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

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Abstract

The paper presents the background and the input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut stock component in NAFO Subarea 0 + Div. 1A offshore + Div. 1B-1F. During 2006-2009 catches have been around 24,000 tons. Catches increased to 26 900 tons in 2010 and remained at the same level in 2012. The increase was due to increased effort in Div. 0B and Div. 1CD. Survey trawlable biomass in Div. 1CD decreased in w2012. This also applied to the offshore biomass in the Greenland shrimp fish survey. A survey in Div. 0A (South) gave the highest biomass in the time series. The third survey in Div. 0A (north) almost doubled the biomass. The recruitment of the 2011 year class in the entire survey area was the lowest since 1997. A combined standardized CPUE series from Div. 0A + 1AB decreased slightly between 2011 and 2012 but is still at a high level. A combined CPUE series from Div. 1CD+0B decreased between 2011 and 2012 due to a decrease in Div. 0B but is still above the level in 1990-2004. CPUE series from the gill net in Div. 0A and Div. 0B were close to or at the highest level in the time series.

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

TAC

Between 1979 and 1994 a TAC was set at 25,000 tons for SA 0+1, including Div. 1A inshore. In 1994 it was decided to make separate assessments for the inshore area in Div. 1A and for SA 0 + Div. 1A offshore + Div.1B-1F. From 1995-2000 the advised TAC for the latter area was 11,000 tons but the TAC was fished almost exclusively in Div. 0B and Div. 1CD. In 2000 there was set an additional TAC of 4,000 tons for Div. 0A+1AB for 2001 and the TAC on 11,000 tons was allocated to Div. 0B and Div. 1CF. The TAC in Div. 0A+ Div. 1AB was in 2002 increased to 8,000 tons for 2003. Total advised TAC for 2004 and 2005 remained at 19,000 tons. In 2006 the advised TAC in Div. 0A+1AB was increased 5,000 tons to 13,000 tons. The total advised TAC remained at 24,000 tons in 2008 and 2009. In 2010 the TAC for Div. 0B+ Div. 1CF was increased by 3,000 tons to 14,000 tons and the total TAC for Subarea 0+1 (excluding inshore areas in Div. 1A) was 27,000 tons. The TAC remained at 27,000 tons in 2011-2013.

Catches in SA 0 + Div. 1A offshore + Div.1B-1F

During the period 1982-1989 nominal catches of Greenland halibut in SA 0 + Div. 1A offshore + Div.1B-1F fluctuated between 300 and 4,500 tons. Catches increased from 2,927 tons in 1989 to 11,633 tons in 1990. Catches remained at that level in 1991 but increased again in 1992 to 18,457 tons. During 1993-2000 catches have fluctuated between 8,250 and 11,750 tons. Catches increased to 13,760 tons in 2001 and further to 19,716 tons in 2005. In 2006 catches increased to 24,164, remained at that level in 2007 but decreased slightly to 22,071 tons in 2008. Catches increased again to 24,805 tons in 2009 and further to 26,934 tons in 2010 and catches remained at that level in 2011 - 2012 – 27,260 tons in in 2012 (Fig. 1).

The increase in catches from 1989 to 1990 was due to a new trawl fishery by Canada and Norway and increased effort by Russia and Faeroe Islands in Div. 0B, while the increase from 1991 to 1992 was caused by a further increase in effort by Russia in Div. 0B and an increase in fishing activity in SA 1. The increase in catches between 2000 and 2006 was primarily due to an in increase in effort in Div. 0A and Div. 1A. The increase in catches between 2009 and 2010 was due to increased effort in Div. 0B and 1CD.

Catches in SA 0

In 1983 annual catches in SA 0 were about 4,500 tons. Catches then dropped to a level of 1,000 tons or lower, where they remained until they increased from 1,087 tons in 1989 to 9,753 tons in 1990. Catches decreased in 1991 to 8,745 tons, to increase again in 1992 to 12,788 tons. Catches then decreased gradually to 3,233 tons in 1995 and fluctuated between 3,924 and 5,438 tons between 1996 and 2000. Until 2000 almost all catches in SA 0 were taken in Div. 0B. In 2001 a commercial fishery started in Div. 0A. Catches in SA 0 increased to 8,107 tons in 2001 and further to 9,201 tons in 2003 and remained at that level in 2004 and 2005. Catches increased to 12,319 in 2006 but decreased slightly to 11,489 tons in 2007 and further to 10,432 tons in 2008. Catches increased again to 12,400 tons in 2009 and further to 13,225 tons in 2010. Catches decreased slightly in 2011 to increase again in 2012 to 13,331 tons (Table 1).

The increase in catches seen since 2000 was mainly due to an increased effort in Div. 0A where catches increased from a level of about 300 ton, where they have been since 1996 (trial fishery not officially reported), to 3,073 tons in 2001 and further to 4,142 tons in 2003. Catches remained at that level in 2004 and 2005. In 2006 catches increased to 6,634 tons due to increased effort, but decreased to 6,173 tons in 2007 and further to 5,257 tons in 2008. Catches increased again in 2009 to 6,627 tons and remained at that level in 2010 – 2012 - 6,365 tons in 2012 (Table 1).

About half of the catches in Div. 0A in 2012 were taken by trawlers, mainly twin trawlers, while the other half was taken by gill net. The long lines fishery in the area has apparently stopped. The fishery was prosecuted by Canadian vessels.

Catches in Div. 0B 2012 amounted to 6, 966 tons which is at the same level as in 2011 and 2012. Offshore gillnetters took about 1/3 of the catches while trawlers, mainly twin trawlers, took about 2/3. All catches were taken by Canadian vessels. 292 tons reported from Cumberland Sound Cumberland Sound are not included.

Catches in SA1

The catches in Subarea 1 (Div. offshore 1A + Div. 1B-1F) were below 2,500 tons during 1982-1991. In 1992 catches increased to 5,669 tons, decreased to 3,870 tons in 1993 and increased again in 1994. During 1995-1999 catches were around 4,500-5,000 tons. Catches increased to 5,728 tons in 2000, remained at that level in 2001 and increased gradually to 9,495 tons in 2003 and remained at this level in 2004 and 2005. Catches increased to 11,945 tons in 2006 due to increased effort by Greenland in Div. 1AB and remained at that level in 2007 and 2008. In 2009 catches amounted to 12,405 tons and increased further to 13,709 tons in 2010 and remained at that level in 2011 and 2012 (13,929 tons). Almost all catches have been taken offshore (Table 2). The inshore catches amounted to 440 tons in 2012.

Catches in Div. 1AB (mainly in Div. 1A) increased gradually from 575 tons in 2001 to 4,007 tons in 2003 and remained at that level in 2004-2005. Catches increased again in 2006 to 6,223 and remained at that level during 2007-2012 (6,459 tons in 2012). All catches were taken off shore by trawlers from Faeroe Islands, Russia (SCS 13/09) and Greenland (SCS 13/08).

Catches in Div. 1CD have been stable around 5,600 tons during 2000 to 2009, but catches increased to 7,247 in 2010 due to increased effort. Catches remained at that level in 2011 and 2012 (7,470 tons). Catches were taken by vessels from Greenland (SCS 13/08), Norway, EU-Germany and Russia (SCS 13/09). All catches offshore were taken by trawl. 440 tons were taken inshore in Div. 1B-1F, mainly by gill net.

Reported discards in the trawl fishery is small, normally < 1% of the total catch.

2. Input data

2.1 Research trawl survey

Div. 1C-1D GHL-survey

Since 1997 Greenland has conducted stratified random bottom trawl surveys for Greenland halibut in September-October in NAFO Div. 1C-D at depth between 400 and 1500 m. In 2012 a total of 50 hauls were made (SCR 13/06).
The biomass of Greenland halibut was estimated as 64 948.8 tons, which is a decrease compared to 86 591 tons in 2011 and the and the lowest in the time series since 2000 (Fig. 2a, 2d). The abundance in 2012 was estimated at $54.271*10^6$ which is a decrease compared to $74.978*10^6$ in 2011 and the lowest since 1997 (Fig. 2b). The weighted mean catch per tow showed a decrease from 1.66 tons km^{-2} in 2011 to 1.24 tons km^{-2} in 2012 (Fig. 2c). The overall length distribution was dominated by two modes at 52 and 47-48 cm, respectively, where the length distribution use to be monomodal with a mode around 49 cm (Fig. 2d).

Greenland deep sea survey in Baffin Bay (Div. 1A)

There was no survey in 2012. Greenland has conducted surveys primarily aimed at Greenland halibut in the Baffin Bay in 2001, 2004 and 2010. The biomass and abundance of Greenland halibut was in 2010 estimated as 79.332 tons and $1.04*10^8$ specimens, respectively (SCR 11/10). The surveys did not cover the same areas but a comparison of the abundance and biomass in areas covered both in 2001 and 2010 showed a small increase in biomass from 46.521 tons in 2001 to 52.428 tons in 2010 while there was a decrease in abundance from 101.8 mill. in 2001 to 63.5 mill. in 2010. The biomass has hence been relatively constant while there were significantly more and smaller fish in 2001. The biomass in the area covered both in 2004 and 2010 was estimated to 47.244 tons and 38.632 tons, respectively while the abundance was estimated at 58.8 mill. and 54.4 mill., respectively. The length in 2010 ranged from 20 cm to 105 cm. The overall length distribution (weighted by stratum area) was totally dominated by a mode at 45 cm, while the mode was at 46 cm at depths > 800 m. Generally the length distributions in the deeper depth strata were dominated by a single mode and fish size increased with depth as seen in previous surveys.

Canadian deep sea surveys in Baffin Bay (Div. 0A) and Davis Strait (Div. 0B)

Canada has conducted 7 surveys in the southern part of Div. 0A, beginning in 1999. The biomass has varied from 68,760 tons to 86,176 tons (Fig. 2ef). The 2012 estimate of biomass is 102,486 t. However, one very large set in a depth stratum that comprises 30% of the area covered contributed to this increase. With this set removed the biomass estimate drops 15% to 86,874 t. Also, the 2006 survey suffered from poor coverage and two of the four strata that were missed fell within the depths 1001-1500 m, these strata had accounted for 11,000 – 13,000 tons of biomass in previous surveys. The abundance in 2012 was estimated at 1.31×10^8 (1.02×10^8 with outlier removed). This compares to previous highs of 1.19×10^8 in 1999 and 2001 (Fig. 2g). Mean biomass per tow is not influenced by the large set to the same extent as total biomass. In 2012 it was 2.07 t/ km^2 (1.76 t/ km^2 with outlier removed) (2 hi). This is similar to previous highs of 2.00 t/ km^2 and 1.94 km^2 in 2001 and 2004, respectively. The overall length distribution ranged from 6 cm to 90 cm with a small mode at 21 cm and a larger one at 42 cm, slightly higher than seen in previous surveys (64% <45 cm (57% with outlier removed) (Fig. 2j) (SCR 13/033).

In 2012 the survey also covered the northern part of Division 0A from 73°N to 75°35'N, which had been surveyed previously in 2010 and 2004. The 2012 estimates of biomass and abundance were 82,669 t (S.E. 6695 t) and 9.4×10^7, respectively. This is a significant increase from previous estimates that ranged from 45,877 t to 46,689 t. This increase is due to the increase in survey area due to good weather and little ice in the northern strata . Mean biomass

per tow was also higher in 2012, 1.26 t/km^2 compared to 0.85 and 1.18 t/km^2 in 2004 and 2010, respectively. Mean biomass per tow has varied without any clear trend within depth strata across survey years (SCR 13/033). Length ranged from 18 to 78 cm with a mode at 45 cm and a smaller mode at 21 cm, similar to that observed for 0A-South; 46% were <45 cm (Fig. 2k) (SCR 13/033).

Division 0B was surveyed in 2011, the third time this area has been surveyed using M/Tr Pâmiut. Previous surveys were conducted in 2000 and 2001. Prior to this there had been a survey conducted in 1986 using the RV Gadus Atlantica. Total estimated biomass and abundance were 83,043 tons and 8.30×10^7, respectively. Biomass had increased compared to previous years (Fig. 2d). Abundance was lower than in 2001 but higher than in 2000. Biomass and abundance were reduced at depths 1251-1500 m and fewer fish <45 cm were present at depths 1001-1500 m in 2011 compared to 2000 and 2001. Lengths ranged from 6 cm to 92 cm with 30% <45 cm. The length distribution had a single mode at 51 cm, an increase in modal length compared to 2001 (45 cm) and 2000 (42 cm) (SCR 12/23).

Greenland shrimp-survey

Since 1988 annual trawl surveys with a shrimp trawl have been conducted off West Greenland in July-September. The survey covers the area between 59°N and 72°30'N (Div. 1A-1F), from the 3-mile limit to the 600-m depth contour line. The survey area was restratified in 2004 based on better information about depths. All biomass and abundance indices have been recalculated. The recalculation did not change the trends in the development of the different stocks. The trawl was changed in 2005 but the data have not been adjusted for that and the two time series are not directly comparable.

Estimated total trawlable biomass of Greenland halibut in the offshore areas has during 2005-2012 fluctuated between 49,779 and 25,644 tons estimated in 2012. The 2012 estimate is a decline form 40, 003 tons in 2011(Fig. 2l).

The abundance was estimated at 534 mill. in 2011 which was the highest in the time series. The abundance decreased to 187 mill. in 2012 which is the lowest in the 2005-2012 time series and not seen lower since 1997 although the figures are not directly comparable. The decrease in abundance was seen in all divisions except Div. 1BS.

Recruitment

A recruitment index was estimated for the Greenland shrimp survey. By means of the Petersen-method ages 1, 2 and 3+ were separated in the survey catches. The number of one-year-old fish in the total survey area including Disko Bay increased gradually from 1996 to a peak of 500 million in 2001. The number of one-year old fish was in 2011 estimated as 530 mill. which is an increase from 310 mill.in 2010 and the highest in the time series. The increase between 2010 and 2011 was caused by an increase in abundance both offshore in Div. 1A and inshore in Disko Bay. In 2012 the 2011 year class was estimated to 175 mill. - the lowest estimate since 1996 and at the level of the early 90'es (Fig. 3).

To allow comparison of abundance throughout the time series, the 2005 to 2012 catches were divided by a conversion factors to adjust the new Cosmos trawl catches to the old Skjervoy trawl catches. For Greenland halibut the conversion were length dependent and x in the equations is the individual fish length. Greenland halibut conversion factor: 0.0404x+0.6527.

The offshore recruitment has been rather stable between 2003 and 2010. The recruitment increased to the highest level in the time series in 2011 but decrease to lowest level seen since 1997 (1996 year-class) in 2012. The decrease in recruitment between 2011 and 2012 was seen in all divisions (Fig. 4). In 2012 61% of the one year old fish was found in the offshore areas.

In Disko Bay the recruitment has been decreasing between 2003 and 2008 and increased since then to the highest level seen since 2001 in 2011. In 2012 the recruitment decreased again to the lowest level seen since 2008 (Fig. 4).

Generally there is a steep decline between abundance at age 1 and age 2 and 3+ which also was observed in the 2012 survey. Further, it has been noted, that the year-classes estimated to be a very strong year-class at age 1 have

not shown up as a particularly strong year-classes at age 5-8 in the fishery catches or in the 1CD survey for Greenland halibut.

2.2 Commercial fishery data.

Length distribution

SA 0

Length distributions were available from the gill net, single trawl and twin trawl fishery in Div. 0B and from the gill net fishery in Div. 0A.

The catch in the gill net fishery in Div. 0A was dominated by a mode at 65 cm, similar to that seen in previous years (Fig.5).

The catches in the gill net fishery in Div. 0B was dominated by a mode around 63 cm as in 2011. The length distributions in the single and twin trawl fishery in Div. 0B had modes at 52 cm and 50 cm, respectively. The modes have been around 51 cm, for both types of gear in recent years (Fig. 5).

SA1

Length frequencies were available from Greenlandic trawl fishery in Div. 1A and from Russian (SCS 13/09), Greenlandic and Norwegian trawl fishery in Div. 1D.

In Div. 1A the mode was at 48 cm in the Greenlandic trawl fishery (Fig. 7). In recent years the trawl catches have been dominated by fish on 44-52 cm.

In Div. 1D the catches by Norway, Russia and Greenland showed clear modes at 48, 54 and 51, respectively (Fig. 8, 9, 10). The mode in catches has been within this range for several years.

Age distribution.

There is considerable uncertainty about accuracy in the current age reading methods (see section in STACREC 2011 report) and the age reading procedure is currently under revision hence no age based analysis are presented.

Catch rate

The fleets used for standardization of catch rates are grouped according to NAFO's protocol:

Code for country.

2	CAN-MQ	Canada Maritimes & Quebec
3	CAN-N	Canada Newfoundland
5	FRO	Faroe Islands
6	GRL	Denmark Greenland
7	E/DNK	Denmark Mainland
8	E/FRA-M	France Mainland
9	FRA-SP	France St. Pierre et Miquelon
10	E/DEU	Federal Republic of Germany
14	JPN	Japan
15	NOR	Norway
16	E/POL	Poland
18	ROM	Romania

19	E/ESP	Spain
20	SUN	Union Soviet Socialist Republics
27	CAN-M	Canada Maritimes
28	CAN-Q	Canada Quebec
31	E/LVA	Latvia
32	E/EST	Estonia
33	E/LTU	Lithuania
34	RUS	Russia
38	EU	European Union
39	CAN	Canada
40	CAN-CA	Canada Central & Arctic

All vessels fishing in SA1 have been given the code 6 (Greenland).

Code for Trawl Gear:
Bottom otter trawl (charters),8,OTB
Bottom otter trawl (side or stern not specified),10,OTB
Bottom otter trawl,12,OTB-2
Otter twin trawl,192,OTT

Code for Tonnage:

0	Not known
2	0-49.9
3	50-149.9
4	150-499.9
5	500-999.9
6	1000-1999.9
7	2000 and over

Ex. Code 401927 is 40: Canada Central & Arctic, 192: Otter twin trawl, 7: Over 2000 Gross Tonnage

SA0
There have been frequent vessel changes in this fishery over the years and the catch from single and double trawl gear was often aggregated as "otter trawl" catch when this gear was first introduced to the fishery in the early 2000s. Very few of the vessels operating in the fishery in 2012 have been in the fishery for more than 3 years. A standardized catch rate is produced using a General Linear Model. The model was updated in 2013 with the 2012 data. Catches (t) and hours fished with values less than 10 were removed.

Div. 0A
In Div. 0A the standardized CPUE index have been increasing between 2010 and 2012, but generally the standardized catch rates have been relatively stable since 2002 (Fig. 12a) (Appendix 1). The increase could also be seen in the un-standardized catch rates for both single and twin trawl gears (Fig. 11a).

Standardized CPUE for Gill nets has been increasing gradually between 2006 and 2011 but decreased slightly in 2012 (Fig. 12b) (Appendix 4).

Un-standardized CPUE for gillnets has increased gradually from 5.36 t/100 nets in 2004 to 12.79 t/100 nets in 2011 but decrease to 11.8 t/100 nets in 2012 (Fig. 11c).

Div. 0B
In Div. 0B the overall CPUE index increased to the highest observed level in 2009 but declined in 2010 to increase slightly in 2011 but decreased again in 2012 to the low level seen in 2003 and 2004 (Fig. 12c) (Appendix 5). The un-standardized catch rates for both twin and single trawls decreased in 2012 (Fig. 11b).

The standardized CPUE for gill net in Div. 0B has been increasing since 2007 and was in 2012 at the highest level in the time series (Fig. 12) (Appendix 8).

Un-standardized CPUE for gillnets remained relatively stable at 3-4 t/100 nets from 2003 to 2008, then increased to 6.54 t/100 nets in 2010. In 2011 the CPUE dropped slightly to 5.98 t/100 nets to increase again in 2012 to 6.7 t/100 net, the highest level in the time series (Fig. 11c).

SA1

Un-standardized catch rates were available for the Greenland trawl fishery in Div. 1A and 1D (SCS 13/08). Further, catch rates were available from logbooks submitted by all countries to the Greenland authorities. Standardized catch rates were available from the trawl fishery in Div. 1AB and 1CD. Until 2008 the fleets in the catch rate analysis have been grouped by nation, but information about gross tonnage is now available in the Greenland logbook database and the fleets are grouped based on size and gear according to NAFO's protocol. This has not changed the trends in the CPUE series but the SE and CV of the estimates have been reduced significantly. In the GLM model catches (t) and hours fished with values less than 10 are removed.

Div 1AB

Un-standardized catch rates from large (>2000 GT) trawlers in Div 1A have been relatively stable since 2005 around 0.93 ton/hr but showed a slight increase between 2009 to 2010 and increased substantially between 2010 and 2011 to 1.4 ton hr^{-1} and 1.3 ton hr^{-1} for single trawlers and twin trawlers, respectively. The CPUE decreased slightly to 1.3 ton/hr for single trawlers while it increased to 1.5 ton/hr for twin trawlers. CPUE for trawlers 1000-2000 Gross Tons single trawlers has been increasing since 2006 but declined between 2009 and 2010 to increase again in 2011. The CPUE decreased from 0.74 ton/hr in 2011 to 0.63 ton/hr in 2012. The CPUE for 1000-2000 Gross Tons twin trawlers was stable 1.1 ton/hr between 2011 and 2012. (Fig.11e). The large trawlers takes approximately 2/3 of the catches equally distributed between single and twin trawlers. While the small single trawlers takes slightly above half of the catches taken by the small trawlers.

Standardized catch rate series, based on logbook data from the Greenland authorities, were available for the offshore trawl fishery in Div. 1AB for the period 2002-2012. Standardized catch rates in Div. 1AB has been declining between 2006 and 2008 but has been increasing since then and was in 2011 on the highest level in the time series. The CPUE decreased slightly in 2012 but is still at a very high level. (Fig. 12a, Appendix 2).

Div. 1CD

In Div. 1CD the CPUE for three Greenland vessels fishing there has been fluctuating between 0.55 ton/hr and 0.87 ton/hr since 2000. In 2011 the CPUE was 0.87 ton hr^{-1} compared to 0.79 ton h^{-1} in 2010. The CPUE was back at the 2010 level in 2012. (SCS 13/08).

The un-standardized catch rates for all trawlers fishing in Div. 1CD increased between 2011 and 2012, except for trawlers > 2000 tons trawlers (that takes app. 19% of the catches). The high catch rates for > 2000 GT single trawlers in 1988 and 1989 is from a single large vessel (4000 GT) and the decrease in catch rates in 2007 for large > 2000 GT twin trawlers was caused by a significant decrease in catch rates from one out of two vessels (Fig.11f).

Standardized catch rate series, based on logbook data from the Greenland authorities, were available for the offshore trawl fishery in Div. 1CD for the period 1988-2011 (Fig.12c). Standardized catch rates in Div. 1CD decreased gradually from 1989-1997 but have shown an increasing trend since then. CPUE decreased between 2009 and 2010 but increased again in 2011-2012 and the CPUE is at the high level seen in 1989 (Appendix 6).

Combined standardized catch rate in Div. 0A-1AB

The combined Div. 0A+1AB standardized CPUE series decreased slightly between 2009 and 2010 to increase again in 2011, but was back at the 2010 level in 2012. The catch rate has, however, been relatively stable since 2001 (Fig. 12a) (Appendix 3).

Combined standardized catch rate in Div. 0B-1CD

The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2004. The CPUE gradually

increased to peak in 2009. CPUE decreased slightly between 2009 and 2010 to increase again in 2011 but decreased in 2012. The estimate is, however, still higher than the estimates from 1990-2004. The high catch rates seen in 1988 and 1989 is from a single very large trawler fishing in Div. 1CD (Fig. 11e) (Appendix 7).

Unstandardized gillnet CPUE is significantly higher in Div. 0A compared to Div. 0B and the unstandardized trawl CPUE in 2012 were also higher in Div. 0A and 1AB compared to Div, 0B-1CD,

It is not known how the technical development of fishing gear, etc. has influenced the catch rates. There are indications that the coding of gear type in the log books is not always reliable, which also can influence the estimation of the catch rates. Further, due to the frequency of fleet changes in the fishery in both SA0 and SA1 and change in fishing grounds in Div. 0A and 1A, both the un-standardized and the standardized indices of CPUE should, however, be interpreted with caution.

3. **Assessment**

A Greenland halibut age determination workshop in 2011 concluded that there is considerable uncertainty about accuracy in the current age reading methods (see section in STACREC 2011 report) and the age reading procedure is currently under revision hence no age based analysis are up dated.

3.1 Yield per Recruit Analysis.

The level of total mortality has in 1994-1996 been estimated by means of catch-curves using data from the offshore longline fishery in Div. 1D. Z was estimated from regression on ages 15-21. A relative F-at-age was derived from the catch curve analysis, where the trawl, longline and gillnet catches were weighed and scaled to the estimated stock composition. In all three years STACFIS considered that the estimation of Z was based on too limited samples and represented too small a part of the fishery and that the outcome of the catch curve analysis was too uncertain to be used in the yield per recruit analysis. No Yield per Recruit Analysis were made due to lack of age data.

3.2 XSA.

Extended Survivors Analysis
An XSA has been run unsuccessfully several times during the 1990'ies, using a survey series covering 1987-1995 as tuning. STAFIS considered the XSA's unsuitable for an analytic assessment due to high log-catchability residuals and S.E.'s and systematic shift in the residuals by year. Further, a retrospective plot of F_{bar} showed poor convergence. In 1999 the XSA analyses was rerun including the latest two years surveys (1997-1998, new vessel and gear) but the outcome of the analysis did not improve.

An XSA analysis was run using the stock data for SA 0+1, calibrated with trawl survey data (age 5-15) from the Greenland deep sea surveys (1997-2001) in Div. 1CD. The assessment results were considered to be provisional due to problems with the catch-at-age data and the short time series, the assessment is, however, considered to reflect the dynamics in the stock. The rate of exploitation had been relatively stable in recent years between 0.2-0.3 (F_{bar} 7-13). The input parameters to the analysis and the outcome of the analysis is given in SCR 02/68.

The XSA was run again in 2003 with the 2002 survey and catch data and updated catch data from 2001 (very small changes). The assessment results were considered to be provisional due to problems with the catch-at-age data and the short time series. The assessment was, however, considered to some extent to reflect the dynamics in the stock. The rate of exploitation had been relatively stable in recent years between 0.2-0.3 (F_{bar} 7-13). The summary of the XSA is given in SCR (03/54).

The XSA was not run this year as no catch-at-age data were available for 2003-2012.

3.3 Spawning stock/recruitment relations.

A spawning stock/recruitment plot based on the available observations from the joint Japan/Greenland survey and the Greenland survey is shown in Fig.5. No further analysis of spawning stock recruitment relationships have been made due to few observations distributed on two different surveys, poor estimate of spawning stock biomass (survey trawls only take a very small proportion of the mature fish), poor estimates of ages of old fish, the survey covers only a restricted part of the area covered by the assessment, and knife edge maturity ogive was applied. Further, the age of the recruits is poorly estimated (the Petersen method). The plot was not updated because there was no aging of Greenland halibut in the recent surveys.

3.4 Relative F

A relative F was estimated from the catches and the swept area biomass estimates from Div. 1CD (Catch/Biomass) (Fig. 13). F has fluctuated between 0.02 and 0.17 but has been relatively stable around 0.08 since during 1997 2011, but F increased to 0.11 in 2012 due to a decline in the estimated biomass.

3.5 ASPIC

ASPIC was run in 1999 with standardized CPUE data and a biomass index as inputs. Three CPUE series were available, one series covering Div. 0B during the period 1990-1998, one covering Div. 1CD during the period 1987-1998 and a series combining the two data sets. The biomass index was from 1CD and covered the period 1987-1995 and 1997-1998. Several runs showed that the combined CPUE series from Div. 0B+1CD fitted the total catch data best in terms of r^2 and "total objective function". Runs with biomass alone gave relatively bad fits in terms of "total objective function" and r^2 and the modeled population trajectory declining drastically over the period. Runs with the CPUE series from 0B gave unrealisticly high B_{msy} and negative r^2. The run with the combined CPUE series showed, however, that sensitivity analysis should be run, because "the B1-ratio constraint term contributed to loss". Several runs with different realistic values for the constraint did not solve the problem. Further, the coverage index and nearness index was equal in all runs. Several runs with different constraints on r and MSY were tried but it did not change the outcome of the analysis. Removing the three first years from the input data gave negative r^2. To get measures of variance the run with the combined CPUE series was bootstrapped (500 re-samplings).

The results showed that estimated fishing mortalities 1987-1998 have been less than the (bias-reduced) estimate of F_{msy} (0.22) except for one year (1992). A number of essential parameters are quite imprecisely estimated (r, q, F_{msy}), and it is considered that the estimates of MSY and F_{msy} were not precise enough to be used.

An ASPIC was run in 2009, but the outcome of the analysis did not change significantly from the analysis in 1999, mainly because there is very little contrast in the input data and the data series were relatively short.

The ASPIC Fox model was tested again during this assessment. Three different formulations were run: 1) one was with the 0B + 1CD CPUE series and the 0B +1CD catch for 1988-2011; 2) with two 1CD survey series (1988-1995 and 1997-2011) and 1CD catch (1988-2011); and 3) one 1CD survey series (1997-2011) and 1CD catch (1988-2011). The first formulation using CPUE resulted in a poor fit of observed and estimated values, with low r-square (.319) and low nearness index (.369). The logistic fit failed in the second formulation. The third formulation resulted in an unbelievably high MSY with F of 0. The estimate of catchability (q) was also extremely low. The model fit was not robust to changes in model parameters. Given that there is little variation in this time series and it is still relatively short (1997-2012) for a long lived species like Greenland halibut this model was not accepted.

4. Conclusion

Since catches peaked with 18,000 tons in 1992 they have been stable at around 10,000 tons until 2000. Since then catches have gradually increased to 18,696 tons in 2003 and they remained at that level during 2004-2005. The TAC was increased by 5,000 tons in 2006 and catches increased to 24,164 and the TAC has hence been taken. The increase in catches has been due to increased effort in Div. 0A and Div. 1A. Catches remained at that level in 2007, - 23,416 tons but decreased slightly to 22,380 tons in 2008. Catches increased to 24,805 tons in 2009 and further to 26,934 tons in 2010 due to increased effort in Div. 0B and Div. 1CD. Catches remained at that level in 2012 (27,260 tons).

Div. 0A+1AB

The biomass in the southern part of Div. 0Ahas varied from 68,760 tons to 86,176 tons. The 2012 estimate of biomass was 102,486 t.

In 2012 the survey also covered the northern part of Division 0A from 73°N to 75°35'N, which had been surveyed previously in 2010 and 2004. The 2012 estimates of biomass was 82,669 tons almost the double of previous estimates.

The standardized CPUE index for Div. 0A has been increasing since 2010 and is at the highest level seen since 2004 Standardized catch rates in Div. 1AB has been increasing between 2008 and 2011 but declined slightly in 2012 but it is the second largest in the time series. The combined Div. 0A+1AB standardized CPUE series decreased slightly between 2009 and 2010 to increase again in 2011 but deceased again in 2012. The CPUE has shown an increasing trend since 2007. Unstandardized catch rates for both gill net are almost double as high in Div. 0A+1AB compared to 0B+1CD and the trawl CPUE is more than 50% higher.

Standardized CPUE for Gill nets has been increasing gradually between 2006 and 2011 but decreased slightly in 2012.

Length frequencies in the fisheries in Div 0A and Div. 1AB have been stable in recent years.

Div 0B+1C-F.

The biomass in Div. 1CD increased between 2003 and 2005, decreased slightly during 2006-2007 and then increased to a record high level in 2008. The biomass decreased in 2009 but increased again in 2010 to a level a little above the average for the time series and the biomass increased further in 2011 to the third highest level in the time series. The biomass decreased in 2012 to the lowest level seen since 2000.

Estimated total trawlable biomass of Greenland halibut in the offshore areas estimated in the Greenland shrimp survey has during 2005-2012 fluctuated between 49,779 and 25,644 tons estimated in 2012. The 2012 estimate is a decline form 40, 003 tons in 2011.

The offshore recruitment (age one) has been rather stable between 2003 and 2010. The recruitment increased to the highest level in the time series in 2011 but decrease to lowest level seen since 1997 (1996 year-class) in 2012.

Standardized CPUE rates in Div. 0B and Div.1CD decreased between 2009 and 2010 but increased again in 2011. The CPUE in Div. 1CD increased further in 2012 to the highest level seen since 1990, while the CPUE decreased in Div. 0B to the level seen in 2003-2004. The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2004. The CPUE gradually increased to peak in 2009. CPUE decreased slightly between 2009 and 2010 to increase again in 2011 but decreased in 2012. The estimate is, however, still higher than the estimates from 1990-2004.

The standardized CPUE for gill net in Div. 0B has been increasing since 2007 and was in 2012 at the highest level in the time series.

Length compositions in the commercial catches in Div. 0B + 1CD have been stable in recent years.

5. Biological reference points

Yield per recruit analysis or other age-based methods are not available, for estimating biological reference points.

There is no accepted analytical model so quantitative estimation of reference points is not possible. SC has recormeded that a proxy of B_{lim} should be estimated based on the survey indexes that are used as the primary basis for advice for this stock.

A preliminary proxy for B_{lim} was set as 30% of the mean of survey biomass for 1997-20012 in Div. 1CD and the mean of 7 surveys in the southern part of Div. 0A conducted during 1999-2012, respectively. Fig. 14 and Fig. 15.

B_{msy} is not known for this stock. If it is assumed that the stock is at or close to B_{msy} the B_{lim} should according to Report of the NAFO Study Group on Limit Reference Points Lorient, France, 15-20 April, 2004 (SCS 04/12) be set at 30% of Bmsy. If the stock increases B_{lim} should be increased accordingly.

6. References

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Table 1. Greenland halibut catches (metric tons) by year and country for Subarea 0 (Split on Div. 0A and 0B) from 1987 to 2009. Minor (300 ton or less) catches from Div. 0A are included in some of the 0B catches prior to 2001.

Count.	87	88	89	90	91	92	93	94	95	96	97	98	99	00[e]	01[c]	02[d]	03[f]	4	5	6	7	8	9	10	11	12[h]
0A																										
CAN							681		82	576	3		517		2628	3561	4142	3751	4209	6634	6173	5257	6627	6390	6260	6365
POL															445											
TOT 0A							681		82	576	3		517		3073	3561	4142	3751	4209	6634	6173	5257	6627	6390	6260	6365
0B																										
CAN		2	180	844	395	2624	592	402	1859	2354	3868	3924	4267	5438	5034	3910	5059	5771	5789	5585	5318	5175	5622	6835	6865	6966
EST							631																			
FRO	388	963	596	2252	2401	463	1038			578	452															
JAP				113	232	337	252	600	1031	500																
LAV							84																			
NOR			282	5016[b]	3959		373																			
RUS		59	29	1528	1758	9364	4229[a]	3674	261	600																
TOT 0B	388	1024	1087	9753	8745	12788	7199	4676	3151	4032	4320	3924	4267	5438	5034	3910	5059	5771	5789	5585	5318	5175	5622	6835	6865	6966
TOT 0AB	388	1024	1087	9753	8745	12788	7880	4676	3233	4608	4323	3924	4784	5438	8107	7471	9201	9522	9998	12219	11491	10432	12249	13225	13125	13331

[a] The Russian catch is reported as area unknown, but has previously been reported from Div. 0B
[b] Double reported as 10031 tons
[d] Excluding 782 tons reported by error
[e] STACFIS estimate
[f] excluding 2 tons reported by error
[h] excluding 292 tons from Cumberland Sound

Table 2. Greenland halibut catches (metric tons) by year and country for Subarea 1 (Split on Div. 1AB and Div. 1CF) from 1987 to 2012. The Greenland catches are excl. inshore catches in Div. 1A. Offshore catches in Div. 1A prior to 2000 are negligible.

	Year																										
Coun.	87	88	89	90	91	92	93	94	95	96	97	98	99[a]	0	1	2	3[g]	4	5	6	7	8	9	10	11	12
1AB																										
GRL															340[c]	1619[c]	3558[c]	3500[c]	3363[bc]	5530[bc]	5596[bc]	5524[bc]	6094[bc]	5682[bc]	5722[bc]	5810[bc]
RUS															85	279	259	241	549	565	575	570	517	654	648	546
FRO														96	150	150	117	153	125	128	125	149	124	126	102	103
EU																	73[e]	141[e]								
TOT 1AB														96	575	2048	4007	3908	4037	6223	6296	6243	6735	6462	6472	6459
1CF																										
GRL	1646	605	540	841	933	191	186	872	1399	1876	2312	2295	2529	2659	2012	2284	2059	2102[b]	2380[b]	2430[b]	1805[b]	1888	1457	2491	2493	2712
FRO				54	123	151	128	780			127	125	116	147	150	150	135	150	149	147	150	184	149	152		
JPN	855	1576	1300	985	673	2895	1161	820	323																	
NOR					611	2432	2344	3119	2472	1785	1893	1338	1360	1590	1550	1734	1423	1364	1456[b]	1379	1441	1452[b]	1501	1572	1720	1743
RUS							5		296	254		543	552	792	829	654	1328	1214	1147	1222	689	763	1056	1214	865	1231
EU							46	266	527	455	446	350	330	444[b]	537[b]	536	543[d]	665[f]	549	544	1516	1517	1511	1818	1824	1784
TOT 1CD	2501	2181	1840	1880	2340	5669	3870	5857	5017	4370	4778	4651	4887	5632	5078	5358	5488	5495	5681	5722	5601	5804	5670	7247	6902	7470
Total	2501	2181	1840	1880	2340	5669	3870	5857	5017	4370	4778	4651	4887	5728	5653	7406	9495	9403	9718	11945	11897	12047	12404	13709	13374	13929

[a] Excluding 7603 tons reported by error

[b] Reported to the Greenland Fisheries License Control Authority. Statlant 21A data from Div. ICD from Greenland during 2004-2007 include double reported catches.

[c] Offshore catches

[d] Including 2 tons taken in an experimental fishery

[e] Spanish research fishery

[f] Includes 131 tons taken in Spanish research fishery

[g] Excludes 1366 tons reported from Div. 1A by error

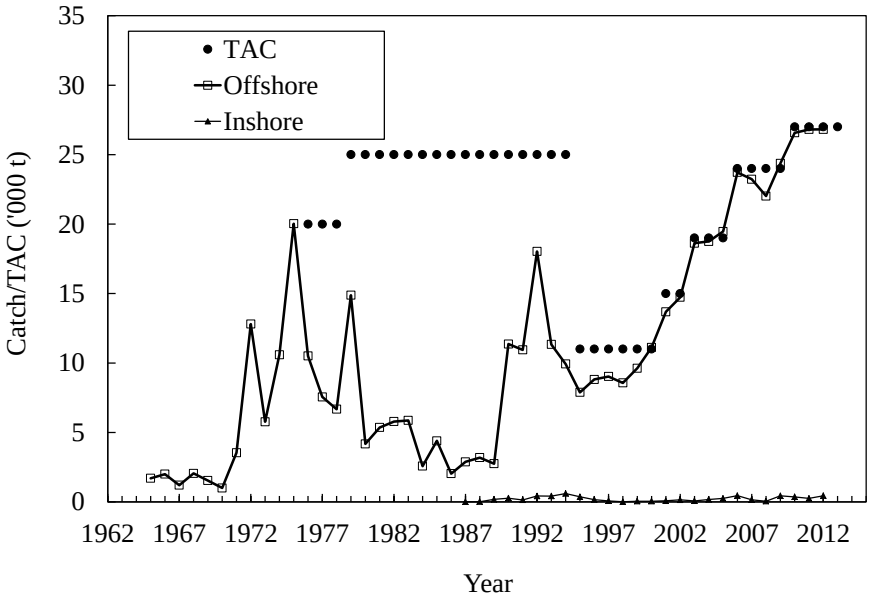

Fig. 1. Catches in SA0 and Div. 1A offshore + Div. 1B-1F and recommended TAC. For TAC before 1995 see text.

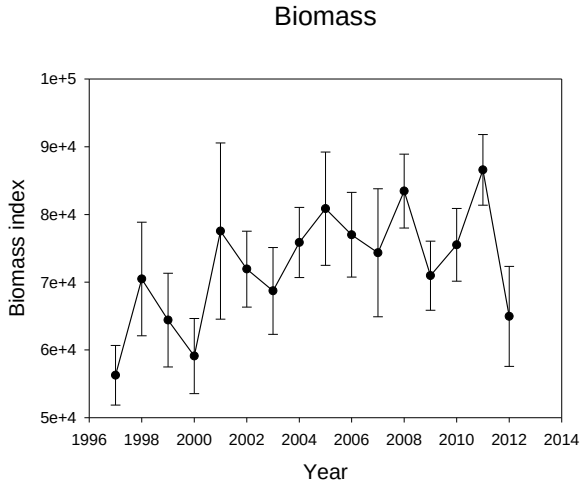

Fig. 2a. Biomass index with S.E. from the Greenland deep sea survey in Div. 1CD.

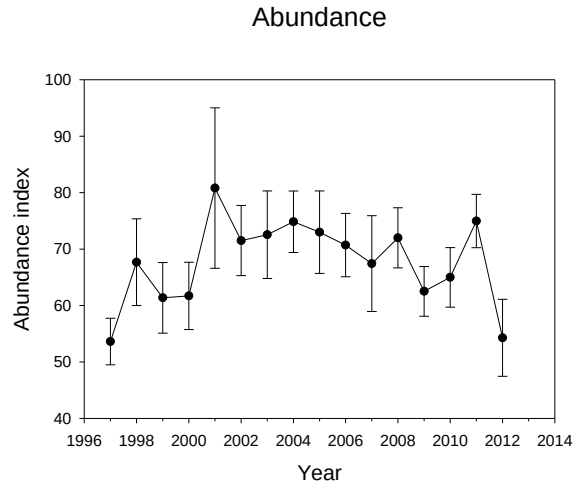

Fig. 2b. Abundance with S.E. from the Greenland deep sea survey in 1CD..

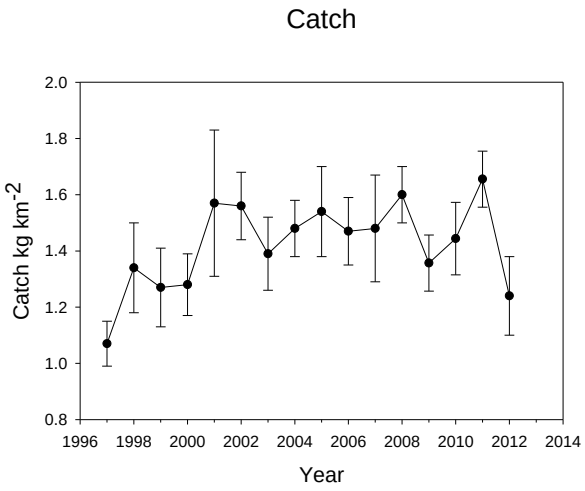

Fig. 2c. Mean catch per km^2 swept with S.E. in the Greenland deep sea survey in Div. 1CD.

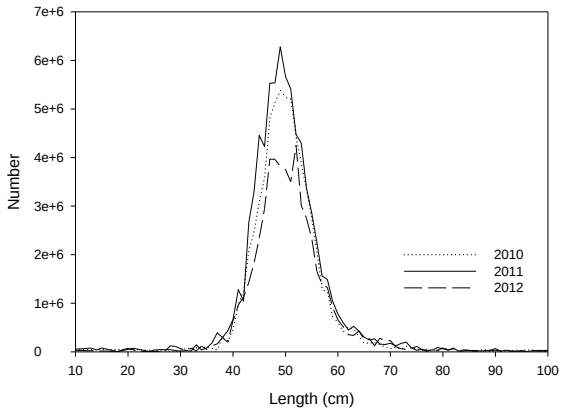

Fig. 2d. Mean catch per km^2 swept with S.E. in the Greenland deep sea survey in Div. 1CD.

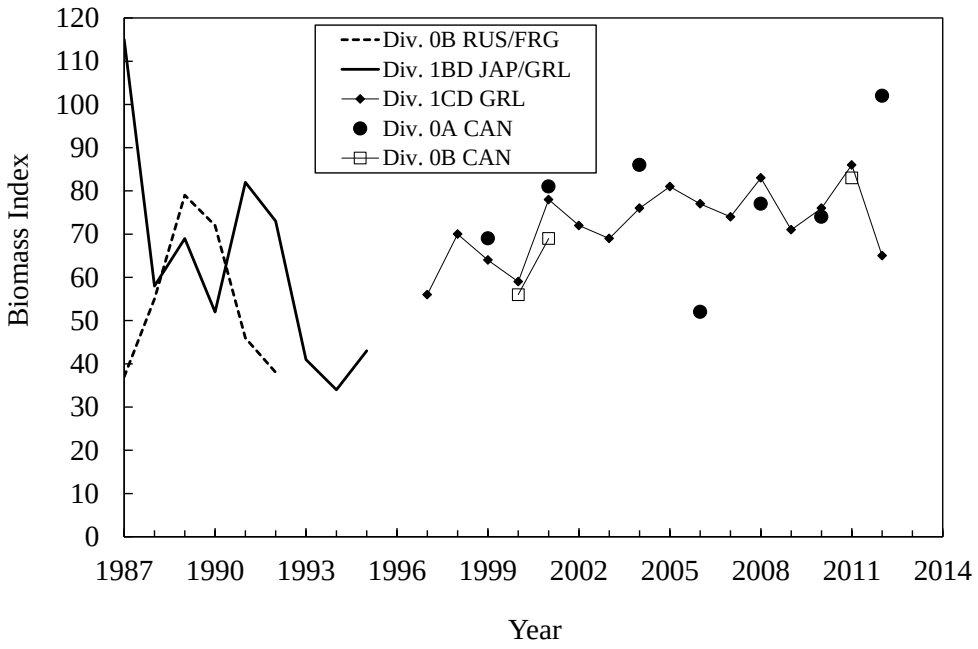

Fig. 2e. Biomass estimates from various surveys in SA 0 and 1. Survey estimates from Div. 0A does not include surveys in the northern part in 2004, 2010 and 2012. Note that the survey in Div. 0A in 2006 had incomplete coverage (see text).

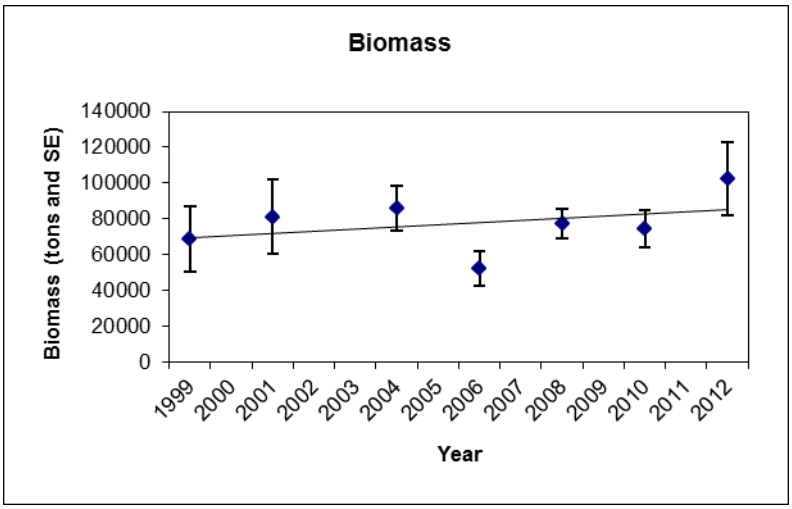

Fig. 2f. Biomass estimates for Greenland halibut in Div. 0A (South) with SE and trendline.

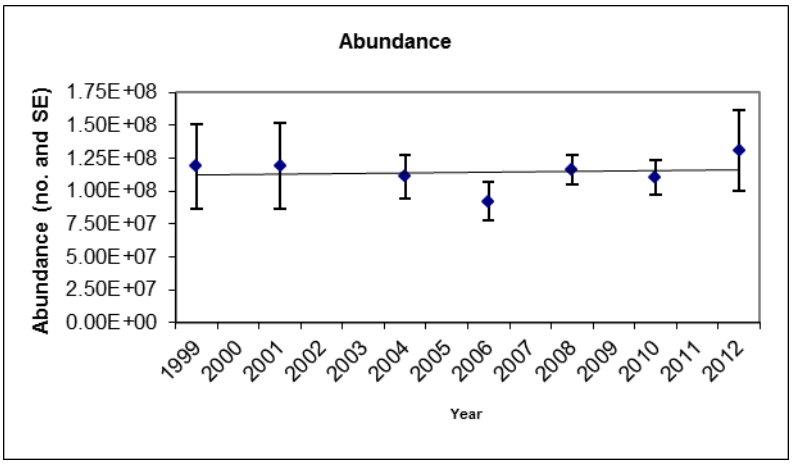

Fig. 2g. Abundance (right) estimates for Greenland halibut in Div. 0A (South) with SE and trendline.

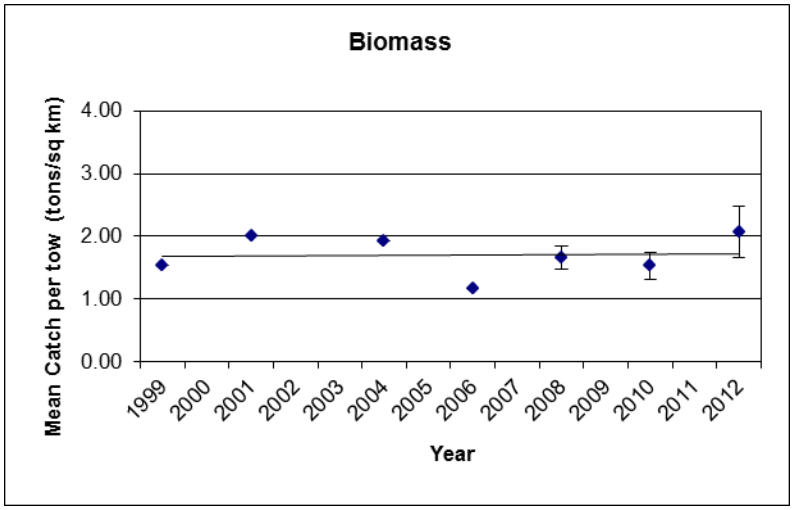

Fig. 2h. Mean catch per tow (with SE for most recent years and linear trend line) for Greenland halibut in Division 0A-South.

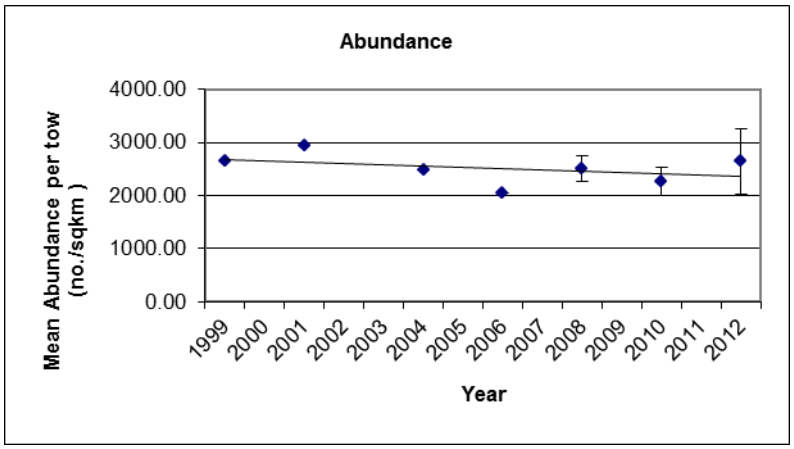

Fig. 2i. Mean abundance per tow (with SE for most recent years and linear trend line) for Greenland halibut in Division 0A-South.

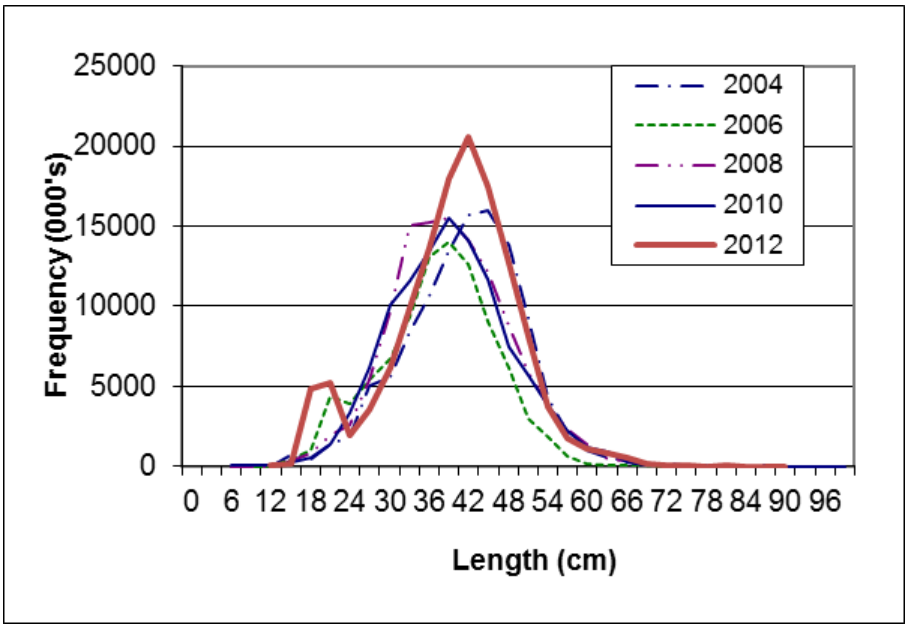

Fig. 2j. Abundance at length for the Greenland halibut in NAFO Division 0A-South, 2004 to 2012 (weighted by stratum area). Includes data from large set.

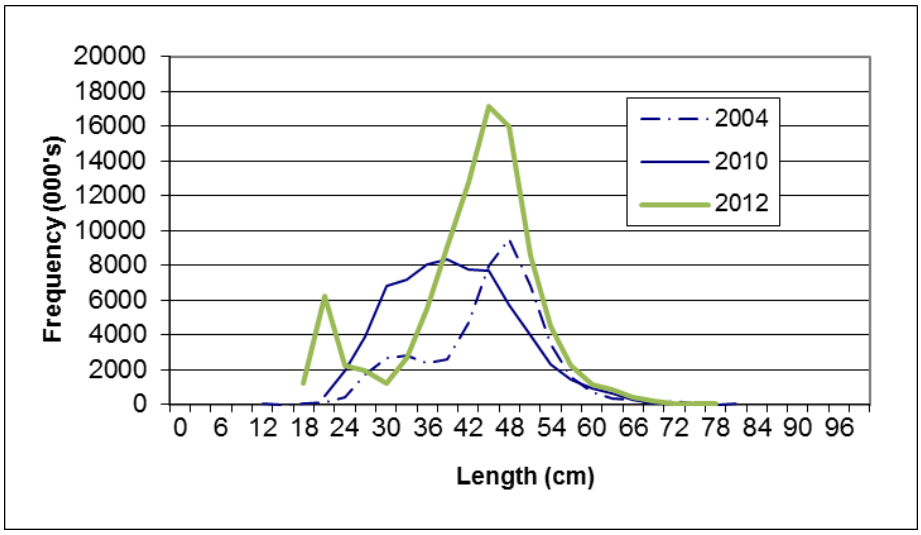

Fig. 2k. Abundance at length for the Greenland halibut in NAFO Division 0A-North, 2004, 2010 and 2012 (weighted by stratum area)

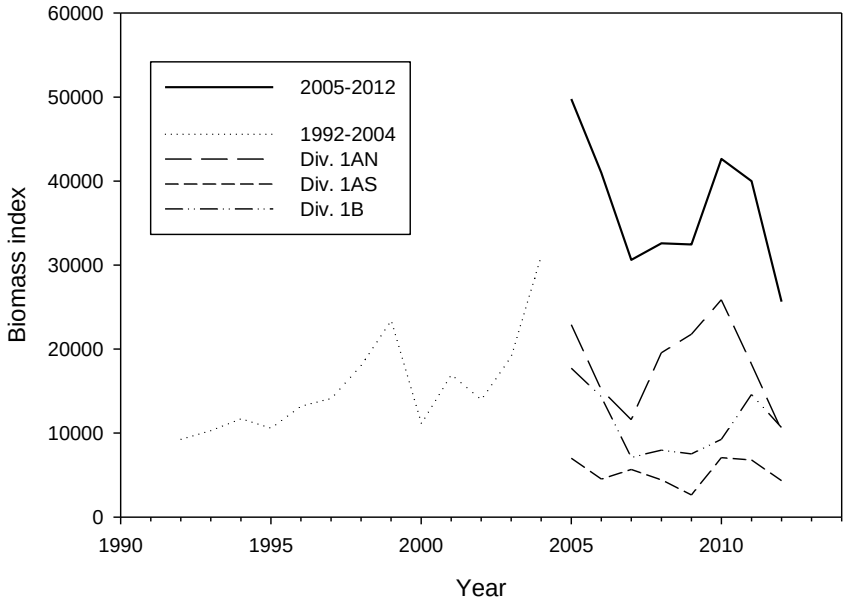

Fig. 2l. Biomass index from the Greenland shrimp survey by most important Divisions and in total offshore (including 1C-1F, which have little biomass).

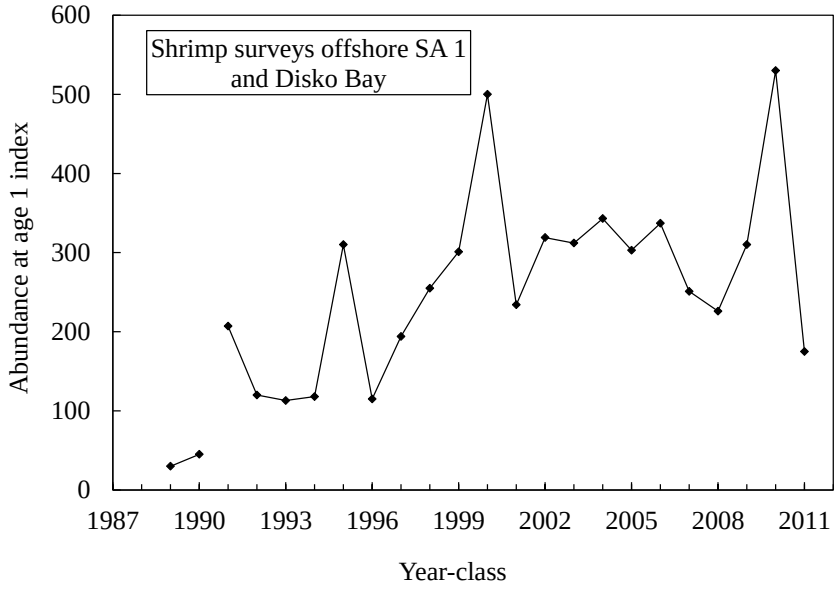

Fig.3. Abundance of age-one Greenland halibut in the entire area covered by the Greenland shrimp survey including inshore Disko Bay and Div. 1AN (North of 70°37.5'N) adjusted for change in survey gear in 2005.

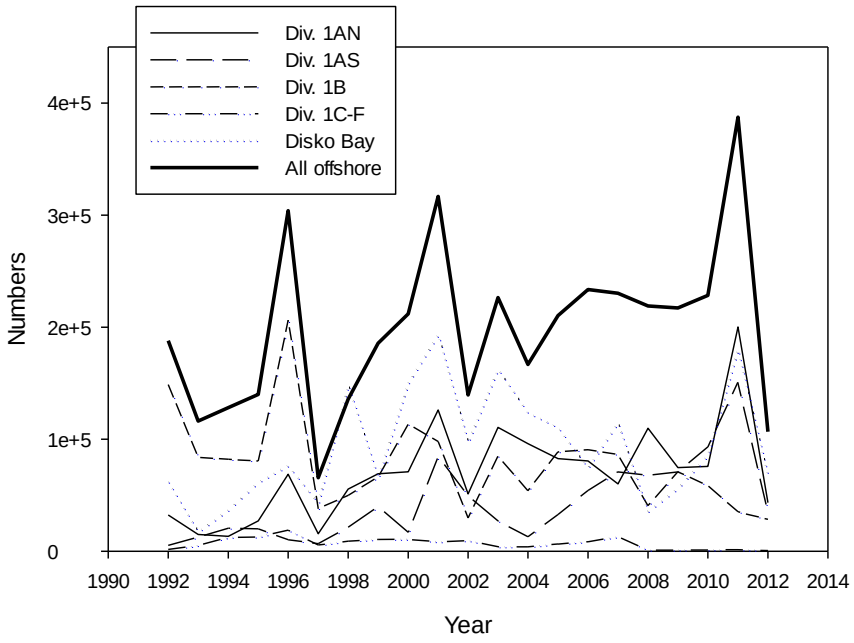

Fig 4. Number of one-year of Greenland halibut by division and year.

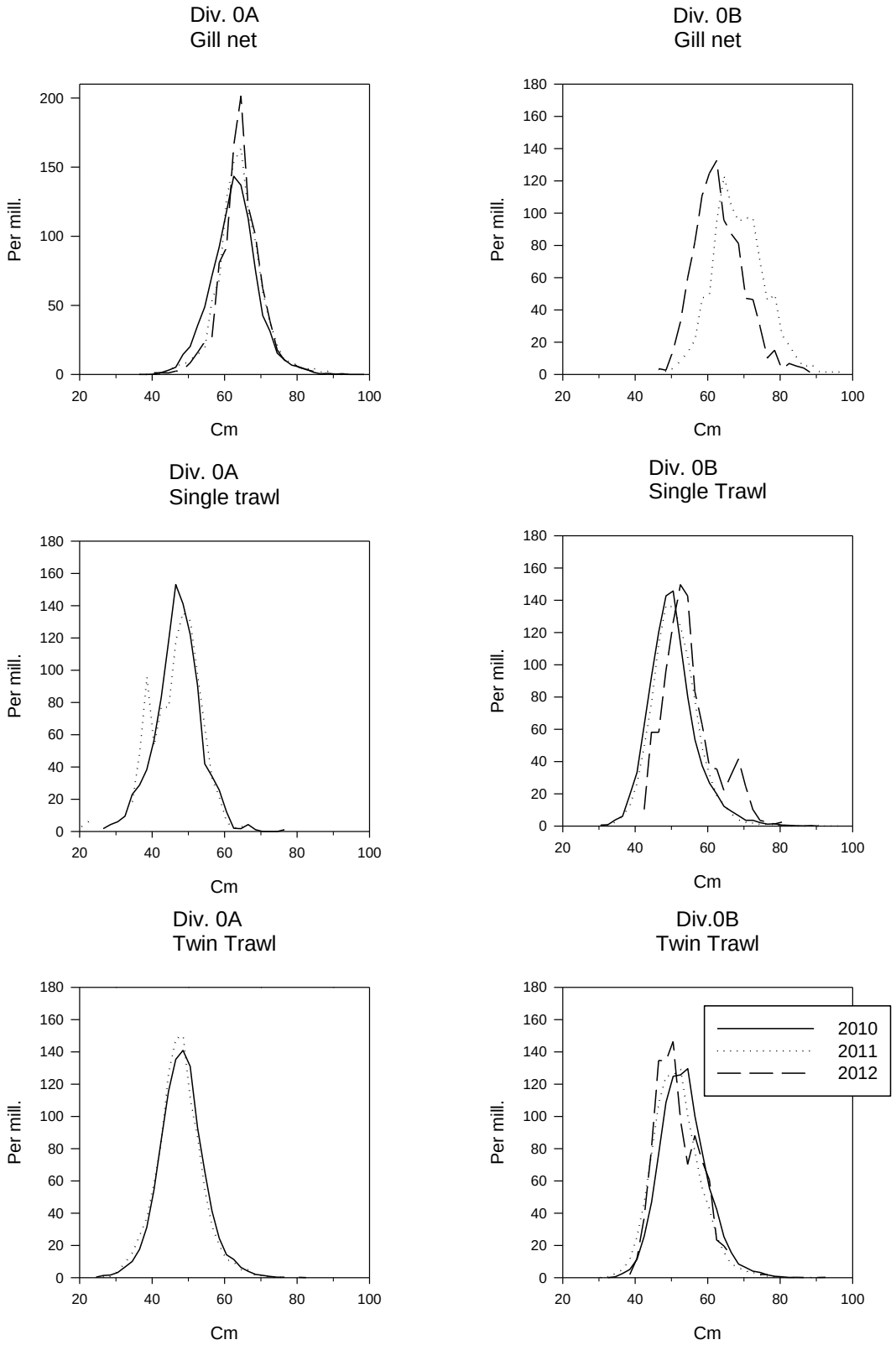

Fig.5. Length distribution from the fishery in Subarea 0 in 2010-2012 in per mill., 2 cm groups. No data from the trawl fishery in Div. 0A.

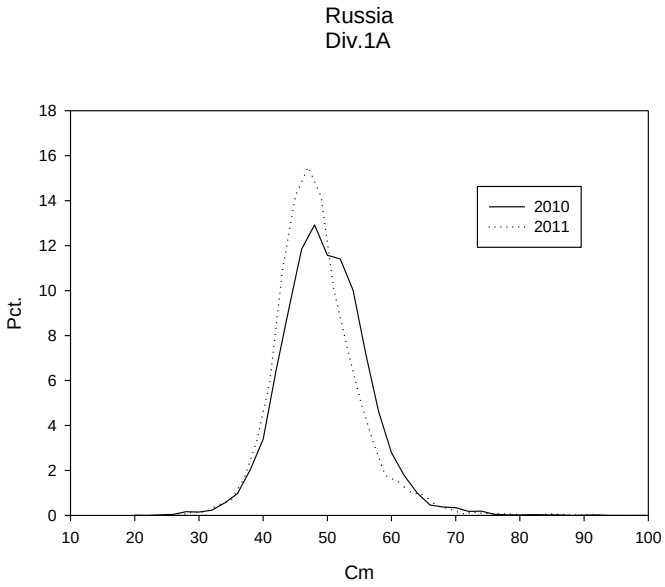

Fig. 6. Length distribution in the Russian trawl fishery in Div. 1A in 2009-2011 in percent, 2-cm groups. No Data from 2012.

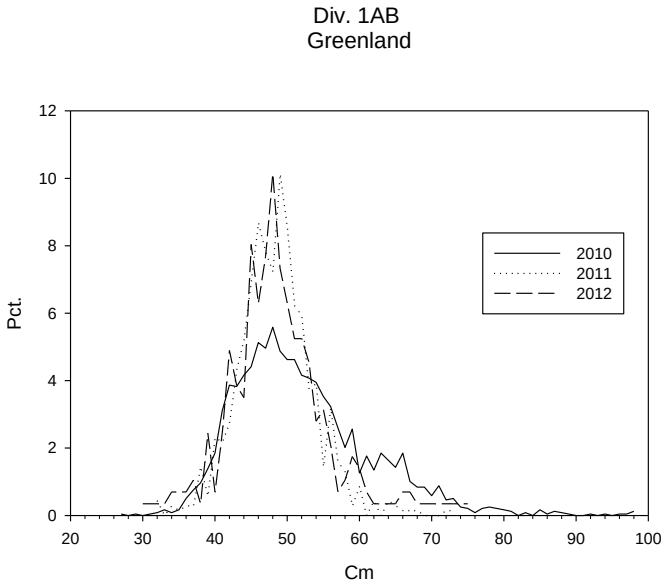

Fig. 7. Length distribution in the Greenland trawl fishery in Div. 1A in 2010-2012 in percent, 1-cm groups.

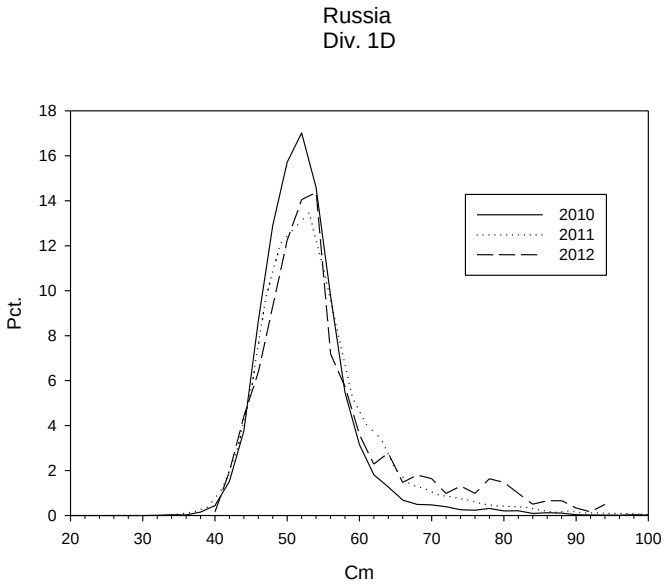

Fig. 8. Length distribution in the Russian trawl fishery in Div. 1D in 2010-2012 in percent, 2-cm groups.

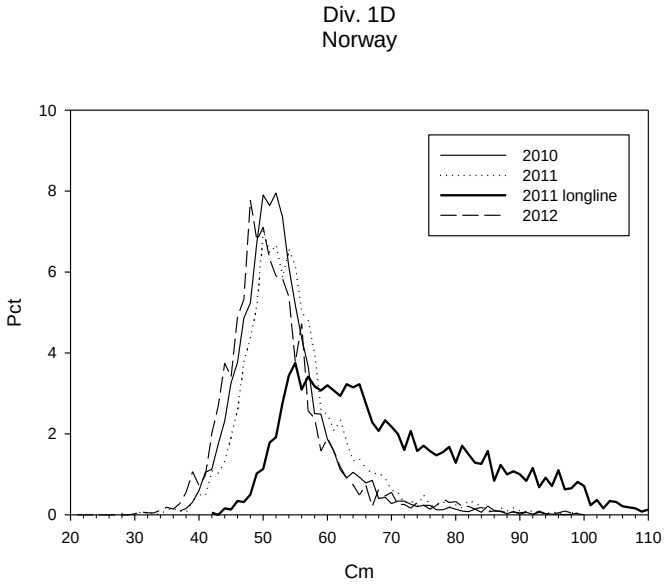

Fig. 9. Length distribution from the Norwegian Trawl fishery in Div. 1D in 2010-2012, and a small Norwegian longline fishery in 2011 in percent, 1-cm groups. No longline fishery in 2012.

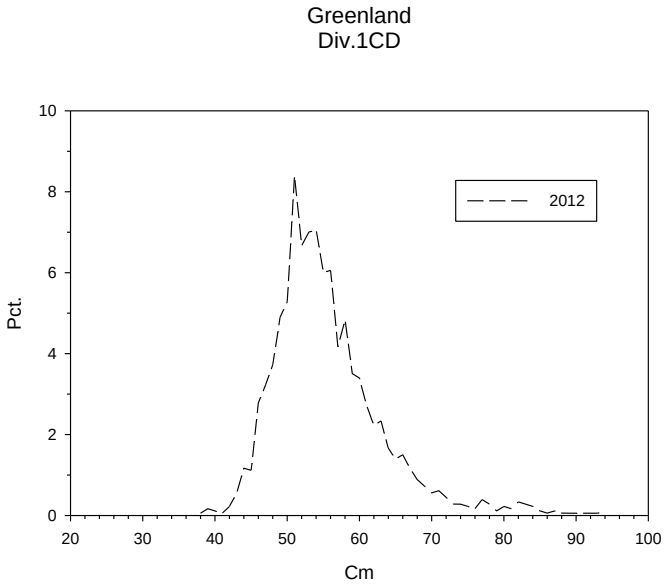

Fig. 10. Length distribution from the Greenland trawl fishery in Div. 1D in 2012, No data from 2010 and 2011.

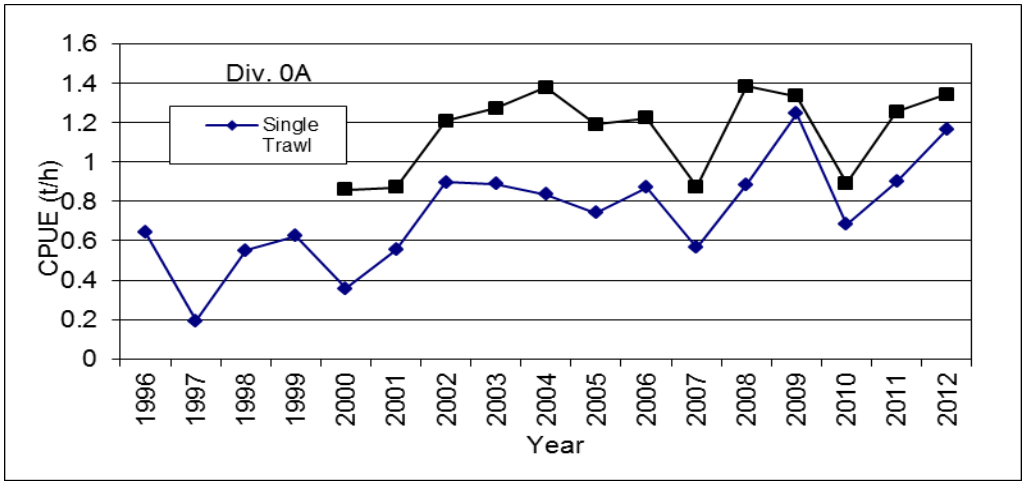

Fig. 11a. Un-standardized CPUE from the trawl fishery in Div. 0A.

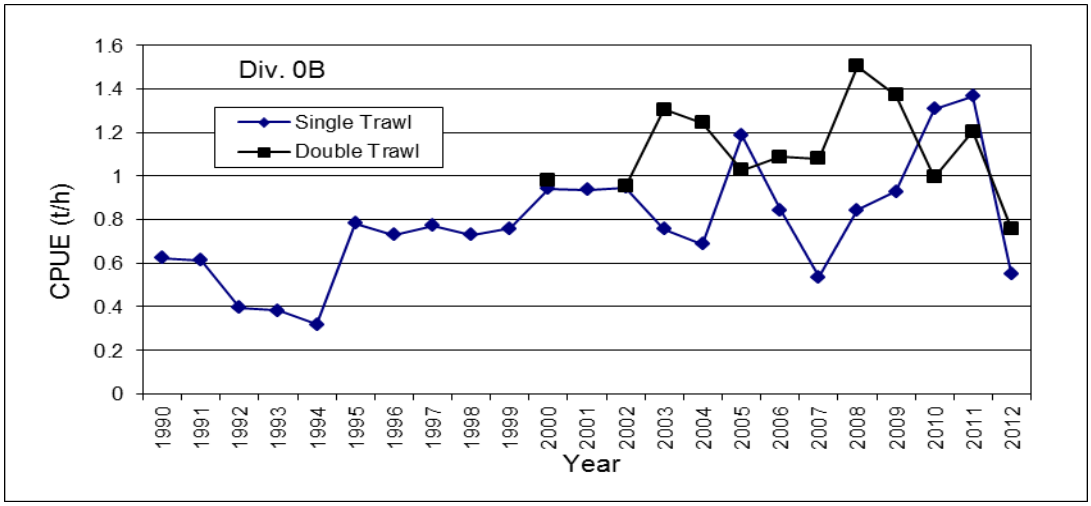

Fig. 11b. Un-standardized CPUE from the trawl fishery in Div. 0B.

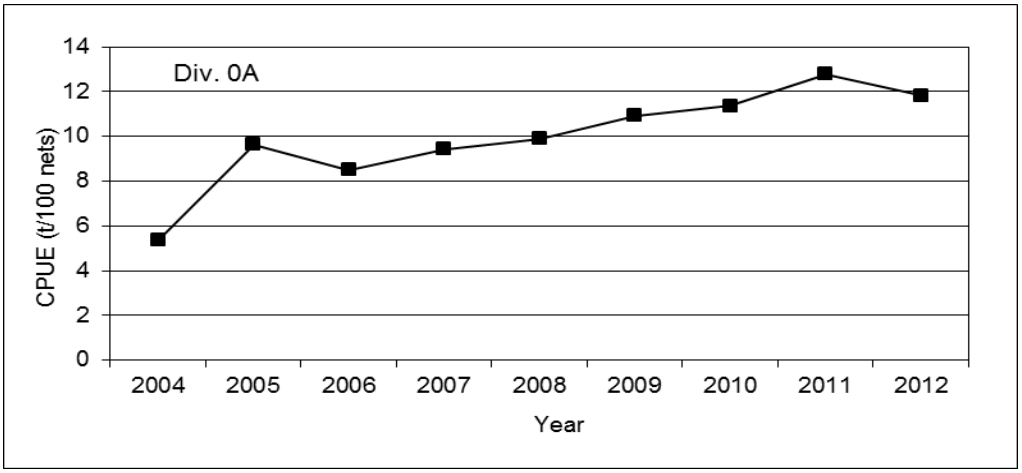

Figure 11c. Un-standardized CPUE from the gillnet fishery in Div. 0A.

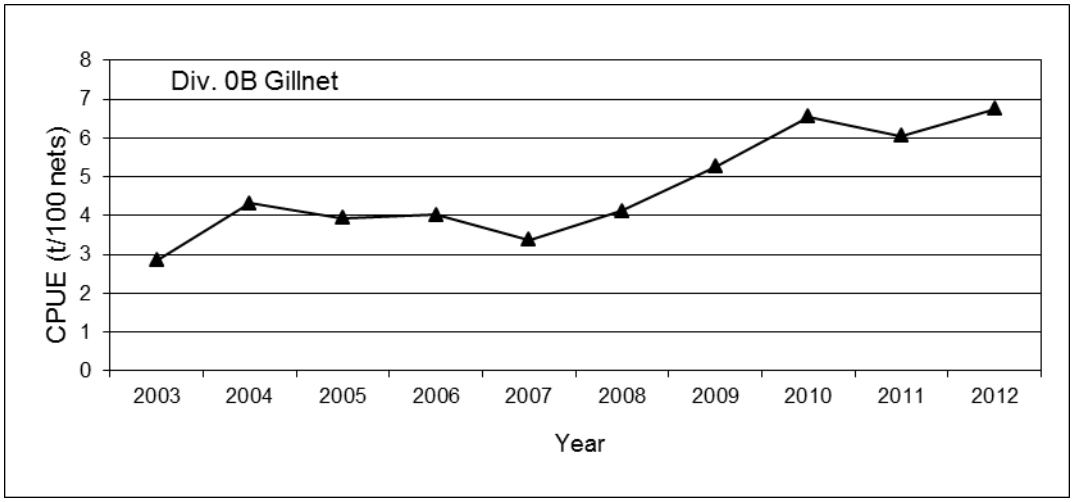

Figure 11d. Un-standardized CPUE from the gillnet fishery in Div. 0B.

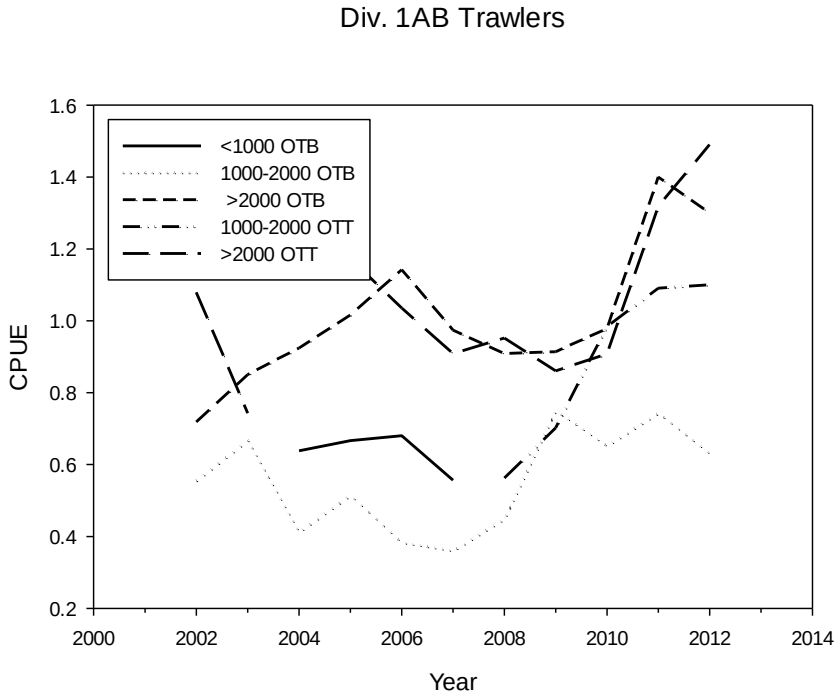

Fig. 11e. Unstandardized trawl CPUE series from Div. 1AB.

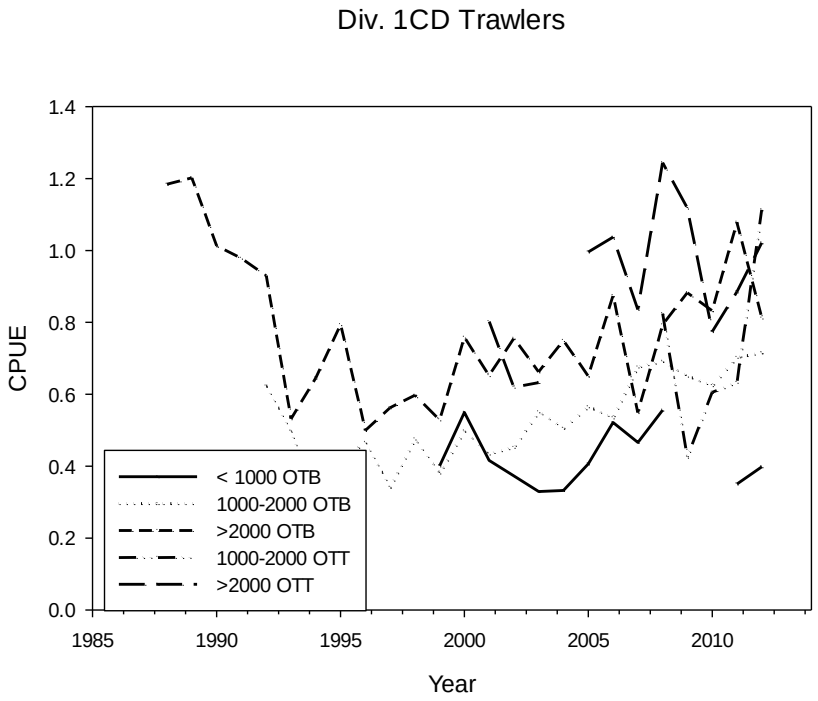

Fig. 11f. Unstandardized catch rates from different fleets fishing in Div. 1CD.

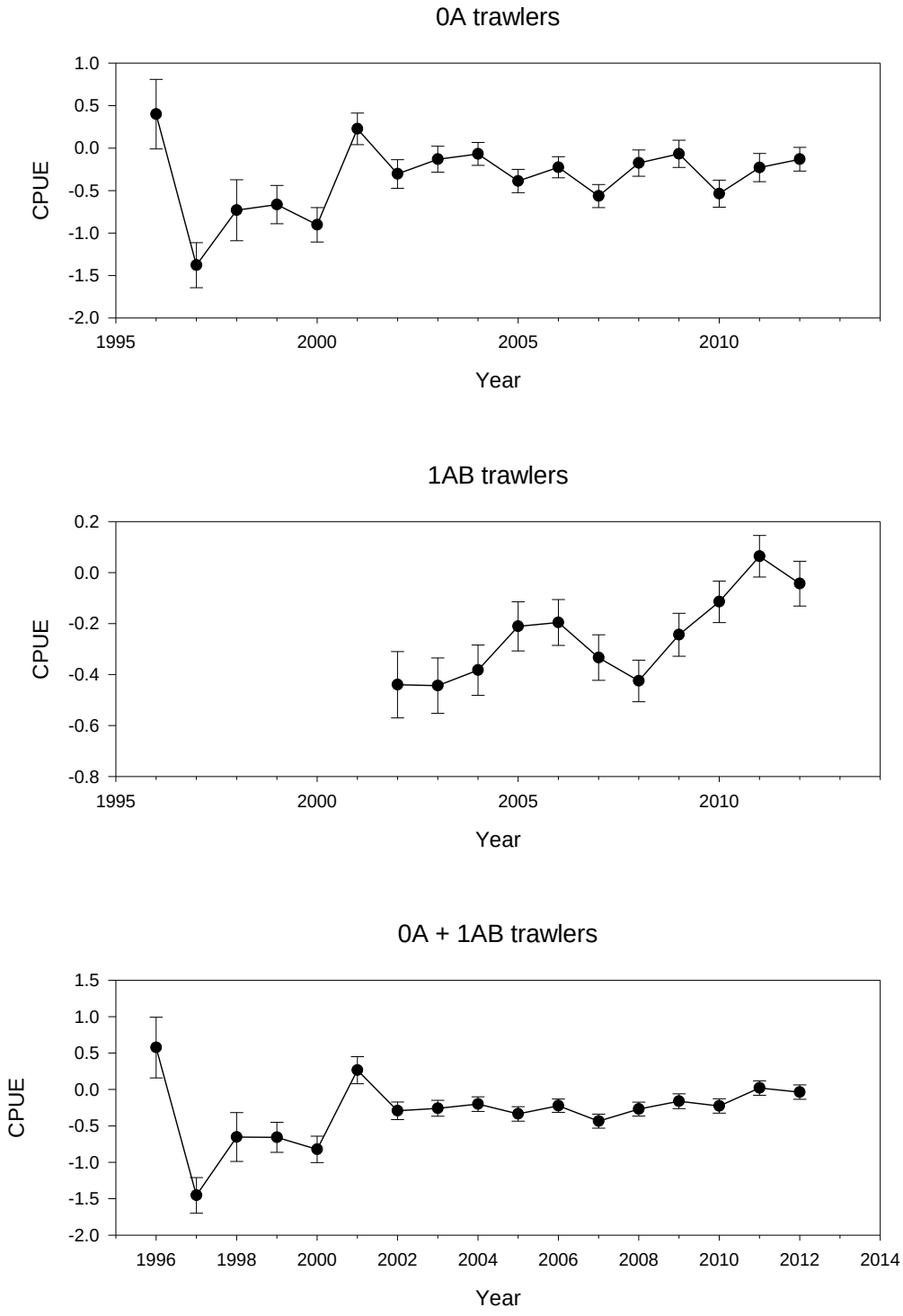

Fig. 12a. Standardized CPUE series from trawlers in 0A, Div. 1AB and 0B+1AB combined with +/- S.E.

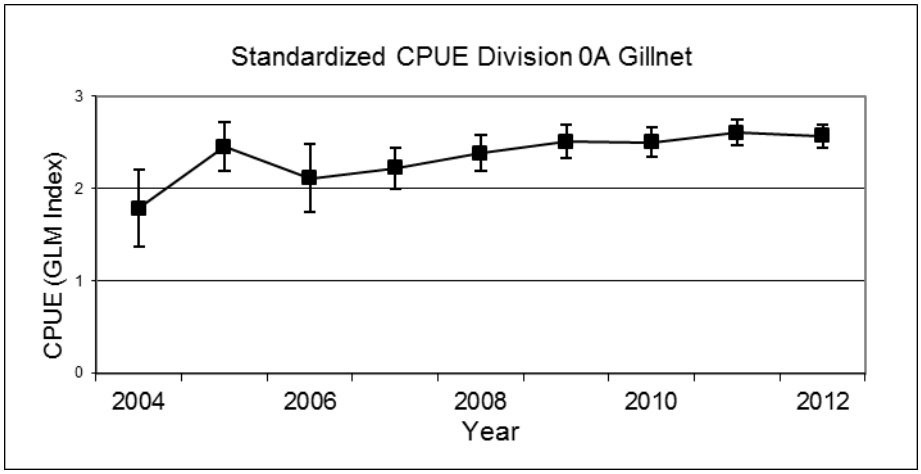

Fig 12b. Standardized CPUE series from gill net in Div. 0A with +/- S.E

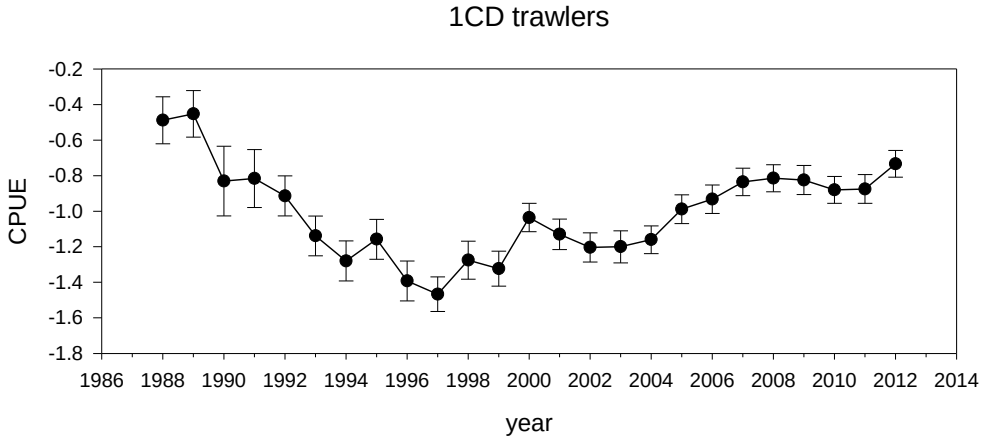

Fig. 12c. Standardized trawl CPUE index from trawlers in Div. 1CD with +/- S.E..

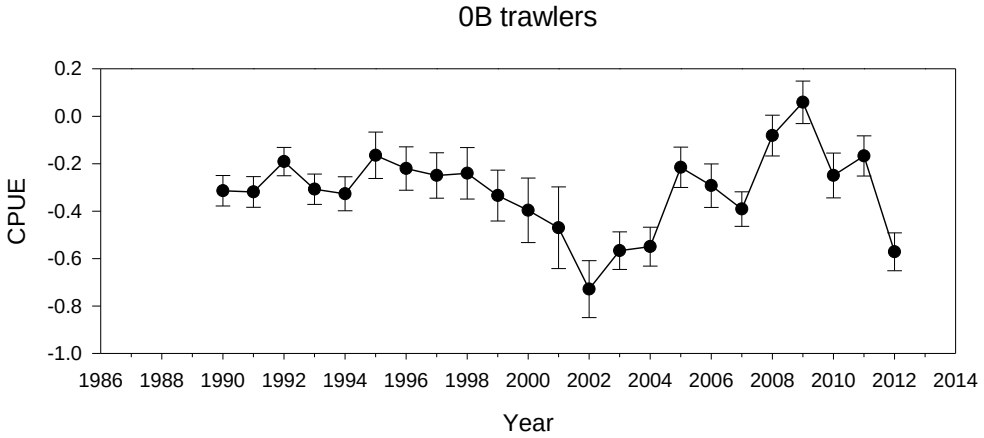

Fig 12d. Standardized CPUE series from trawlers in Div. 0B with +/- S.E.

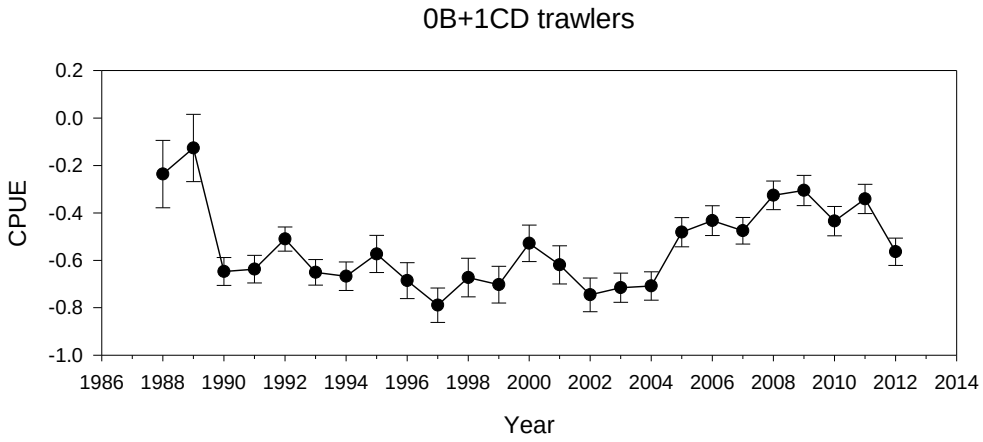

Fig. 12e. Combined standardized trawl CPUE index from trawlers in Div. 0B +1CD with +/- S.E.

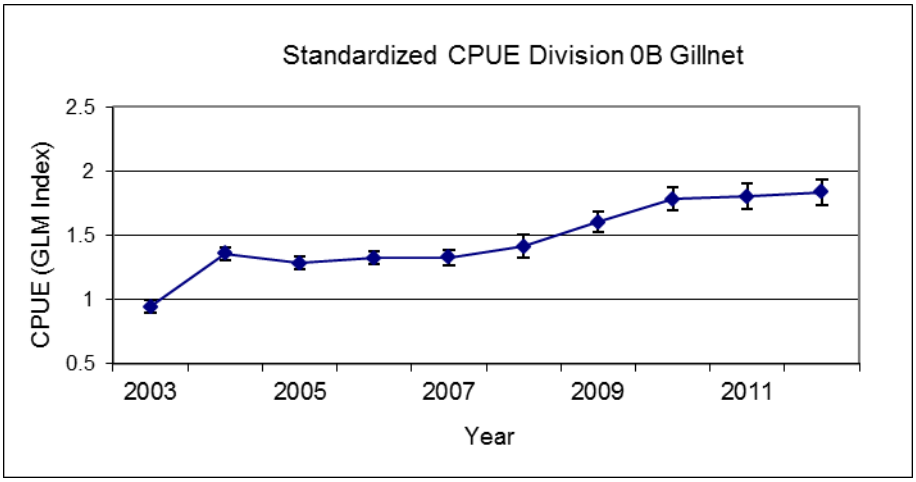

Fig 12 f. Standardized CPUE series from gill net in Div. 0B with +/- S.E

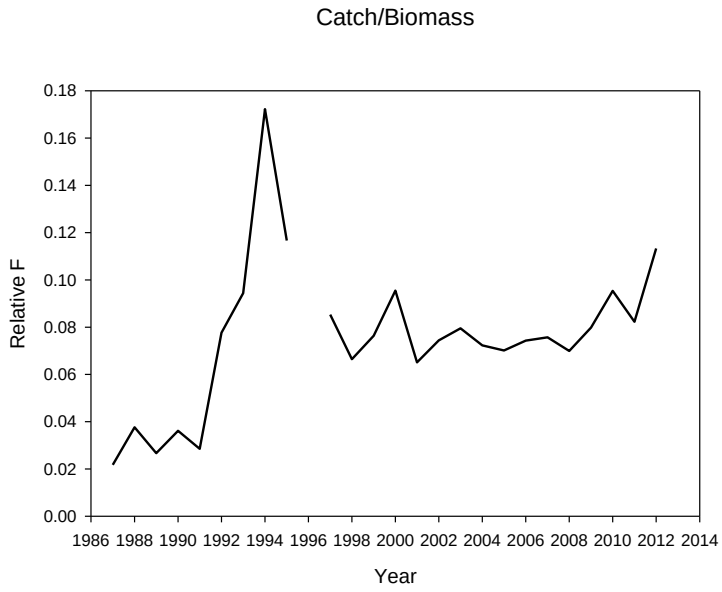

Fig 13. Relative F (catch/swept area biomass) in Div.1CD.

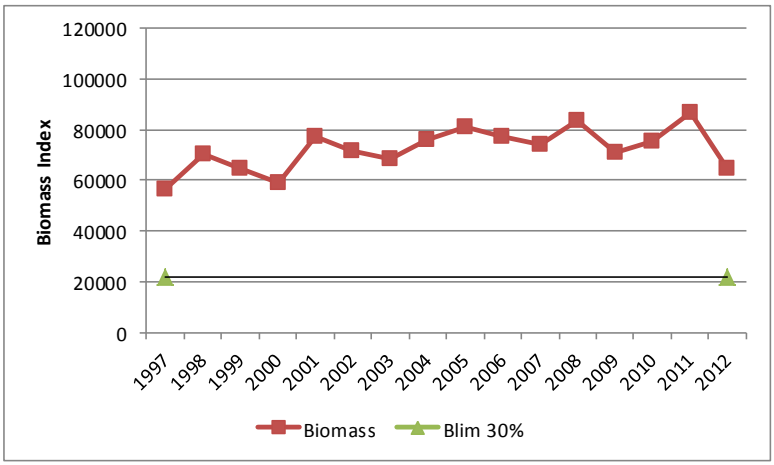

Fig. 14. Biomass trends in Div. 1CD and preliminary $B_{lim.}$

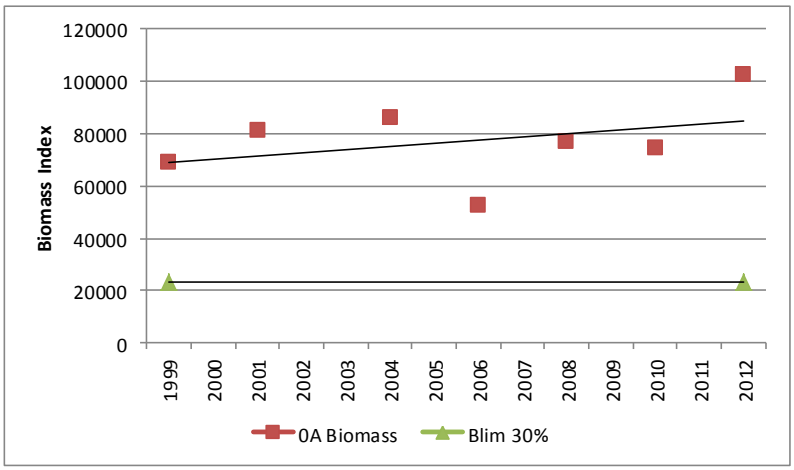

Fig. 15. Biomass trends in Div. 0A and preliminary $B_{lim.}$

Appendix 1. Standardized CPUE index from trawlers in Div. 0A.

Greenland halibut, 0A trawlers 1
14:53 Sunday, June 9, 2013

The GLM Procedure

Class Level Information

Class	Levels	Values
Year	17	1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
md	6	6 7 8 9 10 11
kode	5	2126 2127 5127 21926 21927

Number of Observations Read 144
Number of Observations Used 144

Greenland halibut, 0A trawlers 2
14:53 Sunday, June 9, 2013

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	17.47436768	0.69897471	6.12	<.0001
Error	118	13.46667864	0.11412440		
Corrected Total	143	30.94104632			

R-Square	Coeff Var	Root MSE	lcph Mean
0.564763	-507.1704	0.337823	-0.066609

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	16	10.65060246	0.66566265	5.83	<.0001
md	5	2.05739529	0.41147906	3.61	0.0045
kode	4	4.76636993	1.19159248	10.44	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	16	8.59857504	0.53741094	4.71	<.0001
md	5	1.41772727	0.28354545	2.48	0.0353
kode	4	4.76636993	1.19159248	10.44	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.066027784	B	0.13515378	0.49	0.6261
Year	1996	0.529849318	B	0.48176492	1.10	0.2737
Year	1997	-1.246947084	B	0.27491174	-4.54	<.0001
Year	1998	-0.599693833	B	0.36211786	-1.66	0.1004
Year	1999	-0.533506147	B	0.23097997	-2.31	0.0226
Year	2000	-0.771977801	B	0.20637067	-3.74	0.0003
Year	2001	0.356813599	B	0.22863343	1.56	0.1213
Year	2002	-0.173433486	B	0.17333371	-1.00	0.3191
Year	2003	-0.000007911	B	0.16530043	-0.00	1.0000
Year	2004	0.062456753	B	0.15858540	0.39	0.6944
Year	2005	-0.256876565	B	0.15717365	-1.63	0.1049
Year	2006	-0.094807551	B	0.14133496	-0.67	0.5037
Year	2007	-0.433623591	B	0.14172388	-3.06	0.0027
Year	2008	-0.045107679	B	0.15983091	-0.28	0.7783
Year	2009	0.063126243	B	0.16601150	0.38	0.7044
Year	2010	-0.405531858	B	0.16441813	-2.47	0.0151
Year	2011	-0.098320101	B	0.17074433	-0.58	0.5658
Year	2012	0.000000000	B	.	.	.

md	6	0.175134272 B	0.36385566	0.48	0.6312
md	7	0.285576094 B	0.12239390	2.33	0.0213
md	8	0.180662913 B	0.10054990	1.80	0.0749
md	9	0.217863053 B	0.09006730	2.42	0.0171
md	10	0.288312139 B	0.08592970	3.36	0.0011
md	11	0.000000000 B	.	.	.
kode	2126	-0.391029878 B	0.11023488	-3.55	0.0006
kode	2127	-0.290332808 B	0.06813184	-4.26	<.0001
kode	5127	-1.310144579 B	0.39839859	-3.29	0.0013
kode	21926	0.052144469 B	0.11732813	0.44	0.6575
kode	21927	0.000000000 B	.	.	.

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

The GLM Procedure
Least Squares Means

Year	lcph LSMEAN	Standard Error	Pr > |t|
1996	0.39926262	0.40920164	0.3312
1997	-1.37753378	0.26479463	<.0001
1998	-0.73028053	0.35877981	0.0440
1999	-0.66409284	0.22569416	0.0039
2000	-0.90256450	0.20255804	<.0001
2001	0.22622690	0.18579189	0.2258
2002	-0.30402018	0.16860881	0.0739
2003	-0.13059461	0.15298759	0.3950
2004	-0.06812994	0.13484704	0.6143
2005	-0.38746326	0.13753276	0.0057
2006	-0.22539425	0.12436473	0.0725
2007	-0.56421029	0.13534636	<.0001
2008	-0.17569437	0.15458377	0.2580
2009	-0.06746045	0.16041720	0.6749
2010	-0.53611855	0.15931370	0.0010
2011	-0.22890680	0.16652261	0.1719
2012	-0.13058670	0.13986265	0.3524

Appendix 2. Standardized CPUE index from trawlers in Div. 1AB

Greenland halibut, 1AB trawlers 9
10:23 Thursday, May 23, 2013

The GLM Procedure

Class Level Information

Class	Levels	Values
year	11	2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
MD	8	1 6 7 8 9 10 11 12
kode	5	6125 6126 6127 61926 61927

Number of Observations Read 140
Number of Observations Used 140

Greenland halibut, 1AB trawlers 10
10:23 Thursday, May 23, 2013

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	21	12.21130048	0.58149050	8.80	<.0001
Error	118	7.79415021	0.06605212		
Corrected Total	139	20.00545070			

R-Square	Coeff Var	Root MSE	lcph Mean
0.610399	-112.2448	0.257006	-0.228969

Source	DF	Type I SS	Mean Square	F Value	Pr > F
year	10	2.42496348	0.24249635	3.67	0.0003
MD	7	1.97483305	0.28211901	4.27	0.0003
kode	4	7.81150395	1.95287599	29.57	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
year	10	3.16352633	0.31635263	4.79	<.0001
MD	7	2.60625276	0.37232182	5.64	<.0001
kode	4	7.81150395	1.95287599	29.57	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.4342756392	B	0.28225288	1.54	0.1266
year	2002	-.3971335045	B	0.13683010	-2.90	0.0044
year	2003	-.4006605940	B	0.11636470	-3.44	0.0008
year	2004	-.3399508195	B	0.11017340	-3.09	0.0025
year	2005	-.1677160066	B	0.10805615	-1.55	0.1233
year	2006	-.1523839891	B	0.10552427	-1.44	0.1514
year	2007	-.2904192692	B	0.10125751	-2.87	0.0049
year	2008	-.3819503991	B	0.09817342	-3.89	0.0002
year	2009	-.2006609929	B	0.09430156	-2.13	0.0354
year	2010	-.0714294249	B	0.09370733	-0.76	0.4474
year	2011	0.1071266177	B	0.09785974	1.09	0.2759
year	2012	0.0000000000	B	.	.	.
MD	1	0.0356266045	B	0.38177617	0.09	0.9258
MD	6	-.4119608612	B	0.33049298	-1.25	0.2150
MD	7	-.5703296789	B	0.27858378	-2.05	0.0429
MD	8	-.3352498490	B	0.27298857	-1.23	0.2219
MD	9	-.2655627769	B	0.27174660	-0.98	0.3304
MD	10	-.1181193324	B	0.27180171	-0.43	0.6647
MD	11	-.1105336007	B	0.27372043	-0.40	0.6871
MD	12	0.0000000000	B	.	.	.

kode	6125	-.4089086142 B	0.08617643	-4.75	<.0001
kode	6126	-.5917845955 B	0.06556059	-9.03	<.0001
kode	6127	-.0209760083 B	0.06336931	-0.33	0.7412
kode	61926	-.2541078849 B	0.08379497	-3.03	0.0030
kode	61927	0.0000000000 B	.	.	.

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

The GLM Procedure
Least Squares Means

year	lcph LSMEAN	Standard Error	Pr > |t|
2002	-0.44002947	0.13039021	0.0010
2003	-0.44355656	0.10896600	<.0001
2004	-0.38284679	0.09918251	0.0002
2005	-0.21061197	0.09628681	0.0307
2006	-0.19527996	0.08990958	0.0319
2007	-0.33331524	0.08944643	0.0003
2008	-0.42484637	0.08173152	<.0001
2009	-0.24355696	0.08445051	0.0047
2010	-0.11432539	0.08134664	0.1625
2011	0.06423065	0.08147524	0.4321
2012	-0.04289597	0.08775021	0.6259

Appendix 3. Standardized CPUE index from trawlers in Div. 0A+1AB.

```
                    Greenland halibut, 0A+1AB trawlers                    4
                                                  14:53 Sunday, June 9, 2013

                            The GLM Procedure

                         Class Level Information

Class       Levels  Values

year            17  1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
                    2007 2008 2009 2010 2011 2012

MD               8  1 6 7 8 9 10 11 12

kode            10  2126 2127 5127 6125 6126 6127 21926 21927 61926 61927


                  Number of Observations Read         284
                  Number of Observations Used         284

                    Greenland halibut, 0A+1AB trawlers                    5
                                                  14:53 Sunday, June 9, 2013

                            The GLM Procedure

Dependent Variable: lcph

 Source                     DF       Sum of Squares   Mean Square  F Value  Pr > F

 Model                      32   26.77151844    0.83660995     8.06  <.0001

 Error                     251   26.04621948    0.10376980

 Corrected Total           283   52.81773792


            R-Square     Coeff Var      Root MSE     lcph Mean

            0.506866     -219.6673      0.322133     -0.146646


 Source                     DF     Type I SS   Mean Square  F Value  Pr > F

 year                       16    9.11379162    0.56961198     5.49  <.0001
 MD                          7    1.85569553    0.26509936     2.55  0.0147
 kode                        9   15.80203129    1.75578125    16.92  <.0001


 Source                     DF   Type III SS   Mean Square  F Value  Pr > F

 year                       16    9.03968116    0.56498007     5.44  <.0001
 MD                          7    1.87658518    0.26808360     2.58  0.0137
 kode                        9   15.80203129    1.75578125    16.92  <.0001


 Parameter                Estimate             Standard Error    t Value    Pr > |t|

 Intercept             0.321467283 B      0.34477436       0.93      0.3520
 year      1996        0.612179579 B      0.44765244       1.37      0.1727
 year      1997       -1.417820452 B      0.24430723      -5.80      <.0001
 year      1998       -0.617026442 B      0.33396337      -1.85      0.0658
 year      1999       -0.620633083 B      0.20357599      -3.05      0.0025
 year      2000       -0.786225709 B      0.17798734      -4.42      <.0001
 year      2001        0.301179935 B      0.20081091       1.50      0.1349
 year      2002       -0.256464724 B      0.11640684      -2.20      0.0285
 year      2003       -0.221815814 B      0.10544443      -2.10      0.0364
 year      2004       -0.164412365 B      0.09987199      -1.65      0.1010
 year      2005       -0.299482422 B      0.09824192      -3.05      0.0025
 year      2006       -0.186239648 B      0.09044362      -2.06      0.0405
 year      2007       -0.399376992 B      0.09071885      -4.40      <.0001
 year      2008       -0.232861672 B      0.09496889      -2.45      0.0149
 year      2009       -0.124561674 B      0.09378325      -1.33      0.1853
 year      2010       -0.190387948 B      0.09239232      -2.06      0.0404
```

year	2011	0.055566340 B	0.09712268	0.57	0.5677
year	2012	0.000000000 B	.	.	.
MD	1	0.181595725 B	0.47247153	0.38	0.7010
MD	6	-0.241614116 B	0.38487582	-0.63	0.5307
MD	7	-0.280945336 B	0.33855200	-0.83	0.4074
MD	8	-0.201516682 B	0.33527176	-0.60	0.5483
MD	9	-0.148308260 B	0.33454284	-0.44	0.6579
MD	10	-0.030246471 B	0.33464486	-0.09	0.9281
MD	11	-0.204401037 B	0.33571237	-0.61	0.5432
MD	12	0.000000000 B	.	.	.
kode	2126	-0.165266915 B	0.10453004	-1.58	0.1151
kode	2127	-0.162268384 B	0.07531231	-2.15	0.0321
kode	5127	-1.305549376 B	0.38260207	-3.41	0.0008
kode	6125	-0.366165140 B	0.10185895	-3.59	0.0004
kode	6126	-0.573385082 B	0.08113179	-7.07	<.0001
kode	6127	-0.057256379 B	0.07805335	-0.73	0.4639
kode	21926	0.288171161 B	0.10851427	2.66	0.0084
kode	21927	0.137903303 B	0.07277532	1.89	0.0593
kode	61926	-0.216437701 B	0.10228472	-2.12	0.0353
kode	61927	0.000000000 B	.	.	.

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

The GLM Procedure
Least Squares Means

year	lcph LSMEAN	Standard Error	Pr > |t|
1996	0.57594189	0.41626892	0.1677
1997	-1.45405814	0.24434710	<.0001
1998	-0.65326413	0.33503630	0.0523
1999	-0.65687077	0.20565230	0.0016
2000	-0.82246340	0.18077367	<.0001
2001	0.26494224	0.18526466	0.1539
2002	-0.29270241	0.12167443	0.0169
2003	-0.25805350	0.10981823	0.0196
2004	-0.20065005	0.10005093	0.0460
2005	-0.33572011	0.09931060	0.0008
2006	-0.22247734	0.09180503	0.0161
2007	-0.43561468	0.09611599	<.0001
2008	-0.26909936	0.09605248	0.0055
2009	-0.16079936	0.10079648	0.1119
2010	-0.22662564	0.09861455	0.0224
2011	0.01932865	0.09787778	0.8436
2012	-0.03623769	0.09873663	0.7139

Appendix 4. Standardized CPUE index from Gill nets in Div. 0A

Greenland halibut, 0A gillnets

The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
Year	9	2004 2005 2006 2007 2008 2009 2010 2011 2012
Month	5	7 8 9 10 11
CGT	3	40413 40414 40415

Number of Observations Read	50
Number of Observations Used	50

Greenland halibut, 0A gillnets

The GLM Procedure

Dependent Variable: lcpue

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	1.81867998	0.12990571	1.65	0.1144
Error	35	2.75995330	0.07885581		
Corrected Total	49	4.57863328			

R-Square	Coeff Var	Root MSE	lcpue Mean
0.397210	12.44241	0.280813	2.256900

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	8	1.09482153	0.13685269	1.74	0.1246
Month	4	0.45190500	0.11297625	1.43	0.2437
CGT	2	0.27195346	0.13597673	1.72	0.1931

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	8	1.45399524	0.18174941	2.30	0.0423
Month	4	0.38698491	0.09674623	1.23	0.3172
CGT	2	0.27195346	0.13597673	1.72	0.1931

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	2.389853291	B	0.18566115	12.87	<.0001
Year 2004	-0.785993389	B	0.31758714	-2.47	0.0183
Year 2005	-0.115013703	B	0.17120907	-0.67	0.5061
Year 2006	-0.457845085	B	0.17200112	-2.66	0.0117
Year 2007	-0.347866375	B	0.17360221	-2.00	0.0529
Year 2008	-0.185979769	B	0.19044185	-0.98	0.3355
Year 2009	-0.063660867	B	0.17760159	-0.36	0.7222
Year 2010	-0.069703986	B	0.17760159	-0.39	0.6971
Year 2011	0.037530470	B	0.17760159	0.21	0.8339
Year 2012	0.000000000	B	.	.	.
Month 7	0.002603087	B	0.16139416	0.02	0.9872
Month 8	0.186709647	B	0.12562261	1.49	0.1462
Month 9	0.212944782	B	0.12199125	1.75	0.0897
Month 10	0.189112654	B	0.12318150	1.54	0.1337
Month 11	0.000000000	B	.	.	.
CGT 40413	0.300414143	B	0.23473748	1.28	0.2090
CGT 40414	-0.113439740	B	0.11872319	-0.96	0.3459
CGT 40415	0.000000000	B	.	.	.

Greenland halibut, 0A gillnets

The GLM Procedure

Least Squares Means

Year	lcpue LSMEAN	Standard Error	Pr > |t|
2004	1.78445874	0.30550254	<.0001
2005	2.45543842	0.12611535	<.0001
2006	2.11260704	0.09870106	<.0001
2007	2.22258575	0.13331110	<.0001
2008	2.38447236	0.17296081	<.0001
2009	2.50679126	0.15765064	<.0001
2010	2.50074814	0.15765064	<.0001
2011	2.60798260	0.15765064	<.0001
2012	2.57045213	0.15765064	<.0001

Appendix 5. Standardized CPUE index from trawlers in Div. 0B

```
                    Greenland halibut, 0B trawlers                     10
                                          14:53 Sunday, June 9, 2013

                           The GLM Procedure

                       Class Level Information

Class       Levels  Values

Year            23  1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
                    2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
                    2012

md              12  1 2 3 4 5 6 7 8 9 10 11 12

kode            13  2126 2127 3125 5126 5127 14124 15126 15127 20126 20127
                    21926 21927 41927


                  Number of Observations Read         584
                  Number of Observations Used         584

                    Greenland halibut, 0B trawlers                     11
                                          14:53 Sunday, June 9, 2013

                           The GLM Procedure

Dependent Variable: lcph

                                   Sum of
Source                     DF       Squares   Mean Square  F Value  Pr > F

Model                      45   167.9064837     3.7312552    47.64  <.0001

Error                     538    42.1378029     0.0783231

Corrected Total           583   210.0442866


           R-Square     Coeff Var      Root MSE     lcph Mean

           0.799386     -48.86349      0.279863     -0.572744


Source                     DF     Type I SS   Mean Square  F Value  Pr > F

Year                       22   107.5399757     4.8881807    62.41  <.0001
md                         11    16.5253108     1.5023010    19.18  <.0001
kode                       12    43.8411972     3.6534331    46.65  <.0001


Source                     DF   Type III SS   Mean Square  F Value  Pr > F

Year                       22    9.63071897    0.43775995     5.59  <.0001
md                         11   15.43800241    1.40345476    17.92  <.0001
kode                       12   43.84119718    3.65343310    46.65  <.0001


                                          Standard
Parameter              Estimate              Error    t Value    Pr > |t|

Intercept          -0.153390268 B      0.16772991      -0.91      0.3609
Year      1990      0.257486259 B      0.09547106       2.70      0.0072
Year      1991      0.252281823 B      0.09709375       2.60      0.0096
Year      1992      0.380337580 B      0.09141427       4.16      <.0001
Year      1993      0.263847682 B      0.09599660       2.75      0.0062
Year      1994      0.244574166 B      0.10175682       2.40      0.0166
Year      1995      0.406766729 B      0.12118573       3.36      0.0008
Year      1996      0.351051015 B      0.11119176       3.16      0.0017
Year      1997      0.321826531 B      0.11125027       2.89      0.0040
Year      1998      0.330953956 B      0.11727968       2.82      0.0050
Year      1999      0.237175366 B      0.11327312       2.09      0.0367
Year      2000      0.174792974 B      0.14274286       1.22      0.2213
Year      2001      0.101412844 B      0.17664633       0.57      0.5661
Year      2002     -0.157265586 B      0.12488009      -1.26      0.2085
```

Year	2003	0.004751961 B	0.08800953	0.05	0.9570
Year	2004	0.021669903 B	0.08961378	0.24	0.8090
Year	2005	0.356201140 B	0.09322163	3.82	0.0001
Year	2006	0.278979237 B	0.10923975	2.55	0.0109
Year	2007	0.180359777 B	0.10065367	1.79	0.0737
Year	2008	0.489814729 B	0.08820722	5.55	<.0001
Year	2009	0.630207341 B	0.09163048	6.88	<.0001
Year	2010	0.321934971 B	0.10413117	3.09	0.0021
Year	2011	0.404257773 B	0.08942500	4.52	<.0001
Year	2012	0.000000000 B	.	.	.
md	1	0.070770772 B	0.10240536	0.69	0.4898
md	2	0.302213317 B	0.17793770	1.70	0.0900
md	3	0.117915272 B	0.29827875	0.40	0.6928
md	4	0.163046529 B	0.09737456	1.67	0.0946
md	5	0.472448831 B	0.06711673	7.04	<.0001
md	6	-0.015329379 B	0.06753686	-0.23	0.8205
md	7	-0.291174571 B	0.05951958	-4.89	<.0001
md	8	-0.207279308 B	0.05727905	-3.62	0.0003
md	9	-0.288215645 B	0.05505911	-5.23	<.0001
md	10	-0.345541422 B	0.05231874	-6.60	<.0001
md	11	-0.230118364 B	0.05270099	-4.37	<.0001
md	12	0.000000000 B	.	.	.
kode	2126	-0.503829874 B	0.17096620	-2.95	0.0033
kode	2127	-0.263272874 B	0.15170007	-1.74	0.0832
kode	3125	-1.096022189 B	0.18832796	-5.82	<.0001
kode	5126	-0.401197221 B	0.19942027	-2.01	0.0447
kode	5127	-0.169558962 B	0.16858085	-1.01	0.3150
kode	14124	-0.704527606 B	0.17268241	-4.08	<.0001
kode	15126	0.047398609 B	0.17398712	0.27	0.7854
kode	15127	0.031700243 B	0.18712926	0.17	0.8655
kode	20126	-1.025959630 B	0.16523192	-6.21	<.0001
kode	20127	-1.040619416 B	0.17025117	-6.11	<.0001
kode	21926	-0.093892119 B	0.19454209	-0.48	0.6296
kode	21927	0.059433593 B	0.15482957	0.38	0.7012
kode	41927	0.000000000 B	.	.	.

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

The GLM Procedure
Least Squares Means

Year	lcph LSMEAN	Standard Error	Pr > |t|
1990	-0.31379248	0.06429092	<.0001
1991	-0.31899691	0.06468296	<.0001
1992	-0.19094116	0.05950544	0.0014
1993	-0.30743105	0.06405334	<.0001
1994	-0.32670457	0.07151277	<.0001
1995	-0.16451201	0.09802526	0.0939
1996	-0.22022772	0.09161902	0.0166
1997	-0.24945220	0.09546818	0.0092
1998	-0.24032478	0.10824263	0.0268
1999	-0.33410337	0.10745676	0.0020
2000	-0.39648576	0.13576081	0.0036
2001	-0.46986589	0.17237005	0.0066
2002	-0.72854432	0.12002618	<.0001
2003	-0.56652677	0.07912791	<.0001
2004	-0.54960883	0.08175877	<.0001
2005	-0.21507759	0.08477468	0.0115
2006	-0.29229950	0.09179500	0.0015
2007	-0.39091896	0.07286432	<.0001
2008	-0.08146401	0.08600273	0.3439
2009	0.05892861	0.08978791	0.5119
2010	-0.24934376	0.09460368	0.0086
2011	-0.16702096	0.08458982	0.0488
2012	-0.57127874	0.07991868	<.0001

Appendix 6. Standardized CPUE index for trawlers in Div.1CD.

Greenland halibut, 1CD trawlers 1
11:08 Thursday, May 23, 2013

The GLM Procedure

Class Level Information

Class	Levels	Values
year	25	1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
kode	6	6124 6125 6126 6127 61926 61927

Number of Observations Read 290
Number of Observations Used 290

Greenland halibut, 1CD trawlers 2
11:08 Thursday, May 23, 2013

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	40	49.55168661	1.23879217	17.74	<.0001
Error	249	17.38628694	0.06982445		
Corrected Total	289	66.93797355			

R-Square	Coeff Var	Root MSE	lcph Mean
0.740263	-49.98429	0.264243	-0.528652

Source	DF	Type I SS	Mean Square	F Value	Pr > F
year	24	18.75458186	0.78144091	11.19	<.0001
MD	11	8.85137553	0.80467050	11.52	<.0001
kode	5	21.94572922	4.38914584	62.86	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
year	24	12.46799814	0.51949992	7.44	<.0001
MD	11	5.93926134	0.53993285	7.73	<.0001
kode	5	21.94572922	4.38914584	62.86	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.243740523 B	0.09047056	2.69	0.0075
year	1988	0.244726183 B	0.14589297	1.68	0.0947
year	1989	0.280839569 B	0.13949636	2.01	0.0452
year	1990	-0.097068808 B	0.19997696	-0.49	0.6278
year	1991	-0.082719647 B	0.16751604	-0.49	0.6219
year	1992	-0.180454339 B	0.11934397	-1.51	0.1318
year	1993	-0.405808798 B	0.11875669	-3.42	0.0007
year	1994	-0.546881833 B	0.11920631	-4.59	<.0001
year	1995	-0.424717530 B	0.11846819	-3.59	0.0004
year	1996	-0.659076425 B	0.11850024	-5.56	<.0001
year	1997	-0.733717916 B	0.10452074	-7.02	<.0001
year	1998	-0.542703902 B	0.11295237	-4.80	<.0001
year	1999	-0.590316400 B	0.10540116	-5.60	<.0001
year	2000	-0.302388551 B	0.09934317	-3.04	0.0026
year	2001	-0.397119271 B	0.09457291	-4.20	<.0001

year	2002	-0.470736704	B	0.09161662	-5.14	<.0001
year	2003	-0.467162240	B	0.09879095	-4.73	<.0001
year	2004	-0.427300892	B	0.09066850	-4.71	<.0001
year	2005	-0.254827290	B	0.09182139	-2.78	0.0059
year	2006	-0.198856483	B	0.08975147	-2.22	0.0276
year	2007	-0.101913140	B	0.09333265	-1.09	0.2759
year	2008	-0.081130688	B	0.08792401	-0.92	0.3570
year	2009	-0.090936506	B	0.09261386	-0.98	0.3271
year	2010	-0.146542212	B	0.08687858	-1.69	0.0929
year	2011	-0.141426998	B	0.09011508	-1.57	0.1178
year	2012	0.000000000	B	.	.	.
MD	1	-0.394715635	B	0.09927392	-3.98	<.0001
MD	2	-0.932404519	B	0.12447678	-7.49	<.0001
MD	3	-0.814224255	B	0.27978481	-2.91	0.0039
MD	4	-0.378620356	B	0.20736672	-1.83	0.0691
MD	5	-0.256632636	B	0.12511075	-2.05	0.0413
MD	6	-0.438003051	B	0.09350801	-4.68	<.0001
MD	7	-0.342654279	B	0.07929369	-4.32	<.0001
MD	8	-0.314486642	B	0.06967946	-4.51	<.0001
MD	9	-0.170221822	B	0.06282409	-2.71	0.0072
MD	10	-0.208368019	B	0.05897544	-3.53	0.0005
MD	11	-0.148053463	B	0.05884172	-2.52	0.0125
MD	12	0.000000000	B	.	.	.
kode	6124	-2.504059871	B	0.17925801	-13.97	<.0001
kode	6125	-0.574859972	B	0.06617439	-8.69	<.0001
kode	6126	-0.375301377	B	0.05848708	-6.42	<.0001
kode	6127	-0.063780134	B	0.06063639	-1.05	0.2939
kode	61926	-0.144074108	B	0.11013539	-1.31	0.1920
kode	61927	0.000000000	B	.	.	.

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

The GLM Procedure
Least Squares Means

year	lcph LSMEAN	Standard Error	Pr > |t|
1988	-0.48841126	0.13234950	0.0003
1989	-0.45229788	0.13073355	0.0006
1990	-0.83020625	0.19571888	<.0001
1991	-0.81585709	0.16275249	<.0001
1992	-0.91359178	0.11256634	<.0001
1993	-1.13894624	0.11232459	<.0001
1994	-1.28001928	0.11242003	<.0001
1995	-1.15785497	0.11238726	<.0001
1996	-1.39221387	0.11218476	<.0001
1997	-1.46685536	0.09698632	<.0001
1998	-1.27584135	0.10658427	<.0001
1999	-1.32345384	0.09810076	<.0001
2000	-1.03552600	0.08009641	<.0001
2001	-1.13025672	0.08611833	<.0001
2002	-1.20387415	0.08221781	<.0001
2003	-1.20029968	0.09082704	<.0001
2004	-1.16043834	0.07851392	<.0001
2005	-0.98796473	0.08099292	<.0001
2006	-0.93199393	0.08005179	<.0001
2007	-0.83505058	0.07719826	<.0001
2008	-0.81426813	0.07618682	<.0001
2009	-0.82407395	0.08139239	<.0001
2010	-0.87967966	0.07545150	<.0001
2011	-0.87456444	0.08067390	<.0001
2012	-0.73313744	0.07486055	<.0001

Appendix 7. Combined Standardized CPUE index for trawlers in Div. 1CD and Div. 0B.

```
                    Greenland halibut, 0B + 1CD trawlers                 13
                                                  14:53 Sunday, June 9, 2013

                              The GLM Procedure

                           Class Level Information

Class       Levels  Values

year            25  1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
                    1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
                    2010 2011 2012

MD              12  1 2 3 4 5 6 7 8 9 10 11 12

kode            19  2126 2127 3125 5126 5127 6124 6125 6126 6127 14124
                    15126 15127 20126 20127 21926 21927 41927 61926 61927


                  Number of Observations Read         874
                  Number of Observations Used         874

                    Greenland halibut, 0B + 1CD trawlers                 14
                                                  14:53 Sunday, June 9, 2013

                              The GLM Procedure

Dependent Variable: lcph

                                      Sum of
Source                          DF       Squares   Mean Square  F Value  Pr > F

Model                           53   203.4252408     3.8382121    42.57  <.0001

Error                          820    73.9337276     0.0901631

Corrected Total                873   277.3589683


           R-Square     Coeff Var      Root MSE     lcph Mean

           0.733437     -53.80115      0.300272     -0.558114


Source                          DF     Type I SS   Mean Square  F Value  Pr > F

year                            24   94.21458835    3.92560785    43.54  <.0001
MD                              11   23.26670614    2.11515510    23.46  <.0001
kode                            18   85.94394628    4.77466368    52.96  <.0001


Source                          DF   Type III SS   Mean Square  F Value  Pr > F

year                            24   12.55994937    0.52333122     5.80  <.0001
MD                              11   13.24966155    1.20451469    13.36  <.0001
kode                            18   85.94394628    4.77466368    52.96  <.0001


                                                    Standard
Parameter                    Estimate                   Error    t Value    Pr > |t|

Intercept                -0.052397977 B        0.08033928      -0.65      0.5144
year      1988            0.327627912 B        0.14852539       2.21      0.0277
year      1989            0.437325962 B        0.14700836       2.97      0.0030
year      1990           -0.083356742 B        0.07648211      -1.09      0.2761
year      1991           -0.073571352 B        0.07702697      -0.96      0.3398
year      1992            0.053523488 B        0.06968605       0.77      0.4427
year      1993           -0.087140786 B        0.07269598      -1.20      0.2310
year      1994           -0.103426145 B        0.07735220      -1.34      0.1816
year      1995           -0.009303498 B        0.09014633      -0.10      0.9178
year      1996           -0.122069993 B        0.08643487      -1.41      0.1582
year      1997           -0.225842309 B        0.08326034      -2.71      0.0068
year      1998           -0.109103131 B        0.08933179      -1.22      0.2223
year      1999           -0.139271435 B        0.08490593      -1.64      0.1013
year      2000            0.035674057 B        0.08827322       0.40      0.6862
year      2001           -0.055544498 B        0.08823210      -0.63      0.5292
year      2002           -0.182326949 B        0.07968285      -2.29      0.0224
year      2003           -0.151911000 B        0.07135565      -2.13      0.0336
```

year	2004	-0.144712415 B	0.06984839	-2.07	0.0386
year	2005	0.082669330 B	0.07190712	1.15	0.2506
year	2006	0.131260146 B	0.07469424	1.76	0.0792
year	2007	0.088632659 B	0.07374523	1.20	0.2298
year	2008	0.237877636 B	0.06848061	3.47	0.0005
year	2009	0.258510963 B	0.07151351	3.61	0.0003
year	2010	0.129173214 B	0.07296359	1.77	0.0770
year	2011	0.222748511 B	0.06949558	3.21	0.0014
year	2012	0.000000000 B	.	.	.
MD	1	-0.191344385 B	0.07620466	-2.51	0.0122
MD	2	-0.507791732 B	0.10979040	-4.63	<.0001
MD	3	-0.352372866 B	0.22436469	-1.57	0.1167
MD	4	0.044487761 B	0.09194600	0.48	0.6286
MD	5	0.314291801 B	0.06120236	5.14	<.0001
MD	6	-0.158573297 B	0.05851595	-2.71	0.0069
MD	7	-0.287469488 B	0.05026258	-5.72	<.0001
MD	8	-0.202228430 B	0.04709604	-4.29	<.0001
MD	9	-0.211627664 B	0.04440425	-4.77	<.0001
MD	10	-0.258299147 B	0.04225871	-6.11	<.0001
MD	11	-0.165809340 B	0.04264389	-3.89	0.0001
MD	12	0.000000000 B	.	.	.
kode	2126	-0.301518167 B	0.09390892	-3.21	0.0014
kode	2127	-0.098400892 B	0.06405750	-1.54	0.1249
kode	3125	-1.018692119 B	0.12059547	-8.45	<.0001
kode	5126	-0.037754262 B	0.13924999	-0.27	0.7864
kode	5127	0.073155359 B	0.08412541	0.87	0.3848
kode	6124	-2.509619697 B	0.19732672	-12.72	<.0001
kode	6125	-0.672407401 B	0.07232554	-9.30	<.0001
kode	6126	-0.423732923 B	0.06455250	-6.56	<.0001
kode	6127	-0.091698423 B	0.06632343	-1.38	0.1672
kode	14124	-0.519622951 B	0.09311650	-5.58	<.0001
kode	15126	0.217312206 B	0.09771590	2.22	0.0264
kode	15127	0.196867176 B	0.12185369	1.62	0.1066
kode	20126	-0.833366765 B	0.07665962	-10.87	<.0001
kode	20127	-0.846644186 B	0.08634662	-9.81	<.0001
kode	21926	0.142499378 B	0.13146481	1.08	0.2787
kode	21927	0.188691802 B	0.06935079	2.72	0.0066
kode	41927	0.120998380 B	0.15351789	0.79	0.4308
kode	61926	-0.167532182 B	0.12299000	-1.36	0.1735
kode	61927	0.000000000 B	.	.	.

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

The GLM Procedure
Least Squares Means

year	lcph LSMEAN	Standard Error	Pr > |t|
1988	-0.23589106	0.14210556	0.0973
1989	-0.12619301	0.14171442	0.3735
1990	-0.64687571	0.05906681	<.0001
1991	-0.63709033	0.05838777	<.0001
1992	-0.50999548	0.05070266	<.0001
1993	-0.65065976	0.05425978	<.0001
1994	-0.66694512	0.06023482	<.0001
1995	-0.57282247	0.07833296	<.0001
1996	-0.68558897	0.07585245	<.0001
1997	-0.78936128	0.07270559	<.0001
1998	-0.67262210	0.08162498	<.0001
1999	-0.70279041	0.07766594	<.0001
2000	-0.52784492	0.07695056	<.0001
2001	-0.61906347	0.08100379	<.0001
2002	-0.74584592	0.07130584	<.0001
2003	-0.71542997	0.06166260	<.0001
2004	-0.70823139	0.06004238	<.0001
2005	-0.48084964	0.06154032	<.0001
2006	-0.43225883	0.06294720	<.0001
2007	-0.47488631	0.05599305	<.0001
2008	-0.32564134	0.06061691	<.0001
2009	-0.30500801	0.06374474	<.0001
2010	-0.43434576	0.06177762	<.0001
2011	-0.34077046	0.06151374	<.0001
2012	-0.56351897	0.05769207	<.0001

Greenland halibut, 0B + 1CD trawlers 13
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The GLM Procedure

Class Level Information

Class	Levels	Values
year	25	1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
kode	19	2126 2127 3125 5126 5127 6124 6125 6126 6127 14124 15126 15127 20126 20127 21926 21927 41927 61926 61927

Number of Observations Read 874
Number of Observations Used 874

Greenland halibut, 0B + 1CD trawlers 14
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The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	53	203.4252408	3.8382121	42.57	<.0001
Error	820	73.9337276	0.0901631		
Corrected Total	873	277.3589683			

R-Square	Coeff Var	Root MSE	lcph Mean
0.733437	-53.80115	0.300272	-0.558114

Source	DF	Type I SS	Mean Square	F Value	Pr > F
year	24	94.21458835	3.92560785	43.54	<.0001
MD	11	23.26670614	2.11515510	23.46	<.0001
kode	18	85.94394628	4.77466368	52.96	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
year	24	12.55994937	0.52333122	5.80	<.0001
MD	11	13.24966155	1.20451469	13.36	<.0001
kode	18	85.94394628	4.77466368	52.96	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		-0.052397977 B	0.08033928	-0.65	0.5144
year	1988	0.327627912 B	0.14852539	2.21	0.0277
year	1989	0.437325962 B	0.14700836	2.97	0.0030
year	1990	-0.083356742 B	0.07648211	-1.09	0.2761
year	1991	-0.073571352 B	0.07702697	-0.96	0.3398
year	1992	0.053523488 B	0.06968605	0.77	0.4427
year	1993	-0.087140786 B	0.07269598	-1.20	0.2310
year	1994	-0.103426145 B	0.07735220	-1.34	0.1816
year	1995	-0.009303498 B	0.09014633	-0.10	0.9178
year	1996	-0.122069993 B	0.08643487	-1.41	0.1582
year	1997	-0.225842309 B	0.08326034	-2.71	0.0068
year	1998	-0.109103131 B	0.08933179	-1.22	0.2223
year	1999	-0.139271435 B	0.08490593	-1.64	0.1013
year	2000	0.035674057 B	0.08827322	0.40	0.6862
year	2001	-0.055544498 B	0.08823210	-0.63	0.5292
year	2002	-0.182326949 B	0.07968285	-2.29	0.0224
year	2003	-0.151911000 B	0.07135565	-2.13	0.0336
year	2004	-0.144712415 B	0.06984839	-2.07	0.0386
year	2005	0.082669330 B	0.07190712	1.15	0.2506

year	2006	0.131260146	B	0.07469424	1.76	0.0792
year	2007	0.088632659	B	0.07374523	1.20	0.2298
year	2008	0.237877636	B	0.06848061	3.47	0.0005
year	2009	0.258510963	B	0.07151351	3.61	0.0003
year	2010	0.129173214	B	0.07296359	1.77	0.0770
year	2011	0.222748511	B	0.06949558	3.21	0.0014
year	2012	0.000000000	B	.	.	.
MD	1	-0.191344385	B	0.07620466	-2.51	0.0122
MD	2	-0.507791732	B	0.10979040	-4.63	<.0001
MD	3	-0.352372866	B	0.22436469	-1.57	0.1167
MD	4	0.044487761	B	0.09194600	0.48	0.6286
MD	5	0.314291801	B	0.06120236	5.14	<.0001
MD	6	-0.158573297	B	0.05851595	-2.71	0.0069
MD	7	-0.287469488	B	0.05026258	-5.72	<.0001
MD	8	-0.202228430	B	0.04709604	-4.29	<.0001
MD	9	-0.211627664	B	0.04440425	-4.77	<.0001
MD	10	-0.258299147	B	0.04225871	-6.11	<.0001
MD	11	-0.165809340	B	0.04264389	-3.89	0.0001
MD	12	0.000000000	B	.	.	.
kode	2126	-0.301518167	B	0.09390892	-3.21	0.0014
kode	2127	-0.098400892	B	0.06405750	-1.54	0.1249
kode	3125	-1.018692119	B	0.12059547	-8.45	<.0001
kode	5126	-0.037754262	B	0.13924999	-0.27	0.7864
kode	5127	0.073155359	B	0.08412541	0.87	0.3848
kode	6124	-2.509619697	B	0.19732672	-12.72	<.0001
kode	6125	-0.672407401	B	0.07232554	-9.30	<.0001
kode	6126	-0.423732923	B	0.06455250	-6.56	<.0001
kode	6127	-0.091698423	B	0.06632343	-1.38	0.1672
kode	14124	-0.519622951	B	0.09311650	-5.58	<.0001
kode	15126	0.217312206	B	0.09771590	2.22	0.0264
kode	15127	0.196867176	B	0.12185369	1.62	0.1066
kode	20126	-0.833366765	B	0.07665962	-10.87	<.0001
kode	20127	-0.846644186	B	0.08634662	-9.81	<.0001
kode	21926	0.142499378	B	0.13146481	1.08	0.2787
kode	21927	0.188691802	B	0.06935079	2.72	0.0066
kode	41927	0.120998380	B	0.15351789	0.79	0.4308
kode	61926	-0.167532182	B	0.12299000	-1.36	0.1735
kode	61927	0.000000000	B	.	.	.

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

The GLM Procedure
Least Squares Means

year	lcph LSMEAN	Standard Error	Pr > |t|
1988	-0.23589106	0.14210556	0.0973
1989	-0.12619301	0.14171442	0.3735
1990	-0.64687571	0.05906681	<.0001
1991	-0.63709033	0.05838777	<.0001
1992	-0.50999548	0.05070266	<.0001
1993	-0.65065976	0.05425978	<.0001
1994	-0.66694512	0.06023482	<.0001
1995	-0.57282247	0.07833296	<.0001
1996	-0.68558897	0.07585245	<.0001
1997	-0.78936128	0.07270559	<.0001
1998	-0.67262210	0.08162498	<.0001
1999	-0.70279041	0.07766594	<.0001
2000	-0.52784492	0.07695056	<.0001
2001	-0.61906347	0.08100379	<.0001
2002	-0.74584592	0.07130584	<.0001
2003	-0.71542997	0.06166260	<.0001
2004	-0.70823139	0.06004238	<.0001
2005	-0.48084964	0.06154032	<.0001
2006	-0.43225883	0.06294720	<.0001
2007	-0.47488631	0.05599305	<.0001
2008	-0.32564134	0.06061691	<.0001
2009	-0.30500801	0.06374474	<.0001
2010	-0.43434576	0.06177762	<.0001
2011	-0.34077046	0.06151374	<.0001
2012	-0.56351897	0.05769207	<.0001

Appendix 8. Standardized CPUE index for Gill net in Div. 0B.

Greenland halibut, 0B gillnets

The GLM Procedure

Class Level Information		
Class	Levels	Values
Year	10	2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Month	6	5 6 7 8 9 10
CGT	3	40144 40413 40414

Number of Observations Read	66
Number of Observations Used	66

Greenland halibut, 0B gillnets

The GLM Procedure

Dependent Variable: lcpue

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	16	6.84749073	0.42796817	5.04	<.0001
Error	49	4.16376141	0.08497472		
Corrected Total	65	11.01125214			

R-Square	Coeff Var	Root MSE	lcpue Mean
0.621863	17.95511	0.291504	1.623517

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	9	5.08027036	0.56447448	6.64	<.0001
Month	5	1.71866216	0.34373243	4.05	0.0038
CGT	2	0.04855821	0.02427911	0.29	0.7527

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	9	4.99155933	0.55461770	6.53	<.0001
Month	5	1.67057402	0.33411480	3.93	0.0045
CGT	2	0.04855821	0.02427911	0.29	0.7527

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	1.925102310	B	0.13249822	14.53	<.0001
Year 2003	-0.890656090	B	0.14814305	-6.01	<.0001
Year 2004	-0.480218973	B	0.15895313	-3.02	0.0040
Year 2005	-0.551705969	B	0.14814305	-3.72	0.0005
Year 2006	-0.511053045	B	0.14814305	-3.45	0.0012
Year 2007	-0.508593877	B	0.14814305	-3.43	0.0012
Year 2008	-0.421132804	B	0.14814305	-2.84	0.0065
Year 2009	-0.232238177	B	0.15895313	-1.46	0.1504
Year 2010	-0.050753876	B	0.15895313	-0.32	0.7509
Year 2011	-0.033975007	B	0.13755094	-0.25	0.8059
Year 2012	0.000000000	B	.	.	.
Month 5	0.299648943	B	0.14250196	2.10	0.0406
Month 6	-0.021401424	B	0.14389323	-0.15	0.8824
Month 7	-0.215931038	B	0.14250196	-1.52	0.1361
Month 8	0.084293348	B	0.14250196	0.59	0.5569
Month 9	0.012854115	B	0.14738218	0.09	0.9309
Month 10	0.000000000	B	.	.	.
CGT 40144	-0.185823806	B	0.32095877	-0.58	0.5653
CGT 40413	-0.164585151	B	0.31476201	-0.52	0.6034
CGT 40414	0.000000000	B	.	.	.

Greenland halibut, 0B gillnets

The GLM Procedure

Least Squares Means

Year	lcpue LSMEAN	Standard Error	Pr > |t|
2003	0.94422056	0.19515569	<.0001
2004	1.35465768	0.20399338	<.0001
2005	1.28317068	0.19515569	<.0001
2006	1.32382360	0.19515569	<.0001
2007	1.32628277	0.19515569	<.0001
2008	1.41374384	0.19515569	<.0001
2009	1.60263847	0.20399338	<.0001
2010	1.78412277	0.20399338	<.0001
2011	1.80090164	0.16559952	<.0001
2012	1.83487665	0.16329394	<.0001