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

by

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Abstract

This paper present the assessment of Greenland halibut in the inshore part of NAFO Div. 1A. The area covers the fjords in the three distinctive geographical areas, Disko Bay, Uummannaq and Upernavik. Information from the commercial fishery (only landings, no effort information) and research survey (longline survey in two of the three areas in rotation, approx. 30 fixed stations in each area) were available for the assessment. Catch-at-age data for each of the three inshore areas were available from the fishery covering area, gear and season. The assessments were as follows. **Disko Bay:** For a period for more than 10 years landings more or less increased annually from about 2 000 tons in 1987 to 10 500 t in 1998 and 99. Since then landings have declined and was last year 7 072 tons. Long-line survey results since 1993 do indicate stable abundance indices until 2000. CPUE in 2001 is remarkably higher although uncertain. Length composition in both commercial and survey indicates strong recruiting year-classes coming into the survey in 2000. Estimates on fishing mortality (F) indicate that F has increased in the entire period. **Uummannaq:** Catches have been increasing from less than 2 000 t before 1987 to a record high in 1999 of 8 425 t. Since then landings have declined to 6 558 tons in 2001. Mean lengths in survey have been stable in the entire period. Survey abundance peaked in 1999 and has since decreased to the same level as in 1996. Catch at age 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. Length distribution in the winter fishery has been increasing in 2002, while the summer fishery has been stable. Estimates on F indicate that F has been relative stable. **Upernavik:** Landings have increased from about 1 000 t prior to 1992 to about 5 000 t in 1996 and 1997. In 1998 landings were the highest on record, 7 012 tons. Since then landings have decreased by 50%. Survey results indicate a fall in abundance since 1994. Size and age distribution have changed to smaller fish but stabilized in recent years. Estimates on fishing mortality F indicate that continuing increase in F. New fishing grounds in the northern part of the district are being exploited however, little information exists from these areas.

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 resident in the fjords and thus isolated from its origin spawning stock (Riget and Boje, 1989). Thus, the component does probably not contribute to the spawning stock in the Davis Strait (Boje, 1994 and 1999). Only sporadic spawning is observed in the inshore area (Jørgensen and Boje, 1994) and the inshore component is not assumed to be a self-sustainable stock, but dependent on recruits (immigration) from the nursery area south of Disko Island (Bech, 1995b).

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 16 869 tons in 2001, and constitute far the majority (~99%) of inshore landings in Greenland. The inshore landings were around 7 000 tons in the late 1980's and increased until the late 1990's to a maximum of 25 000 tons. Since then landings have decreased to near 17 000 tons in 2001 (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 not quota but in the latest years restrictions have been made on new vessels in fishery and from 1998 a special fishery licence to land catches of Greenland halibut is required. 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 or by means of dog sledges. In the latest years bigger vessels (>25 foot) have 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. In the late nineties authorities introduced regulation on gillnets in order to limit effort. A total ban for gillnets has been in force from year 2000. However, many exemptions have been given to this ban. Most recently a re-opening of a all year gillnet fishery in Ilulissat in front of the icefjord. In Upernavik and Uummannaq in areas outside the Icefjords in the following periods: Upernavik 1. February - 30. April and again from 1. June to 30. September. In Uummannaq in the periods 1. February – 30. June and again from 1. October to 31. December. The gillnet fishery is regulated by a minimum mesh-size of 110 mm (half meshes), while there are no gear regulations on the longline fishery.

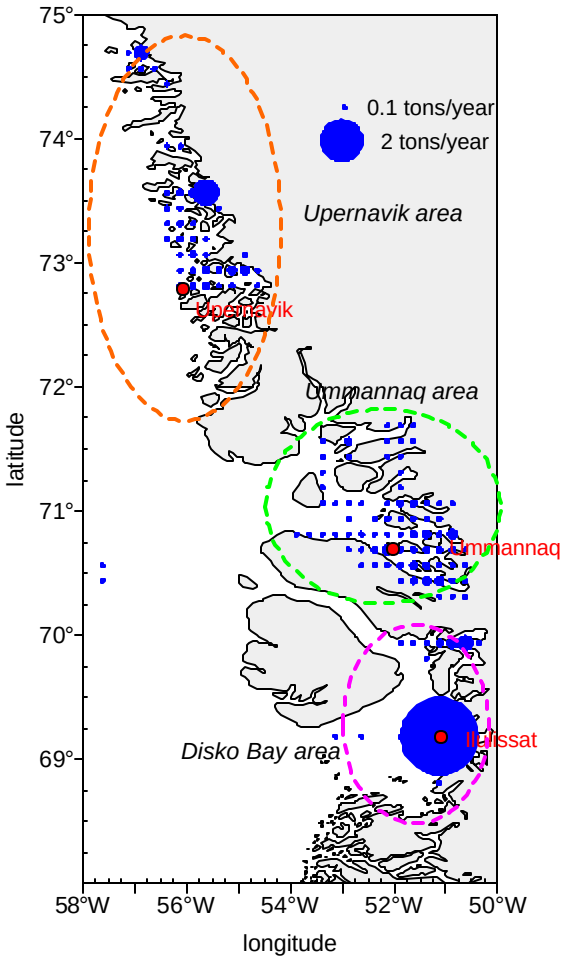

Figure 1. Location of main inshore fishing grounds for Greenland halibut in Div.1A. Landings is shown in tons per. Squarre (field-code). Catch statistics are provensial. For Disko Bay catch statistics was available for 96%; for Uummannaq 75%; for Upernavik 100% of the total landings.

Table 1. Landings and Greenland halibut (tons) in Div. 1A distributed on the main fishing grounds: Disko Bay, Uummannaq and Upernavik. Conversion factor 1.1 for gutted fish with head, 1.50 for gutted fish without head, 1.52 for gutted fish without head and tail fin). 1) Unofficial data from the fishing industry (Royal Greenland, NUKA, Upernavik Seafood & Uummannaq Seafood.

Area/year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[1]	20001[1]
Disko Bay	2258	2670	2781	3821	5372	6577	5367	5201	7400	7837	8601	10671	10593	7574	7072
Uummannaq	2897	2920	2859	2779	3045	3067	3916	4004	7234	4579	6294	6912	8425	7568	6558
Upernavik	1634	777	1253	1245	1495	2156	3805	4844	2403	4846	4879	7012	5258	3764	3239
Unknown area	407	636	599	507	17	133							55	2239	
Total in 1A inshore:															
STATLAN 21A	6696	6384	6927	7465	9243	11932	13204	14067	17046	17271	20835	19669	24333		
STACFIS	7196	7003	7492	8352	9929	11933	13088	14049	17037	17262	19774	24595	24332	21144	16869

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, Torssukataq (Fig. 1). The winter fishery in Ilulissat Icefjord, Kangia, is a traditional fishery from the ice with longlines (mainly field-code LG029, 30 & 31). The fishery near Ilulissat is conducted within a relative small area (field-code LG028) and consist of a mixture of gillnet and longline fishery. The majority of the landings in Disko Bay were caught within this area (in 2001 3 900 tons). The fishery in LG028 is mainly carried out in winter, spring and summer. Often the fish disappear from the area in mid July, where after the fishery move to Torssukataq north of Ilulissat (Simonsen and Roepstorff, 2000). The fishery in Torssukataq is almost exclusively carried out in the period July - August. The catches in Disko Bay have increased in 1990'ies (Fig. 2), and had its maximum in 1999 and 98 at around 10 500 tons. Since then catches have declined to 7 052 tons in 2001.

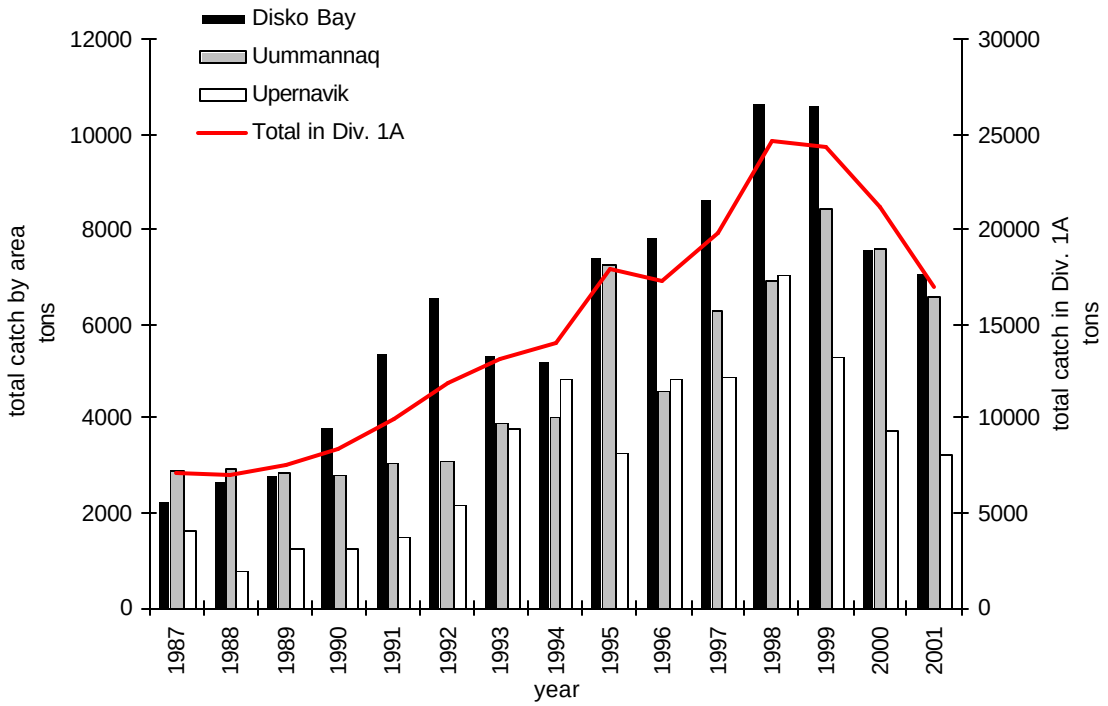

Fig. 2. Landings in NAFO Div. 1A since 1987 for the 3 main fishing areas. Landings for 1998 to 2001 are provisional. See also Table 1.

Uummannaq

The 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. Earlier times Qarajaqs Icefjord was the main fishing area but during the last decade the fishery has spread further north to include 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 until 1999. The two latest years landings have declined, in 2001 landings were down to 6 558 tons (Fig. 2 and Table 1).

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 have up till now been prohibited in Upernavik but dispensations have been given for a fishery outside the Icefjords in 2002.

The catches in the Upernavik area have increased steadily from about 1 000 tons in the late 1980's to about 3 to 4 000 tons in 1993 to 1995 (Fig. 2 and Table 1). The total catch in 1998 was the highest on record 7 012 tons. Since then landings have declined and was 3 239 tons in 2001.

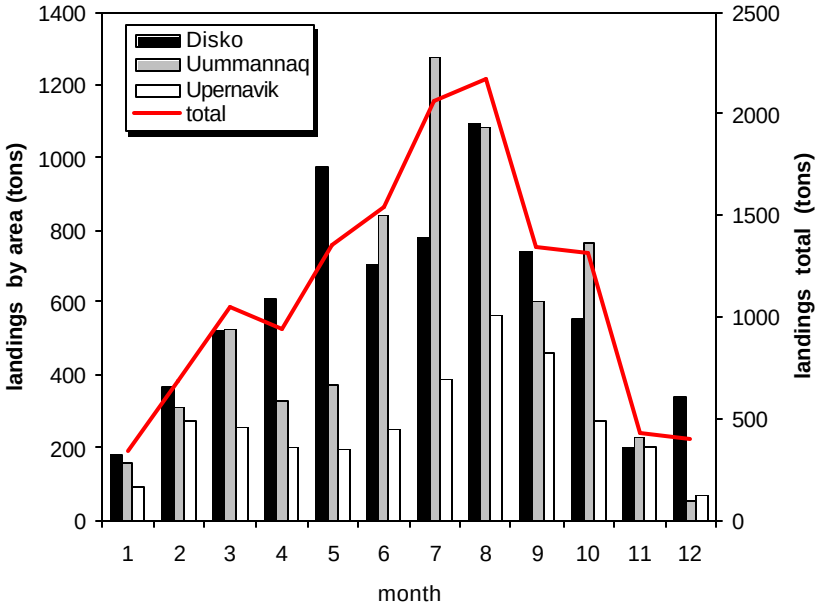

Fig. 3. Landings in NAFO Div.1A, inshore in 2001 allocated on area and month.

3. Input data

3.1 Research Fishery

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 (for further details see Simonsen *et al*. (2000)).

In July-August 2001 the research longline vessel 'Adolf Jensen' covered the fjord areas of Disko Bay and Uummannaq. The survey coverage was not complete either in Disko Bay or Uummannaq.

In Disko Bay only the stations in the Ilulissat area was carried out (10 stations). Station nr. 29 where excluded from the dataset as the line had drifted more than 4 n.m.

In Uummannaq only 4 stations in Qarajaqs Fjord was carried out due to abortion of the survey (technical problems with survey vessel).

Mean length from survey was calculated as simple arithmetic mean on all standard stations pr year (Table 3).

CPUE from survey from calculated as catch of Greenland halibut on all standard stations pr year divided by effort (no. baited hooks) and expressed as kg/100 hooks.

CPUE was also calculated on a length stratified (by 5 cm) basic. The number of Greenland halibut pr. 5 cm group on all standard stations divided by effort (no. baited hooks)

Even though the survey is standardised with fixed stations, gear etc our experience is that stations often have to be displaced to another area due to heavy sea ice. The review of the survey in 2000 (Simonsen *et al, 2000*) showed that stations in certain some areas (typical close to the glaciers) had significant higher catch rates than others. Therefore a further standardization of CPUE was done by GLM analysis. A multiplicative model was carried out using information on area (field-code), depth and year. First a full model was applied. The model was significant but over-parameterized. Therefore the variable DEPTH was sub-categorized into SHALLOW, MEDIUM and DEEP depth, while variable FIELDCODE was –sub-categorized in **H**IGH, **M**EDIUM and **L**OW CPUE.

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 year-classes 1-3 is provided from the survey, for details see SCR Doc. 02/48 (Engelstoft & Jørgensen, 2002)

3.2 Commercial fishery data

Landings data

No official data was provided on the inshore landings of Greenland halibut in 2001. Instead landing data was obtained from the Greenland Fishery Licence Control. These data was not allocated on gear why it was assumed that it was the same as in 1999 (latest year with information). Summer was defined at the month June-October (both included), remaining months was classified as winter.

Processed fish is normally converted to whole fish weight using conversion factor set by the authorities. In 1998 and 1999 a new set of conversion factors was introduced. The conversion factor for gutted fish with head and tail was multiplied by a factor 1.05, this was changed to 1.10 (previously 1.05). The conversion factor for gutted fish without tail and tail fin was before 1.52 and changed to 1.35 (previously 1.52). The conversion factors used in for the 2001 landing data are not known but is likely to be the new factors.

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 have changed over time and differ between companies, these figures have not been used since the 1998 assessment.

In order to obtain length distributions for the commercial catches/landings random samplings from gillnet and longline fishery were carried out in the three main areas in February/March and July/August. Samples from the longline fishery were obtained from all areas and both seasons while the gill net fishery only was covered in Disko Bay during winter. Thus the distribution from the gillnet fishery in Disko Bay winter was applied to the Disko Bay summer and Uummannaq both winter and summer.

Effort

In 1999 logbooks has been introduced in the inshore fishery on a voluntary basis. The reporting has been very limited in both 1999 and 2000 and no logbooks were available from the fishery in 2001.

Earlier attempts to estimate fishing effort has shown a significant correlation between effort (expresses as fishing days) and landings (Simonsen and Boje, 1999).

Estimation of fishing mortality

I previous years assessment levels of fishing mortality have been estimated from catch-curve analyses using the linear decay in the fully recruited age classes in the longline fishery summer/winter to estimate mortality (Z). However, the fishery probably takes place on smaller sub-components and size composition in these components

varies within season and locality. Therefore the estimation of F has been considered uncertain and not been accepted as face value.

In order to clarify the evolution in mortality a slightly different approach was attempted in this year assessment. The total catch at age matrix for each area was LN transformed and the fate of the year classes followed in time. For the ages 10-14 (fully exploited age-groups by line and gillnet) mortality was estimated by linear regression (catch-curve analysis). An F bar index was set up by using the Upernavik year-class 1983 as reference (this year-class was considered to have been exposed to the lowest fishery exploitation rate).

Catch-at-age data

Samples from area were disaggregated by season and gear and then raised by the catch proportions to give the 2001 catch at age in numbers. Calculations of catch-at-age data from 1988 to 1990 are described in Boje (1991), from 1991 to 1994 in Bech (1995A), from 1995-97 in Simonsen and Boje (1997) and for 1998 in Simonsen (1998). (Table 4)

As in latest years assessment a compiled age / length and weight key for the recent 3 years was used for each area (Table 5).

3.3 Recruitment data

Recruitment index

A recruitment index was provided from the Greenland trawl survey (SCR doc 02/48). The linkage between the Disko Bay area recruitment index and subsequent recruitment to the fishery at age 7 to 10 (Catch in numbers) was inspected by simple correlation. Thus it was assumed that Greenland halibut at age 1-3 in Disko Bay recruit to the fishery at age 7-10 in Ilulissat and Torssukataq. Furthermore, that effort was constant in the period. The latter is, as stated elsewhere, probably not correct. However, it could not be corrected, as no direct information on fishing-effort exists.

In 2001 a pilot study was carried out in the Disko Bay area in order to examine the feasibility of a new survey targeting pre-recruit to the fishery (ages 4-7). The pilot survey was carried in Disko Bay outside Ilulissat in the period July 31 to August 2. The gear used was multi-gang gillnets. Each setting was approx. 300 m long and composed of 4 sections, one of each mesh size (mesh sizes 45, 52, 60 and 70 mm (knot to knot) with twines 0.28, 0.40, 0.40 and 0.50 mm correspondingly), with 2 m space between each section to prevent catchability interactions between sections. The net was set at 300-400 m. depth.

3.4 Biological data

Migrations

A review of the tagging experiments in West Greenland in the period 1986-1998 has been conducted (Boje 2002). No fish tagged in the fjords in Div. 1A have been caught in the offshore area in Div. 1A or in the more southern offshore spawning area. Fishing effort in Div. 1A offshore area is insignificant, contrary to 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 is 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 2001.

Maturity

Observations of sexual maturity of Greenland halibut were carried out in all areas in 2001. For further details see paper SCR 02/38 (Simonsen and Gundersen, 2002)

Condition and Weight at age

An age independent condition index was set up for Greenland halibut. The length – weight relationship was found to fit a power function:

$$W = K * L^B$$

where W=weight; L is total length, b is a constant and K is the condition factor. b was found to be 3.3 (N=3240, r^2=0.98).

Thus the condition factor was defined as

$$K = \frac{W}{L^{3.3}} * 10^6$$

For weight at age information 10 fish in each cm-group was sampled, length and weight measured and the otolith age estimated. Mean weight at each age group was calculated as simple arithmetic mean.

3.5 Analytic assessment

The possibilities of an analytic assessment have been explored in previous assessment by means of a separable VPA. However, Scientific Council have not approved the VPA as taken face value due to inaccurate determination of terminal F's and lack of effort data. However, it was felt that the VPA provided a likely scenario of stocks trends for the recent years. The separable VPA was run for this assessment including the 2001 data but did not show any improvement or new trends and was thus not presented.

4. Assessment

4.1 Longline survey results.

Mean length

In Disko Bay the survey showed some discrepancy between Ilulissat and Torssukataq area (Fig. 4). In Torssukataq the mean size has been stable over time with in in average larger fish compared to Ilulissat. In Ilulissat mean lengths until 1998 has been stable, but in the last two years mean size have increased and reached the level of Torssukataq.

In Uummannaq mean size have increased until 2000 (Fig. 4) followed by a slight decline in 2001 data (even though sparse) indicate a minor fall in mean length.

In Upernavik there have been a decreasing trend from 1994 to 1998 while the 2000 survey indicate a stabilization in mean length (Fig. 4).

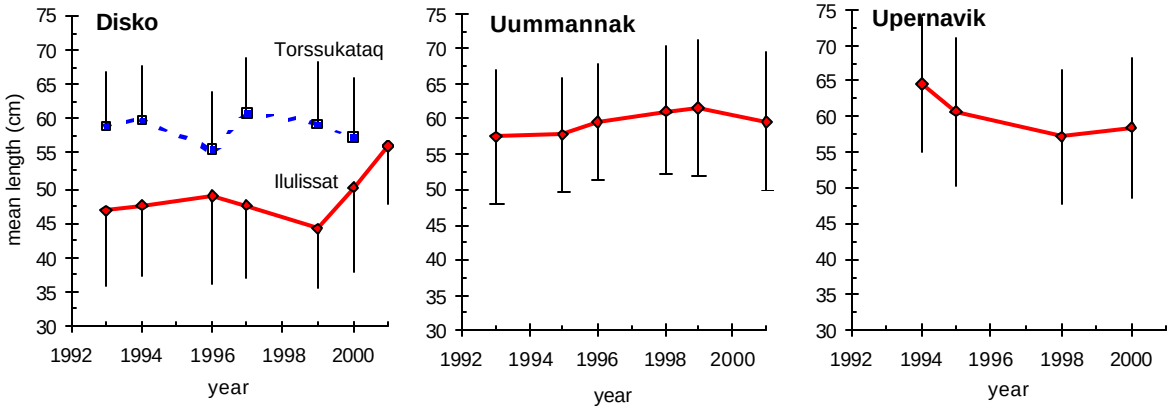

Figure 4. Mean length for research longline surveys since 1993 +/- S.D

CPUE

In order to compensate for that not all areas have been covered during the survey due to heavy sea-ice, technical problems with ships etc., the CPUE index was standardized by means of a GLM analysis (multiplicative model) was carried out using information on area (field-code), depth and year. First a full model was applied, then a reduced model sub-categorizing the variables (in order no to over-parameterize). Output from GLM is shown in Table 7, Appendix.

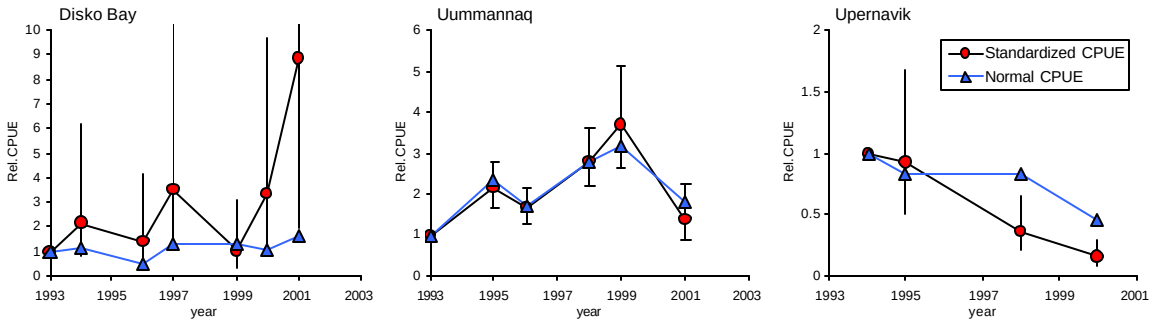

Fig. 5. CPUE index, both normal index and standardized index (see text above).

In Disko Bay the CPUE index have been fluctuating without any trend until 2001 which is about four times the average for the period 1993 to 2000. However, the year effect is no significant. According to local fishers the distribution of Greenland halibut in 2001 was somewhat unusual as high concentrations of fish where to be found in the Ilulissat area throughout summer. Usually catch rate drop in mid-July, which has been interpreted as a migration of fish out of the area (Simonsen and Roepstorff, 2000).

In Uummannaq CPUE has been increasing until 1999 but decreased significantly in 2001.

In Upernavik the CPUE index has decreased significantly throughout the time series.

CPUE length-stratified

From CPUE on length-stratified samples it was found:

In Disko Bay in all years, except 1993 and 2001, the modal length has been around 60 cm. In 1993 it was above, and in 2001, below 60 cm. Especially in 2000 length classes 40 to 50 cm where abundant suggest incoming year classes above average (Fig. 6).

In Uummannaq there is a shift in modal length from 50 cm in 1993 to 65 cm in 1998 and 99 (Fig. 6).

In Upernavik larger fish have become less abundant and the modal has shifted from 65 cm in 1994 to 55-60 cm in 2000 (Fig. 6).

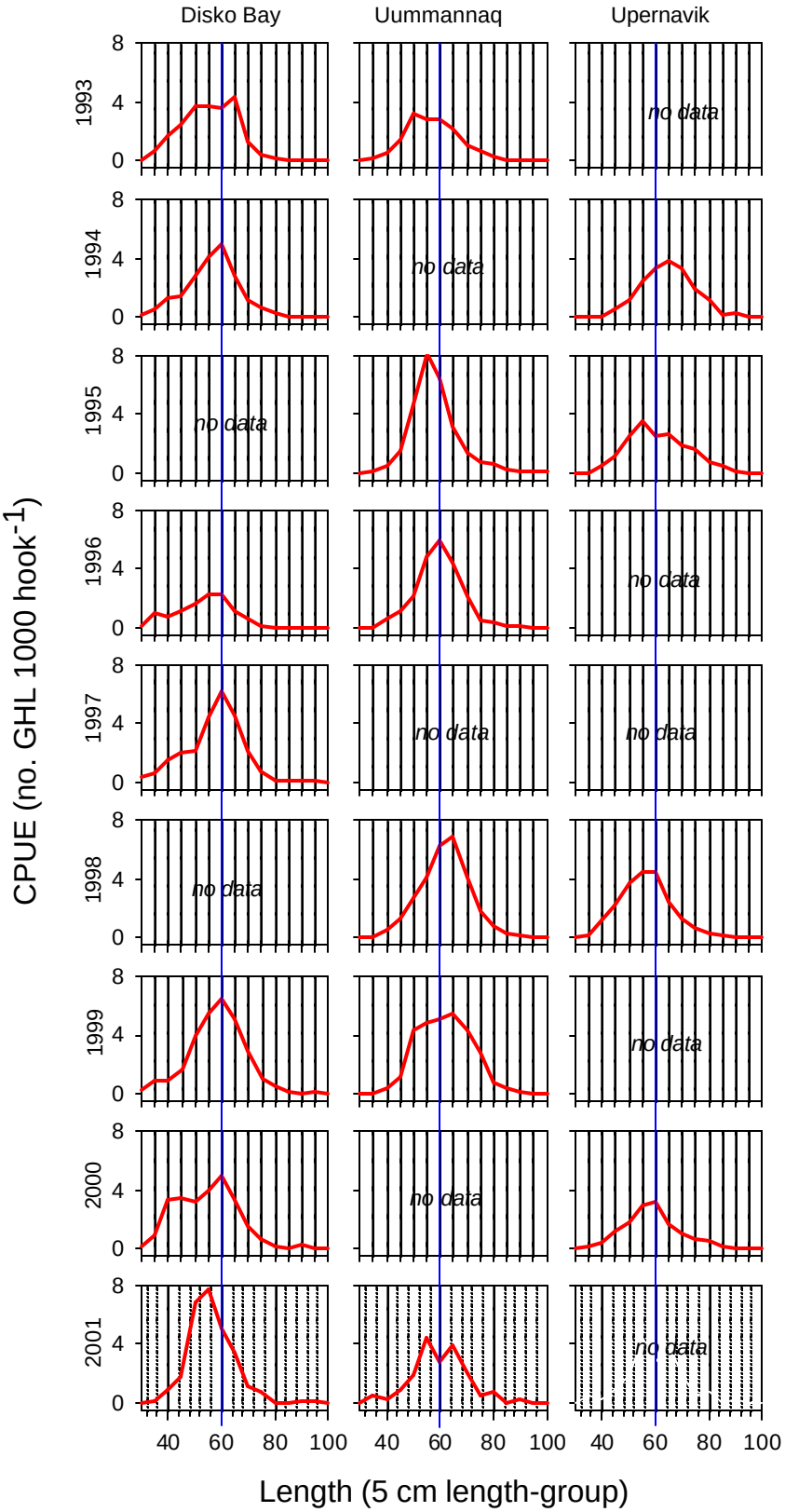

Fig. 6. CPUE (N/1000 hooks) of G. halibut from longlinesurvey stratified in 5 cm length interval.

4.2. Commercial fishery

Size distribution

Mean lengths from the longline landings in the period 1993 to 2001 in Disko Bay, Uummannaq and Upernavik are showed in Fig. 7. Fish caught in summer are general smaller than fish caught during winter season.

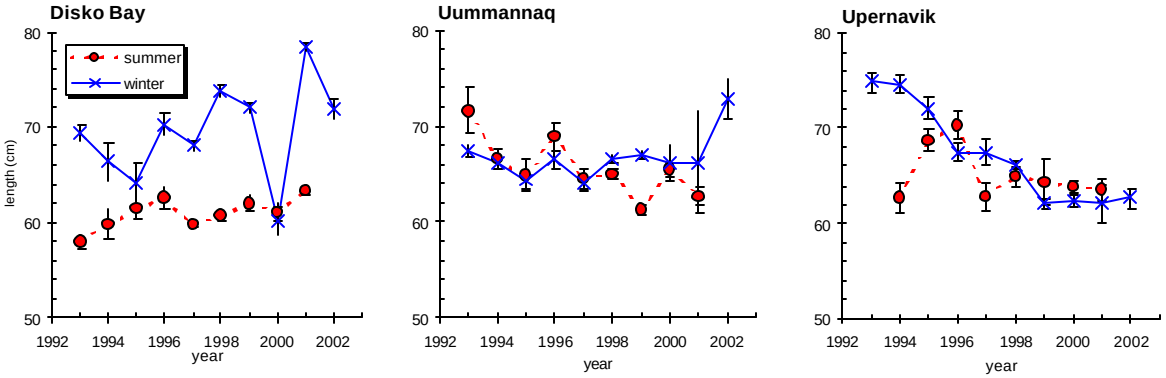

Fig. 7. Mean length of Greenland halibut in commercial longline catches from Ilulissat, Uummannaq and Upernavik +/- 95% conf.

Disko Bay showed an overall positive trend in mean length except for the winter 2000. Fishing at the traditional winter fishing grounds was impossible for most of the winter 2000 due to bad sea-ice conditions (the fishery is conducted from the sea-ice). Instead an open-water fishery developed at alternative fishing grounds. The winter fishery in 2001 caught the largest fish observed since 1993. Mean length in the summer fishery has showed an increasing trend. Also here the 2001 fish was among the largest observed since 1993.

In Uummannaq, a negative trend in the summer fishery was observed from 1993 to 1999. In 2000 mean length increased but dropped again in 2001 to the 1999 level. In the winter fishery the average size has been relatively stable up to 2001. In 2002 mean size increased sharply.

In Upernavik mean length increased up to 1996 where after it stabilized at around 65 cm. In the winter fishery, mean length decreases significantly until 1999 and have since been stable around 62 cm.

Fishing mortality

A real value of recent F for age-groups exploited by the fishery F could not be estimated. The F-bar (age 10-14) index showed that F has increased in all areas, most in Disko Bay and Upernavik (Figure 9). In these areas the level of F is about 4 times higher than in the beginning of the time series. In Uummannaq F has increased about a two-fold. F was estimated to on the level same level in Upernavik and Disko Bay while somewhat lower in Uummannaq (about 25%). As stated below the fishery mainly explores age groups 10 and younger. Therefore the analysis may not reflect recent fishing patterns.

Catch at age

Exploitation patterns for fish age 10 and below have increased for all tree areas (Fig. 8). In Disko Bay exploitation have been around 70 % since the early 1990's. In Uummannaq the same trend have been observed since mid-1990's. The exploitation pattern in Upernavik have until 1996 been on relative old fish (20% age 10 and below) but have since developed to exploit still younger age groups. For all areas there have been a continuous shift from a broad exploitation on many age groups to few age-groups. Today over 80% of the fishery is conducted on 4 age-groups.

From the cohorts in the fishery, as shown in figure 9, it can be seen that the year-classes fished in the 1980'ies and early 1990's stayed much longer in the fishery compared to present times.

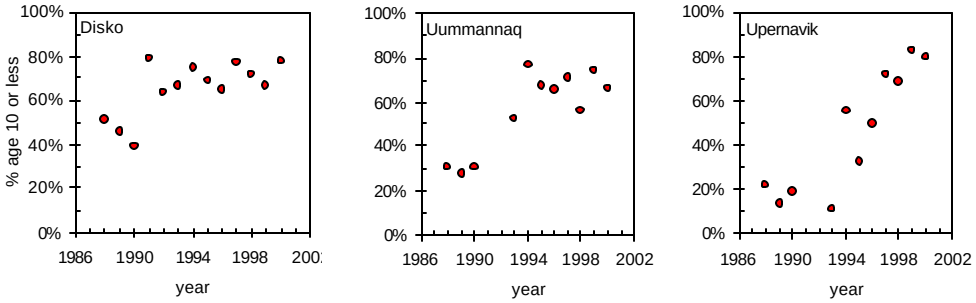

Fig. 8. The development in exploitation of the *age 10 and below* expressed as percentages for each year.

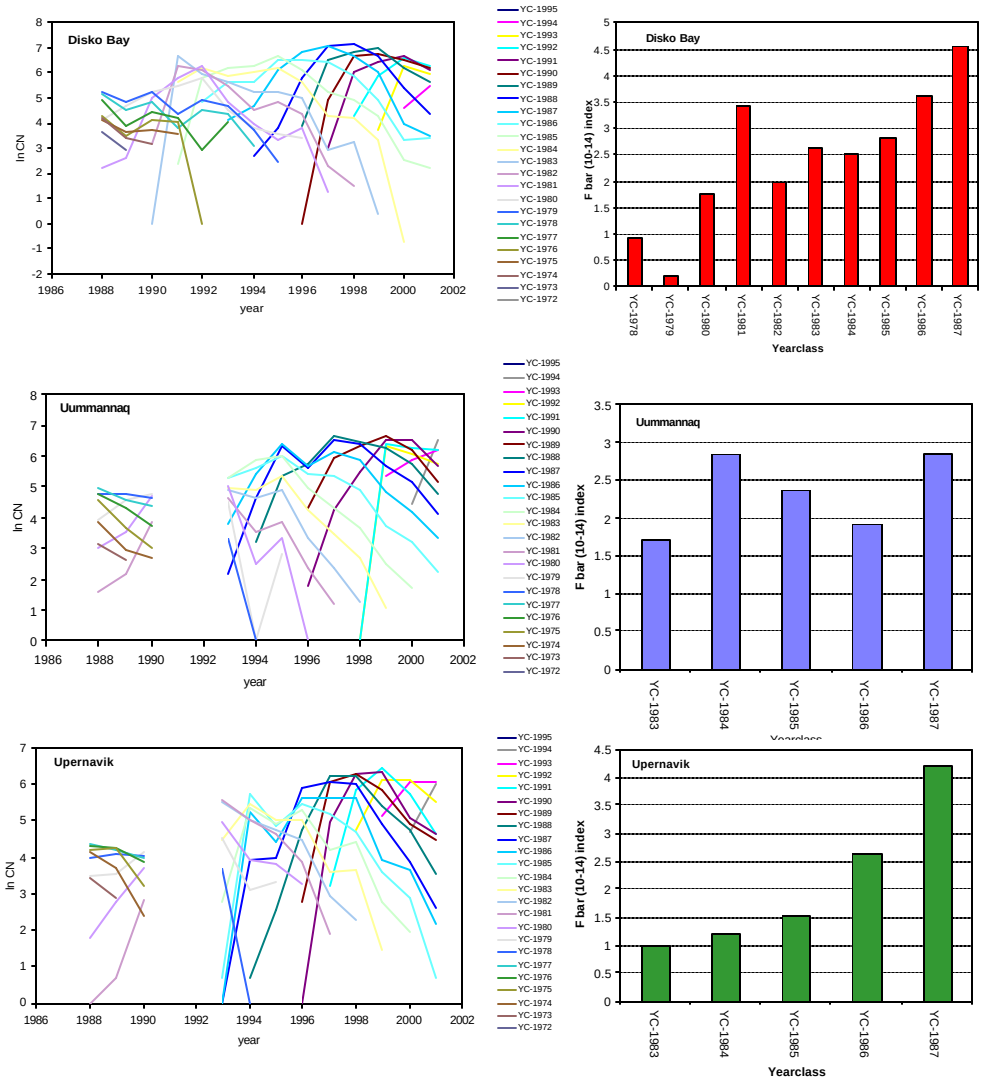

Fig. 9. Left panel: LN to catch in numbers in each area. The fate of the different year-classes can be followed. Right panel: time. For the ages 10-14 Z was estimated by linear regression. An F bar index was set up by using the Upernavik year-class 1983 as reference (this YC was considered to have been exposed to the lowest fishery exploitation rate).

Recruitment

Recruitment of ages 1, 2 and 3+ from the offshore and Disko Bay area are presented in SCR 02/48.

A linkage between the recruitment at age 1-3 and the subsequent recruitment to the inshore fishery in the fjords has not been firmly investigated due to the short time series. An exploratory analyses for the Disko Bay area (Fig. 10) showed that only for age-3 caught at age 7 in the fishery was there a positive and significant correlation (P=0.03). In general there were little or no correlation. However, as stated earlier further studies should be made before any firm conclusions can be drawn.

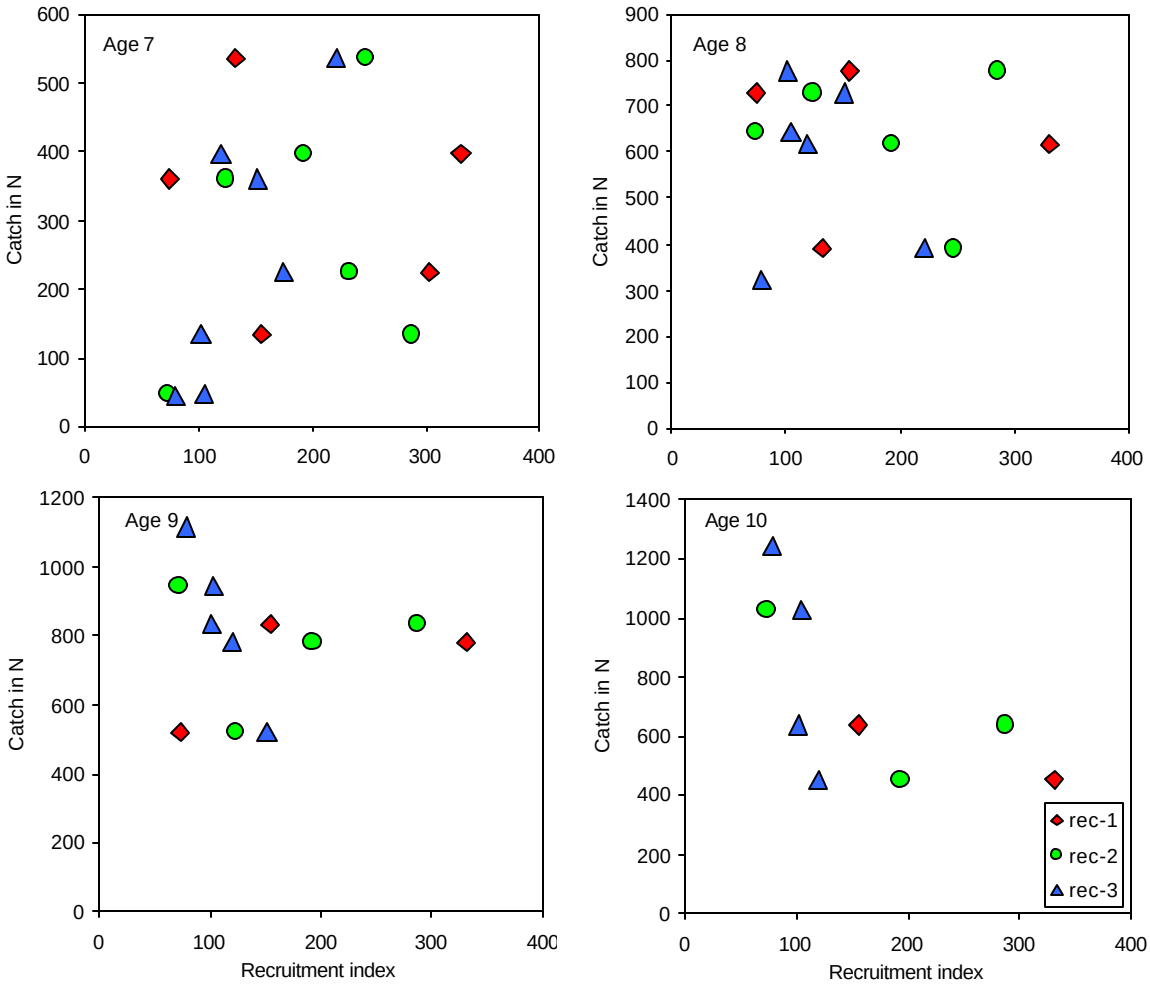

Fig. 10. Correlation between the Disko Bay recruitment index at age 1-3 and the subsequent recruitment to the fishery at age 7 to 10.

The preliminary result of the pilot survey using gillnets (targeting the pre-fishery Greenland halibut at ages 4 to 7) were promising. A total of eight settings were made, catching about 200 fish (range 12 to 46 per setting). Catch distributions from the 4 different mesh sizes pooled for the 8 settings are shown fig 11B. Assuming a bimodal selectivity curve (Fig. 11A), allowing a catch process other than "gilled", the catches with the length range 30-50 cm approximately represents the stock (Fig 11C).

Further trials will be conducted in 2002 with the aim to replace the longline survey with a gillnet survey within near future. The gillnet survey target specifically the pre-fishery fish, enabling a better forecast for the fishery, while the longline survey target the exploited age-groups. Further, the selectivity pattern is unknown for longlines, thus preventing a qualified estimation of stock composition.

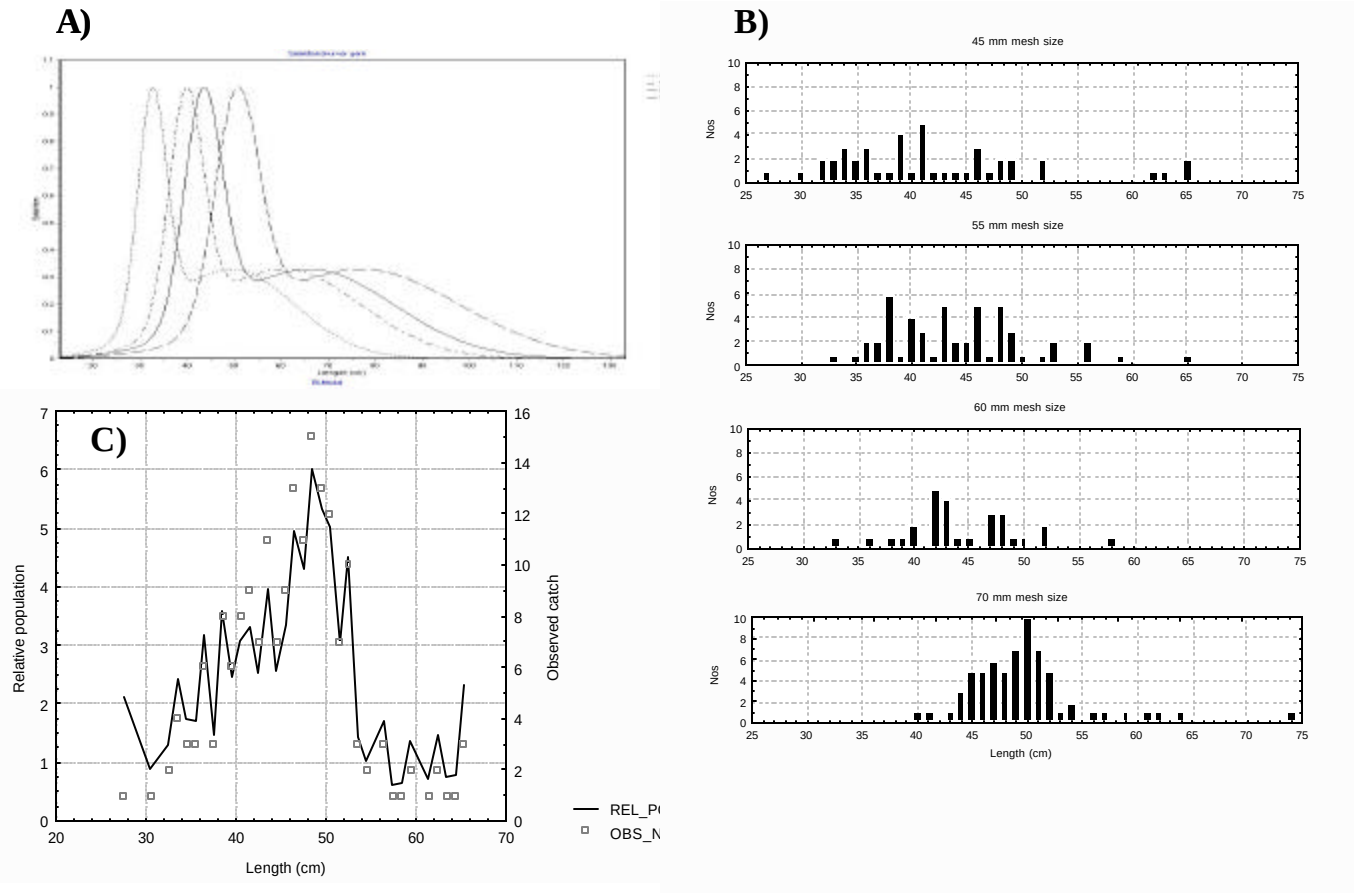

Fig. 11. Results from the gill-net survey; A) Bi-modal selectivity curves for 4 mesh sizes used in the study. B) Length distributions of catches with 4 different mesh sizes. C) Observed versus estimated population numbers using the bi-modal selectivity model.

Condition index and weight at age

The condition index (K) was applied on length-stratified samples (larger or smaller than 60 cm) and on sex in each area (Figure 12). In Disko Bay the lowest K was found in 1996, but otherwise to fluctuate with no clear trend or difference in the time series neither between size and/or sex. Compared to the other areas the Uummannaq area had the lowest K. Neither here was any clear trend observed in time. In Upernavik the larger fish and especially the female fish had a high K. Also here the index fluctuated with no clear trend.

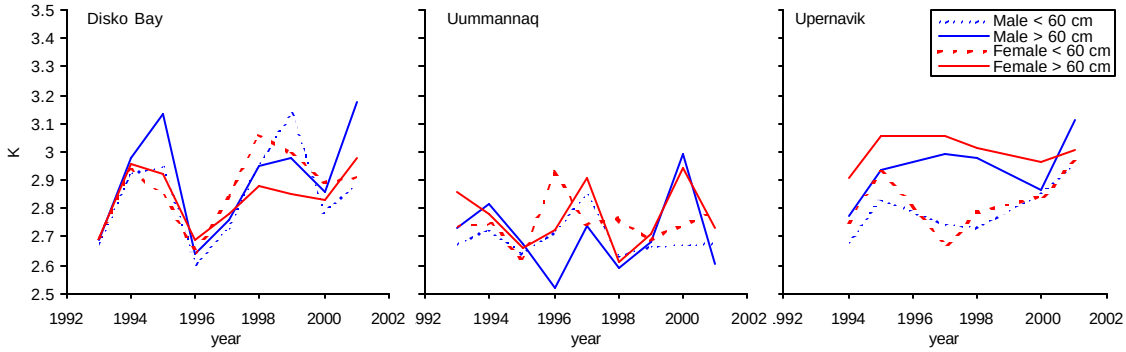

Fig. 12. Conditions index (K) on area, size and sex.

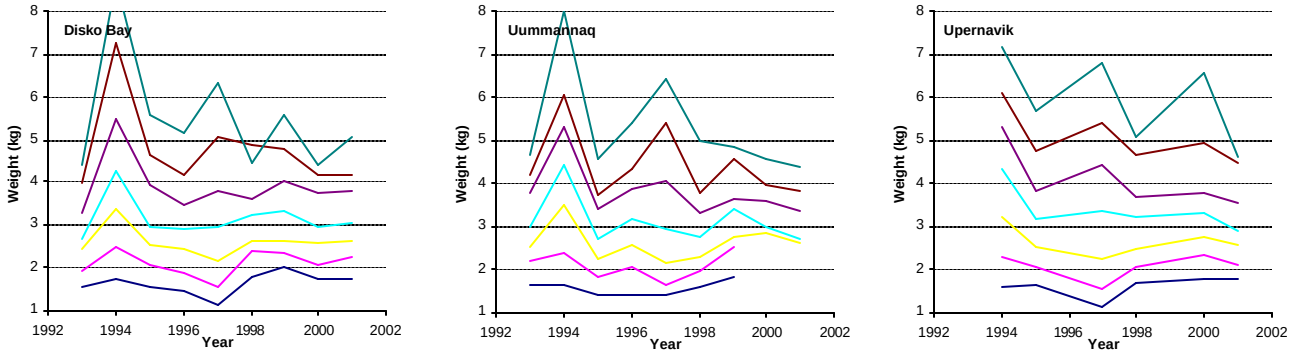

Fig. 13. Weight at age for ages 8-14

Some peculiarities were observed in the weight at age data (Fig 12). In 1994 weights for all ages were higher than adjacent years. In 1997 only the older ages (>12 y) have higher mean weight at age while it was lower for ages 8-11. This is likely to reflect errors in age estimations. Ignoring the years 1994 and 1997 no dramatic change in weight at age was observed in the time series.

5. State of the stock components

The abrupt decline in landings in the most recent years raises concern. The lack of information on fishing effort makes it difficult to fully evaluate whether it is a result of declining stock biomass or fishing effort. Estimates of F suggest increasing fishing mortality in some areas (Disko Bay and Upernavik) and stability in others (Uummannaq), but this is based on ages 10-14 which are not well represented in the catches and thus may not reflect recent fishing patterns. Nevertheless, in recent years an extensive reorganization in the fishing industry has been taking place and this is likely to have resulted in a reduction in fishing effort as landing feasibility was reduced. However, indices from both survey and commercial fishery do indicate especially in Upernavik and to some degree in Uummannaq a stock decline.

Disko Bay

For a period for more than 10 years landings more or less increased annually from about 2 000 tons in 1987 to 10 500 t in 1998 and 99. Since then landings have declined and was last year 7 072 tons. The reason for this decline is unknown.

Survey results from 1993 onwards do not indicate any major changes in abundance, except for the year 2001, when the abundance-index was remarkably higher, although estimated with uncertainty. Length composition in the survey data indicate above average recruiting year-classes entering the fishery in 2000 and 2001. In the commercial fishery the mean length in the summer fishery has been relatively stable while an increase has been observed in the winter fishery

Uummannaq

Catches have been increasing from less than 2 000 t before 1987 to a record high in 1999 of 8 425 t. Since then landings have declined to 6 558 tons in 2001.

Survey results from 1993 to 1999 indicate an increase in abundance until 1999. In 2001 survey abundance index decreased statically significantly to a level observed in the mid 1990's. Catch composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age groups, but has recently stabilized.

Upernavik

Landings have increased from about 1 000 t prior to 1992 to about 5 000 t in 1996 and 1997. In 1998 landings were the highest on record, 7 012 tons. Since then landings have decreased by 50%.

Survey results from 1993 onwards indicate a steady and significant decline in abundance. Mean length compositions in both commercial and survey catches have decreased, most significantly in the winter fishery. In the traditional fishing grounds at Upernavik up to 73°45'N younger and fewer age groups are caught. New fishing grounds in the northern part of the district have been exploited only recently. Little information exists from these areas

6. General comments

It must be stressed that the lack of official landing data for both the year 2000 and 2001 hampers the assessment of the inshore stock components in Div. 1 A. Official data on landings allocated on area (field-code), fishing gear and effort must be considered an absolute minimum. Improvement of the current assessment depends on upon this.

A voluntary logbook was introduced in 1999 for parts of the inshore Greenland halibut fishery. However, the return rate has been very low and shows no sign of improvement. Authorities should consider means to ensure a higher return rate of logbooks in the Greenland halibut commercial fishery in Div. 1A.

The abrupt decline in landings the latest years raises concern. Especially because the missing information on fishing effort makes it difficult to conclude whether it is a result of declining stock biomass or fishing effort.

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.

A earlier study of the by-catch of Greenland halibut in the commercial shrimp fishery (Jørgensen and Carlsson, 1998) suggest that the by-catch is considerable and could have a negative effect on recruitment to the inshore stock component. However, 22 mm sorting grids have since then been made mandatory in the shrimp fishery (since October 2000) and have probably limited by-catch.

7. References

Bech, G., 1995a. An assessment of the inshore Greenland halibut stock component in NAFO Divisions 1A. NAFO Scr.Doc. 95/67

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

Boje, J. (1991). An assessment of the Greenland halibut stock component in NAFO Subareas 0+1. NAFO Scr. Doc. 91/38

Boje, J. (1994). Migrations of Greenland halibut in Northwest Atlantic based on tagging experiments in Greenland waters 1986-92. NAFO Scr.Doc. 94/18

Boje, J. (2002). Intermingling and seasonal migrations of Greenland halibut (*Reinhardtius hippoglossoides*) populations determined from tagging studies. Fishery Bulletin 100: 414-422.

Engelstoft, J. J. and O. A. Jørgensen (2002). Biomass and abundance of dermersal fish stocks off West-Greenland estimated from the Greenland trawl survey 1988-2001. NAFO SCR Doc. 02/48.

Jørgensen, O. A. and D. M. Carlsson (1998). An estimate of by-catch of fish in the West Greenland shrimp fishery based on survey data. NAFO Scr.Doc. 98/41(N3030)

Jørgensen, O. A. and J. Boje (1994). Sexual maturity of Greenland halibut in NAFO Subarea 1. NAFO Sc.Working Paper 94/42(N2412).

Jørgensen, O.A. and Boje, J., 1994. Sexual maturity of Greenland halibut in NAFO Subarea 1. NAFO Scr.Doc., 94/42(No. N2412).

Riget, F. and J. Boje (1989). Fishery and some biological aspects of Greenland halibut (Reinhardtius hippoglossoides) in West Greenland waters. Sci.Council Studies(13): 41-52.

Simonsen, C. S. (1998). An assessment of the inshore Greenland halibut stock component in NAFO Division 1A inshore. NAFO Scr.Doc. 98/44 (N3035).

Simonsen, C. S. and J. Boje (1997). An assessment of the inshore Greenland halibut stock component in NAFO Division 1A. NAFO Scr.Doc. 97/78 (N2915).

Simonsen, C. S. and J. Boje (1999). An assessment of the inshore Greenland halibut stock component in NAFO Division 1A. NAFO Scr.Doc. 99/48

Simonsen, C.S. and Roepstorff, A., 2000. Udvikling og adfærd af fisk & fiskere i Diskobugt området. In: H. M. and O.R. Rasmussen (Editors), Innusuk -Arktisk Forsknings Journal. Direktoratet for Kultur, Uddannelse og Forskning, Nuuk, Grønland, pp. 29-43. *In danish*

Simonsen, C.S., Boje, J. and Kingsley, M.C.S., 2000. A Review Using Longlining to Survey Fish Populations with Special Emphasis on an Inshore Longline Survey for Greenland Halibut (Reinhardtius hippoglossoides) in West Greenland, NAFO Division 1A. NAFO Scr.Doc., 00/29

Simonsen, C.S. 2001. Logbook in the inshore fishery for Greenland halibut in NAFO Div. 1A. NAFO Scr. working doc., 01/26.

Simonsen, C.S. and Gundersen A. C. (2002). Maturity of Greenland Halibut (Reinhardtius hippoglossoides) in the Fjords of Northwest Greenland. NAFO Scr.Doc. 02/38

Smidt, E. L. B. (1969). The greenland halibut, Reinhardtius hippoglossoides, biology and exploitation in Greenland waters. Meddelelser fra Danmarks Fiskeri- og Havunders¢gelser 6(4): 79-148.

Appendix

Table 1. Landings and Greenland halibut (tons) in Div. 1A distributed on the main fishing grounds: Disko Bay, Uummannaq and Upernavik. Conversion faktor 1.1 for gutted fish with head, 1.50 for gutted fish without head, 1.52 for gutted fish without head and tail fin). 1) Unofficial data from the fishing industry (Royal Greenland, NUKA, Upernavik Seafood & Uummannaq Seafood.

Area/year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[1]	20001[1]
Disko Bay	2258	2670	2781	3821	5372	6577	5367	5201	7400	7837	8601	10671	10593	7574	7072
Uummannaq	2897	2920	2859	2779	3045	3067	3916	4004	7234	4579	6294	6912	8425	7568	6558
Upernavik	1634	777	1253	1245	1495	2156	3805	4844	2403	4846	4879	7012	5258	3764	3239
Unknown area	407	636	599	507	17	133							55	2239	
Total in 1A inshore:															
STATLAN 21A	6696	6384	6927	7465	9243	11932	13204	14067	17046	17271	20835	19669	24333		
STACFIS	7196	7003	7492	8352	9929	11933	13088	14049	17037	17262	19774	24595	24332	21144	16869

Table 2. Landings of Greenland halibut allocated on area, season and gear. Allocation on gear was obtained from the distribution from the fishery in 1999 as no information was provided with the landings figures for 2001.

		summer		winter		Total
		longline	gillnet	longline	gillnet	
Disko	Ilulissat	1337	1662	1028	2882	
	Torssukataq	513	356	47	77	7574
Ummannaq		4434	134	1749	241	7568
Upernavik		1941		1298		3764

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	2000	2001
Disko bay	-	62.4	53.5	62.2	55.9	56.5	-	53.6	57.0	-	56.7	54.3	56.1
Uummannaq	67.8	70.5	-	61.8	57.5	-	57.8	59.5	-	61.2	61.5		59.7
Upernavik	-	-	-	-	-	64.6	60.8	-	-	57.1		58.4	

Table 4. Catch at age of Greenland halibut. - indicates insufficient or missing sampling

A) Disko Bay

	Catch in numbers (thousands)													
age/year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
4	0	0	0	5	34	7	0	0	0	0	0	1	0	1
5	0	0	0	5	92	15	3	0	8	0	0	4	9	15
6	1	0	0	11	122	62	15	0	1	21	74	41	98	33
7	9	0	1	279	332	280	112	45	47	132	397	360	535	224
8	59	14	24	806	476	479	281	459	323	646	775	619	729	390
9	182	106	141	535	390	339	539	639	941	1113	944	836	780	521
10	173	121	185	333	451	280	396	798	651	1168	1248	1028	636	450
11	132	94	188	238	532	240	190	463	454	607	754	786	478	485
12	73	49	126	76	309	122	91	185	273	185	346	426	223	280
13	63	33	80	45	140	91	50	127	145	69	132	136	52	78
14	65	39	59	67	92	112	45	27	75	19	68	72	28	33
15	38	31	42	57	18	75	41	36	44	10	27	29	12	31
16+	33	41	44	44	0	86	36	27	69	6	6	2	1	16
Total	828	528	890	2501	2988	2188	1799	2806	3031	3976	4770	4340	3583	2557

B) Uummannaq

	Catch in numbers (thousands)													
age/year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
4	0	0	0-	-		0	0	0	1	0	0	8	0	0
5	0	0	0-	-		0	0	0	0	0	0	70	19	65
6	1	0	1-	-		9	24	6	6	0	0	218	86	113
7	5	2	3-	-		45	105	217	76	69	0	554	357	674
8	20	9	15-	-		200	226	564	308	377	235	596	441	507
9	52	35	47-	-		202	271	601	279	793	566	690	543	315
10	121	98	108-	-		142	346	413	286	702	657	789	669	492
11	143	120	121-	-		138	139	414	232	460	586	526	487	303
12	121	99	101-	-		104	105	219	142	206	355	295	311	178
13	96	76	82-	-		158	34	138	69	75	138	131	170	121
14	49	38	42-	-		93	12	49	28	32	39	42	68	60
15	23	19	20-	-		28	0	28	11	10	15	12	24	28
16+	17	20	21-	-		20	3	22	15	6	5	4	8	12
Total	648	516	561	-	-	1139	1265	2671	1453	2732	2595	3935	3184	2868

C) Upernaci

	Catch in numbers (thousands)													
age/year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
4	0	0	0-	-		0	0	0	0	0	0	14	0	0
5	0	0	0-	-		0	0	0	3	4	0	55	2	28
6	0	0	0-	-		0	2	0	0	25	116	172	108	144
7	0	0	0-	-		0	51	13	16	142	343	449	420	404
8	6	2	2-	-		2	188	55	114	428	538	619	446	422
9	33	16	17-	-		16	316	84	359	500	535	566	302	258
10	55	34	41-	-		86	217	128	275	430	505	343	160	103
11	80	59	62-	-		252	239	133	238	278	410	229	133	104
12	74	66	57-	-		268	154	147	206	175	275	138	116	87
13	68	69	52-	-		143	155	117	151	67	112	51	48	36
14	62	73	48-	-		95	51	103	90	37	84	36	38	14
15	31	40	25-	-		40	23	45	48	19	39	16	17	9
16+	22	31	17-	-		46	0	42	39	8	10	5	9	3
Total	431	390	321	-	-	948	1396	867	1539	2111	2968	2679	1800	1611

Table 5. Age-length keys used in 2001 assessment.

Disko Bay age-length key, data combined from 1999-2001

length \ age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	total
30	6	11																	17
35	1	33	19																53
40		2	56	7															65
45			10	64	13														87
50				15	105	12													132
55					31	93	21	1											146
60					1	15	71	45	12	1									145
65							8	45	71	27			1						152
70								2	24	58	25	17							126
75							1		3	22	29	14	4						73
80											6	5	10	1					22
85										1	3	1	11						16
90											1		1	1	2				5
95											1	1	3		1				6
100																			0
total																			1045

Ummannaq age-length key, data combined from 1999+2001

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	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
40	0	0	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	8
45	0	0	5	6	9	0	0	0	0	0	0	0	0	0	0	0	0	0	20
50	0	0	3	5	29	4	3	2	0	0	0	0	0	0	0	0	0	0	46
55	0	0	0	1	23	29	13	4	0	0	0	0	0	0	0	0	0	0	70
60	0	0	0	0	0	11	15	28	13	4	1	0	0	0	0	0	0	0	72
65	0	0	0	1	1	2	0	25	28	16	5	0	0	0	0	0	0	0	78
70	0	0	0	0	0	1	2	4	10	18	20	15	0	0	0	0	0	0	70
75	0	0	0	0	0	0	1	3	2	6	22	14	11	3	0	0	0	0	62
80	0	0	0	0	0	0	1	0	0	3	12	5	14	2	1	1	0	0	39
85	0	0	0	0	0	0	0	0	0	0	4	2	1	5	0	0	0	0	12
90	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	1	0	0	7
95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total																			486

Upernavik age-length age-length key, data combined from 1999-01

length \ age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	total
30	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
35	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
40	0	0	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
45	0	0	1	17	4	0	0	0	0	0	0	0	0	0	0	0	0	0	22
50	0	0	0	2	57	17	0	0	0	0	0	0	0	0	0	0	0	0	76
55	0	0	0	0	16	87	25	0	0	0	0	0	0	0	0	0	0	0	128
60	0	0	0	0	0	14	82	32	16	1	0	0	0	0	0	0	0	0	145
65	0	0	0	1	0	0	2	29	57	34	25	1	0	0	0	0	0	0	149
70	0	0	0	0	0	0	0	0	9	58	20	13	3	0	0	0	0	0	103
75	0	0	0	0	0	0	0	0	0	2	1	8	11	1	0	0	0	0	23
80	0	0	0	0	0	0	0	0	0	0	1	1	1	5	1	0	0	0	9
85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total																			671

Table 6 Weight and weight at age for each component in Div. 1A inshore compiled on data for the last 3 years 1999-2001. Due to missing sampling in 2000 in Uummannaq only 1999 and 2001 values were used.

	Disko Bay			Uummannaq			Upernavik		
AGE	**length**	**weight**	**N**	**length**	**weight**	**N**	**length**	**weight**	**N**
4	36.27	0.40	75	47.09	0.91	11	35.00	0.36	3.00
5	41.56	0.63	133	49.12	1.14	17	42.17	0.61	12.00
6	47.20	0.98	133	53.23	1.37	64	47.00	0.94	20.00
7	52.56	1.44	156	58.47	1.84	47	52.79	1.39	75.00
8	57.17	1.88	122	60.86	2.19	35	56.83	1.76	118.00
9	61.56	2.39	99	64.41	2.57	66	61.09	2.26	109.00
10	64.04	2.72	79	67.42	2.98	53	64.00	2.68	61.00
11	67.55	3.18	109	70.30	3.41	47	66.70	3.12	82.00
12	71.50	3.93	117	76.13	4.39	64	70.06	3.60	95.00
13	75.80	4.57	51	77.05	4.73	38	74.83	4.50	46.00
14	77.83	5.05	23	80.54	5.19	28	79.04	5.44	22.00
15	85.83	7.59	23	85.08	6.67	12	81.93	6.08	15.00
16	90.13	8.03	8	80.00	4.44	1	86.50	7.49	6.00
17	93.67	10.25	9	86.00	6.39	2	95.00	9.37	2

Table 7. Output from standardization of CPUE by GLM analysis.

CPUE LONGLINE SURVEY DISKO BAY 08:20 Monday, May 20, 2002 773

The GLM Procedure

Class Level Information

Class	Levels	Values
AR	7	1994 1996 1997 1999 2000 2001 19930
FELT	3	H L M
DYB	3	DEEP MEDIUM SHALLOW

Number of observations 179

The GLM Procedure

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	2731.300735	273.130073	17.43	<.0001
Error	168	2632.209495	15.667914		
Corrected Total	178	5363.510230			

R-Square	Coeff Var	Root MSE	LNCPUE Mean
0.509238	-232.5623	3.958272	-1.702026

Source	DF	Type I SS	Mean Square	F Value	Pr > F
AR	6	158.846380	26.474397	1.69	0.1263
FELT	2	1786.326172	893.163086	57.01	<.0001
DYB	2	786.128182	393.064091	25.09	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
AR	6	63.666311	10.611052	0.68	0.6682
FELT	2	1256.617229	628.308615	40.10	<.0001
DYB	2	786.128182	393.064091	25.09	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		-5.208091905 B	0.95296734	-5.47	<.0001
AR	1994	0.777328723 B	1.03637752	0.75	0.4543
AR	1996	0.358089778 B	1.06138764	0.34	0.7363
AR	1997	1.271508671 B	1.09070862	1.17	0.2454
AR	1999	0.052474695 B	1.07979793	0.05	0.9613
AR	2000	1.215905759 B	1.05078077	1.16	0.2489
AR	2001	2.181017088 B	1.49276842	1.46	0.1459
AR	19930	0.000000000 B	.	.	.
FELT	H	2.662029407 B	0.85789096	3.10	0.0022
FELT	L	-5.896692764 B	0.79900623	-7.38	<.0001
FELT	M	0.000000000 B	.	.	.
DYB	DEEP	4.698995014 B	1.26651244	3.71	0.0003
DYB	MEDIUM	4.806731699 B	0.68388415	7.03	<.0001
DYB	SHALLOW	0.000000000 B	.	.	.

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

CPUE LONGLINE SURVEY UUMMANNAQ 08:20 Monday, May 20,
The GLM Procedure

Class Level Information

Class	Levels	Values
AR	6	1995 1996 1998 1999 2001 19930
FELT	3	H L M
DYB	3	DEEP MEDIUM SHALLOW

Number of observations 100

The GLM Procedure

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	35.53987027	3.94887447	5.83	<.0001
Error	90	60.96742175	0.67741580		
Corrected Total	99	96.50729202			

R-Square	Coeff Var	Root MSE	LNCPUE Mean
0.368261	59.59154	0.823053	1.381157

Source	DF	Type I SS	Mean Square	F Value	Pr > F
AR	5	15.47246125	3.09449225	4.57	0.0009
FELT	2	14.61989345	7.30994672	10.79	<.0001
DYB	2	5.44751557	2.72375779	4.02	0.0213

Source	DF	Type III SS	Mean Square	F Value	Pr > F
AR	5	16.45626853	3.29125371	4.86	0.0006
FELT	2	17.74563415	8.87281708	13.10	<.0001
DYB	2	5.44751557	2.72375779	4.02	0.0213

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.140653629 B	0.32783467	0.43	0.6689
AR	1995	0.770869077 B	0.26584230	2.90	0.0047
AR	1996	0.517822525 B	0.25134450	2.06	0.0423
AR	1998	1.030709255 B	0.25225867	4.09	<.0001
AR	1999	1.303789843 B	0.33490320	3.89	0.0002
AR	2001	0.338781156 B	0.46392599	0.73	0.4671
AR	19930	0.000000000 B	.	.	.
FELT	H	0.729233035 B	0.36076669	2.02	0.0462
FELT	L	-1.219633980 B	0.26920069	-4.53	<.0001
FELT	M	0.000000000 B	.	.	.
DYB	DEEP	0.894205065 B	0.31837588	2.81	0.0061
DYB	MEDIUM	0.709015862 B	0.28944591	2.45	0.0162
DYB	SHALLOW	0.000000000 B	.	.	.

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

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The GLM Procedure

Class Level Information

Class	Levels	Values
AR	4	1995 1998 2000 19940
FELT	3	H L M
DYB	3	DEEP MEDIUM SHALLOW

Number of observations 121

The GLM Procedure

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	194.1096055	27.7299436	5.38	<.0001
Error	113	582.3493998	5.1535345		
Corrected Total	120	776.4590052			

R-Square	Coeff Var	Root MSE	LNCPUE Mean
0.249993	363.3386	2.270140	0.624800

Source	DF	Type I SS	Mean Square	F Value	Pr > F
AR	3	52.1240600	17.3746867	3.37	0.0210
FELT	2	30.6241810	15.3120905	2.97	0.0553
DYB	2	111.3613645	55.6806822	10.80	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
AR	3	62.4760171	20.8253390	4.04	0.0090
FELT	2	20.5475480	10.2737740	1.99	0.1410
DYB	2	111.3613645	55.6806822	10.80	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		-1.014850184 B	0.73108029	-1.39	0.1678
AR	1995	-0.078654510 B	0.60061750	-0.13	0.8960
AR	1998	-1.002663201 B	0.57883716	-1.73	0.0860
AR	2000	-1.819458952 B	0.60951424	-2.99	0.0035
AR	19940	0.000000000 B	.	.	.
FELT	H	0.015044259 B	0.70370372	0.02	0.9830
FELT	L	-0.958449143 B	0.49142213	-1.95	0.0536
FELT	M	0.000000000 B	.	.	.
DYB	DEEP	2.813238408 B	0.74059299	3.80	0.0002
DYB	MEDIUM	3.041620888 B	0.66553316	4.57	<.0001
DYB	SHALLOW	0.000000000 B	.	.	.

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