) were below 1,600 tons during the period 1982-1990. In 1991 catches increased to 2,376 tons and were around 5,500 tons in the period 1992-1995, but decreased to around 4,500 in the period 1996-1998. Catches increased slightly to 5,100 tons in 1999. Almost all catches were taken offshore. Trawlers from Greenland, EU-Germany, Norway and Russia took 4,220 tons and Grenlandic longliners took 744 tons. Further 131 tons taken by longlines were not reported. Almost all the catches were taken in Div. 1D. Inshore catches were estimated to 5 tons. (Table 2).

2. Input data

2.1 Research trawl survey

1CD GHL-survey

In 1999 a stratified random bottom trawl survey for Greenland halibut was conducted in September-October (SCR 00/10) as the third in the surveyseries. The surveys covered NAFO Division 1CD between the 3-nm line and the midline to Canada at depths between 400 and 1500 m. In 1999 the biomass and abundance was estimated at 64,398 tons and $61.366*10^6$ specimens which is a statistically insignificant (95% level) decrease from 70,474 tons and $67.667*10^6$ specimens estimated in 1998 but above (statistically insignificant) the 56,260 tons and $53.613*10^6$ specimens estimated in 1997. The highest densities were found at depths > 1000 in Div. 1D. Two small strata, which normally yield biomasses and abundances around 2, 000 and $2*10^6$ individuals, were not covered in 1999. The over all length distribution was dominated by modes around 46-49 cm similar to the length distribution observed in the previous years. The over all age distribution was dominated by a mode around age 7.

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 14,800 tons during 1992 – 1998. In 1999 the biomass was estimated at 15,020 which is a small increase compared to 13,111 tons estimated in 1998. The abundance was estimated at $199*10^6$, which is an increase from $175*10^6$ specimens in 1998. The increase in biomass and abundance was primarily seen in Div. 1AN and 1BN (SCR 00/22). Around 70 % of the catches were comprised of one-year-old fish.

In the Disko Bay the biomass and abundance was estimated at 8,117 tons and $94*10^6$ which is a decrease from the record high 12,500 tons and $182*10^6$ estimated in 1998.

The biomass in the nursery area (1AS and 1B) was estimated at 7,517 tons compared to 6,478 tons in 1998 while The abundance was estimated at $121*10^6$ compared to $106*10^6$ in 1998. The estimate from 1999 is above the level in 1990-1991 and 1997-1998, but below the 1992-1996 levels ($200*10^6$).

0A GHL-survey

In October 1999 a stratified random bottom trawl survey was conducted in Div. 0A to 71°30'N covering depths between 400 and 1500 m (SCR 00/31). The survey was conducted by the same vessel and used the same gear as the survey in Div. 1CD. The biomass was estimated at 83,340 tons and the abundance at 141 $*10^6$, respectively. The highest densities were found between 1001 and 1250 m throughout both the Baffin Bay and the Davis Strait. Length ranged from 6.5 to 94.5 cm with a single broad mode around 38.5 cm. Ages ranged from 2 to 15 years, with the highest abundance at age four (1995 year class). The majority (96.1%) was less than eight years.

The length distributions in the three surveys are shown in fig.1.

Recruitment

A recruitment index was provided from the shrimp trawl survey. By means of the Petersen-method ages 1, 2 and 3+ were separated in the survey catches in the nursery area during the period 1988 to 1998. In 1999 the ages were separated using age length keys from the nursery area and Disko bay (the results were almost similar to the results obtained by the Petersen method). 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. 2).

The recruitment index has been declining since the presumably large 1991 year-class, but the recruitment has been above the level in the 1980'ies. The recruitment increased again with the 1995 year class, which was the largest on record. With a mean catch of 223 one year old specimens per hour the 1998 year-class in the off shore recruitment area seems to be a little above average for the time series. In Disko Bay catches of one year old fish is the second largest on record (496 specimens per hour). The very large 1997 year-class has been reduced to average as age 2.

SSB/Recruitment

The relation between the spawning stock in numbers (ages 10-18) in Div. 1CD from the joint Japan/Greenland survey and the Greenland GHL 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. Note that the coverage in 1989 and 1990 was incomplete and that there was no survey in 1996. The over all recruitment of the 1998 year class was the second largest in the timeseries. This is caused by a combination of good recruitment in both Disk Bay and the offshore nursery grounds and in Div. 1AN (00/22).

2.2 Biological studies

A study of maturity at age and size of Greenland halibut and geographic distribution of spawning fish (SCR 00/06) showed for adult females sampled in the commercial fishery in 0B that in the period 1993-1995 that 32% were spent and 68% were maturing for the next year. This was very similar to results from Div 2GH. For the period 1996-1999 15% was spawning, 57% was spent and 28% were maturing for the present year. This is also more or less similar to what was observed in Div. 2GH but different from the rest of the area studied (2J3KLMNO).

The age and length composition of commercial catches in the Russian fishery for Greenland halibut in Division 1D in September-October, 1999 were analyzed (SCR 00/07). Males dominated the catches at depths down to about 1300 m and fish length increased with depth. Fish age ranged between 4 and 19 yeas, with age 6 as the most abundant. Further, information on length-weight, age-weight and age-length by sex was given.

2.3 Commercial fishery data.

Length and age distribution

Catch-at-age data from the offshore trawl fishery in Div. 1D were obtained from a Russian trawler (SCS 00/9 and SCR 00/07) and from length frequencies from Greenlandic trawlers combined with age data from the GHL survey in Div. 1CD. Catch-at-age from the longline fishery in 1CD (875 tons) was estimated using Canadian longline data.

Catch-at-age by gear (trawl and longlines + gill net based on data sampled from the longline fishery) and for gears combined was available from SA 0 (SCR 00/26). Table 3 and 4 shows catch-at-age and weight-at-age, respectively.

The age distributions for trawl and longline + gillnets are given in Fig.4.

Age 7 is the most dominant in the trawl fishery while age 8 was the most dominant in 1998. Age 7 has been the most dominant in 0B in both 1998 and 1999. The shift in age composition is probably caused by a shift in the length frequencies sampled in Div. 1D. In 1999 the mode in the Greenland catches was around 50 cm, but the mode in the Russian length frequencies used to raise 2,347 tons of the trawl catches was around 46 cm. In 1998 all trawl catches in Div. 1CD was raised using German catch-at-age data. The mode in the German catches were about 51cm. Further, there are discrepancies in the interpretation of the otolith between the three countries (SCS 99/9, SCR 00/10, SCS

00/09). The mode in the age distribution in the gill net and longline fishery has shifted from 10 – 11 in 1998 to 9 in 1999. The two age distributions are however not comparable because the age distribution in 1998 was based on samples from the gill net fishery while the distribution in 1999 is based on samples from the long line fishery.

Mean weight at age

The overall mean weight at age for the ages 7-12 in the commercial offshore fishery has been stable in resent years (Table 4).

Catch rate

Unstandardized catch rates were available from the Canadian trawl fishery in 0B (SCR 00/26). The Canadian catch rates increased to a little above the level for the period 1996-1998.

Unstandardized catch rates were taken from logbooks from the trawl fishery Div. 1CD and from (SCS 00/11) for EU(German) trawlers during 1996-1999. The catch rates from the Greenland, German and Norway fleets showed minor decreases compared to 1998, but they are still at the same level as in resent years (on small Norwegian vessel, new in the fishery and with low catch rates, was excluded from both the unstardaized and standardized analysis) Fig. 5.

Further, catch rates from the offshore longline fishery in Div. 1CD were available for the period 1994-1999. The catch rates in the longline fishery in Div. 1CD increased from 113 kg/hr in 1994 to 181 kg/hr in 1995, but have been decreasing gradually since from 110 kg/hr in 1996 to 81 kg/hr in 1997 and 74 kg/hr in 1998 and further to 50 kg/hr in 1999. The 1999 data represents, however, only 37% of the catches.

Standardized catch rate series from the offshore trawl fishery in SA0 (0B) was available for the period 1990-1998 and they showed stable catch rates during the period (SCR 99/47).

Standardized catch rate series for the offshore trawl fishery in SA1 (1CD) for the period 1987-1999 based on available logbook data and data from the EU-German trawl fishery (SCS 00/11).

The standardized catch rates in SA 1 dropped from 1989-1990 but has been stable since then except for a drop in 1993. The catch rate dropped slightly between 1998 and 1999 (Fig. 6). The decrease in the catch rate in SA1 in 1999 was caused by small decreases in Greenlandic, German and Norwegian catch rates (Fig. 5).

A combined catch rate for SA0 and SA1 was made based on the data from the two areas. The catch rates were stable in the period 1987-1989 (One large vessel in SA1 only and catches < 2600 tons), but dropped in 1990. From then on the catch rates haven been stable with minor fluctuations and the catch rates in 1999 are the same as in 1990 (Fig. 6, Appendix 1). Due to frequency of fleet changes in the fishery in both SA0 and SA1, and the few data from SA0 in 1999, the standardized indices of CPUE should however be treated 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. In 1999 data were sampled from the Canadian longline fishery (399 tons). The total longline catches in the area was about 10% of the total catches, hence no Catch-curve analysis was attempted.

3.2 XSA/ separable VPA.

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 has not improved. An XSA analysis was not attempted this year.

Separable VPA

A number of combinations of F and S were used to estimate numbers at age from a separable VPA. Average q's were estimated for each combination using the survey data from the Greenland Greenland halibut survey (age 5-16) 1997-1999 and population estimates from the separable VPA. The average q's were used to estimate survey based population numbers. The ln-transformed sum of the residuals of the difference between the separable VPA estimated population number at age and the estimates from the survey was minimized in order to find the most appropriate combination of F and S to be used as input parameters in a separable VPA. The most appropriate F and S was estimated at F=0.5 for age 8 and S=1.8.

The output is shown in Appendix 2. There is seen a systematic shift in the residuals from 1994 to 1995. This is probably caused by the introduction of the gill net fishery in Div 0B and the increase in the longline catches in 1995. Hence the assumption of constant exploitation pattern has not been fulfilled. The estimated biomasses are about 1/3 of what should be expected from the swept area estimats from Div. 1CD and the pattern of the development in the estimated biomasses does not fit the pattern observed in the surveys, especially not at the beginning of the period. The recruitment at age 5 in 1999 is estimated to be almost two times larger than in the pervious years. The 1994 year-class was estimated to be among the smallest from the shrimp survey (fig.2-3).

Further, it should be pointed out that there have been inconsistencies in the aging during the years because of poor sampling. In SA1 age length key from the Canadian fishery in 0B (1997), German fishery (1998), Russian fishery (1998) and Greenlandic surveys (various years) has been used and there has been considerable variation in the interpretation of the otolith. Further, samples from gill net has been used to raise longline catches and visa versa.

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. 3. 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 small proportion of the mature fish, the survey covers only a restricted part of the area covered by the assessment, further, knife edge maturity ogive was applied) and poor estimate of age of the recruits (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 1999 (catches, survey biomass index, and CPUE index) have only changed very little compared to previous year 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. The age composition in the catches seems stable. Standardized catch in Div. 1CD have declined slightly from 1998 to 1999, but the catch rates from Div. 1CD seems to be at an average level for the period 1990-1999. The combined catch rate has showed very little variation in the same period. An unstandardized longline CPUE index showed a decrease from 1995 to 1999.

Survey biomass decreased slight from 1998 to 1999 but was higher than in 1997. The length distribution in the survey 1999 showed a mode around 46-49 cm, as seen in previous year's surveys. A new survey covering Div. 0A gave an estimated biomass of 83,000 tons. The length distribution showed a broad mode around 38 cm. The recruitment increased compared to 1998 and seems to be well above 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

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

Brodie W.B. 1999. Analysis of data from the commercial fishery for Greenland halibut in Subarea 0. NAFO SCR Doc. 99/47.

Brodie W.B. 2000. Data from the commercial fishery for Greenland halibut in Subarea 0. NAFO SCR Doc. 00/26.

Engelstoft, J.J. and O. Jørgensen. 2000. Biomass and Abundance of dermersal fish stocks off West Greenland estimated from the Greenland trawl survey, 1988-1999.NAFO SCR Doc. 00/22.

Gorchinsky K.V. 20000. Age-length Composition of Commercial Catches of Greenland Halibut from Division 1D September October 1999, NAFO SCR Doc. 00/07.

Jørgensen O.A. 2000. Survey for Greenland halibut in NAFO Divisions 1C-1D, 1999. NAFO SCR Doc. 00/10.

Morgan M.J and W.R. Bowering. 2000. Maturity at Age and Size of Greenland Halibut (Reinhardtius hippoglossoides) and Geographic Distribution of Spawning Fish. NAFO SCR Doc. 00/06.

Ratz H.-J., M. Stein and P. Cornus. German research report. SCS Doc. 99/11.

Treble, M.A., W.B. Brodie, W.R. Bowering, O.A. Jørgensen. 2000. Analysis of Data from a Trawl Survey in NAFO Division 0A, 1999. NAFO SCR Doc. 00/31.

Table 1. Greenland halibut catches (metric tons) by year and country for Subarea 0 from 1987 to 1999.

	Year												
Country	87	88	89	90	91	92	93	94[a]	95[a]	96[a]	97[a]	98[a]	99[a]
CAN	-	2	-	589	256	2194	883	-	1656	2293	3805	3811	4567
EST	-	-	-	-	-	-	631	-	-	-	-	-	-
FRO	388	963	596	2252	2401	463	1038	-	-	3013	-	-	-
JAP	-	-	-	113	232	337	252	600	1031	500	-	-	-
LAV	-	-	-	-	-	-	83	-	-	-	-	-	-
NOR	-	-	282	5016[d]	3959	-	373	-	-	-	-	-	-
RUS	-	59	29	1528	1758	9364	4229[b]	3674	261	915	-	-	-
TOTAL	388	1024	907	9498	8606	12358	7489	4274	5299[c]	6721	5740[e]	4370[f]	4567

[a] Provisional data.
[b] The russian catch is reported as area unknown, but has peviously been reported from 0B
[c] Including 2351 tons non-reported.
[d] Dobbel reported as 10031 tons
[e] Including 1935 tons non-reported
[f] Including 559 tons unreported

Table 2. Greenland halibut catches (metric tons) by year and country for Subarea 1 from 1987 to 1999.

	Year												
Country	87	88	89	90	91	92	93	94[a]	95[a]	96[a]	97[a]	98[a]	99[a]
GRL (excl. 1A inshore)	-	-	-	-	965	227	213	885	1405	1880	2312	2296	2622
FRO	-	-	-	54	123	151	128	780	-	142	128	-	-
JPN	907	1581	1300	988	677	2902	1198	820	337	-	-	-	-
NOR	-	-	-	-	611	2432	2344	3119	2472	1839	1893	1339	1356
RUS	-	-	-	-	-	-	5	-	296	254	-	543	552
EU	-	-	-	-	-	-	46	217	527	450	446	350	439
1A-F (excl. 1A inshore)	907	1581	1300	1042	2376	5712	3934	5821	5704[b]	4565	4779	4528	5100[c]

[a] Provisional data.
[b] Including 667 tons non-reported.
[c] Including 131 tons non-reported

Table 3. Catch numbers at age

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE													
5	2	1	1	4	20	53	241	252	98	169	60	76	271
6	31	29	36	87	318	678	651	855	478	647	428	378	1129
7	182	190	244	592	1742	2967	2422	2460	1995	2430	1951	818	1773
8	296	354	409	1711	2679	4311	2356	1685	1190	2016	2401	1140	1172
9	193	245	212	1356	1418	2604	1048	949	744	872	1152	905	668
10	77	115	75	711	533	951	590	293	371	415	481	583	372
11	40	80	47	359	221	398	224	182	326	208	256	430	233
12	18	61	48	195	144	231	130	159	284	158	127	209	182
13	10	58	44	189	108	158	72	124	157	76	100	155	170
14	9	46	42	115	60	85	59	57	109	64	22	99	94
15	6	35	26	67	36	45	37	54	120	43	13	19	59
16	3	15	12	17	6	23	26	34	52	38	12	4	38
17	4	4	1	3	2	1	4	10	26	14	0	0	18
+gp	2	1	0	0	0	0	2	7	13	22	0	0	6
TOT.NUM	873	1234	1197	5406	7287	12505	7862	7121	5963	7172	7003	4816	6185
TONS	1295	2605	2207	10540	10982	18070	11423	10095	11003	11286	10519	8898	9667

Table 4. Catch weights at age (kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
5	0,29	0,29	0,29	0,33	0,34	0,33	0,58	0,43	0,47	0,51	0,36	0,50	0,54
6	0,51	0,51	0,51	0,54	0,54	0,56	0,72	0,62	0,64	0,67	0,55	0,72	0,70
7	0,74	0,74	0,74	0,79	0,79	0,80	0,96	0,91	0,93	0,93	0,86	0,97	0,98
8	1,08	1,08	1,08	1,10	1,12	1,13	1,26	1,26	1,33	1,37	1,27	1,25	1,28
9	1,41	1,42	1,42	1,52	1,57	1,59	1,80	1,72	1,81	1,89	1,83	1,57	1,65
10	1,97	2,05	2,00	2,11	2,27	2,28	1,43	2,19	2,40	2,47	2,37	2,24	2,25
11	2,58	2,80	2,68	2,94	3,22	3,02	3,25	2,73	2,93	3,17	3,01	3,09	2,70
12	3,52	3,88	3,73	3,90	4,24	4,02	4,10	3,43	3,65	4,03	3,84	3,84	3,67
13	4,64	5,01	4,87	4,96	5,50	5,33	5,26	4,48	4,48	5,06	4,93	4,74	4,72
14	5,79	6,16	6,20	6,26	6,82	6,76	6,17	5,75	5,66	5,95	5,70	6,04	5,59
15	6,61	7,44	7,65	7,96	8,33	7,76	7,42	6,58	6,65	7,29	6,79	6,60	6,66
16	7,99	8,88	9,36	9,90	9,89	8,58	8,04	7,36	7,74	8,63	8,00	13,45	7,73
17	9,56	9,86	9,56	11,86	9,56	11,95	9,24	9,42	10,28	9,16			9,11
+gp		11,33					10,25	11,15	11,00	11,10			11,01

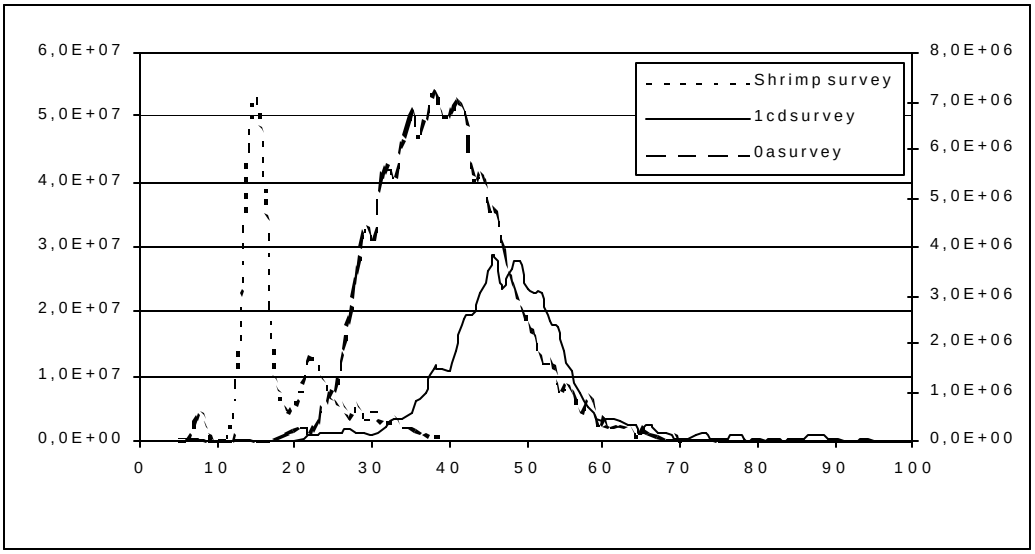

Fig. 1. Length frequencies of Greenland halibut in the Greenland shrimp survey (left y-axis), the Greenland surveys in Div. 1CD and the Canadian survey in Div. 0A (right y-axis).

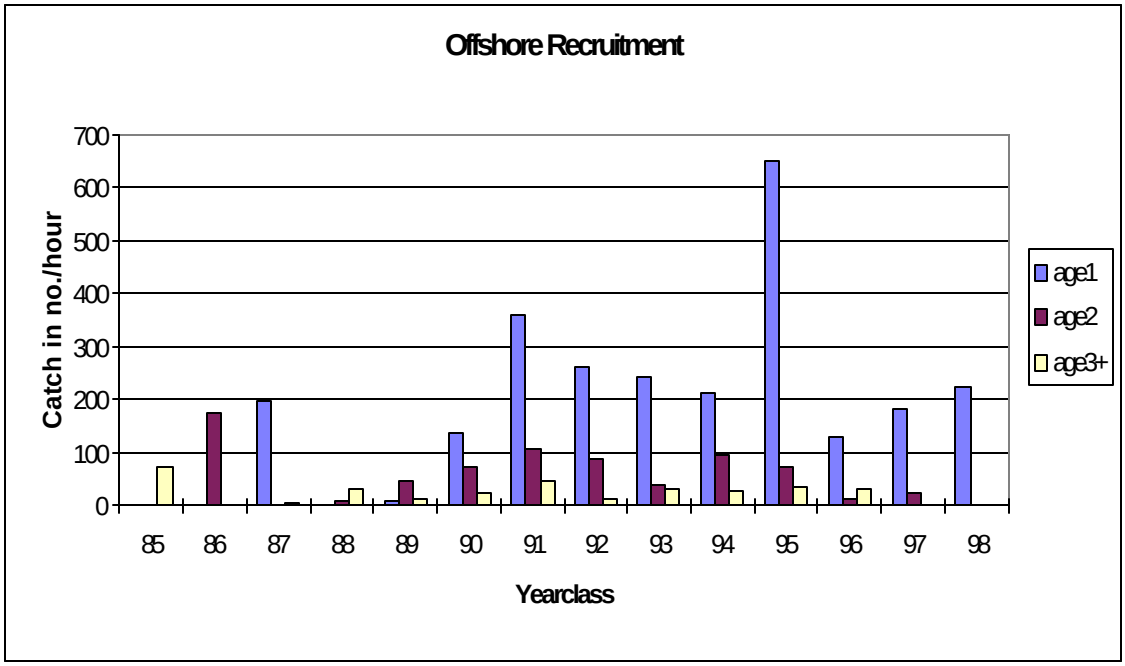

Fig. 2. Year-class strength of Greenland halibut of ages 1-3 in number per hour trawled in the offshore nursery area.

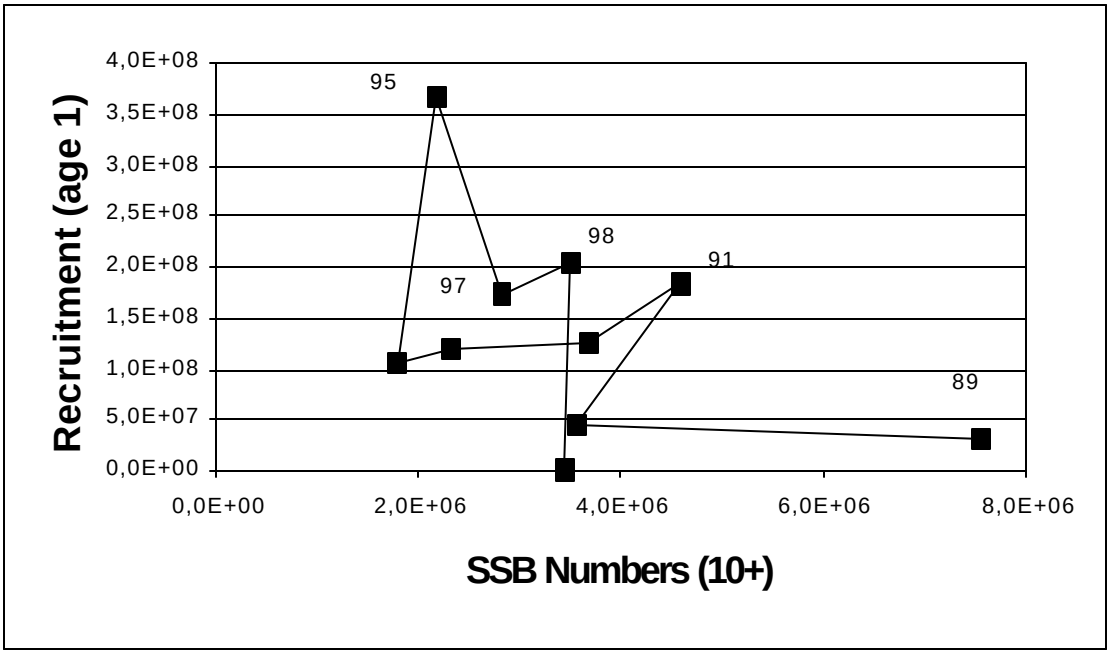

Fig. 3. Spawning stock in numbers (ages 10-18 in Div.1CD from the joint Japan/Greenland survey and the Greenland survey (1997-1999)) plotted vs number of fish age 1 the following year estimated from the Greenland shrimp trawl survey. Note pure coverage in 1989 and 1990 and that there was no survey in 1996.

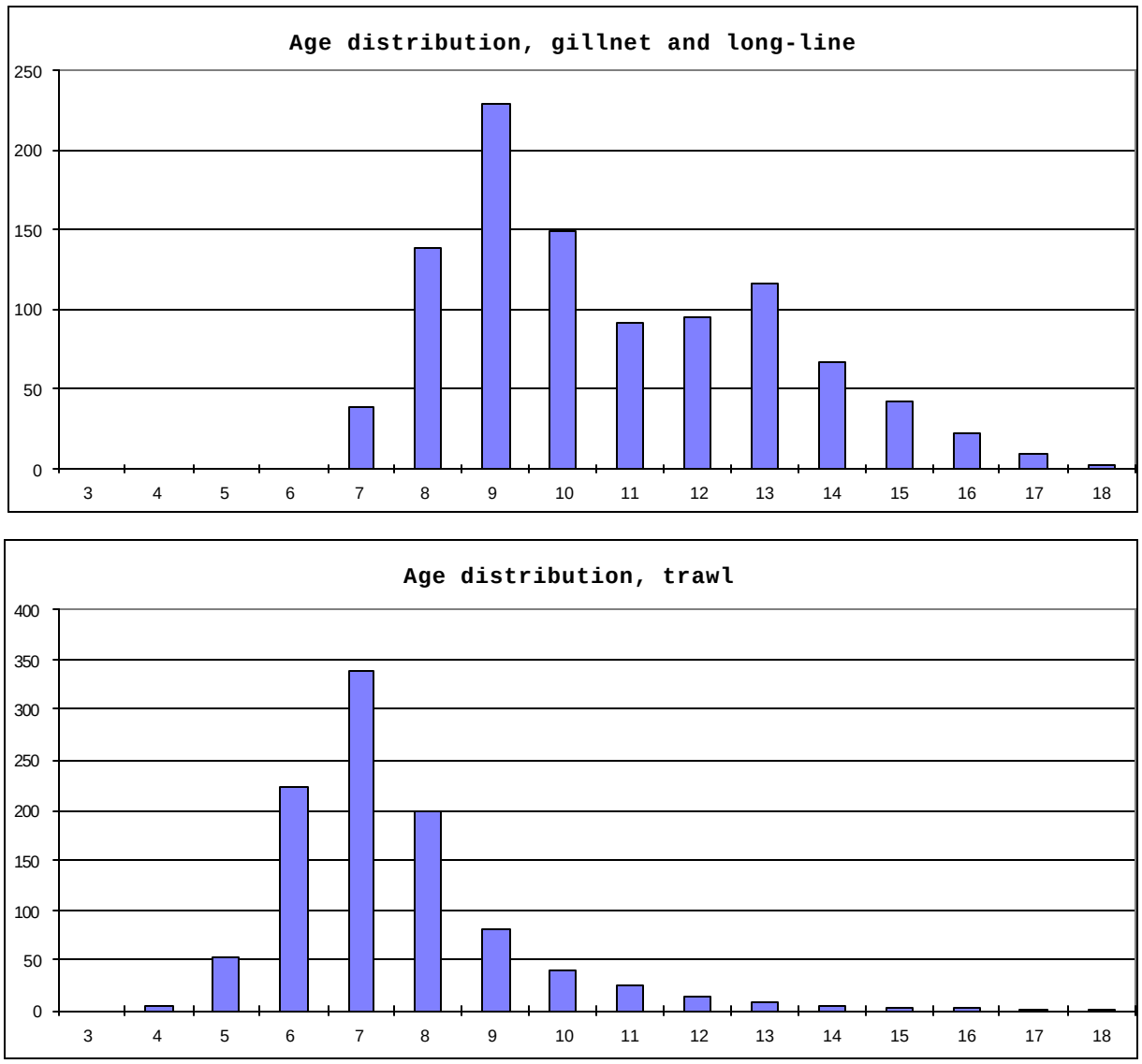

Fig 4. Age distribution in the offshore gill net and longline and trawl fishery in SA 0+1 in 1999 in per mill.

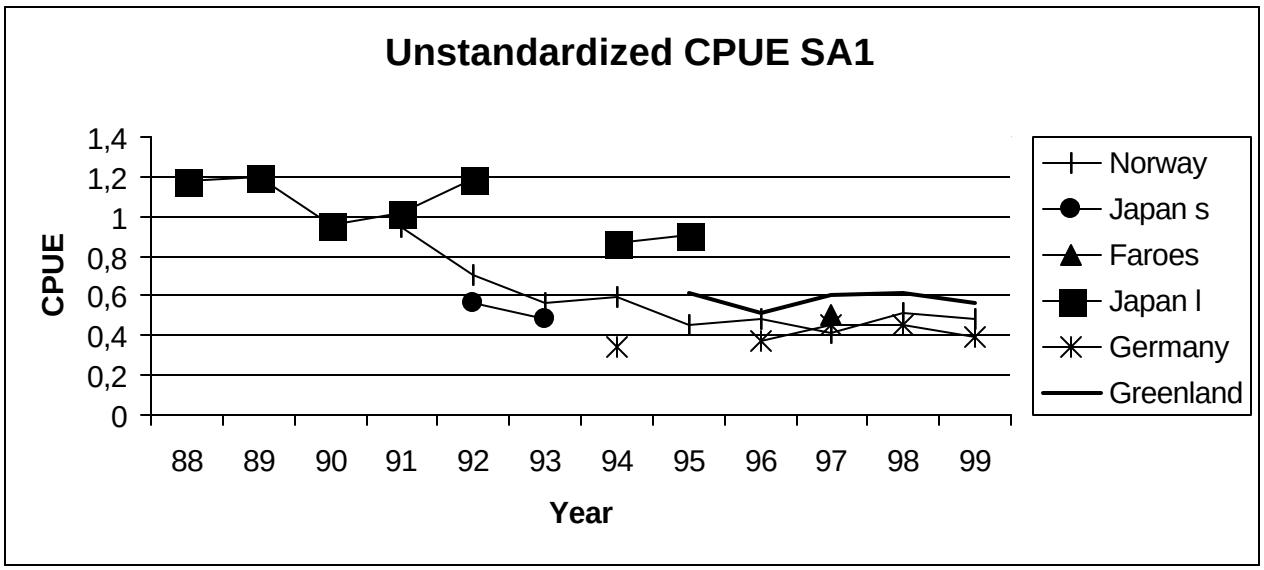

Fig. 5. Unstandardized trawl CPUE series from Div. 1CD.

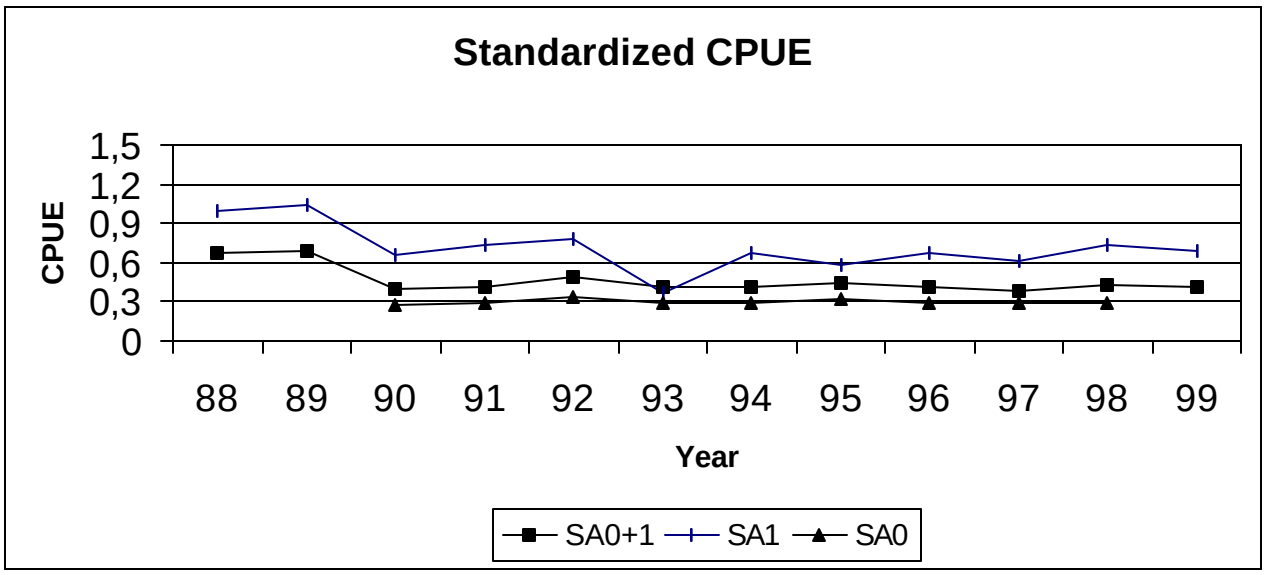

Fig. 6. Standardized trawl CPUE indices from SA1 (Div. 1CD) and SA0+1 (Div. 0B) (not corrected for retransformation) and SA0 corrected for retranformation.

Appendix 1. Combined standardized CPUE index SA0+1

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YR	13	87 88 89 90 91 92 93 94 95 96 97 98 99
MD	11	1 2 4 5 6 7 8 9 10 11 12
CGT	17	2 3 4 6 7 8 9 2126 2127 5126 5127 14124 14125 15126 15127 20126 20127

Number of observations in data set = 458

General Linear Models Procedure

Dependent Variable: LCPH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	38	90.6855622	2.3864622	42.53	0.0001
Error	419	23.5131870	0.0561174		
Corrected Total	457	114.1987492			

R-Square	C.V.	Root MSE	LCPH Mean
0.794103	-31.04365	0.23689	-0.76309

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	12	38.7484836	3.2290403	57.54	0.0001
MD	10	6.4548691	0.6454869	11.50	0.0001
CGT	16	45.4822096	2.8426381	50.66	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	12	2.9321736	0.2443478	4.35	0.0001
MD	10	5.3061644	0.5306164	9.46	0.0001
CGT	16	45.4822096	2.8426381	50.66	0.0001

Parameter		Estimate		T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-0.890411843	B	-8.91	0.0001	0.09989715
YR	87	0.573309289	B	2.20	0.0284	0.26075151
	88	0.502346264	B	2.87	0.0043	0.17509747
	89	0.519352970	B	3.21	0.0014	0.16188233
	90	-0.045551430	B	-0.51	0.6124	0.08984067
	91	0.010748545	B	0.12	0.9065	0.09150141
	92	0.165394323	B	1.81	0.0703	0.09116092
	93	-0.007733703	B	-0.08	0.9332	0.09217842
	94	0.018484793	B	0.19	0.8459	0.09507176
	95	0.071207111	B	0.71	0.4784	0.10035595
	96	0.009054072	B	0.11	0.9150	0.08475010
	97	-0.054992277	B	-0.66	0.5122	0.08383411
	98	0.038471826	B	0.45	0.6525	0.08536792
	99	0.000000000	B	.	.	.
MD	1	-0.612523949	B	-2.41	0.0163	0.25395457
	2	-1.055280819	B	-4.12	0.0001	0.25614751
	4	-0.540885537	B	-1.95	0.0519	0.27740057
	5	-0.286308613	B	-1.43	0.1545	0.20074275

General Linear Models Procedure

Dependent Variable: LCPH

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
MD	6	-0.842931329 B	-5.23	0.0001	0.16113720
	7	-0.408999239 B	-6.53	0.0001	0.06266083
	8	-0.303829098 B	-5.46	0.0001	0.05564694
	9	-0.342084006 B	-6.63	0.0001	0.05163092
	10	-0.362369493 B	-7.40	0.0001	0.04899214
	11	-0.197780243 B	-3.99	0.0001	0.04961920
	12	0.000000000 B	.	.	.
CGT	2	0.285921518 B	3.15	0.0018	0.09079002
	3	0.740136348 B	6.44	0.0001	0.11484878
	4	0.270843101 B	1.67	0.0952	0.16195746
	6	0.612600853 B	2.44	0.0153	0.25148604
	7	0.972871689 B	12.67	0.0001	0.07677771
	8	0.217242910 B	2.42	0.0159	0.08977168
	9	0.555805629 B	6.16	0.0001	0.09018579
	2126	0.387178407 B	4.92	0.0001	0.07876770
	2127	0.830203564 B	12.23	0.0001	0.06785884
	5126	0.679495794 B	5.76	0.0001	0.11791461
	5127	0.887529051 B	14.68	0.0001	0.06046361
	14124	0.314112160 B	5.29	0.0001	0.05943222
	14125	0.527827988 B	3.51	0.0005	0.15031448
	15126	1.081403021 B	16.18	0.0001	0.06684648
	15127	1.041107425 B	11.94	0.0001	0.08718140
	20126	0.015755561 B	0.39	0.6998	0.04083379
	20127	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. Estimates followed by the letter 'B' are biased, and are not unique estimators of the parameters.

Appendix 2. Output from Separable VPA and VPA

```
1

     Title : GREENLAND HALIBUT NAFO SUBAREAS 0+1

     At  5/06/2000   2:41

     Separable analysis
     from 1987 to 1999 on ages  5 to 16
     with Terminal F of  .500 on age  8 and Terminal S of 1.800

     Initial sum of squared residuals was   296.353 and
       final sum of squared residuals is     58.651 after  52 iterations

     Matrix of Residuals


      Years,    1987/88,1988/89,
       Ages

       5/ 6,     -.419, -2.192,
       6/ 7,      .122, -1.056,
       7/ 8,      .102,  -.873,
       8/ 9,      .546,  -.012,
       9/10,      .725,   .510,
      10/11,      .473,   .531,
      11/12,      .147,   .204,
      12/13,     -.538,   .082,
      13/14,    -1.035,  -.067,
      14/15,     -.742,   .306,
      15/16,     -.280,   .823,

       TOT ,      .031,   .017,
       WTS ,      .001,   .001,



      Years,    1989/90,1990/91,1991/92,1992/93,1993/94,1994/95,1995/96,1996/97,1997/98,1998/99,        TOT,         WTS,

       5/ 6,    -1.336, -2.848, -1.390, -1.363,   .230,  1.177,  -.406,   .462,  -.182, -1.039,       .003,        .269,
       6/ 7,     -.065, -1.883,  -.585,  -.501,  -.260,   .515,  -.599,  -.144,   .575,  -.337,       .006,        .459,
       7/ 8,     -.426, -1.696,  -.588,  -.468,   .034,   .762,  -.342,  -.365,   .441,  -.488,       .005,        .487,
       8/ 9,     -.082,  -.450,  -.093,   .221,   .199,   .404,  -.491,  -.284,   .427,  -.052,       .003,        .907,
       9/10,     -.216,   .185,   .191,   .199,   .459,   .429,  -.313,  -.352,   .029,   .206,       .001,        .912,
      10/11,     -.270,   .754,   .410,   .525,   .700,  -.284,   .030,  -.119,  -.204,   .573,       .000,        .775,
      11/12,     -.084,   .535,   .098,   .224,  -.100,  -.593,   .204,  -.076,  -.081,   .545,       .000,       1.000,
      12/13,      .005,   .234,   .049,   .270,  -.380,  -.128,   .801,  -.100,  -.470,  -.101,       .001,        .843,
      13/14,      .262,   .606,   .190,  -.129,  -.385,  -.203,   .176,   .485,  -.451,  -.004,       .003,        .688,
      14/15,      .847,   .701,   .291,  -.221,  -.456, -1.013,   .271,   .911,  -.243,   .078,       .004,        .501,
      15/16,     1.707,  1.879,   .338,  -.634,  -.548,  -.332,   .375,   .496,   .698, -1.237,       .004,        .329,

       TOT ,      .009,   .007,   .007,   .007,   .007,   .004,   .002,   .003,   .004,   .002,      -7.720,
       WTS ,      .001,   .001,   .001,   .001,   .001,  1.000,  1.000,  1.000,  1.000,  1.000,


       Fishing Mortalities (F)

              ,    1987,   1988,   1989,
     F-values,   .0518,  .0999,  .0812,

              ,    1990,   1991,   1992,   1993,   1994,   1995,   1996,   1997,   1998,   1999,
     F-values,   .3853,  .3690,  .6632,  .4376,  .4079,  .5292,  .4897,  .4114,  .4524,  .5000,

      Selection-at-age (S)

              ,       5,      6,
     S-values,   .0287,  .1663,

              ,       7,      8,      9,     10,     11,     12,     13,     14,     15,     16,
     S-values,   .7213, 1.0000,  .9233,  .7259,  .7711,  .8727, 1.0645, 1.1379, 1.3983, 1.8000,

1

Traditional vpa  Terminal populations from weighted Separable populations

       Fishing mortality residuals
       YEAR,       1987,    1988,    1989,

       AGE
         5,       -.0013,  -.0028,  -.0023,
         6,       -.0035,  -.0131,  -.0103,
         7,        .0110,  -.0347,  -.0232,
         8,        .0796,   .0187,   .0187,
         9,        .1068,   .0528,   .0167,
        10,        .0557,   .0506,  -.0018,
        11,        .0390,   .0484,   .0016,
        12,        .0073,   .0698,   .0269,
        13,       -.0082,   .1184,   .0672,
        14,       -.0136,   .1817,   .1457,
        15,       -.0099,   .0945,   .1423,
        16,        .0000,   .0272,  -.0350,
```

Fishing mortality residuals

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	-.0107,	-.0088,	-.0143,	.0067,	.0087,	-.0038,	.0129,	-.0035,	-.0061,	.0000,
6,	-.0569,	-.0316,	-.0365,	-.0025,	.0156,	-.0415,	.0101,	.0155,	-.0120,	.0433,
7,	-.2137,	-.0823,	-.0845,	.0313,	.0890,	-.1134,	-.0245,	.1105,	-.1107,	.0764,
8,	-.0393,	.0573,	.1939,	.1497,	.0411,	-.2244,	-.0428,	.1778,	-.0351,	.0094,
9,	.1598,	.1656,	.2957,	.0817,	.0926,	-.1445,	-.0909,	.0885,	.0164,	-.0270,
10,	.1865,	.1012,	.2365,	.1789,	-.0682,	-.0660,	-.0458,	.0284,	.1045,	-.0618,
11,	.0973,	-.0423,	-.0225,	.0032,	-.0517,	-.0073,	-.0977,	-.0160,	.1634,	-.0952,
12,	.0474,	-.0662,	-.1751,	-.1077,	.0511,	.3182,	-.1019,	-.0988,	.0102,	-.0366,
13,	.2194,	-.0346,	-.2429,	-.2668,	-.0050,	.2886,	-.0611,	-.1055,	.0632,	.1037,
14,	.2571,	-.0278,	-.2553,	-.2023,	-.2379,	.1858,	.4518,	-.2487,	.0870,	.1429,
15,	.1459,	-.0594,	-.3868,	-.2145,	-.1160,	.2165,	.1125,	-.0414,	-.3501,	.1446,
16,	-.4430,	-.5554,	-.6336,	-.1329,	-.0026,	.0671,	.0101,	-.2352,	-.5227,	.4811,

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Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR,	1987,	1988,	1989,
AGE			
5,	.0002,	.0001,	.0001,
6,	.0051,	.0036,	.0033,
7,	.0483,	.0374,	.0354,
8,	.1314,	.1186,	.0999,
9,	.1546,	.1450,	.0917,
10,	.0932,	.1231,	.0572,
11,	.0789,	.1255,	.0643,
12,	.0525,	.1570,	.0978,
13,	.0469,	.2247,	.1537,
14,	.0453,	.2954,	.2382,
15,	.0625,	.2342,	.2559,
16,	.0931,	.2070,	.1113,
+gp,	.0931,	.2070,	.1113,
0 FBAR 7-14,	.0814,	.1533,	.1048,

Table 8 Fishing mortality (F) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE											
5,	.0003,	.0018,	.0047,	.0192,	.0204,	.0114,	.0270,	.0083,	.0069,	.0144,	.0099,
6,	.0072,	.0297,	.0738,	.0703,	.0834,	.0465,	.0915,	.0839,	.0632,	.1264,	.0912,
7,	.0642,	.1839,	.3938,	.3470,	.3832,	.2682,	.3287,	.4072,	.2156,	.4371,	.3533,
8,	.3460,	.4262,	.8570,	.5873,	.4490,	.3048,	.4469,	.5892,	.4173,	.5094,	.5053,
9,	.5155,	.5063,	.9080,	.4858,	.4693,	.3441,	.3612,	.4684,	.4341,	.4347,	.4457,
10,	.4662,	.3690,	.7179,	.4966,	.2279,	.3181,	.3096,	.3270,	.4330,	.3011,	.3537,
11,	.3944,	.2422,	.4888,	.3407,	.2629,	.4007,	.2799,	.3013,	.5123,	.2904,	.3680,
12,	.3837,	.2558,	.4036,	.2743,	.4072,	.7800,	.3255,	.2603,	.4050,	.3997,	.3550,
13,	.6296,	.3581,	.4630,	.1991,	.4293,	.8519,	.4601,	.3325,	.5448,	.6360,	.5044,
14,	.6955,	.3921,	.4994,	.2957,	.2263,	.7879,	1.0090,	.2195,	.6018,	.7118,	.5111,
15,	.6846,	.4565,	.5405,	.3974,	.4544,	.9564,	.7972,	.5339,	.2825,	.8437,	.5534,
16,	.2505,	.1087,	.5601,	.6549,	.7317,	1.0196,	.8915,	.5054,	.2917,	1.3811,	.7261,
+gp,	.2505,	.1087,	.5601,	.6549,	.7317,	1.0196,	.8915,	.5054,	.2917,	1.3811,	
0 FBAR 7-14,	.4369,	.3417,	.5914,	.3783,	.3569,	.5070,	.4401,	.3632,	.4455,	.4650,	

1

Traditional vpa Terminal populations from weighted Separable populations

Table 9 Relative F at age

YEAR,	1987,	1988,	1989,
AGE			
5,	.0026,	.0005,	.0007,
6,	.0631,	.0232,	.0310,
7,	.5940,	.2436,	.3379,
8,	1.6144,	.7736,	.9539,
9,	1.8996,	.9460,	.8755,
10,	1.1455,	.8027,	.5457,
11,	.9693,	.8182,	.6132,
12,	.6447,	1.0240,	.9338,
13,	.5761,	1.4654,	1.4669,
14,	.5564,	1.9266,	2.2730,
15,	.7680,	1.5275,	2.4424,
16,	1.1445,	1.3502,	1.0618,
+gp,	1.1445,	1.3502,	1.0618,
0 REFMEAN,	.0814,	.1533,	.1048,

Table 9 Relative F at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	MEAN 97-99
AGE											
5,	.0007,	.0053,	.0080,	.0509,	.0572,	.0224,	.0613,	.0230,	.0154,	.0309,	.0231,
6,	.0165,	.0870,	.1247,	.1857,	.2337,	.0917,	.2080,	.2309,	.1419,	.2718,	.2149,
7,	.1469,	.5381,	.6658,	.9172,	1.0738,	.5291,	.7468,	1.1213,	.4840,	.9399,	.8484,
8,	.7920,	1.2474,	1.4491,	1.5525,	1.2582,	.6012,	1.0154,	1.6224,	.9368,	1.0953,	1.2182,
9,	1.1800,	1.4816,	1.5353,	1.2841,	1.3149,	.6787,	.8207,	1.2897,	.9744,	.9347,	1.0663,
10,	1.0671,	1.0800,	1.2138,	1.3127,	.6386,	.6275,	.7035,	.9005,	.9719,	.6476,	.8400,
11,	.9027,	.7087,	.8265,	.9005,	.7365,	.7904,	.6359,	.8295,	1.1499,	.6245,	.8680,
12,	.8782,	.7486,	.6824,	.7250,	1.1409,	1.5386,	.7396,	.7166,	.9092,	.8596,	.8285,
13,	1.4411,	1.0481,	.7829,	.5262,	1.2029,	1.6804,	1.0455,	.9155,	1.2229,	1.3676,	1.1687,
14,	1.5920,	1.1474,	.8443,	.7817,	.6342,	1.5541,	2.2926,	.6044,	1.3509,	1.5308,	1.1620,
15,	1.5670,	1.3359,	.9138,	1.0506,	1.2733,	1.8864,	1.8112,	1.4701,	.6342,	1.8144,	1.3062,
16,	.5733,	.3181,	.9470,	1.7311,	2.0502,	2.0111,	2.0256,	1.3915,	.6547,	2.9700,	1.6721,
+gp,	.5733,	.3181,	.9470,	1.7311,	2.0502,	2.0111,	2.0256,	1.3915,	.6547,	2.9700,	
0 REFMEAN,	.4369,	.3417,	.5914,	.3783,	.3569,	.5070,	.4401,	.3632,	.4455,	.4650,	

1

Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1987,	1988,	1989,
AGE			
5,	10230,	13875,	15153,
6,	6514,	8804,	11941,
7,	4150,	5578,	7550,
8,	2584,	3403,	4625,
9,	1448,	1951,	2602,
10,	930,	1068,	1452,
11,	567,	730,	813,
12,	379,	451,	554,
13,	235,	309,	332,
14,	219,	193,	213,
15,	107,	180,	124,
16,	36,	86,	123,
+gp,	73,	29,	10,
0 TOTAL,	27472,	36656,	45491,

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 87-97	AMST 87-97
AGE													
5,	13587,	11937,	12050,	13613,	13428,	9349,	6831,	7776,	11959,	20462,	0,	11295,	11621,
6,	13041,	11691,	10256,	10323,	11494,	11324,	7956,	5723,	6638,	10223,	17361,	9623,	9915,
7,	10245,	11144,	9767,	8199,	8282,	9101,	9304,	6249,	4529,	5363,	7754,	7853,	8143,
8,	6273,	8269,	7981,	5670,	4988,	4859,	5991,	5765,	3579,	3142,	2982,	5229,	5492,
9,	3602,	3820,	4648,	2915,	2713,	2740,	3084,	3298,	2753,	2030,	1625,	2857,	2984,
10,	2043,	1851,	1982,	1613,	1544,	1460,	1672,	1849,	1777,	1535,	1131,	1547,	1588,
11,	1180,	1103,	1102,	832,	845,	1058,	914,	1056,	1148,	992,	978,	908,	927,
12,	656,	685,	745,	582,	509,	559,	610,	595,	672,	592,	639,	566,	575,
13,	432,	385,	456,	428,	381,	292,	221,	379,	395,	386,	342,	341,	350,
14,	245,	198,	231,	247,	302,	213,	107,	120,	234,	197,	176,	200,	208,
15,	144,	105,	115,	121,	158,	207,	83,	34,	83,	110,	83,	115,	125,
16,	82,	63,	57,	58,	70,	87,	69,	32,	17,	54,	41,	65,	69,
+gp,	15,	21,	2,	13,	35,	65,	65,	0,	0,	34,	19,		
0 TOTAL,	51545,	51272,	49394,	44616,	44749,	41315,	36906,	32876,	33784,	45120,	33130,		

1

Run title : GREENLAND HALIBUT NAFO SUBAREAS 0+1

At 5/06/2000 2:41

Traditional vpa Terminal populations from weighted Separable populations

Table 11 Spawning stock number at age (spawning time) Numbers*10**-3

YEAR,	1987,	1988,	1989,
AGE			
5,	0,	0,	0,
6,	0,	0,	0,
7,	0,	0,	0,
8,	0,	0,	0,
9,	0,	0,	0,
10,	930,	1068,	1452,
11,	567,	730,	813,
12,	379,	451,	554,
13,	235,	309,	332,
14,	219,	193,	213,
15,	107,	180,	124,
16,	36,	86,	123,
+gp,	73,	29,	10,

Table 11 Spawning stock number at age (spawning time) Numbers*10**-3

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
8,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
9,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
10,	2043,	1851,	1982,	1613,	1544,	1460,	1672,	1849,	1777,	1535,
11,	1180,	1103,	1102,	832,	845,	1058,	914,	1056,	1148,	992,
12,	656,	685,	745,	582,	509,	559,	610,	595,	672,	592,
13,	432,	385,	456,	428,	381,	292,	221,	379,	395,	386,
14,	245,	198,	231,	247,	302,	213,	107,	120,	234,	197,
15,	144,	105,	115,	121,	158,	207,	83,	34,	83,	110,
16,	82,	63,	57,	58,	70,	87,	69,	32,	17,	54,
+gp,	15,	21,	2,	13,	35,	65,	65,	0,	0,	34,

1

Run title : GREENLAND HALIBUT NAFO SUBAREAS 0+1

At 5/06/2000 2:41

Traditional vpa Terminal populations from weighted Separable populations

Table 12 Stock biomass at age (start of year) Tonnes

YEAR,	1987,	1988,	1989,
AGE			
5,	2957,	4024,	4394,
6,	3309,	4490,	6090,
7,	3067,	4128,	5587,
8,	2786,	3676,	4995,
9,	2042,	2770,	3694,
10,	1828,	2189,	2904,
11,	1465,	2043,	2178,
12,	1335,	1751,	2066,
13,	1091,	1551,	1616,
14,	1267,	1189,	1319,
15,	704,	1339,	946,
16,	290,	765,	1147,
+gp,	736,	292,	98,
0 TOTALBIO,	22875,	30204,	37035,

Table 12 Stock biomass at age (start of year) Tonnes

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	4484,	4035,	3977,	7896,	5774,	4394,	3484,	2800,	5980,	11050,
6,	7042,	6289,	5743,	7432,	7126,	7247,	5331,	3148,	4779,	7156,
7,	8093,	8848,	7814,	7871,	7537,	8464,	8653,	5374,	4393,	5256,
8,	6900,	9295,	9018,	7145,	6285,	6463,	8207,	7321,	4474,	4022,
9,	5475,	5997,	7390,	5248,	4666,	4960,	5828,	6035,	4322,	3349,
10,	4311,	4203,	4518,	3920,	3381,	3505,	4130,	4383,	3980,	3453,
11,	3470,	3552,	3327,	2704,	2307,	3100,	2899,	3178,	3558,	2252,
12,	2558,	2904,	2996,	2385,	1747,	2041,	2458,	2284,	2582,	2172,
13,	2144,	2116,	2433,	2254,	1705,	1307,	1116,	1869,	1871,	1822,
14,	1534,	1352,	1564,	1526,	1738,	1207,	637,	683,	1413,	1101,
15,	1149,	876,	895,	897,	1042,	1379,	608,	228,	547,	735,
16,	815,	620,	492,	465,	515,	670,	592,	259,	228,	416,
+gp,	172,	200,	30,	128,	354,	683,	672,	0,	0,	326,
0 TOTALBIO,	48148,	50286,	50197,	49870,	44176,	45420,	44615,	37563,	38127,	43109,

1

Run title : GREENLAND HALIBUT NAFO SUBAREAS 0+1

At 5/06/2000 2:41

Traditional vpa Terminal populations from weighted Separable populations

Table 13 Spawning stock biomass at age (spawning time) Tonnes

YEAR,	1987,	1988,	1989,
AGE			
5,	0,	0,	0,
6,	0,	0,	0,
7,	0,	0,	0,
8,	0,	0,	0,
9,	0,	0,	0,
10,	1828,	2189,	2904,
11,	1465,	2043,	2178,
12,	1335,	1751,	2066,
13,	1091,	1551,	1616,
14,	1267,	1189,	1319,
15,	704,	1339,	946,
16,	290,	765,	1147,
+gp,	736,	292,	98,
0 TOTSPBIO,	8715,	11117,	12274,

Table 13 Spawning stock biomass at age (spawning time) Tonnes

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
8,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
9,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
10,	4311,	4203,	4518,	3920,	3381,	3505,	4130,	4383,	3980,	3453,
11,	3470,	3552,	3327,	2704,	2307,	3100,	2899,	3178,	3558,	2252,
12,	2558,	2904,	2996,	2385,	1747,	2041,	2458,	2284,	2582,	2172,
13,	2144,	2116,	2433,	2254,	1705,	1307,	1116,	1869,	1871,	1822,
14,	1534,	1352,	1564,	1526,	1738,	1207,	637,	683,	1413,	1101,
15,	1149,	876,	895,	897,	1042,	1379,	608,	228,	547,	735,
16,	815,	620,	492,	465,	515,	670,	592,	259,	228,	416,
+gp,	172,	200,	30,	128,	354,	683,	672,	0,	0,	326,
0 TOTSPBIO,	16154,	15822,	16256,	14278,	12788,	13891,	13113,	12885,	14180,	12277,

1

Run title : GREENLAND HALIBUT NAFO SUBAREAS 0+1

At 5/06/2000 2:41

Traditional vpa Terminal populations from weighted Separable populations

Table 14 Stock biomass at age with SOP (start of year) Tonnes

	YEAR,	1987,	1988,	1989,
	AGE			
	5,	2984,	4030,	4424,
	6,	3340,	4497,	6131,
	7,	3095,	4134,	5624,
	8,	2812,	3682,	5028,
	9,	2061,	2774,	3719,
	10,	1845,	2193,	2924,
	11,	1478,	2046,	2192,
	12,	1347,	1754,	2080,
	13,	1101,	1553,	1627,
	14,	1278,	1191,	1328,
	15,	710,	1341,	952,
	16,	292,	766,	1155,
	+gp,	743,	292,	98,
0	TOTALBIO,	23088,	30254,	37281,

Table 14 Stock biomass at age with SOP (start of year) Tonnes

	YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
	AGE										
	5,	4647,	4136,	3980,	7779,	5842,	4415,	3483,	2861,	5976,	11179,
	6,	7299,	6448,	5747,	7323,	7210,	7282,	5329,	3217,	4777,	7239,
	7,	8388,	9071,	7820,	7755,	7625,	8505,	8650,	5492,	4391,	5317,
	8,	7151,	9529,	9025,	7039,	6359,	6494,	8204,	7482,	4472,	4069,
	9,	5674,	6148,	7395,	5170,	4721,	4984,	5826,	6168,	4319,	3388,
	10,	4468,	4309,	4522,	3863,	3421,	3522,	4128,	4479,	3978,	3494,
	11,	3597,	3642,	3330,	2664,	2334,	3115,	2898,	3248,	3556,	2278,
	12,	2651,	2977,	2998,	2349,	1768,	2051,	2457,	2335,	2581,	2198,
	13,	2222,	2169,	2435,	2220,	1725,	1313,	1116,	1910,	1870,	1843,
	14,	1589,	1386,	1566,	1503,	1758,	1213,	637,	698,	1413,	1114,
	15,	1191,	898,	895,	884,	1054,	1386,	608,	233,	546,	743,
	16,	845,	635,	492,	458,	521,	673,	592,	265,	228,	420,
	+gp,	179,	205,	30,	126,	358,	686,	672,	0,	0,	330,
0	TOTALBIO,	49900,	51554,	50234,	49133,	44697,	45640,	44599,	38387,	38107,	43612,
1											

Run title : GREENLAND HALIBUT NAFO SUBAREAS 0+1

At 5/06/2000 2:41

Traditional vpa Terminal populations from weighted Separable populations

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

	YEAR,	1987,	1988,	1989,
	AGE			
	5,	0,	0,	0,
	6,	0,	0,	0,
	7,	0,	0,	0,
	8,	0,	0,	0,
	9,	0,	0,	0,
	10,	1845,	2193,	2924,
	11,	1478,	2046,	2192,
	12,	1347,	1754,	2080,
	13,	1101,	1553,	1627,
	14,	1278,	1191,	1328,
	15,	710,	1341,	952,
	16,	292,	766,	1155,
	+gp,	743,	292,	98,
0	TOTSPBIO,	8796,	11136,	12356,

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

	YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
	AGE										
	5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	8,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	9,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	10,	4468,	4309,	4522,	3863,	3421,	3522,	4128,	4479,	3978,	3494,
	11,	3597,	3642,	3330,	2664,	2334,	3115,	2898,	3248,	3556,	2278,
	12,	2651,	2977,	2998,	2349,	1768,	2051,	2457,	2335,	2581,	2198,
	13,	2222,	2169,	2435,	2220,	1725,	1313,	1116,	1910,	1870,	1843,
	14,	1589,	1386,	1566,	1503,	1758,	1213,	637,	698,	1413,	1114,
	15,	1191,	898,	895,	884,	1054,	1386,	608,	233,	546,	743,
	16,	845,	635,	492,	458,	521,	673,	592,	265,	228,	420,
	+gp,	179,	205,	30,	126,	358,	686,	672,	0,	0,	330,
0	TOTSPBIO,	16741,	16221,	16268,	14067,	12939,	13959,	13108,	13168,	14172,	12420,
1											

Run title : GREENLAND HALIBUT NAFO SUBAREAS 0+1 ,

At 5/06/2000 2:42

Table 16 Summary (without SOP correction)

Traditional vpa Terminal populations from weighted Separable populations

,	RECRUITS, Age 5	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 7-14,
1987,	10230,	22875,	8715,	1295,	.1486,	.0814,
1988,	13875,	30204,	11117,	2605,	.2343,	.1533,
1989,	15153,	37035,	12274,	2207,	.1798,	.1048,
1990,	13587,	48148,	16154,	10540,	.6525,	.4369,
1991,	11937,	50286,	15822,	10982,	.6941,	.3417,
1992,	12050,	50197,	16256,	18070,	1.1116,	.5914,
1993,	13613,	49870,	14278,	11423,	.8001,	.3783,
1994,	13428,	44176,	12788,	10095,	.7894,	.3569,
1995,	9349,	45420,	13891,	11003,	.7921,	.5070,
1996,	6831,	44615,	13113,	11286,	.8607,	.4401,
1997,	7776,	37563,	12885,	10519,	.8164,	.3632,
1998,	11959,	38127,	14180,	8898,	.6275,	.4455,
1999,	20462,	43109,	12277,	9667,	.7874,	.4650,
Arith. Mean ,	12327,	41663,	13365,	9122,	.6534,	.3589,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		
1						

Run title : GREENLAND HALIBUT NAFO SUBAREAS 0+1 ,

At 5/06/2000 2:42

Table 17 Summary (with SOP correction)

Traditional vpa Terminal populations from weighted Separable populations

,	RECRUITS, Age 5	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 7-14,
1987,	10230,	23088,	8796,	1295,	.1472,	1.0093,	.0814,
1988,	13875,	30254,	11136,	2605,	.2339,	1.0017,	.1533,
1989,	15153,	37281,	12356,	2207,	.1786,	1.0066,	.1048,
1990,	13587,	49900,	16741,	10540,	.6296,	1.0364,	.4369,
1991,	11937,	51554,	16221,	10982,	.6770,	1.0252,	.3417,
1992,	12050,	50234,	16268,	18070,	1.1108,	1.0007,	.5914,
1993,	13613,	49133,	14067,	11423,	.8120,	.9852,	.3783,
1994,	13428,	44697,	12939,	10095,	.7802,	1.0118,	.3569,
1995,	9349,	45640,	13959,	11003,	.7883,	1.0048,	.5070,
1996,	6831,	44599,	13108,	11286,	.8610,	.9997,	.4401,
1997,	7776,	38387,	13168,	10519,	.7988,	1.0219,	.3632,
1998,	11959,	38107,	14172,	8898,	.6279,	.9995,	.4455,
1999,	20462,	43612,	12420,	9667,	.7783,	1.0117,	.4650,
Arith. Mean ,	12327,	42037,	13489,	9122,	.6480		.3589,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			
1							