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

by

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1. Introduction

The Greenland halibut stock component in Div. 1A inshore is considered to be recruited from the Davis Strait stock, but the adults appear isolated from its origin spawning stock (Boje et al. 1994). Thus, the component do probably not contribute to the spawning stock in the Davis Strait (Boje, 1994) and only sporadic spawning is observed in the inshore area (Jørgensen and Boje 1994). Hence, the inshore component is not assumed to be a self-sustainable stock, but dependent on immigration from the nursery area south of Disko Island (Bech 1995).

2. Description of the fishery and nominal caches

The main inshore fishing grounds for Greenland halibut are in Div. 1A (Fig. 1), where the total landings amounted to 24 277 tons in 1999, and comprising 99 % of the total inshore landings in Greenland. The inshore landings in Div. 1A were around 7,000 tons in the late 1980's, but have since then increased steadily (Fig. 2 and Table 1).

The inshore fishery in Div. 1A is located in three main areas: Disko Bay, Uummannaq and Upernavik (Fig. 1). The fishery is unquoted , but from 1998 a special fishery licence was required to land Greenland halibut catches. New license issues have since been limited. The total number of licenses is around 1200. There are no landing limitations on the fishery licenses.

The fishery is traditionally performed with longlines from small open boats below 20 GRT, or by means of dog sledges. In the latest years bigger boats (>25 foot) have however increased in numbers. Typically the fishery is carried out in the inner parts of the ice fjords at depth between 500 to 800 m. In the middle of the 1980s gillnets were introduced to the inshore fishery, and were used more commonly in the following years. Authorities have in recent years tried to discourage the use of gillnets, which has lead to an increased proportion of longline catches. A total ban for gillnets has been in force from year 2000, however, many exemptions have been given to this ban. Gillnet fishery is regulated by a minimum mesh-size of 110 mm (half meshes), while there are no gear regulations on longline fishery. In recent years longline catches have comprised of around 75 % of the catch.

Disko Bay

The Greenland halibut fishery is conducted in, and in front of an ice fjord in the immediate vicinity of Ilulissat town, and in an icefjord north of Ilulissat, Torsukattak (Fig. 1). The winter fishery in Ilulissat Icefjord, Kangia, is a typical fishery from the ice with longlines (mainly field-code LG29, 30 & 31). The fishery near Ilulissat is a mixture of gillnet and longline fishery carried out throughout the year around. The fishery in Torsukattak is almost exclusively carried out in the period July - August. Use of gillnets is prohibited in the innermost part of the ice fjords in the Disko Bay area. The catches in Disko Bay have increased continuously since 1990 (Fig. 2), but ceased in 1999, where 1999 catches was

similar to 1998 catches, approximately 10,500 tons (Table 1). The proportion of longline catches lowered from 54 % in 1998 to 38% in 1999.

Uummannaq

Fishery in Uummannaq area is conducted in a large system of icefjords . The main fishing ground is in the southwest part of the fjord system. At an earlier time Qarajaq Icefjord was the main fishing area but in recent years the fishery has moved further north to Sermilik and Itividup Ice fjords (Fig. 1). Use of gillnets is prohibited in the inner parts of the fjords in Uummannaq.

The catches in Uummannaq were stable of about 3,000 tons prior to 1992, but has since increased with some fluctuations. In 1999 landings are historic high at 8,425 tons (Fig. 2 and Table 1). The proportion of longline catches increased from 74% in 1998 to 94% in 1999.

Upernavik

The northernmost area consists of a large number of ice fjords. The main fishing grounds are Upernavik Ice fjord -and Giesecke Ice fjord . New fishing grounds around Kullorsuaq in the northern part of the area are exploited these years (Fig. 1). Use of gillnets is prohibited in Upernavik.

The catches in the Upernavik area have increased steadily from about 1,000 tons in the late eighties to about 3 to 4,000 tons in 1993 to 1995 (Fig. 2 and Table 1). The total catch was in 1998 the highest on record 7,012 tons, but in 1999 catch have reduced to 5,258 tons.

3. Input data

3.1 Research Fishery

3.1.1 Longline surveys

Prior to 1993 various longline exploratory fisheries with research vessels were conducted. Due to variable survey design and gear, these surveys are not comparable. In 1993 a longline survey for Greenland halibut was initiated for the inshore areas of Disko Bay, Uummannaq and Upernavik. The survey is conducted annually covering two of three areas alternately, with approximately 30 fixed stations in each area (see SCR Doc 00/29 for a detailed description).

In July-August 1999 the research longline vessel 'Adolf Jensen' covered the fjord areas of Uummannaq and Disko Bay. The coverage of Uummannaq was insufficient, due to technical problems. In Uummannaq only 9 linesettings was carried out. In Disko Bay23. CPUE and mean length for Greenland halibut in the different areas are shown in Tables 2-3 and figure 4.

3.1.2 Trawl surveys

The Greenland Institute of Natural Resources annually conduct a stratified random trawl survey in the period July to September in the area between 59°N and 72°30'N, from the 3-mile limit to the 600-m depth contour line. The target species is shrimp, hence the trawl used is a shrimp trawl with 20 mm mesh size in codend. However, the survey also covers the offshore nursery grounds for Greenland halibut southwest of Disko Island, as well as the inshore nursery ground, Disko Bay. An index of abundance of yearclasses 1-3 is provided from the survey, for details see Engelstoft and Jørgensen, 2000.

3.2 Commercial fishery data

3.2.1 Analysis of size distribution in landings

At landing, catches of Greenland halibut are separated in price-classes based on weight. In previous assessments the

proportion of 'large fish' in longline landings has been used to analyse the relative proportion of big and small fish in landings. But as the definitions of size-classes has changed over time, these figures was not used in this years assessment.

Random sampling of commercial gillnet and longline landings was carried out in the three main areas in February/Marts and July/August in order to obtain length distributions in the catches (Fig. 5).

3.2.2 Effort

From medio 1999 logbooks has been introduced in the inshore fishery on a voluntary basis. The available logbooks are at present very limited and has not been included in the present assessment.

3.2.3 Estimation of fishing mortality

In order to estimate the level of fishing mortality, catch-curve analyses were performed. Total mortality (Z) was obtained from catch-curves based on catch composition in longlines catches in each of the three areas and for summer and winter respectault. Age groups 10-14 were used for the linear regressions for all samples, assuming that age 10 is fully recruited to the fishery. Average values of Z for each of the three areas, Disko Bay, Uummannaq and Upernavik, were compiled as an average of the estimated Z values. The natural mortality, M was set at 0.15. (Fig. 12)

3.2.4 Yield per recruit analysis

A Yield per recruit analysis was performed for each area. An average of mean weight-at-age and an assumed average exploitation pattern for the period 1988 to 1999 was used. Missing weight-at-age data were estimated by age-weight regressions. Calculations were performed on single recruits in each area[1]. (Fig. 13)

3.2.5 Catch-at-age data

Calculations of catch-at-age data from 1988 to 1990 are described in Boje (1991), from 1991 to 1994 in Bech (1995), from 1995-97 in Simonsen and Boje (1997) and for 1998 in Simonsen (1998). Also in this assessment a compiled age length/weight key for the recent 3 year was used for each area (Table 9 &10). This was done due to frequent shift in age readers with only little or no intercalibration. It was thus assumed that that the relative shift in growth was less than shift in interpretation of otolith structure.

3.3 Recruitment data

A recruitment index was provided from the Greenland trawl survey (Engelstoft and Jørgensen 2000).

Catches of age 1, age 2 and age 3+ were standardised to catch in number per hour as described in (Bech 1995). Data were plotted as year classes to visualise the relative year-class strength (Fig. 10).

3.4 Biological data

A review of the tagging experiments in West Greenland in the period 1986-1998 has been conducted (Boje 1999). No fish tagged in the fjords have been caught in the offshore area in Div. 1A or in the more southern offshore spawning area. There is little to no fishing effort in Div. 1A offshore, but considerable fishing effort in the southern area. Therefore the former assumption that the stocks in the three main areas do not contribute to the offshore spawning stock in Davis Strait south of Div. 1A was confirmed. An insignificant intermingling between the fjords contributes further to the justification for assessing the three inshore areas separately. Tagging of inshore Greenland halibut in Div. 1A was continued in 1999.

Observations of sexual maturity of Greenland halibut was carried out in Disko Bay and Uummannaq in 1999 by visual assessment of the gonad (Table 5 from Riget and Boje 1989).

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1 The software FishLab ver. 1.0 for Excel was used for calc. of reference points.

4. Assessment

4.1 Longline survey results.

In the standardized surveys from 1993 to 1999 mean length in Disko Bay has been stable (between 53.6 to 57.0 cm). In Uummannaq mean lenght has increased while in Upernavik mean length has decreased. (Table 3; Fig. 4). Length disaggregated CPUE for Disko Bay showed a very stable mode around 60 cm (Fig. 5 A). In Uummannaq length disaggregated CPUE have shifted maxima from around 55 to 65 cm. (Fig. 5B). In Upernavik larger fish have become less abundant in catches, explaining the decrease in mean length. (Fig. 5C).

General trends in CPUE from the longline surveys were fairly stable in Disko Bay and Upernavik. In Uummannq an increase was observed (Table 3). However, variation was found to be high in the CPUE from the longlinesurvey (Simonsen *et al,* 2000). This high variation imply that changes in CPUE from year to year is just as likely as when doing longline settings in the same area several times the same year. Therefore, when analysing trends in CPUE caution should be taken.

4.2 Estimation of fishing mortality

Total mortality was estimated by means of catch-curves, and estimates of F are given in table 4 (M assumed 0.15). In Uummannaq F in 1999 was estimated to 0.38 and in Upernavik F in 1999 was estimated to 0.24. No estimate could be provided for Disko Bay because of a non-linear decay in the age interval 10-14 in the winter fishery. The F values estimates in 1999 are lower for Uummannaq and higher for Upernavik compared to 1998. But general lower than values obtained in the beginning of the nineties. This disagrees with information from the fishery, which indicate an increased effort (Simonsen and Boje, 1999). The reason for the noisy F values may bee that the fishery is exploiting different age-components in the different seasons and different localities. The basis input for a catch-curve analysis may thus be violated with the present sampling strategy with only two yearly random samplings from the commercial fishery. Furthermore seasonal migrations in the fjords are observed (Boje, 1999; pers. com. local fishermen), variable recruitment to the fishery and ageing problems may also causes problems in estimating F.

4.3 Effort

Logbooks are not mandatory in the fishery. Howver, in 1999 logbooks was introduced on a voluntary basis and information from these are at present very scarce and could not be used in the present assessment. Ealier attemps to estimate fishing effort has shown a signinficant correlation between effort (expresses as fishing days) and landings (Simonsen and Boje, 1999).

4.4 Biological reference points

Y/R analyses performed for each area using long-term averages of mean weight-at-age and an assumed exploitation pattern gave the following estimates of $F_{0.1}$ and F_{max}.
At Disko Bay $F_{0.1}$ was estimated to 0.19 F_{max} to 0.33
Earlier estimations of F suggest that F is beyond F_{max}.
At Uummannaq $F_{0.1}$ was estimated to 0.24 F_{max} to 0.46.
As the F_{1999} was estimated to 0.38 the exploitation of the inshore stock in Uummannaq is at F_{max}.
At Upernavik $F_{0.1}$ was estimated to 0.30 F_{max} was 0.53
As the F_{199} was estimated to 0.24 the exploitation of the inshore stock in Upernavik is below $F_{0.1}$.

4.5 Analysis of size distribution in landings

Mean lengths from the longline landings in the period 1993 to 2000 in Disko Bay, Uummannaq and Upernavik are showed in Fig. 6. Fish caught in summer are general smaller than fish caught during winter season.

Disko Bay showed an overall positive trend in mean length except for winter 2000. Fishing at the traditional winter

fishing grounds was impossible for most of the winter 2000 due to sea-ice conditions (the fishery is conducted from the ice). Instead an open-water fishery developed at alternative fishing grounds.

In Uummannaq, a negative trend in mean length is seen for the summer fishery while mean lengths was stable in winter fishery . In Upernavik a variable mean length without trend is seen for the summer, while for the winter fishery, mean length decreases significantly (ANOVA, $P<0.05$).

4.6 Catch at age

Age compositions in landings are shown in Table 6-8. Fish younger than age 11 did constitutes an increasing proportion until mid nineties in Disko Bay and Uummannaq. However, in recent years the proportion of fish of 11 year have stabilised.

In Upernavik the fishery have continued to exploit still younger age groups. In 1999 more than 80% of the catches comprises of fish of age 10 or below. In all 3 areas the stock composition is in 1999 comprised of fewer and younger age groups compared to the early nineties.

4.7 Recruitment

Recruitment of ages 1, 2 and 3+ has fluctuated in the period investigated (Fig. 8A + B). Both off- and inshore (Disko Bay) the numbers of one-year-old from the 1998 yearclass were above average. In Disko Bay it was the second highest on record. The 1997 yearclass that was very strong inshore was still above average at age 2. It is difficult to evaulate the reliability of these recruitment estimates as all year-classes before 1994 (at present in the fishery) have been estimated to be average or weak and are therefore difficult to trace in recent catch in numbers.

4.8 Condition index

A simple index (weight-length relationship) of G. halibut condition did only shown minor derivation and no major trends was observed in the period investigated1993-99 (Fig. 7).

5. An analytical approach, separable VPA

A separable VPA was carried out for the Disko Bay area. This area was selected because of longer and more continuous data series compared to Uummannaq and Upernavik.

5.1 Determination of terminal F's

The limited number of years in survey CPUE series (1993-94 and 96-97 and 1999) was considered inadequate for any tuning to catch data. Instead the surveydata was used to calibarate a seperable 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 longline survey (age 5-14) years 1993, 94, 96, 97 and 99 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=0.32 for age 10 and S=2.0 (Appendix A, figure 1).

A separable VPA was performed (Pope 1977, 1979) using 0.35 as terminal F (see 5.1) Input data is given in Appendix A, Table 2 and 3. M was set to 0.15 for all ages. The chosen run of the separable analysis is given in Appendix A, Table 1, the matrix of residuals is shown i appendix A, figure 2.

The generated terminal F's were used to run a cohorte analysis (part of the Lowestoft VPA suite). Catch in numbers is

given in Appendix A, Table 2 and weight at age in Table 3. Catch weights and stock weights at age were assumed similar, thus catch in numbers at age was ajusted in order to ajdust the factor [calc. catch]/[norm. landings] around 1.. As only few weight data are available prior to 1993, an average weight at age for the period was applied to the years 1985-1992. M was set to 0.15 for all ages. No maturity data is available maturity is assumed at age 10.. Reference F is chosen for ages 10-14, which are the age-groups fully recruited to the fishery and contributing mostly to the catch in numbers.

5.4 Output

Output from the VPA is given in Appendix A, Table 4, 5 and 6 and Fig. 3. Fishing mortality (Appendix A, Table 4, Figure 3) is low in the beginning of the time series, in the same level as M. VPA is known to perform very poor when this is the case. In later years F has fluctuated but a general increase is observed. The corresponding biomasses are given is Appendix A, Table 6 and Fig. 3. Due to the low F's in the first part of the time series, biomass estimates as well as recruitment are not considered reliable in that period. For the recent years as decline in biomass is evident along with the high F's.

Comments on the analytical approach

The present assessment cannot be taken face value due to inaccurate determination of terminal F's and the scarcity of effort data from the commercial fishery, but provides a likely scenario of recent years development of the stock. The analyses suggest that a revision of catch in numbers is required, e.g. as inferred from the selection pattern in the separable VPA. The stock dynamics of the Disko Bay Greenland halibut component is rather unusual , as it is assumed that the component does not spawn and that recruitment originates from the offshore component. This implies that biological reference points should account for this non-existing link between biomass and recruitment,

6. State of the stock components

Disko Bay. Catches have been increasing in the past 10 years from about 2,000 to 10,500 t in 1998, but ceased in 1999 at same level.

Survey results since 1993 do not indicate any major changes in abundance or stock composition. Yield per recruit analysis and earlier estimates of fishing mortality suggests an F level above F_{max}. In commercial catches mean length has increased. The stock component in Disko Bay is composed of younger and smaller individuals than in the other two areas. In spite of the increasing fishery, age and length composition in both commercial and survey catches have not changed significant in recent years.

Uummannaq. Catches have been increasing from less than 2,000 t before 1987 to a record high in 1999 of 8,425 t.

Survey results since 1993 indicate some increase in both abundance and mean length. Yield per recruit analysis and estimation of present fishing mortality suggests F level just below F_{max}. Catch composition in the commercial fishery has changed significant since the 1980's towards a higher exploitation of younger age-groups, but have been stable in recent years. Commercial catches from the summer fishery showed a continuos negative trend, while catches in winter have been at a stable length composition. In spite of the increasing fishery the stock component does not appear to be significantly effected.

Upernavik. Catches have increased from about 1,000 t prior to 1992 to about 5,000 t. in 1996 and 1997. In 1998, catches was the highest on record 7,012 tons, followed by a decline in 1999 to 5,258 t.

Survey results since 1993 do not indicate any major changes in abundance. Yield per recruit analysis and estimation of present fishing mortality suggests an F level at or below $F_{0.1}$. Age and length compositions in commercial and survey catches have changed to smaller fish, which in the commercial winter fishery is a significant change. The new and increasing fishery has thus affected the stock component in Upernavik as expected for a fishery on a virgin population. New fishing grounds in the northern part of the district are recently exploited. Little information exists from these areas, but the stock components are here considered virgin.

6.1 General comments

Concern is expressed by the continuing increase in total landings of Greenland halibut in NAFO Div. 1A inshore, especially because lack of information from the commercial fishery impedes the assessment of the stocks.

The fishing mortalities estimated from catch curves should be interpreted carefully. The inshore fishery does contrary to offshore fishery, takes place on smaller sub-components and size composition in these vary within season and locality.

The output of the separable VPA in Disko Bay was considered to be indicative of trends in fishing mortality and stock size but was not considered to be sufficiently reliable to estimate current fishing mortality.

The inshore stocks depend on recruitment from the offshore nursery grounds and the spawning stock in Davis Strait. Available information suggests that spawning only occurs sporadic in the fjords, hence the stock is not self-sustainable. The fish remain in the fjords, and do not contribute back to the offshore spawning stock.

Provisional studies of the by-catch of Greenland halibut in the commercial shrimp fishery suggest that the by-catch is considerable and could have a negative effect on recruitment to the inshore stock component.

Direct measurement of effort in the fishery should be provided. This would make it possible to obtain estimates of Z from the commercial fishery. Furthermore, trends in effort could be compared to trends in F. There is strong indications that effort has increased in recent years. Logbooks have just been introduced for parts of the inshore Greenland halibut fishery and will hopefully provide support to the assessment in the future.

7. References

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Tables:

Table 1. Landings and Greenland halibut (tons) in Div. 1A distributed on the main fishing grounds: Disko Bay, Uummannaq and Upernavik. Conversion faktor 1.05 for gutted fish with head, 1.50 for gutted fish without head, 1.52 for gutted fish without head and tail fin). Catch figures for 1998 include 5768 tons unreported landings..

Area/year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Disko Bay	2258	2670	2781	3821	5372	6577	5367	5201	7400	7837	8601	10671	10 593
Uummannaq	2897	2920	2859	2779	3045	3067	3916	4004	7234	4579	6294	6912	8 425
Upernavik	1634	777	1253	1245	1495	2156	3805	4844	2403	4846	4879	7012	5 258
Unknown	407	636	599	507	17	133							
Total in 1A	7196	7003	7492	8352	9929	11933	13088	14049	17037	17262	19774	24595	24 277

Table 2. CPUE values (kg/100 hooks) from longline surveys conducted in Div.1A inshore areas. Standardized survey since 1993

Area/year	1962	1985	1986	1987	1993	1994	1995	1996	1997	1998	1999
Disko bay	-	-	8.3	16.5	3.1	3.1	-	3.9	4.4	-	3.6
Uummannaq	4.6	13.7	-	8.6	2.8	-	6.6	4.5	-	6.1	8.2
Upernavik	-	-	-	-	-	5.2	3.9	-	-	4.2	

Table 3. Mean length (cm) from catches taken in inshore longline surveys. Standardized survey since 1993

Area/year	1962	1985	1986	1987	1993	1994	1995	1996	1997	1998	1999
Disko bay	-	62.4	53.5	62.2	55.9	56.5	-	53.6	57.0	-	56.7
Uummannaq	67.8	70.5	-	61.8	57.5	-	57.8	59.5	-	61.2	61.5
Upernavik	-	-	-	-	-	64.6	60.8	-	-	57.1	

Table 4. Estimates of fishing mortality (F) from catch curve analysis on commercial samples from 1987 to 1999.

Area/year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Disko Bay	0.42	0.16	0.24	0.51	0.4	0.45	0.51	0.8	0.54	0.44	0.73		
Uummannaq	1.09	1.01	1.01	0.88			1.2	0.98	1.31	0.25	0.45	0.41	0.38
Upernavik		0.35	0.41	0.48			0.42	0.58	0.43		0.20	0.12	0.24

Table 5. Descriptive stage of maturity used for visual analyses of Greenland halibut gonads.

Maturity stage	Physiologiacl stage of gonads	
	Fenale	**Male**
1	Juvenile or immature: overay very small . eggs not visible to the naked eye.	Juvenile or immature: Testes mostly clear and very small having a length of less than ¼ of the abdominal cavity
2	Mature A: Egges becoming visible to the naked eye	Mature A: Testes opaque having a length between ¼ and ½ of the abdominal cavity
3	Mature B: Eggs 1-2 mm in diameter. Less than 50% of the eggs are translucent	Mature B: Testes opaque having a length between ½ and ¾ of the abdominal cavity
4	Mature C: Eggs 2-4 mm in diameter. More than 50% of the eggs are translucent	Mature C: Testes big and white in appearance having a length between ¾ and 1/1 of the abdominal cavity
5	Running stage: Some eggs extruded but several thousands clear eggs remaning	Running stage: sperm is running
6	Spent stage: Overay appears reddish purple. wall is thick and though. some residual clear and opaque eggs are seen	

Table 6. Catch at age of Greenland halibut in 1988-1998 in Disko Bay.

	Catch in numbers (thousands)											
age/year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
4	0	0	0	5	34	7	0	0	0	0	0	1
5	0	0	0	5	92	15	3	0	8	0	0	4
6	1	0	0	11	122	62	15	0	1	21	74	41
7	9	0	1	279	332	280	112	45	47	132	397	360
8	59	14	24	806	476	479	281	459	323	646	775	619
9	182	106	141	535	390	339	539	639	941	1113	944	836
10	173	121	185	333	451	280	396	798	651	1168	1248	1028
11	132	94	188	238	532	240	190	463	454	607	754	786
12	73	49	126	76	309	122	91	185	273	185	346	426
13	63	33	80	45	140	91	50	127	145	69	132	136
14	65	39	59	67	92	112	45	27	75	19	68	72
15	38	31	42	57	18	75	41	36	44	10	27	29
16	18	19	23	35	0	57	21	12	31	3	4	1
17	11	14	15	7	0	12	10	15	5	2	1	1
18	4	8	6	2	0	10	1	0	33	1	0	0
19	0	0	0	0	0	7	3	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	1	0	0	0	0	0
Total	828	528	890	2501	2988	2188	1799	2806	3031	3976	4770	4340

Table 7. Catch at age of Greenland halibut in Uummannaq area in 1988-1998. -indicates insufficient sampling.

	Catch in numbers (thousands)											
age/year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
4	0	0	0	-	-	0	0	0	1	0	0	8
5	0	0	0	-	-	0	0	0	0	0	0	70
6	1	0	1	-	-	9	24	6	6	0	0	218
7	5	2	3	-	-	45	105	217	76	69	0	554
8	20	9	15	-	-	200	226	564	308	377	235	596
9	52	35	47	-	-	202	271	601	279	793	566	690
10	121	98	108	-	-	142	346	413	286	702	657	789
11	143	120	121	-	-	138	139	414	232	460	586	526
12	121	99	101	-	-	104	105	219	142	206	355	295
13	96	76	82	-	-	158	34	138	69	75	138	131
14	49	38	42	-	-	93	12	49	28	32	39	42
15	23	19	20	-	-	28	0	28	11	10	15	12
16	13	14	15	-	-	19	0	17	1	3	4	3
17	4	6	6	-	-	0	2	4	14	3	1	1
18	0	0	0	-	-	0	0	0	0	0	0	0
19	0	0	0	-	-	0	0	1	0	0	0	0
20	0	0	0	-	-	1	0	0	0	0	0	0
21	0	0	0	-	-	0	0	0	0	0	0	0
22	0	0	0	-	-	0	1	0	0	0	0	0
Total	648	516	561	-	-	1139	1265	2671	1453	2732	2595	3935

Table 8. Catch at age of Greenland halibut in Upernavik area 1988-1998. - indicates insufficient sampling.

	Catch in numbers (thousands)											
age/year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
4	0	0	0	-	-	0	0	0	0	0	0	14
5	0	0	0	-	-	0	0	0	3	4	0	55
6	0	0	0	-	-	0	2	0	0	25	116	172
7	0	0	0	-	-	0	51	13	16	142	343	449
8	6	2	2	-	-	2	188	55	114	428	538	619
9	33	16	17	-	-	16	316	84	359	500	535	566
10	55	34	41	-	-	86	217	128	275	430	505	343
11	80	59	62	-	-	252	239	133	238	278	410	229
12	74	66	57	-	-	268	154	147	206	175	275	138
13	68	69	52	-	-	143	155	117	151	67	112	51
14	62	73	48	-	-	95	51	103	90	37	84	36
15	31	40	25	-	-	40	23	45	48	19	39	16
16	13	18	11	-	-	29	0	28	26	7	10	4
17	7	10	5	-	-	10	0	8	4	1	0	0
18	2	3	1	-	-	5	0	3	9	0	0	0
19	0	0	0	-	-	1	0	1	0	0	0	0
20	0	0	0	-	-	1	0	2	0	0	0	0
21	0	0	0	-	-	0	0	0	0	0	0	0
22	0	0	0	-	-	0	0	0	0	0	0	0
Total	431	390	321	-	-	948	1396	867	1539	2111	2968	2679

Table 9. Age-length keys used for 1999. Keys were compiled on data for the last 3 years 1997-99.

Disko Bay age-length key 1997-99

length \ age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	*total*
30	3	7	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*31*
35	1	14	8	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*47*
40	0	0	14	20	35	0	0	0	0	0	0	0	0	0	0	0	0	0	*69*
45	0	0	4	33	42	22	0	0	0	0	0	0	0	0	0	0	0	0	*101*
50	0	0	0	8	66	45	15	0	0	0	0	0	0	0	0	0	0	0	*134*
55	0	0	0	0	0	26	63	53	11	0	0	0	0	0	0	0	0	0	*153*
60	0	0	0	0	0	13	49	83	10	1	0	0	0	0	0	0	0	0	*156*
65	0	0	0	0	0	0	9	34	87	22	0	0	1	0	0	0	0	0	*153*
70	0	0	0	0	0	0	0	2	34	79	21	13	0	0	0	0	0	0	*149*
75	0	0	0	0	0	0	1	0	4	28	42	10	2	0	0	0	0	0	*87*
80	0	0	0	0	0	0	0	0	0	0	9	18	8	0	0	0	0	0	*35*
85	0	0	0	0	0	0	0	0	0	1	3	7	15	0	0	0	0	0	*26*
90	0	0	0	0	0	0	0	0	0	0	1	0	5	1	0	0	0	0	*7*
95	0	0	0	0	0	0	0	0	0	0	1	0	0	2	3	0	0	0	*6*
100	0	0	0	0	0	0	0	0	0	0	1	1	3	2	3	0	0	0	*10*
total																			*1164*

Ummannaq age-length key 1997-99

length \ age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	*total*
30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*
35	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	*5*
40	0	0	17	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	*29*
45	0	0	6	35	12	0	0	0	0	0	0	0	0	0	0	0	0	0	*53*
50	0	0	3	13	54	34	11	2	0	0	0	0	0	0	0	0	0	0	*117*
55	0	0	0	1	29	47	66	13	0	0	0	0	0	0	0	0	0	0	*156*
60	0	0	0	0	0	12	30	74	24	4	1	0	0	0	0	0	0	0	*145*
65	0	0	0	1	1	2	1	35	73	29	8	0	0	0	0	0	0	0	*150*
70	0	0	0	0	0	1	3	4	22	75	32	13	0	0	0	0	0	0	*150*
75	0	0	0	0	0	0	1	3	2	23	68	22	8	3	0	0	0	0	*130*
80	0	0	0	0	0	0	1	0	0	3	29	41	16	2	1	1	0	0	*94*
85	0	0	0	0	0	0	0	0	0	0	4	15	17	3	0	0	0	0	*39*
90	0	0	0	0	0	0	0	0	0	0	0	2	8	3	1	1	0	0	*15*
95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	*1*
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	*2*
total																			*1087*

Upernavik age-length age-length key 1997-99

length \ age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	*total*
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*0*
35	0	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*6*
40	0	0	17	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	*27*
45	0	0	0	34	18	11	0	0	0	0	0	0	0	0	0	0	0	0	*63*
50	0	0	0	7	52	52	9	0	0	0	0	0	0	0	0	0	0	0	*120*
55	0	0	0	0	22	50	55	11	0	0	0	0	0	0	0	0	0	0	*138*
60	0	0	0	0	0	15	65	64	15	0	0	0	0	0	0	0	0	0	*159*
65	0	0	0	0	0	0	0	30	83	28	2	0	1	0	0	0	0	0	*144*
70	0	0	0	0	0	0	0	0	15	87	23	16	4	0	0	0	0	0	*145*
75	0	0	0	0	0	0	0	0	0	20	53	30	8	3	0	0	0	0	*114*
80	0	0	0	0	0	0	0	0	0	0	15	28	17	3	0	0	0	0	*63*
85	0	0	0	0	0	0	0	0	0	0	0	10	15	8	0	0	0	0	*33*
90	0	0	0	0	0	0	0	0	0	0	0	0	4	3	3	0	0	0	*10*
95	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	*3*
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	*1*
total																			*1026*

Table 10. Weight and weight at age for each component in Div. 1A inshore compiled on data for the last 3 years 1997-99

A)

Disko Bay	mean		
age (year)	length (cm)	weight (kg)	N
3	32.50	0.30	4
4	34.25	0.34	24
5	37.17	0.47	47
6	43.64	0.77	85
7	49.49	1.17	169
8	54.36	1.52	143
9	59.31	1.98	127
10	62.95	2.35	130
11	68.24	3.00	135
12	72.24	3.59	131
13	76.88	4.52	77
14	79.31	5.14	49
15	86.62	7.11	34
16	94.33	10.08	3
17	97.67	11.68	3

B)

Uummannaq	mean		
age (year)	length (cm)	weight (kg)	N
4	36.20	0.50	5
5	44.27	0.76	26
6	47.59	0.99	61
7	52.92	1.30	98
8	56.47	1.58	96
9	58.90	1.83	113
10	63.13	2.29	131
11	67.26	2.82	121
12	71.51	3.48	134
13	76.61	4.45	142
14	80.33	5.29	93
15	84.43	6.08	49
16	85.36	6.22	11
17	94.80	9.93	5
18	86.00	5.92	2

C)

Upernavik	mean		
age (year)	length (cm)	weight (kg)	N
4	37.00	0.42	3
5	40.95	0.58	19
6	46.28	0.88	51
7	52.20	1.24	93
8	54.81	1.46	128
9	59.26	1.87	129
10	62.81	2.30	105
11	67.06	2.98	113
12	71.53	3.69	135
13	76.51	4.54	93
14	78.86	5.21	84
15	82.67	6.24	49
16	85.94	7.30	18
17	94.20	8.47	5
19	100.00	10.70	1

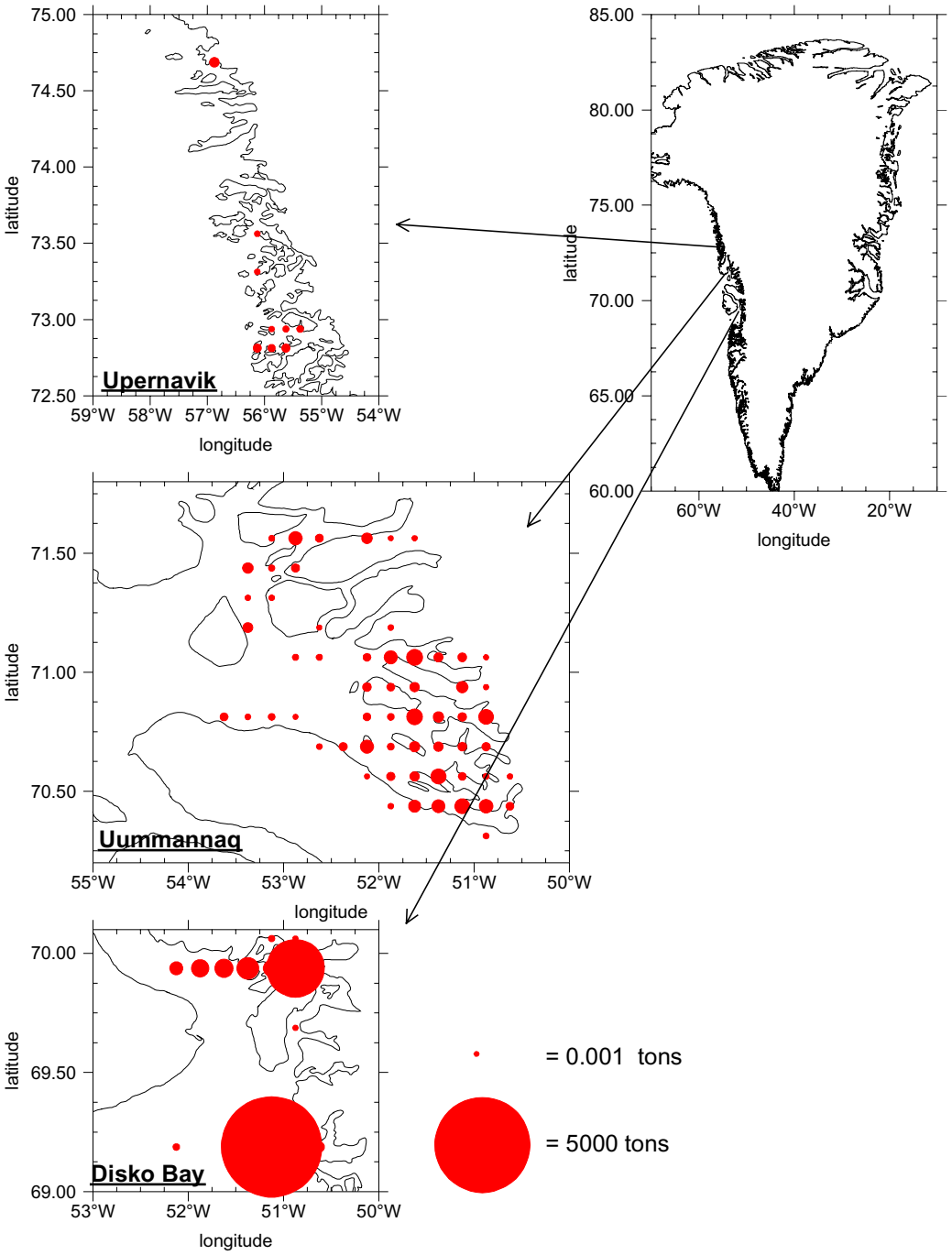

Figure 1. Location of main inshore fishing grounds for Greenland halibut in Div.1A. Landings is shown in kg per. Squarre (field-code). Catch statistics are provensial. For Disko Bay catch statistics was vaiable for 83%; for Uummannaq 11%; for Upernavik 1% of the total landings.

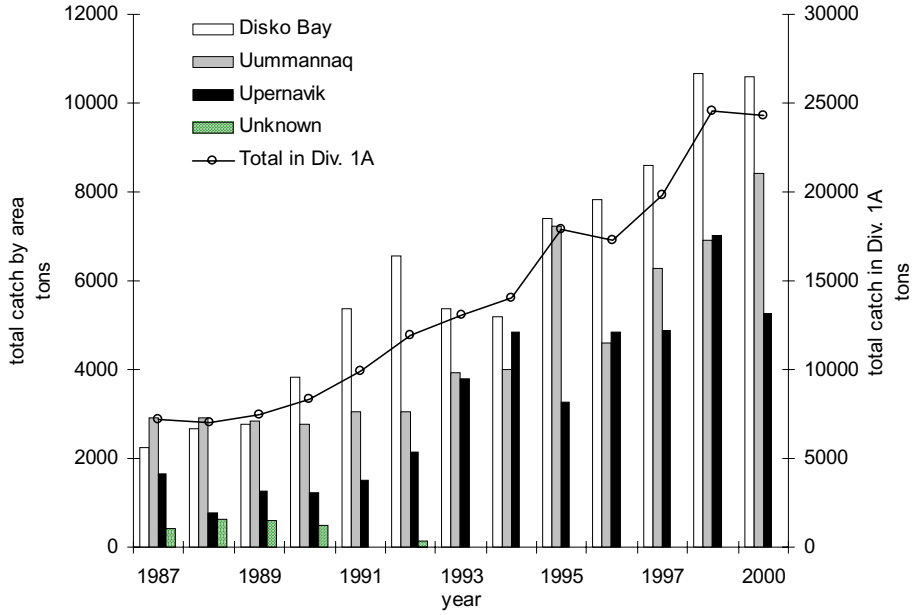

Figure 2. Landings in NAFO Div. 1A in the period 1987-1998 for the 3 main fishing areas. Landings for 1998 and 1999 are provisional.

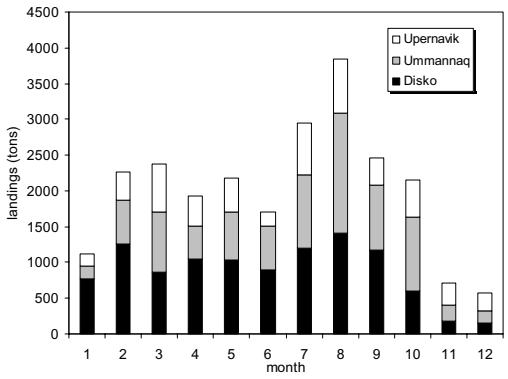

Figure 3. Landings in NAFO Div.1A in 1999 allocated on area and month.

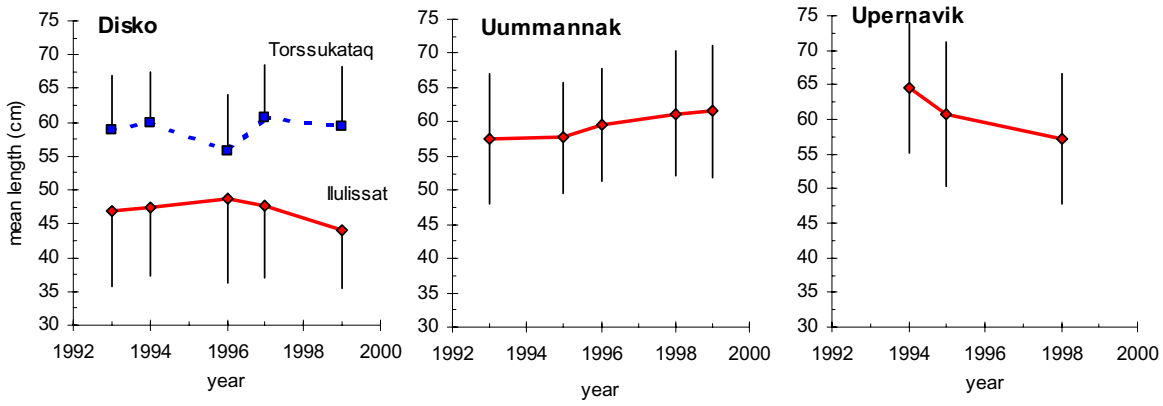

Figure 4. Mean length for research longline surveys 1993-99. +/- S.D

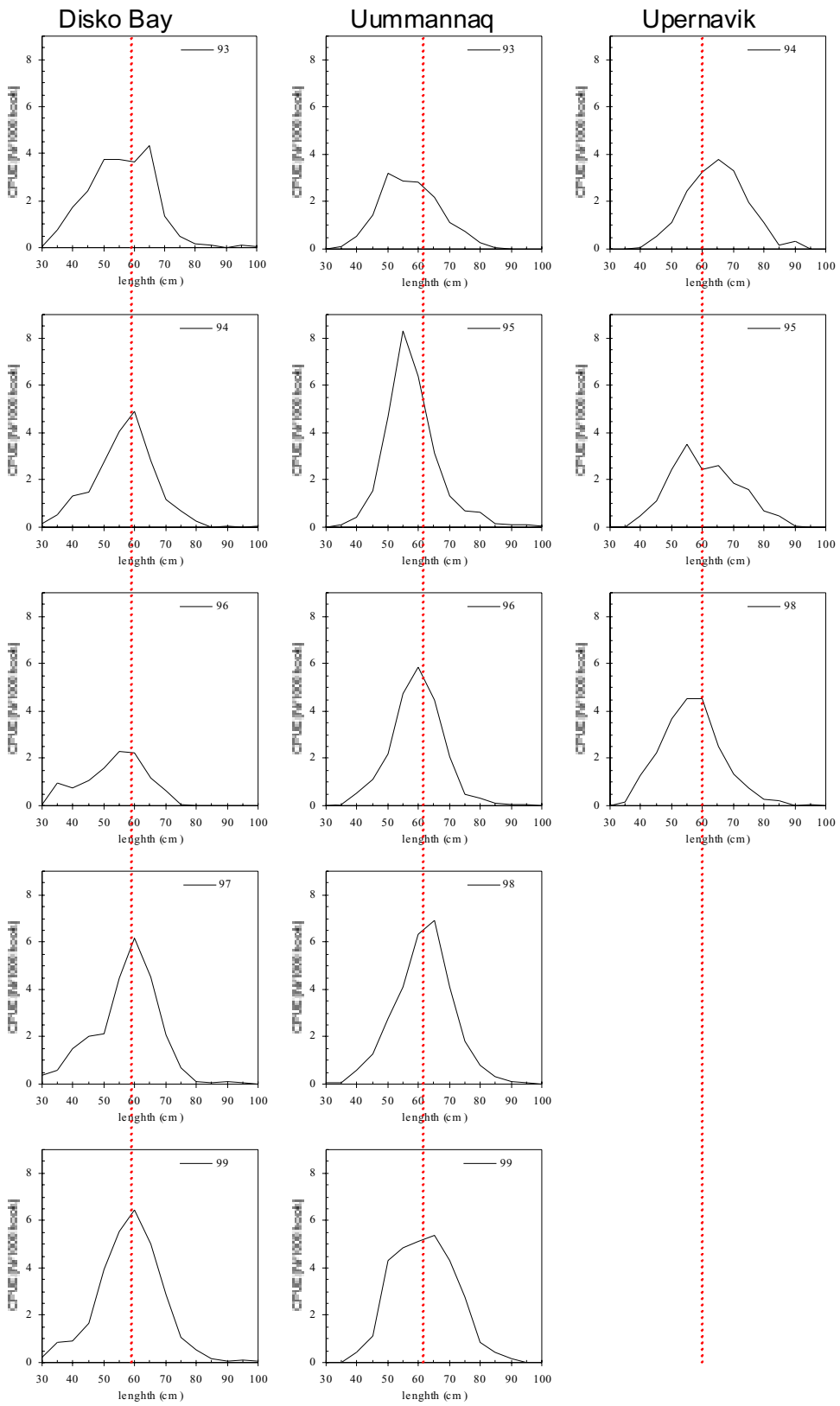

Figure 5. CPUE (N/1000 hooks) of G. halibut from longlinesurvey stratified in 5 cm length interval.

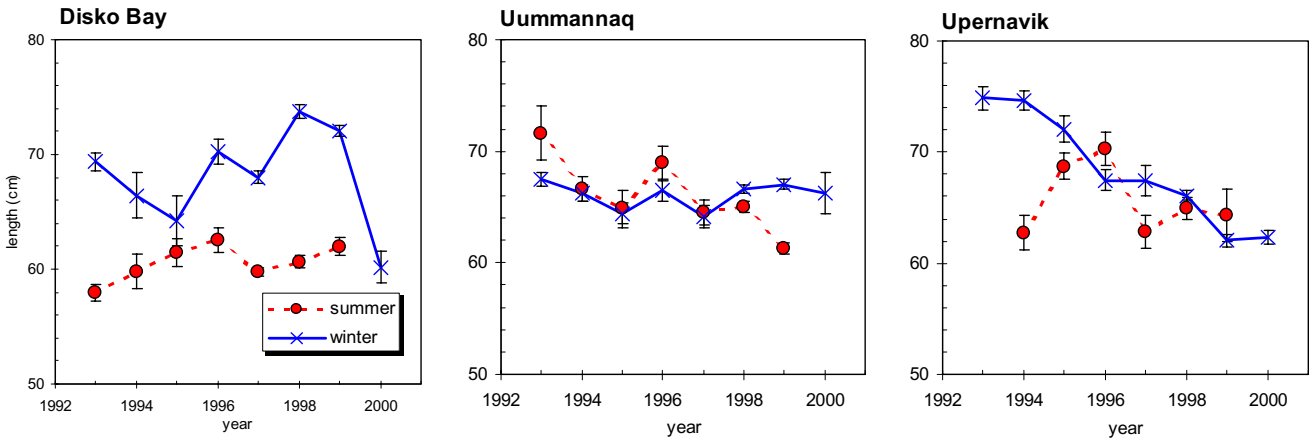

Figure 6. Mean length of Greenland halibut in commercial longline catches from Ilulissat, Uummannaq and Upernavik +/- 95% conf.

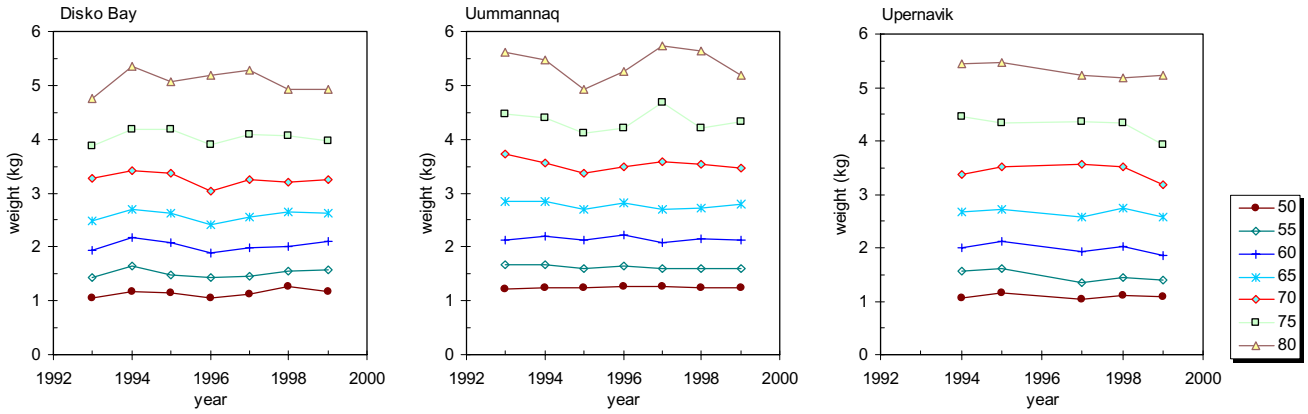

Figure 7. Average weight for 5 cm length interval for Greenland halibut in the com. fishery in the period 1993-99.

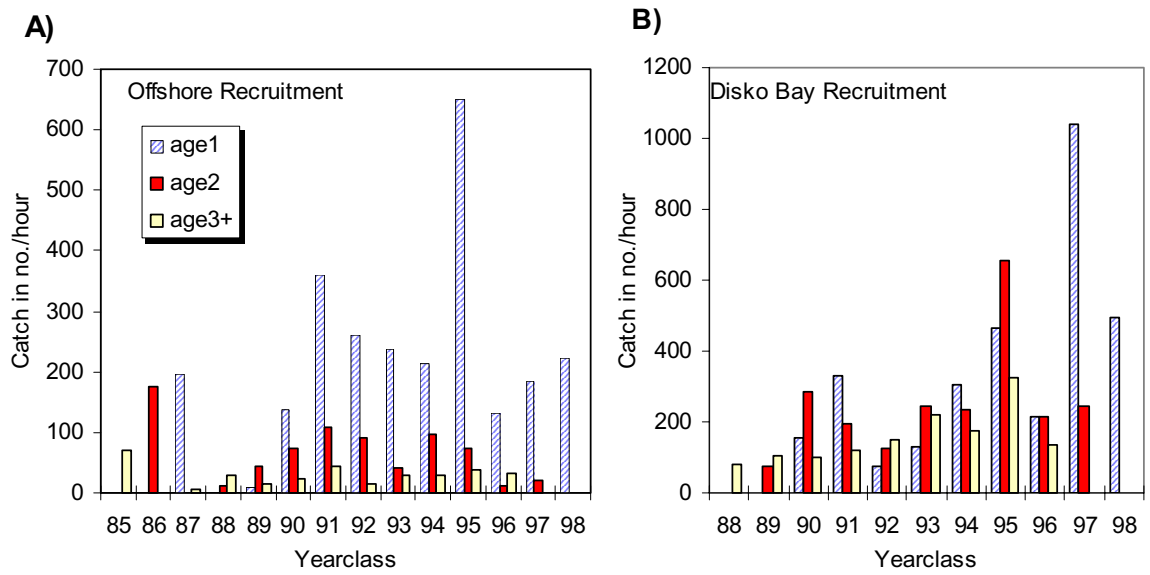

Figure 8. Year-class strength of recruits plotted as catch in numbers per hour, standardized index. The respective year-classes can be followed to age 3 in data from Greenland trawl survey. Mising values are due to missing observations. A) Offshore area, B) Disko Bay area

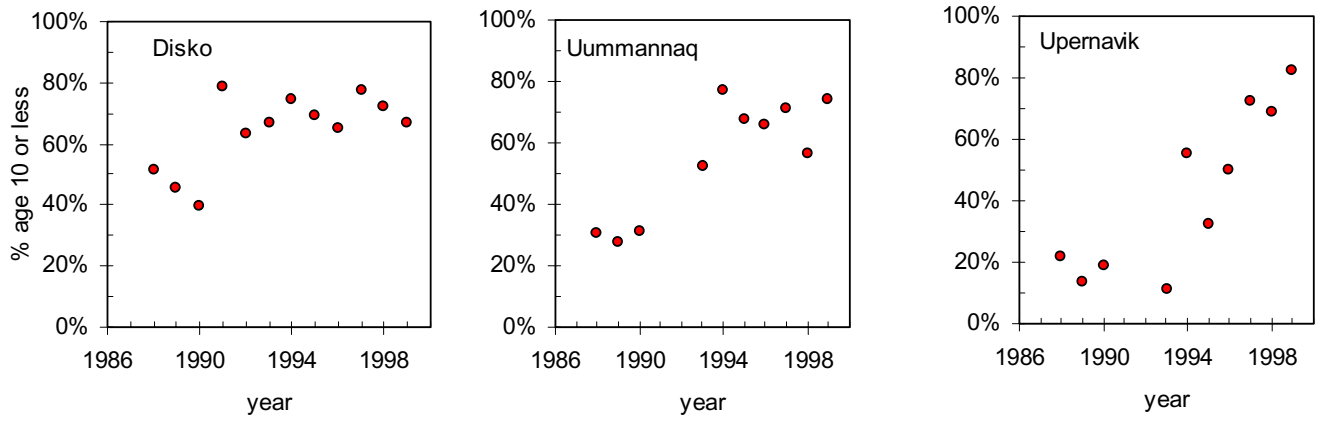

Figure 9. The development in explotation of the *age 10 and below* expressed as percentages for each year.

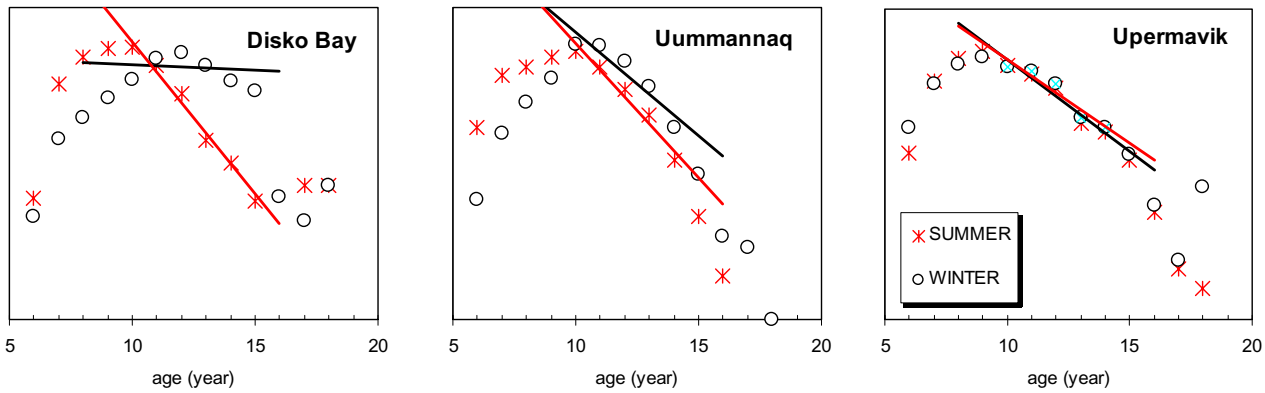

Figure 10. Catchcurves for the 3 main fishing areas bases on catch composiotion in the longline fishery for each season. Agegroup 10-14 was used for linear regression. Z was compiles as average of the estimated Z values. M was set to 0.15.

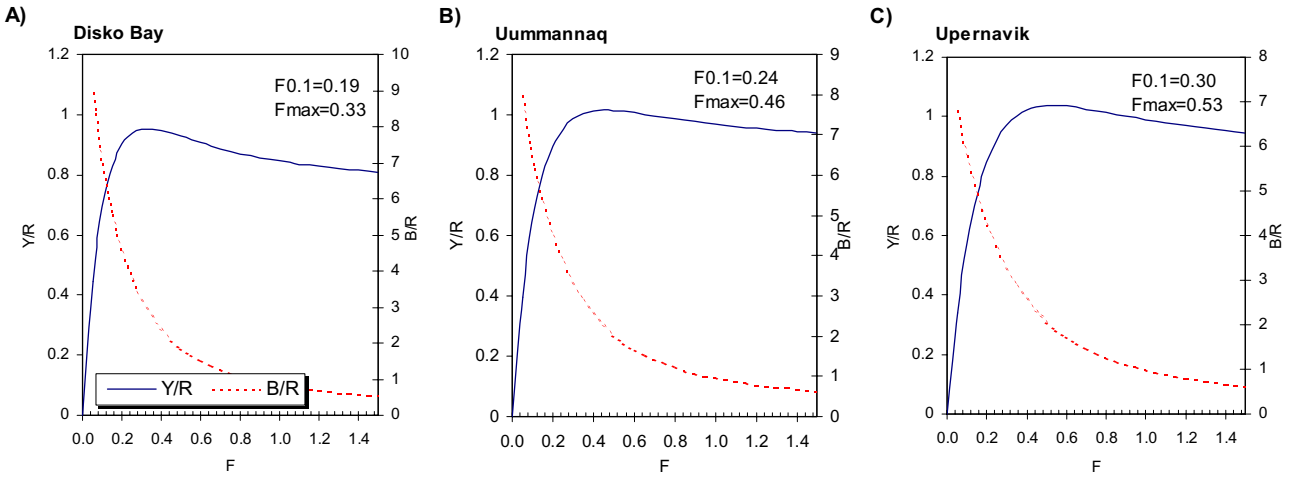

Figure 11. Yield per Recruit and Spawning Stock biomass per Recruit curve in A) Disko Bay, B) Uumannaq and C) Upernavik area.

Appendix analytical assessment

Tabel A. Output from separable VPA

```
Title :  GREENLAND HALIBUT DIV 1A - ILULISSAT

At  9/06/2000  21:08

Separable analysis
from 1985 to 1999 on ages  5 to 17
with Terminal F of  .320 on age 10 and Terminal S of 2.000

Initial sum of squared residuals was   809.295 and
  final sum of squared residuals is    509.106 after 126 iterations

Matrix of Residuals


 Years,    1985/86,1986/87,1987/88,1988/89,
  Ages

  5/ 6,    -5.371, -4.826, -2.318,  -.390,
  6/ 7,     2.031,  2.623,  3.590,  5.518,
  7/ 8,      .841,  1.410,   .996,   .595,
  8/ 9,     -.341,   .231,  -.497,  -.450,
  9/10,     -.219,   .259,  -.080,   .056,
 10/11,      .363,   .586,   .227,  -.039,
 11/12,      .244,   .076,   .251,   .181,
 12/13,      .224,  -.150,   .062,  -.047,
 13/14,      .102,  -.429,  -.494,  -.477,
 14/15,      .069,  -.491,  -.081,  -.011,
 15/16,     -.201,  -.825,  -.095,  -.667,
 16/17,     -.625, -1.384,  -.087, -1.123,

  TOT ,      .000,   .000,   .000,   .000,
  WTS ,      .001,   .001,   .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,      .383, -4.374, -3.230,   .139, -1.643,  3.571, -2.207,  4.054, -6.531, -6.438,      -7.573,        .069,
  6/ 7,     1.684, -4.044,   .063,  2.523,  2.525,  2.521, -2.518, -1.417, -4.605,  1.737,      -4.265,        .078,
  7/ 8,    -3.638, -4.615,  1.154,  1.176,  1.310,   .377,  -.072, -1.013,  -.214,  1.061,        .138,        .124,
  8/ 9,     -.905, -1.662,  1.411,   .890,   .231,   .001,   .196,  -.801,   .300,   .444,        .138,        .296,
  9/10,      .343,   .027,   .271,   .303,  -.346,  -.098,   .336,  -.168,   .202,  -.134,        .138,       1.000,
```

```
 10/11,      .160,   .289,  -.759,   .218,  -.149,  -.194,   .556,  -.481,   .221,   .035,        .138,        .616,
 11/12,      .143,  1.246,  -.785,   .834,   .227,  -.199,   .308,  -.257,   .366,  -.082,        .138,        .484,
 12/13,     -.091,  1.298, -1.229,   .483,   .071,  -.618,  -.052,   .165,   .448,   .193,        .138,        .411,
 13/14,     -.304,   .294, -1.510,  -.690,  -.255,   .220,   .075,   .217,  -.060,  -.311,        .138,        .488,
 14/15,      .385,   .260,   .611,  -.607,   .207,  -.049,  -.855,   .852,   .137,   .053,        .138,        .507,
 15/16,      .197,  -.195,  5.050, -2.706,  -.229,   .338,  -.850,   .859,   .128,  1.738,       2.213,        .135,
 16/17,      .142,   .885,  4.703, -6.280,   .334,  -.475,   .040,   .614,  -.106,   .069,        .138,        .103,

  TOT ,      .000,   .000,   .000,   .000,   .000,   .000,   .000,   .000,   .000,   .000,     -17.340,
  WTS ,      .001,   .001,   .001,   .001,   .001,  1.000,  1.000,  1.000,  1.000,  1.000,
```

Fishing Mortalities (F)

```
        ,    1985,   1986,   1987,   1988,   1989,
F-values,   .2137,  .1617,  .1506,  .1724,  .1356,

        ,    1990,   1991,   1992,   1993,   1994,   1995,   1996,   1997,   1998,   1999,
F-values,   .2309,  .4057,  .4259,  .3535,  .2224,  .3065,  .3918,  .2916,  .4199,  .3200,
```

Selection-at-age (S)

```
        ,       5,      6,      7,
S-values,   .0010,  .0010,  .0367,

        ,       8,      9,     10,     11,     12,     13,     14,     15,     16,     17,
S-values,   .2306,  .5948, 1.0000, 1.3237, 1.5579, 1.8532, 2.0369, 2.9863, 2.5260, 2.0000,
```

1

```
Run title :  GREENLAND HALIBUT DIV 1A - ILULISSAT

At  9/06/2000  21:08
```

SEPARABLY GENERATED FISHING MORTALITIES

```
 YEAR,       1985,    1986,    1987,    1988,    1989,

AGE
   5,        .0002,   .0002,   .0001,   .0002,   .0001,
   6,        .0002,   .0002,   .0001,   .0002,   .0001,
   7,        .0079,   .0059,   .0055,   .0063,   .0050,
   8,        .0493,   .0373,   .0347,   .0397,   .0313,
   9,        .1271,   .0962,   .0896,   .1025,   .0806,
  10,        .2137,   .1617,   .1506,   .1724,   .1356,
  11,        .2829,   .2140,   .1994,   .2281,   .1794,
  12,        .3330,   .2519,   .2346,   .2685,   .2112,
```

13,	.3961,	.2996,	.2791,	.3194,	.2512,
14,	.4353,	.3293,	.3068,	.3511,	.2761,
15,	.6382,	.4828,	.4498,	.5147,	.4048,
16,	.5399,	.4084,	.3804,	.4354,	.3424,
17,	.4275,	.3233,	.3012,	.3447,	.2711,

SEPARABLY GENERATED FISHING MORTALITIES

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	.0002,	.0004,	.0004,	.0004,	.0002,	.0003,	.0004,	.0003,	.0004,	.0003,
6,	.0002,	.0004,	.0004,	.0004,	.0002,	.0003,	.0004,	.0003,	.0004,	.0003,
7,	.0085,	.0149,	.0157,	.0130,	.0082,	.0113,	.0144,	.0107,	.0154,	.0118,
8,	.0532,	.0935,	.0982,	.0815,	.0513,	.0707,	.0903,	.0672,	.0968,	.0738,
9,	.1374,	.2413,	.2533,	.2103,	.1323,	.1823,	.2330,	.1735,	.2498,	.1903,
10,	.2309,	.4057,	.4259,	.3535,	.2224,	.3065,	.3918,	.2916,	.4199,	.3200,
11,	.3057,	.5370,	.5638,	.4679,	.2944,	.4057,	.5186,	.3860,	.5559,	.4236,
12,	.3598,	.6320,	.6636,	.5507,	.3465,	.4774,	.6104,	.4543,	.6542,	.4985,
13,	.4280,	.7518,	.7894,	.6551,	.4122,	.5679,	.7261,	.5404,	.7782,	.5930,
14,	.4704,	.8263,	.8676,	.7200,	.4531,	.6242,	.7981,	.5940,	.8553,	.6518,
15,	.6896,	1.2114,	1.2720,	1.0557,	.6643,	.9152,	1.1700,	.8709,	1.2540,	.9556,
16,	.5833,	1.0247,	1.0759,	.8929,	.5619,	.7741,	.9897,	.7366,	1.0607,	.8083,
17,	.4619,	.8113,	.8519,	.7070,	.4449,	.6129,	.7836,	.5832,	.8399,	.6400,

Run title : GREENLAND HALIBUT DIV 1A - ILULISSAT

At 9/06/2000 21:08

SEPARABLY GENERATED POPULATION NUMBERS

YEAR,	1985,	1986,	1987,	1988,	1989,
AGE					
5,	5144,	2760,	3501,	3583,	5147,
6,	3895,	4427,	2375,	3013,	3083,
7,	8074,	3352,	3809,	2044,	2593,
8,	5978,	6895,	2868,	3261,	1748,
9,	1241,	4898,	5717,	2384,	2697,
10,	957,	941,	3829,	4499,	1852,
11,	671,	665,	689,	2835,	3260,
12,	400,	435,	462,	486,	1942,

13,	232,	247,	291,	315,	320,
14,	137,	134,	158,	190,	197,
15,	105,	76,	83,	100,	115,
16,	72,	48,	41,	46,	51,
17,	65,	36,	27,	24,	25,

SEPARABLY GENERATED POPULATION NUMBERS

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	6770,	7473,	11030,	12376,	9711,	8742,	11508,	19511,	7156,	16906,
6,	4429,	5826,	6429,	9489,	10649,	8356,	7522,	9901,	16788,	6157,
7,	2653,	3811,	5012,	5532,	8165,	9163,	7190,	6472,	8520,	14444,
8,	2221,	2264,	3232,	4247,	4700,	6970,	7799,	6100,	5511,	7221,
9,	1458,	1812,	1775,	2522,	3370,	3843,	5590,	6133,	4909,	4306,
10,	2142,	1094,	1225,	1186,	1759,	2541,	2756,	3811,	4438,	3291,
11,	1392,	1463,	628,	689,	717,	1212,	1610,	1603,	2451,	2510,
12,	2345,	883,	736,	307,	371,	460,	695,	825,	938,	1210,
13,	1354,	1408,	404,	326,	153,	226,	245,	325,	451,	420,
14,	214,	759,	572,	158,	146,	87,	110,	102,	163,	178,
15,	128,	115,	286,	207,	66,	80,	40,	43,	49,	60,
16,	66,	55,	29,	69,	62,	29,	28,	11,	15,	12,
17,	31,	32,	17,	9,	24,	30,	12,	9,	4,	5,

1

Run title : GREENLAND HALIBUT DIV 1A - ILULISSAT

At 9/06/2000 21:08

Cohort analysis Terminal populations from weighted Separable populations

Fishing mortality residuals

YEAR,	1985,	1986,	1987,	1988,	1989,
AGE					
5,	-.0002,	-.0002,	-.0001,	-.0002,	-.0001,
6,	.0050,	.0044,	.0031,	.0001,	-.0001,
7,	.0141,	.0135,	.0060,	-.0025,	-.0050,
8,	.0030,	.0082,	-.0069,	-.0092,	-.0210,
9,	.0468,	.0511,	-.0025,	.0343,	.0170,
10,	.0750,	.1403,	.0354,	.0100,	.0423,
11,	-.0190,	-.0053,	.0265,	.0010,	.0210,
12,	-.0760,	-.0763,	-.0257,	-.0319,	-.0374,

```
 13,       -.1203,  -.1331,  -.0688,  -.0633,  -.0259,
 14,       -.1073,  -.1485,  -.0705,   .0845,   .0827,
 15,       -.2605,  -.1891,  -.0915,  -.1220,   .1698,
 16,       -.1449,  -.1726,   .1247,  -.0865,   .1732,
 17,        .0010,   .1049,   .4898,   .2554,   .5447,
```

```
Fishing mortality residuals
YEAR,       1990,    1991,    1992,    1993,    1994,    1995,    1996,    1997,    1998,    1999,

AGE
  5,       -.0002,   .0004,   .0096,   .0001,   .0001,  -.0003,   .0004,  -.0003,  -.0004,   .0000,
  6,       -.0002,   .0015,   .0208,   .0069,   .0012,  -.0003,  -.0003,  -.0003,   .0049,   .0068,
  7,       -.0082,   .0640,   .0573,   .0407,   .0055,  -.0054,  -.0075,   .0038,   .0401,   .0151,
  8,       -.0397,   .2699,   .0778,   .0417,   .0074,   .0110,  -.0411,   .0228,   .0724,   .0210,
  9,       -.0288,   .0915,   .0270,  -.0531,   .0326,   .0301,  -.0111,   .0367,   .0019,   .0351,
 10,       -.0335,  -.1129,   .0582,  -.0695,   .0071,   .1556,  -.0703,   .0419,   .0062,   .0601,
 11,        .0531,  -.2327,   .4215,  -.0332,  -.0341,   .1395,  -.0388,   .1409,  -.0433,  -.0088,
 12,       -.0082,  -.4536,   .0979,  -.0270,  -.1075,   .0392,   .0584,   .1034,   .0228,  -.0148,
 13,       -.0586,  -.5998,  -.2547,  -.2101,  -.0637,   .1772,   .1975,  -.0294,  -.1800,  -.1050,
 14,        .1300,  -.3920,  -.3811,   .2001,  -.1189,  -.2597,   .5490,   .1238,  -.0109,  -.0474,
 15,       -.0691,   .1696, -1.0901,  -.2699,   .1666,  -.3380,   .5905,  -.0066,   .4234,  -.1044,
 16,        .2514,   .1064, -1.0759,   .2573,  -.1428,  -.0218,   .4704,  -.0900,  -.2172,  -.6237,
 17,        .2953,  -.3352,  -.8519,   .6492,   .0374,   .0990,  -.0877,   .0434,  -.0890,  -.2721,
```

1

Tabel A. Output from Cohorte analysis

Run title : GREENLAND HALIBUT DIV 1A - ILULISSAT

At 9/06/2000 21:08

Cohort analysis Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR,	1985,	1986,	1987,	1988,	1989,
AGE					
5,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0052,	.0046,	.0033,	.0003,	.0000,
7,	.0220,	.0194,	.0115,	.0038,	.0000,
8,	.0523,	.0455,	.0278,	.0305,	.0102,
9,	.1739,	.1473,	.0871,	.1368,	.0977,
10,	.2888,	.3020,	.1860,	.1823,	.1778,
11,	.2639,	.2087,	.2259,	.2291,	.2005,
12,	.2569,	.1756,	.2089,	.2366,	.1738,
13,	.2758,	.1665,	.2103,	.2562,	.2254,
14,	.3281,	.1808,	.2363,	.4356,	.3588,
15,	.3777,	.2937,	.3583,	.3927,	.5746,
16,	.3950,	.2358,	.5052,	.3488,	.5156,
17,	.4285,	.4283,	.7910,	.6001,	.8158,
+gp,	.4263,	.4261,	.7852,	.5964,	.8097,
0 FBAR 10-14,	.2827,	.2067,	.2135,	.2680,	.2273,

Table 8 Fishing mortality (F) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE											
5,	.0000,	.0008,	.0100,	.0004,	.0003,	.0000,	.0008,	.0000,	.0000,	.0003,	.0001,
6,	.0000,	.0019,	.0212,	.0073,	.0014,	.0000,	.0001,	.0000,	.0054,	.0072,	.0042,
7,	.0003,	.0789,	.0729,	.0537,	.0136,	.0058,	.0069,	.0145,	.0555,	.0268,	.0323,
8,	.0136,	.3634,	.1760,	.1232,	.0587,	.0816,	.0492,	.0901,	.1692,	.0948,	.1180,
9,	.1086,	.3328,	.2804,	.1572,	.1649,	.2124,	.2220,	.2101,	.2517,	.2255,	.2291,
10,	.1974,	.2927,	.4842,	.2840,	.2296,	.4621,	.3215,	.3335,	.4261,	.3801,	.3799,
11,	.3588,	.3043,	.9853,	.4347,	.2604,	.5452,	.4798,	.5270,	.5125,	.4147,	.4847,
12,	.3515,	.1784,	.7614,	.5237,	.2390,	.5166,	.6688,	.5578,	.6770,	.4838,	.5728,
13,	.3693,	.1520,	.5346,	.4450,	.3485,	.7451,	.9236,	.5110,	.5982,	.4881,	.5324,

```
        14,        .6004,   .4342,   .4865,   .9201,   .3342,   .3645,  1.3470,   .7178,   .8445,   .6044,       .7222,
        15,        .6205,  1.3810,   .1818,   .7858,   .8308,   .5772,  1.7605,   .8643,  1.6774,   .8512,      1.1310,
        16,        .8347,  1.1311,   .0000,  1.1502,   .4191,   .7523,  1.4601,   .6466,   .8436,   .1846,       .5582,
        17,        .7572,   .4761,   .0000,  1.3562,   .4823,   .7119,   .6959,   .6266,   .7509,   .3679,       .5818,
       +gp,        .7518,   .4735,  1.1213,  1.3435,   .4796,   .7070,   .6911,   .6226,   .7455,   .3662,
0  FBAR 10-14,     .3755,   .2723,   .6504,   .5215,   .2823,   .5267,   .7481,   .5294,   .6116,   .4742,
1
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    Run title :  GREENLAND HALIBUT DIV 1A - ILULISSAT

    At  9/06/2000  21:08

                 Cohort analysis  Terminal populations from weighted Separable populations

       Table  9    Relative F at age
       YEAR,       1985,    1986,    1987,    1988,    1989,

       AGE
         5,        .0000,   .0000,   .0000,   .0000,   .0000,
         6,        .0186,   .0222,   .0153,   .0011,   .0000,
         7,        .0777,   .0938,   .0540,   .0142,   .0000,
         8,        .1848,   .2200,   .1302,   .1140,   .0450,
         9,        .6153,   .7126,   .4080,   .5105,   .4298,
        10,       1.0215,  1.4610,   .8713,   .6804,   .7825,
        11,        .9335,  1.0096,  1.0581,   .8551,   .8821,
        12,        .9089,   .8493,   .9785,   .8830,   .7649,
        13,        .9757,   .8053,   .9853,   .9560,   .9916,
        14,       1.1605,   .8748,  1.1068,  1.6255,  1.5790,
        15,       1.3361,  1.4207,  1.6783,  1.4656,  2.5283,
        16,       1.3972,  1.1407,  2.3663,  1.3019,  2.2688,
        17,       1.5156,  2.0718,  3.7051,  2.2397,  3.5897,
       +gp,       1.5080,  2.0613,  3.6780,  2.2257,  3.5629,
0     REFMEAN,     .2827,   .2067,   .2135,   .2680,   .2273,
```

```
       Table  9    Relative F at age
       YEAR,       1990,    1991,    1992,    1993,    1994,    1995,    1996,    1997,    1998,    1999,       MEAN 97-99

       AGE
         5,        .0000,   .0029,   .0154,   .0008,   .0011,   .0000,   .0011,   .0000,   .0000,   .0007,       .0002,
         6,        .0000,   .0071,   .0326,   .0140,   .0051,   .0000,   .0002,   .0000,   .0088,   .0151,       .0080,
         7,        .0008,   .2896,   .1121,   .1029,   .0483,   .0111,   .0093,   .0275,   .0908,   .0566,       .0583,
         8,        .0362,  1.3345,   .2706,   .2363,   .2077,   .1550,   .0658,   .1701,   .2766,   .1999,       .2156,
         9,        .2892,  1.2221,   .4311,   .3014,   .5842,   .4033,   .2967,   .3969,   .4115,   .4755,       .4280,
        10,        .5257,  1.0749,   .7444,   .5446,   .8131,   .8773,   .4297,   .6300,   .6966,   .8015,       .7094,
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        11,        .9555,  1.1174,  1.5149,   .8335,   .9222,  1.0351,   .6413,   .9954,   .8380,   .8746,       .9027,
        12,        .9362,   .6550,  1.1707,  1.0042,   .8465,   .9808,   .8940,  1.0535,  1.1068,  1.0201,      1.0601,
        13,        .9836,   .5582,   .8220,   .8534,  1.2345,  1.4147,  1.2345,   .9652,   .9780,  1.0292,       .9908,
        14,       1.5989,  1.5946,   .7480,  1.7643,  1.1836,   .6920,  1.8005,  1.3558,  1.3807,  1.2746,      1.3370,
        15,       1.6525,  5.0715,   .2795,  1.5067,  2.9428,  1.0959,  2.3532,  1.6325,  2.7425,  1.7950,      2.0567,
        16,       2.2229,  4.1538,   .0000,  2.2055,  1.4844,  1.4285,  1.9516,  1.2213,  1.3792,   .3892,       .9966,
        17,       2.0164,  1.7484,   .0000,  2.6005,  1.7082,  1.3518,   .9301,  1.1836,  1.2277,   .7758,      1.0623,
       +gp,       2.0020,  1.7389,  1.7239,  2.5761,  1.6988,  1.3424,   .9238,  1.1761,  1.2189,   .7722,
0     REFMEAN,     .3755,   .2723,   .6504,   .5215,   .2823,   .5267,   .7481,   .5294,   .6116,   .4742,
1


    Run title :  GREENLAND HALIBUT DIV 1A - ILULISSAT

    At  9/06/2000  21:08

                Cohort analysis  Terminal populations from weighted Separable populations

       Table 10    Stock number at age (start of year)              Numbers*10**-3
       YEAR,       1985,    1986,    1987,    1988,    1989,

       AGE
         5,         3826,    3845,    4263,    5061,    6064,
         6,         2884,    3293,    3309,    3669,    4356,
         7,         2332,    2470,    2821,    2839,    3157,
         8,         1821,    1964,    2085,    2401,    2434,
         9,         1344,    1487,    1615,    1745,    2004,
        10,         1092,     972,    1105,    1274,    1310,
        11,          678,     704,     618,     790,     914,
        12,          433,     449,     492,     425,     540,
        13,          259,     288,     324,     343,     288,
        14,          150,     169,     210,     226,     229,
        15,          113,      93,     122,     143,     126,
        16,           69,      67,      60,      73,      83,
        17,           65,      40,      45,      31,      44,
       +gp,           25,      12,       6,      12,      25,
0       TOTAL,     15091,   15853,   17075,   19032,   21575,



       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 85-97
AMST 85-97

       AGE
         5,         7731,    8194,   11141,   12276,   10517,    9776,   12238,   19900,    7202,   16906,       0,        7833,
 8833,
         6,         5219,    6654,    7047,    9494,   10561,    9049,    8414,   10525,   17128,    6199,   14547,        5873,
 6498,
         7,         3750,    4492,    5716,    5938,    8112,    9077,    7789,    7241,    9059,   14663,    5297,        4538,
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 5057,
        8,          2718,    3226,    3573,    4574,    4844,    6888,    7767,    6658,    6142,    7376,   12287,         3475,
 3919,
        9,          2074,    2308,    1931,    2579,    3481,    3932,    5463,    6364,    5237,    4464,    5774,         2471,
 2794,
       10,          1564,    1601,    1424,    1256,    1897,    2540,    2737,    3766,    4440,    3504,    3067,         1596,
 1734,
       11,           944,    1105,    1029,     755,     813,    1298,    1377,    1708,    2322,    2496,    2063,          937,
  980,
       12,           644,     567,     702,     330,     421,     540,     648,     734,     868,    1197,    1419,          519,
  533,
       13,           391,     390,     409,     282,     168,     285,     277,     286,     362,     380,     635,          300,
  307,
       14,           198,     233,     288,     206,     156,     102,     117,      95,     147,     171,     201,          174,
  183,
       15,           138,      94,     130,     153,      71,      96,      61,      26,      40,      55,      80,           97,
  105,
       16,            61,      64,      20,      93,      60,      27,      46,       9,       9,       6,      20,           48,
   56,
       17,            43,      23,      18,      17,      25,      34,      11,       9,       4,       4,       5,           27,
   31,
      +gp,            16,       6,       0,      24,      14,       0,      75,       0,       0,       0,       2,
0       TOTAL,      25490,   28957,   33428,   37978,   41140,   43643,   47020,   57320,   52960,   57420,   45396,
1
```

Run title : GREENLAND HALIBUT DIV 1A - ILULISSAT

At 9/06/2000 21:08

Cohort analysis Terminal populations from weighted Separable populations

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

YEAR,	1985,	1986,	1987,	1988,	1989,
AGE					
5,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,
8,	0,	0,	0,	0,	0,
9,	0,	0,	0,	0,	0,
10,	1092,	972,	1105,	1274,	1310,
11,	678,	704,	618,	790,	914,
12,	433,	449,	492,	425,	540,
13,	259,	288,	324,	343,	288,
14,	150,	169,	210,	226,	229,
15,	113,	93,	122,	143,	126,
16,	69,	67,	60,	73,	83,
17,	65,	40,	45,	31,	44,
+gp,	25,	12,	6,	12,	25,

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,	1564,	1601,	1424,	1256,	1897,	2540,	2737,	3766,	4440,	3504,
11,	944,	1105,	1029,	755,	813,	1298,	1377,	1708,	2322,	2496,
12,	644,	567,	702,	330,	421,	540,	648,	734,	868,	1197,
13,	391,	390,	409,	282,	168,	285,	277,	286,	362,	380,
14,	198,	233,	288,	206,	156,	102,	117,	95,	147,	171,
15,	138,	94,	130,	153,	71,	96,	61,	26,	40,	55,
16,	61,	64,	20,	93,	60,	27,	46,	9,	9,	6,
17,	43,	23,	18,	17,	25,	34,	11,	9,	4,	4,
+gp,	16,	6,	0,	24,	14,	0,	75,	0,	0,	0,

1

Run title : GREENLAND HALIBUT DIV 1A - ILULISSAT

At 9/06/2000 21:08

Cohort analysis Terminal populations from weighted Separable populations

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

YEAR,	1985,	1986,	1987,	1988,	1989,
AGE					
5,	2257,	2269,	2515,	2986,	3577,
6,	2155,	2460,	2472,	2741,	3254,
7,	2209,	2339,	2672,	2689,	2990,
8,	2183,	2354,	2500,	2878,	2919,
9,	2039,	2258,	2452,	2649,	3042,
10,	2099,	1869,	2125,	2450,	2519,
11,	1652,	1714,	1506,	1923,	2225,
12,	1335,	1383,	1516,	1309,	1666,
13,	1013,	1125,	1265,	1341,	1126,
14,	743,	838,	1038,	1117,	1131,
15,	708,	583,	762,	894,	788,
16,	550,	529,	474,	581,	658,
17,	652,	404,	455,	312,	446,
+gp,	314,	157,	75,	151,	318,
0 TOTALBIO,	19909,	20282,	21827,	24021,	26661,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	4562,	4835,	6573,	9317,	10233,	7948,	7465,	5831,	3594,	8014,
6,	3899,	4971,	5264,	8829,	12821,	9031,	6512,	5347,	11185,	4767,
7,	3551,	4254,	5413,	6770,	12290,	11110,	7641,	5597,	7754,	17127,
8,	3258,	3868,	4284,	6385,	9160,	10345,	9655,	7643,	6892,	11241,
9,	3148,	3503,	2931,	4413,	8214,	7246,	8610,	10113,	7698,	8830,
10,	3008,	3079,	2738,	2632,	5587,	5746,	5465,	8195,	8555,	8228,
11,	2298,	2691,	2505,	1940,	2990,	3603,	3488,	5081,	5167,	7487,
12,	1984,	1750,	2163,	1040,	1930,	1838,	2079,	2710,	2872,	4302,
13,	1527,	1522,	1596,	1088,	964,	1192,	1128,	1370,	1568,	1715,
14,	980,	1150,	1425,	974,	1111,	525,	601,	564,	838,	879,
15,	861,	586,	812,	883,	630,	603,	400,	192,	296,	388,
16,	483,	505,	161,	660,	666,	205,	384,	91,	92,	64,
17,	428,	229,	178,	151,	352,	321,	113,	108,	52,	41,
+gp,	205,	72,	0,	260,	243,	0,	997,	0,	0,	0,
0 TOTALBIO,	30194,	33015,	36043,	45343,	67191,	59713,	54537,	52842,	56563,	73081,

1

Run title : GREENLAND HALIBUT DIV 1A - ILULISSAT

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Cohort analysis Terminal populations from weighted Separable populations

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

YEAR,	1985,	1986,	1987,	1988,	1989,
AGE					
5,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,
8,	0,	0,	0,	0,	0,
9,	0,	0,	0,	0,	0,
10,	2099,	1869,	2125,	2450,	2519,
11,	1652,	1714,	1506,	1923,	2225,
12,	1335,	1383,	1516,	1309,	1666,
13,	1013,	1125,	1265,	1341,	1126,
14,	743,	838,	1038,	1117,	1131,
15,	708,	583,	762,	894,	788,
16,	550,	529,	474,	581,	658,
17,	652,	404,	455,	312,	446,
+gp,	314,	157,	75,	151,	318,
0 TOTSPBIO,	9066,	8602,	9216,	10077,	10878,

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,	3008,	3079,	2738,	2632,	5587,	5746,	5465,	8195,	8555,	8228,
11,	2298,	2691,	2505,	1940,	2990,	3603,	3488,	5081,	5167,	7487,
12,	1984,	1750,	2163,	1040,	1930,	1838,	2079,	2710,	2872,	4302,
13,	1527,	1522,	1596,	1088,	964,	1192,	1128,	1370,	1568,	1715,
14,	980,	1150,	1425,	974,	1111,	525,	601,	564,	838,	879,
15,	861,	586,	812,	883,	630,	603,	400,	192,	296,	388,
16,	483,	505,	161,	660,	666,	205,	384,	91,	92,	64,
17,	428,	229,	178,	151,	352,	321,	113,	108,	52,	41,
+gp,	205,	72,	0,	260,	243,	0,	997,	0,	0,	0,
0 TOTSPBIO,	11776,	11584,	11577,	9628,	14473,	14032,	14654,	18311,	19441,	23103,

1

Run title : GREENLAND HALIBUT DIV 1A - ILULISSAT

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Cohort analysis Terminal populations from weighted Separable populations

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

YEAR,	1985,	1986,	1987,	1988,	1989,
AGE					
5,	2253,	2282,	2521,	2982,	3577,
6,	2151,	2475,	2477,	2737,	3254,
7,	2205,	2353,	2677,	2685,	2990,
8,	2179,	2369,	2505,	2874,	2918,
9,	2036,	2272,	2457,	2645,	3042,
10,	2095,	1880,	2129,	2447,	2519,
11,	1649,	1724,	1509,	1920,	2225,
12,	1332,	1391,	1519,	1307,	1666,
13,	1011,	1132,	1267,	1339,	1126,
14,	742,	843,	1041,	1115,	1131,
15,	707,	587,	764,	892,	787,
16,	549,	532,	475,	580,	658,
17,	651,	406,	456,	311,	446,
+gp,	313,	158,	75,	151,	318,
0 TOTALBIO,	19873,	20406,	21873,	23986,	26656,

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,	4569,	4832,	6579,	9327,	10224,	7957,	7479,	5837,	3684,	8034,
6,	3905,	4968,	5269,	8839,	12809,	9042,	6524,	5352,	11464,	4779,
7,	3557,	4251,	5418,	6777,	12279,	11124,	7655,	5603,	7948,	17171,
8,	3264,	3866,	4288,	6392,	9152,	10358,	9673,	7651,	7064,	11269,
9,	3154,	3501,	2934,	4417,	8206,	7255,	8626,	10123,	7890,	8852,
10,	3013,	3078,	2741,	2634,	5581,	5753,	5475,	8204,	8769,	8250,
11,	2302,	2690,	2507,	1942,	2987,	3607,	3494,	5086,	5296,	7506,
12,	1988,	1748,	2165,	1041,	1928,	1840,	2083,	2712,	2943,	4313,
13,	1529,	1521,	1597,	1089,	964,	1193,	1130,	1371,	1607,	1719,
14,	982,	1149,	1426,	975,	1110,	525,	602,	564,	859,	881,
15,	863,	586,	813,	884,	629,	604,	401,	192,	304,	389,
16,	484,	505,	161,	661,	665,	205,	385,	91,	95,	65,
17,	429,	228,	178,	152,	352,	321,	113,	108,	54,	41,
+gp,	206,	72,	0,	260,	243,	0,	999,	0,	0,	0,
0 TOTALBIO,	30245,	32995,	36075,	45390,	67129,	59786,	54638,	52895,	57977,	73269,

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Cohort analysis Terminal populations from weighted Separable populations

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

YEAR,	1985,	1986,	1987,	1988,	1989,
AGE					
5,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,
8,	0,	0,	0,	0,	0,
9,	0,	0,	0,	0,	0,
10,	2095,	1880,	2129,	2447,	2519,
11,	1649,	1724,	1509,	1920,	2225,
12,	1332,	1391,	1519,	1307,	1666,
13,	1011,	1132,	1267,	1339,	1126,
14,	742,	843,	1041,	1115,	1131,
15,	707,	587,	764,	892,	787,
16,	549,	532,	475,	580,	658,
17,	651,	406,	456,	311,	446,
+gp,	313,	158,	75,	151,	318,
0 TOTSPBIO,	9050,	8655,	9236,	10063,	10876,

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,	3013,	3078,	2741,	2634,	5581,	5753,	5475,	8204,	8769,	8250,
11,	2302,	2690,	2507,	1942,	2987,	3607,	3494,	5086,	5296,	7506,
12,	1988,	1748,	2165,	1041,	1928,	1840,	2083,	2712,	2943,	4313,
13,	1529,	1521,	1597,	1089,	964,	1193,	1130,	1371,	1607,	1719,
14,	982,	1149,	1426,	975,	1110,	525,	602,	564,	859,	881,
15,	863,	586,	813,	884,	629,	604,	401,	192,	304,	389,
16,	484,	505,	161,	661,	665,	205,	385,	91,	95,	65,
17,	429,	228,	178,	152,	352,	321,	113,	108,	54,	41,
+gp,	206,	72,	0,	260,	243,	0,	999,	0,	0,	0,
0 TOTSPBIO,	11796,	11577,	11587,	9638,	14459,	14049,	14681,	18330,	19927,	23163,
1										

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Table 16 Summary (without SOP correction)

Cohort analysis Terminal populations from weighted Separable populations

,	RECRUITS, Age 5	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 10-14,
1985,	3826,	19909,	9066,	2685,	.2961,	.2827,
1986,	3845,	20282,	8602,	2118,	.2462,	.2067,
1987,	4263,	21827,	9216,	2258,	.2450,	.2135,
1988,	5061,	24021,	10077,	2670,	.2650,	.2680,
1989,	6064,	26661,	10878,	2781,	.2557,	.2273,
1990,	7731,	30194,	11776,	3821,	.3245,	.3755,
1991,	8194,	33015,	11584,	5372,	.4637,	.2723,
1992,	11141,	36043,	11577,	6577,	.5681,	.6504,
1993,	12276,	45343,	9628,	5367,	.5574,	.5215,
1994,	10517,	67191,	14473,	5201,	.3594,	.2823,
1995,	9776,	59713,	14032,	7400,	.5274,	.5267,
1996,	12238,	54537,	14654,	7800,	.5323,	.7481,

```
    1997,        19900,       52842,       18311,        8601,       .4697,       .5294,
    1998,         7202,       56563,       19441,       10671,       .5489,       .6116,
    1999,        16906,       73081,       23103,       10593,       .4585,       .4742,

 Arith.
   Mean   ,       9263,       41415,       13095,        5594,       .4079,       .4127,
0 Units,   (Thousands),    (Tonnes),    (Tonnes),    (Tonnes),
1


    Run title :  GREENLAND HALIBUT DIV 1A - ILULISSAT                                      ,

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        Table 17    Summary     (with SOP correction)

                 Cohort analysis  Terminal populations from weighted Separable populations

,            RECRUITS,    TOTALBIO,    TOTSPBIO,    LANDINGS,   YIELD/SSB,    SOPCOFAC,  FBAR 10-14,
 ,             Age 5
    1985,         3826,       19873,        9050,        2685,       .2967,       .9982,       .2827,
    1986,         3845,       20406,        8655,        2118,       .2447,      1.0061,       .2067,
    1987,         4263,       21873,        9236,        2258,       .2445,      1.0021,       .2135,
    1988,         5061,       23986,       10063,        2670,       .2653,       .9986,       .2680,
    1989,         6064,       26656,       10876,        2781,       .2557,       .9998,       .2273,
    1990,         7731,       30245,       11796,        3821,       .3239,      1.0017,       .3755,
    1991,         8194,       32995,       11577,        5372,       .4640,       .9994,       .2723,
    1992,        11141,       36075,       11587,        6577,       .5676,      1.0009,       .6504,
    1993,        12276,       45390,        9638,        5367,       .5569,      1.0011,       .5215,
    1994,        10517,       67129,       14459,        5201,       .3597,       .9991,       .2823,
    1995,         9776,       59786,       14049,        7400,       .5267,      1.0012,       .5267,
    1996,        12238,       54638,       14681,        7800,       .5313,      1.0018,       .7481,
    1997,        19900,       52895,       18330,        8601,       .4692,      1.0010,       .5294,
    1998,         7202,       57977,       19927,       10671,       .5355,      1.0250,       .6116,
    1999,        16906,       73269,       23163,       10593,       .4573,      1.0026,       .4742,

 Arith.
   Mean   ,       9263,       41546,       13139,        5594,       .4066                     .4127,
0 Units,   (Thousands),    (Tonnes),    (Tonnes),    (Tonnes),
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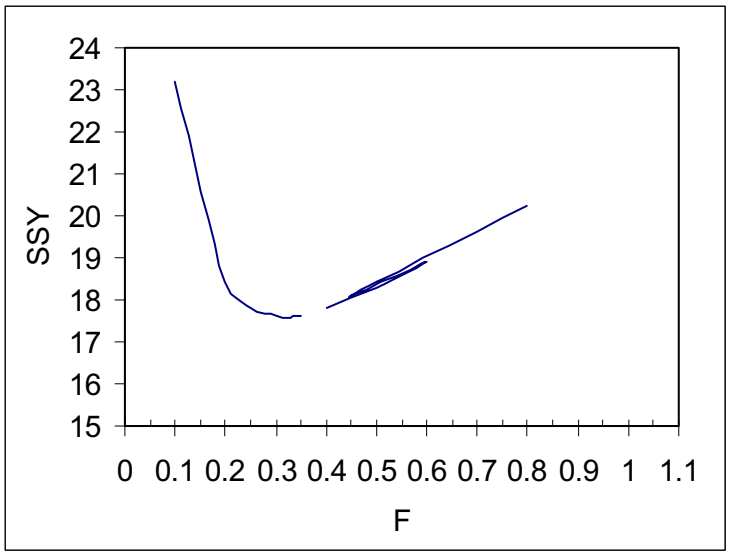

Figure A. A separable VPA was run with different terminal F in the interval 0.1-0.8. CPUE from surveys were available from the years 1993, 94, 96, 97 and 99. The CPUE separated on age-classes 5-14 were used to minimize the sum of squares on the separable generated population numbers from the VPA.

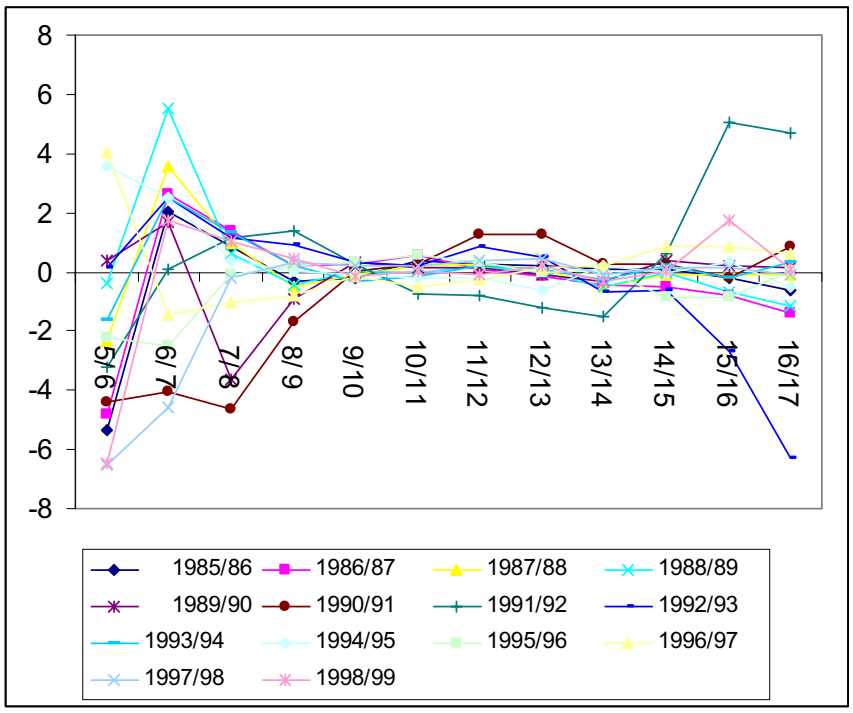

Figure B. Matrix of Residuals from Seperable VPA. Analyse from 1985 to 1999 on ages 5 to 17. with Terminal F of .320 on age 10 and Terminal S of 2.000.

Figure C. Summary plots of landings, fishing mortality, recruitment at age 5 and stock biomass derved from cohorte analysis (Table B, 17)