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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 has been at that level until 2014 where catches increased to 31,000 tons. Survey biomass in Div.0A decreased from an all-time high in 2012 in 2014 but it is still at a high level. Survey biomass in Div. 0B decreased between 2011 and 2013 but increased again in 2014-, while biomass in Division 1CD decreased to the lowest level seen since 1997. Recruitment and biomass decreased in the Greenland shrimp fish survey and the recruitment of the 2013 year class in the entire survey area was the second lowest seen since 1997. A combined standardized CPUE series from Div. 0A + 1AB has been gradually increasing since 2002. A combined CPUE series from Div. 1CD+0B decreased between 2011 and 2012 but increased slightly in 2013 and 2014 and is now among the highest in the time series. A combined standardized CPUE series from SA0 and 1 combined has been increasing gradually since 1997 and was in 2014 at the highest level seen since 1990. CPUE series from the gill net fishery 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 by 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 was 27,000 tons. The TAC remained at 27,000 tons in 2011-2013. In 2014 the TAC was increased by 3,000 tons to 16,000 tons in in Div. 0A+ Div. 1AB and the total TAC for the area (excluding inshore areas in Div. 1A) is 30,000 tons. The TAC remained at 30,000 tons in 2015 (Fig.1).

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 but increased to 28,062 tons in 2013 and further to 31,083 tons in 2014 (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. The increase in catches between 2012 and 2013 was primarily due to increased effort in inshore areas in Div. 1D, while the increase in catches in 2014 was due to increased effort in Div. 0A and Div. 1A.

Catches in SA 0

In 1983 annual catches in SA 0 were about 4,500 tons. Catches then decreased 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. Catches remained at that level in 2013 (13,351 tons, excluding 315 tons taken in Cumberland Sound). Catches increased to 14,937 tons in 2014 (Table 1). 370 tons reported from Cumberland Sound Cumberland Sound are not included

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 tons, 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 – 2013, - 6,314 tons in 2013 to increase again to 7,934 tons in 2014 (Table 1).

Trawlers took 4,316 tons of which 3,697 tons was taken by twin trawl and 3,622 tons was taken by gill net. The longline catches amounted to 1 ton. The fishery was prosecuted by Canadian vessels.

Catches in Div. 0B in 2014 amounted to 7,003 tons which is at the same level as during in 2011- 2013. About 2,556 tons was taken by gill net, while 1,292 tons and 3,155 tons was taken by single- and twin trawlers, respectively. All catches were taken by Canadian vessels.

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. Catches increased to 14,711 tons in 2013 (Table 2) and further to 16,146 tons in 2014. Almost all catches have been taken offshore. However, the inshore catches increased from 440 tons in 2012 to 1289 tons in 2013 and further to 1825 tons in 2014 primarily due to an increased effort

inshore in Div. 1D (Fig. 1).
Catches in Div. 1A(offshore)+Div.1B 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 2007-2013 (6,500 tons in 2013) Catches increased to 7,985 tons in 2014. All catches were taken off shore by trawlers from Faeroe Islands, Russia and Greenland except 18 inshore in Div. 1B.

Catches in Div. 1CD have been stable around 5,600 tons during 2000 - 2009, but catches increased to 7,247 in 2010 due to increased effort. Catches remained at that level in 2011 and 2012 but increased to 8,227 tons in 2013 and remained at that level in 2014 (8,161 tons). Catches were taken by vessels from Greenland, Norway, EU-Germany and Russia. All most all offshore catches were taken by trawl except 55 tons that was taken by longline. Inshore catches in Div. 1B-1F, increased from 400 tons in 2012 to 1,289 tons in 2013 and further to 1807 tons in 2014 mainly due to increased effort in Div. 1D (1,211 tons in 2014).

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. 1CD at depth between 400 and 1500 m. In 2013 only Div. 1D was covered by just 27 valid hauls (SCR 14/02) and the survey is considered incomplete and not used for assessment because the biomass in Div. 1C not could be determined with a reasonable degree of precision. The proportion of the biomass found in Div. 1D has been varying during the years between 65 and 85%. Including survey data from 2014 the biomass in (and abundance) in Div. 1C has been estimated by a GLM (model: lnbiomass= year*division) using data from 2010-2014 where the distribution of the biomass has been rather stable with 63-69% of the biomass found in Div. 1D. The 1CD biomass and abundance in 2013 was estimated to 64049.0 tons and 51.160*10^6, respectively.

The biomass in Div. 1CD in 2014 was estimated at 58 424.6 tons which is the lowest observed since 1997 and a continuation of the gradual decrease seen since the record high estimate on 86591.4 tons in 2011 (Fig 2a, 2c). The abundance was estimated at 44.773*10^6 which is the lowest observed in the time series that dates back to 1997 (Fig. 2b). The overall length distribution was dominated by a single mode at 50 cm, where the length distribution use to be monomodal with a mode around 47-50 cm (Fig. 2d).

Greenland deep sea survey in Baffin Bay (Div. 1A)
There has been no survey since 2010. 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
A stratified-random otter trawl survey was conducted in southern Division 0A (0A-South) and Division 0B (0B) in 2014. Canada has conducted eight surveys in 0A-South and five in Div. 0B since 1999. The 0A-South survey covered the southern strata (approximately 72° N). The survey biomass indices were recalculated in 2014 based on a new stratification scheme (SCR 15/030). Biomass in Div. 0A-South has varied from 60,640 tons

to 108,698 tons (Fig. 2f), however, this high estimate in 2012 is influenced by a very large set in the 601-800 m depth strata that comprises 23% of the survey area. The biomass decreased slightly to 93,532 tons in 2014 and the index has been fluctuating with a slight increasing trend since 1999 (SCR 15/030). The abundance in 2014 was estimated at 1.07 x 10^8 which is within the range of variability of past estimates (Fig. 2g). The overall length distribution in 2014 ranged from 6 cm to 78 cm, a decline from a maximum of 99 cm found in 2008 and 2010 surveys. Modes were observed at 18, 33 and 45 cm in 2014. There has been a gradual shift to larger fish since 2008. The proportion of fish <45cm has declined from approximately 70% in 2008 to 54% in 2014. The 2006 survey suffered from poor coverage in depths >1000 m relative to sets <1000 m which resulted in a lower overall mean biomass per km^2 and under-estimate of the biomass compared to previous and subsequent surveys. As a result the 2006 survey has been removed from the indices and further assessment.

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 x 10^7, respectively. This was 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 in 2012 (SCR 13/033).

Biomass and abundance for 2014 in Div. 0B were 64,873 tons and 5.49x10^7, respectively. Biomass had increased compared to 2013 (53,109 t) but less than that observed in 2011(80,476 t) (Fig. 2i) (SCR 15/030). The 2014 abundance index is estimated at 5.5 x 10^7 (S.E. 4.1 x 10^6), a small increase compared to 2013 (5.1 x 10^7) with both 2013 and 2014 lower than 2011 (7.9 x 10^7) (Fig. 2j). Lengths ranged from 6 cm to 92 cm with 30% <45 cm. The length distribution had a single mode at 48 cm.

Greenland shrimp-fish-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 (excluding Disko Bay) has during 2005-2013 fluctuated between 49,779 tons and 25,644 tons . The biomass decreased from 39,383 tons in 2013 to 23,909 tons in 2014, which is the lowest in the time series that dates back to 2005.

The offshore 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 abundance increased again in 2013 to 521 mill in 2013 to decrease again in 2014 to 232.4 mill. The decrease in both biomass and abundance was seen in all the main distribution areas (Div.1AN, Div. 1AS, Disko Bay and Div.1BN).

Recruitment

A recruitment index was estimated for the Greenland shrimp – fish survey. By means of the Petersen-method ages 1, 2 and 3+ were separated in the survey catches.

The survey gear was changed in 2005. To allow comparison of abundance throughout the time series, the 2005 to 2014 catches were divided by a conversion factor 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 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. The recruitment increased again in 2013 where the 2012 year-class was estimated at 444 mill. to decrease again in 2014 where the 2013 year-class was estimated to 180 mill. (Fig. 3).

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 offshore recruitment (2012 year-class) increased again in 2013 to the second largest level in the time series to decrease again to 130 mill. in 2014, - the third lowest in the time series.. The decrease in recruitment between 2013 and 2014 was seen in all divisions (Fig.4). In 2014 78% of the one year old fish was found in the off shore areas.

In Disko Bay the recruitment has been decreasing between 2003 and 2008 but increased since then to the highest level seen since 2001 in 2011. In 2012 the recruitment decreased to the lowest level seen since 2008 to increase again in 2013, but not as significantly as in the offshore areas. The recruitment decreased again in 2014 to the lowest estimate 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 2014 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
No length distributions were available from the fishery in SA 0 in 2013 and 2014.

SA1
Length frequencies were available from the Greenlandic and the Russian (SCS 15/07) trawl fishery in Div. 1A and from the Greenlandic and Norwegian trawl fishery in Div. 1D.

In Div. 1A the mode was at 50 cm in both the Russian and Greenlandic trawl fishery (Fig. 6 and 7). In recent years the trawl catches have been dominated by fish at 44-52 cm.

In Div. 1D the catches by Norway had modes at 50, 52 and 55 cm while the mode was at 54 cm in the Greenland fishery, respectively (Fig. 8, 9, 10). The catches seems to be composed of slightly larger fish than in previous years where the mode was around 47-50 cm.

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. A standardized catch rate is produced using a General Linear Model. The model was updated in 2014 with the 2013 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 2014 and is now at the highest level seen since a small trial fishery in 1996 (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 and has been stable since then (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 and stayed at that level in 2013 but decreased slightly in 2014 to 11t/100 net (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. 12d) (Appendix 5). The index increased slightly in 2013 and further to about average of the time series The un-standardized catch rates for twin trawl, that takes the majority of the trawl catches, increased between 2013 and 2014, while the single trawl catches rates decreased (Fig. 11b).

The standardized CPUE for gill net in Div. 0B has been increasing since 2007 and was in 2014 at the highest level in the time series (Fig. 12f) (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 but decreased slightly in 2013 to increase again to about 7.7 t/100 net (Fig. 11d).

SA1

Un-standardized catch rates were available for the Greenland trawl fishery in Div. 1A and 1D (SCS 14/12). 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 that take most of the catch 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. Since the CPUE has declined gradually in 2012 and 2013, but increased again in 2014 to the highest level in the time series (Fig. 11e)

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 2002-2014. 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 and 2013 but was in 2014 back at the high level seen in 2011 (Fig. 12a, Appendix 2).

Div. 1CD

The un-standardized catch rates for all trawlers fishing in Div. 1CD increased between 2011 and 2012, except for trawlers > 2000 tons trawlers. The catch rates increased significantly for > 2000 tons single trawlers in 2013 and the smaller single trawlers also showed an increase, while the twin trawlers showed minor decreases between 2012 and 2013.

The catch rates for all three types of trawlers (> 2000 t single and twin trawlers and 1000-2000 t single trawlers) and are now at or close to the highest level seen in the time series.

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 trawler s 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 1988-2014 (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 2011-2013 and the CPUE is at the high level seen in 1989. The CPUE stayed at that level in 2014 despite a minor decrease (Fig. 12c) (Appendix 6).

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

The combined Div. 0A+1AB standardized CPUE series has been relatively stable with an increasing trend since 2002 and increased also between 2013 and 2014. The 2014 estimate and is very close the highest level observed in 2001. (The values from 1996 and 1997 are from trial fisheries with small catches) (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 to increase again in 2013 and 2014 and is close to 2009 value. The high catch rates seen in 1988 and 1989 are from a single very large trawler fishing in Div. 1CD (Fig. 12e) (Appendix 7).

Combined standardized trawl catch rate for SA 0+1

The combined catch rate has been gradually increasing since 1997 and was in 2014 at the largest level seen since 1989 (Fig 12g).

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.

2.3 Biology

Currently, an investigation of otoliths from Greenland halibut by laser/spectrometric is on-going. The aim is to acquire accurate data on the different life history aspects in order to incorporate the useful information into both the top down dynamical modelling and the assessment on this species: stepwise recruitment from age class 0-1, migrations, age at recruitment to the population, timings, feeding and habitat/depth changes, among other factors. The acquisition of the data is carried out through the time/distance analysis of the accumulated trace elements, mainly Magnesium (Mg), Barium (Ba), Strontium (Sr), Manganese (Mn) and Calcium (Ca). In our preliminary results, we have been able to identify the timings for recruitment, age and migrations through the multi-frequency decomposition of the Mg (a proxy for food intake, probably biased by shrimp consumption) and Ba (a proxy for salinity in the surrounding environment) series. We aim to carry out further analysis by sex, area and eventually compare results to a similar approach onto other fish species (red fish and cod, for instance) and model a prototype life history process as function of area/time, environmental forcing and population densities. For further details, see Solari el al. SCR 15/025.

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 was 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 are 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 has not been run in recent years as no catch-at-age data were available for 2003-2014.

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 (Off Shore 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. F remained at that level in 2013 and 2014 despite a decrease in biomass, due to a relative increase in the inshore catches that are not include because the survey does not cover inshore areas.

A relative F cannot be estimated in SA0 because a large fraction of the catches are taken by gill nets that generally catch larger fish than the commercial trawl and the trawl surveys. The trawl fishery seems, however, not to affect the catch rates in the gill net fishery that has been stable in recent years.

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.

3.6 Estimates of MSY from Catches and resilience

A simple Schaefer model was tested on the Greenland halibut stock offshore in NAFO SA 0 and 1 in 2014. The minimum data required for this model is a catch time series and a measure of the resilience of the species. Other input parameters that had to be guessed were the carrying capacity, the biomass as a fraction of the carrying capacity at both the beginning and end of the time series, and the growth rate. MSY was estimated to be between 19 000 and 23 000 t. Sensitivity tests showed that the estimation of MSY was heavily dependent on the guess of especially the biomass at the end of the time series and the growth rate.

3.7 Environmental Forcing of the Greenland halibut stock dynamics at West Greenland

A study showed that year class strength and abundance of Greenland halibut at West Greenland may be driven by environmental pulses (of different frequencies):

(i) The variability in the Sea Surface Temperature (SST_{SD}) in the area of Age 0 drift in the mixing layer is regarded as a system wide variable (a co-factor) for recruitment and abundance. Different trends in SST means and the variability is considered as a key co-factor for recruitment.

(ii) The following relationships ($p<0.05$) were further presented:

(a) Abundance is the inverse of the SST variation considering a lag of 6 years (assumed to be age when they are fully recruited to the fishable population) and can be estimated for short term management planning (5-6 years in advance). The model indicated low abundance in 2014 and 2018 and a high abundance in 2017. Two cycles at different levels of abundance were identified at different recruitment regimes.

(b) Recruitment from age class 0 to age class one (with a lag of 5 years) is both related to overall abundance of Greenland halibut and has a higher sensitivity for SST_{minima}.

(c) The variation in abundance indices from surveys (both means and variability) showed two clear cycles.

(iii) The results showed several years of memory and it is highly differentiated from a random process (Hurst exponent >0.75) and residuals were – as in several dynamical systems of such nature- auto-correlated (not random).
These relationships (variability and lag effects) should be considered as an alternative or complement to assessments that use only the Logistic model –or some derivative- which assumes that (a) residuals are random and (b) there is no memory effect in the series (no dependency on preceding values).
The work is still in progress and has not been peer reviewed and is not included in the assessment (SCR 15/024).

3.8 A survey approach to estimate catch level of Greenland halibut in SA 0+1.
The assessment of Greenland halibut in Subarea 0 and 1A (offshore)+1B-F relies on several fishery independent survey indices. The application of the ICES guidance on data limited stocks (DLS) (ICES 2012a and 2012b) as the basis for the approach for advice on SA0+1 Greenland Halibut could be helpful in providing TAC advice.

ICES has developed and tested an empirical approach that uses the trend in the stock response to fishing pressure (ICES 2012a). The empirical basis was given a generic expression $C_{y+1}=Catch_{recent}*r$:

$Catch_{recent}$ is the average catch over some period,
r is the trend in development of the stock (normally SSB) over some period (e.g. 7 year time frame, r=mean of recent 3 year/mean of next 4 years).
Precautionary buffer (e.g. maximum 20% reduction factor applied to r given certain stock conditions relative to reference points).
Change cap (e.g. maximum 20% change in TAC advice in any given year).

Advice should not be made annually; it would apply over some period of time (e.g. 2-3 years) to allow for the delay between action (change in catch) and response (state of the stock). There would be interim assessments and advice on TAC could be given in interim years if a sudden change in stock status is observed.

In the case of Greenland halibut in Subarea 0 and 1 we are not able to estimate SSB (due to survey trawl selectivity) or $F_{msyproxy}$. However, we have stock abundance indexes based on surveys that are used to assess the status of two portions of the stock area, 0A1AB (0A-south survey) and 0B1C-F (1CD survey). We have a biomass index and B_{lim} (see below).

There are seven surveys available from Div. 0A-south and Div. 1CD combined that cover a 15 year period, 1999, 2001, 2004, 2008, 2010, 2012 and 2014 (the 2006 survey has been dropped due to very poor coverage).

There was some discussion whether we calculate r across 5 or 7 survey points (e.g. 10 or 15 years) or use the data points that fall within the last 5 or 7 calendar years. Also, the Div. 0A survey has moved to an annual cycle (beginning in 2014) so in a year or two the number of years covered by the survey points will change. The change cap limits the rate at which the TAC would change at any one time. There was some consideration as to whether a higher change cap should apply when the stock is declining. Managers would determine the level of risk (change cap and precautionary buffer,) but ICES has provided some guidance (as above) for those cases where management input is not available. It was noted that the precautionary factor would need not apply in the case of SA0+1A(inshore) and 1B-F Greenland halibut given the stock is well above B_{lim} and there have been several recent years with good recruitment. There were no comments on the period of time over which the advice should apply in this case (SCR 15/035) but it was recognized that there may infrequently be a need for revisions to multi-year advice if sudden declines were observed.

In the presentation it was shown that year class strength and abundance in West Greenland halibut (WGHL) may be driven by environmental pulses (of different frequencies):

(i) The variability in the Sea Surface Temperature (SST_{SD}) in the area of Age 1 drift in the mixing layer is regarded as a system wide variable (a co-factor) for WGHL recruitment and abundance. Different trends in SST means and dispersion are reported and the variability is considered as a key co-factor.

(ii) Evidence for the following relationships ($p<0.05$) is further presented:

(a) Abundance is the inverse of the SST variation considering a lag of 6 years (assumed main of recruitment to the adult population) and can be estimated for short term management planning (5-6 years in advance). Floors in abundance are expected in years 2014 and 2018 and a ceiling in 2017. Two cycles at different levels of abundance were identified.

(b) Age class 1 (considering a lag of 5 years) is both related to overall abundance and showed higher sensitivity for SST_{minima}.

(c) CPUE (both means and variability) showed two clear cycles.

(iii) The population system showed several years of memory and it is highly differentiated from a random process (Hurst exponent >0.75) and residuals were –as in several dynamical systems of such nature- auto-correlated (not random).

These relationships were not reported earlier as variability and lags were not considered - due to the use of the Logistic model –or some derivative- which assumes that (a) residuals are random and (b) there is no memory effect in the series (no dependency on preceding values).

The work is still in progress and has not been peer reviewed and is not included in the assessment.

4. Conclusion

Since catches peaked with 18,000 tons in 1992 and they have been stable at around 10,000 tons until 2000. Since then catches have gradually increased to 31,000 tons in 2014 together with an increase in TAC. The TAC has generally been taken in all years since 2000.

Div. 0A+1AB
Biomass in Div. 0A decreased from the all-time high in 2012, but is still at a high level.

The standardized CPUE index for Div. 0A has been increasing since 2010 and is in 2014 at the highest level seen since 2001. Standardized catch rates in Div. 1AB has been increasing between 2008 and 2011, declined in 2012 and 2013 but increased again in 2014 to the highest level in the time series. The combined Div. 0A+1AB standardized CPUE series has been gradually increasing since 2002 and the CPUE is at the highest level since 2001.

Standardized CPUE for Gill nets has been stable since 2009.

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 has been decreasing gradually from an all-time high in 2011to the lowest estimate since 1997 in 2014

Estimated total biomass of Greenland halibut in the offshore areas estimated in the Greenland shrimp survey has been fluctuating without clear trend during 2005-2013. The biomass was in 2014 the lowest in the time series that dates back to 2005.

Division 0B was surveyed again in 2013 and 2104. The biomass decreased between 2011 and 2013, but increased again in 2014 to about the average of the short series.

Standardized CPUE rates in Div. 1CD have generally been increasing since 2002. The CPUE decreased slightly between 20013 and 2014 but is the second largest estimate since 1988-1989 where only one very large vessel fished in the area. The CPUE in Div. has been increasing in 2013 and 2014 and is now at about average of the time series. The combined Div. 0B+1CD standardized CPUE series has been increasing since 2011 and is now at back at the high level seen in 2008-2009.

The standardized CPUE for gill net in Div. 0B has been increasing since 2007 and was in 2014 at the highest level in the time series.

Length compositions in the commercial catches in 1CD have been stable in recent years.

SA 0+1

The offshore recruitment (age one) declined between 2013 and 2014 and 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 to increase again to the third largest estimate in the times series in 2013. The recruitment decreased again in 2014 to the second lowest estimate in the time series.

A standardized CPUE index for all trawlers fishing in SA 0+1 has been increasing between 2002 and 2006 and has been fluctuating at a high level since then. The 2014 estimate is the highest seen since 1989.

The combined biomass estimate from Div. 0A-South+Div. 1CD has been relatively stable since 2001 at a level well above $B_{lim.}$

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 1997-2012 in a combined proxy for Div. 0A-South+1CD (Fig. 14).

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 B_{msy}. 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 2014. Minor (300 ton or less) catches from Div. 0A are included in some of the 0B catches prior to 2001.

	Year																											
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]	13[h]	14[h]
0A																												
CAN							681		82	576	3		517		2628	3561	4142	3751	4209	6634	6173	5257	6627	6390	6260	6365	6314	7934
POL															445													
TOT 0A							681		82	576	3		517		3073	3561	4142	3751	4209	6634	6173	5257	6627	6390	6260	6365	6314	7934
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	7037	7003
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	7037	7003
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	13351	14937

[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 catches 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 2014. The Greenland catches are <u>excl. inshore catches in Div. 1A</u>. 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	13	14
1AB																												
GRL															340[c]	1619[c]	3558[c]	3500[c]	3363[c]	5530[c]	5596[c]	5524[c]	6094[c]	568[c]	5722[c]	5810[c]	5865[c]	7333[c]
RUS															85	279	259	241	549	565	575	570	517	654	648	546	546	550
FRO														96	150	150	117	153	125	128	125	149	124	126	102	103	102[h]	102
EU																	73[e]	141[e]										
TOT 1AB														96	575	2048	4007	3908	4037	6223	6296	6243	6735	6462	6472	6459	6513	7985
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	3514	4072
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	1496	996
RUS							5		296	254		543	552	792	829	654	1328	1214	1147	1222	689	763	1056	1214	865	1231	1223	1224
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	2017	1869
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	8211	8161
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	14763	16146

[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

[h] Reported from Div. 1D

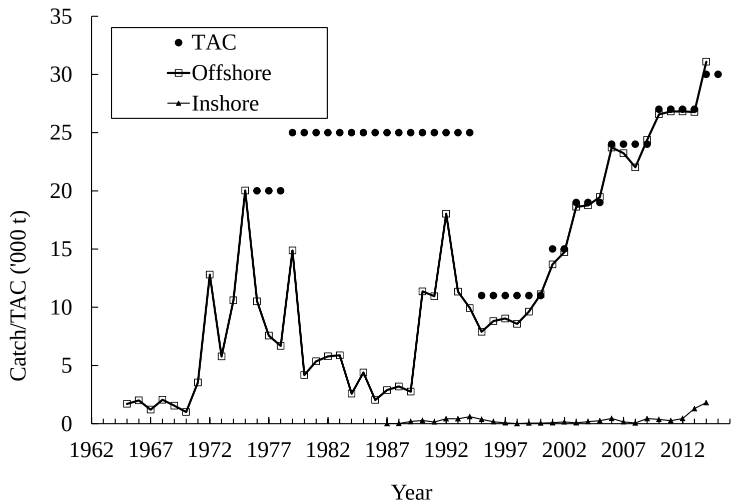

Fig. 1. Catches in SA0 and Div. 1A offshore + Div. 1B-1F and recommended TAC. For TAC before 1995 see text.

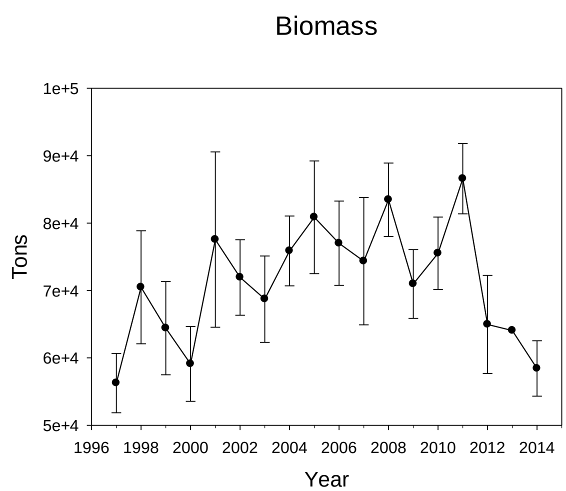

Fig. 2a. Biomass index with S.E. from the Greenland deep sea survey in Div. 1CD.

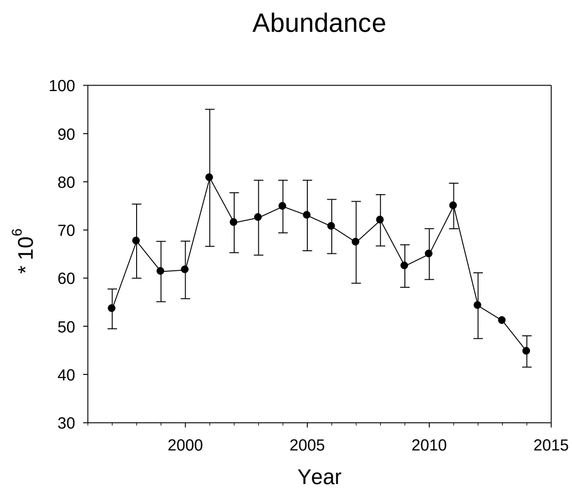

Fig. 2b. Abundance with S.E. from the Greenland deep sea survey in 1CD.

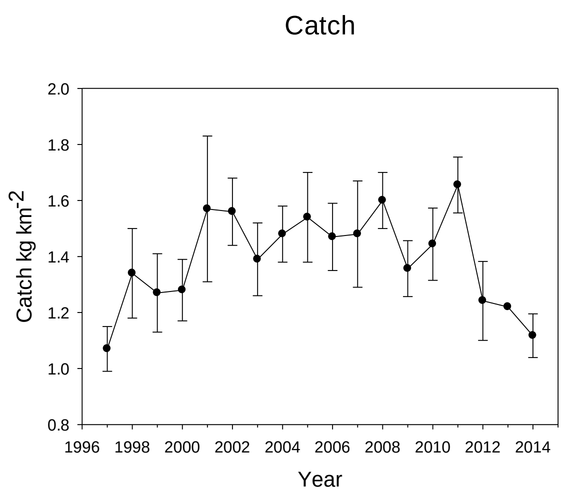

Fig. 2c. Mean catch per km^2 swept with S.E. in the Greenland deep sea survey in Div. 1CD.

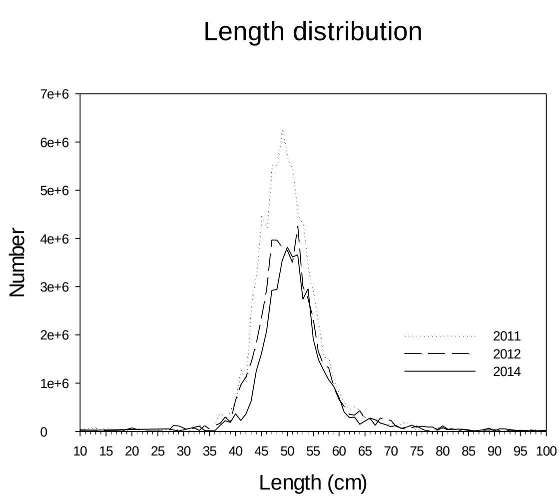

Fig. 2d. Overall length distribution of Greenland halibut in numbers (weighted by stratum area) in Div. 1CD by year No data from 2013..

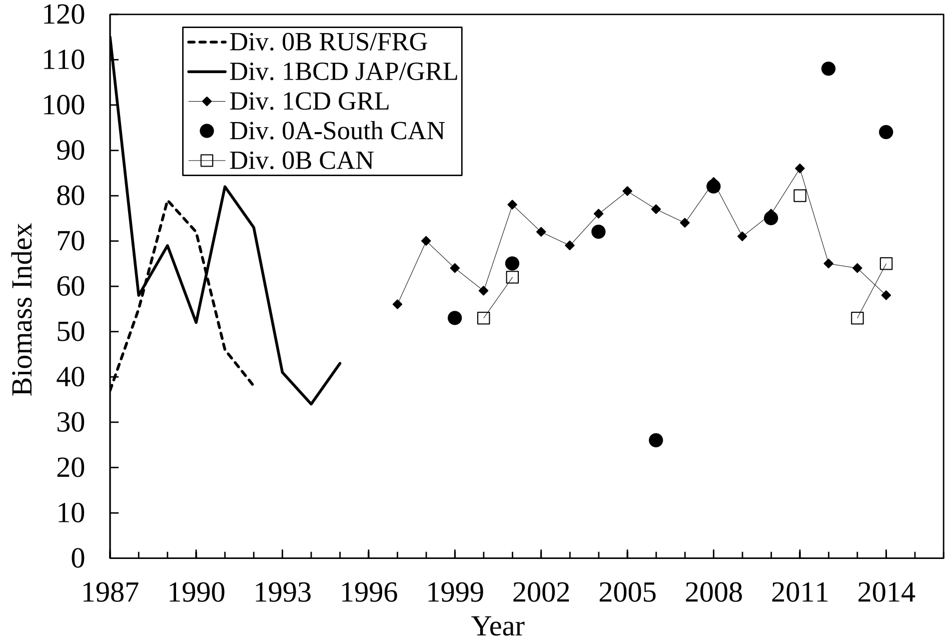

Fig. 2e. Biomass estimates from various surveys in SA 0 and 1. Survey estimates from Div. 0A does not include surveys in the northern part in 2004, 2010,.2012 and 2014. No survey in 2013. Note that the survey in Div. 0A in 2006 had incomplete coverage (see text).

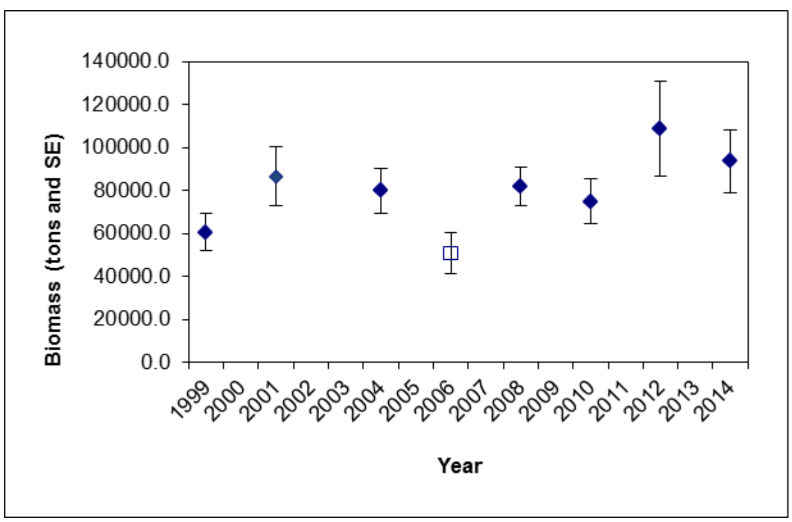

Fig. 2f. Biomass estimates for Greenland halibut in Div. 0A (South) with SE.

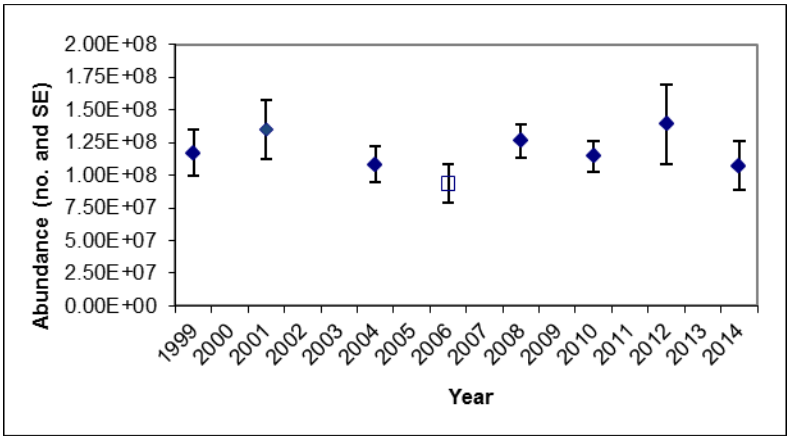

Fig. 2g. Abundance estimates for Greenland halibut in Div. 0A (South) with SE.

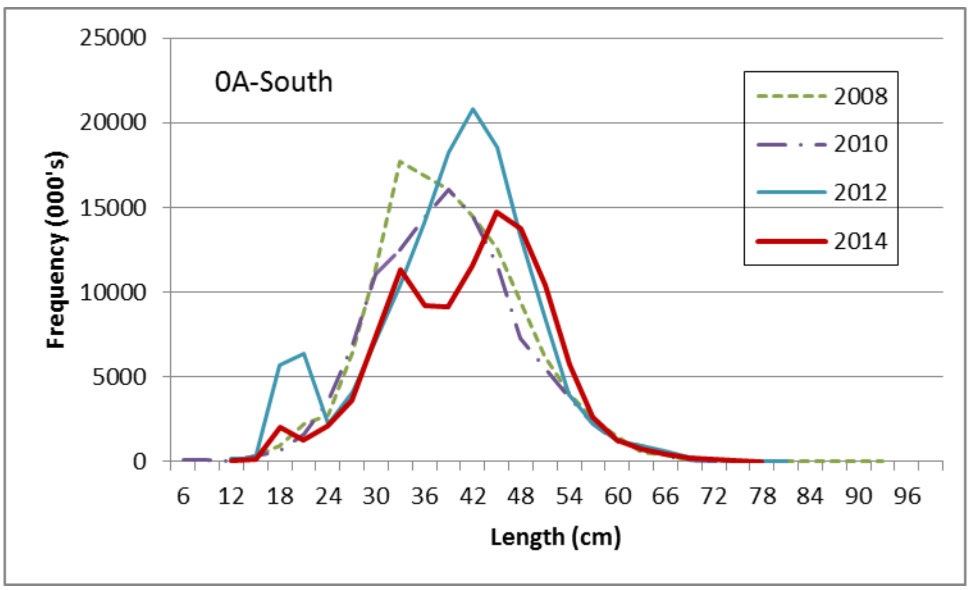

Fig. 2h. Abundance at length for the Greenland halibut in NAFO Division 0A-South, 2004 to 2014 (weighted by stratum area).

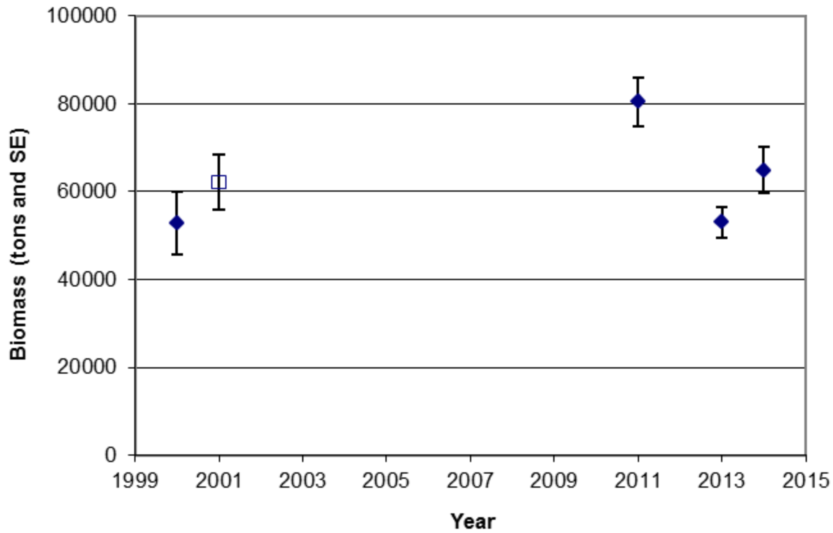

Fig. 2 i. Biomass estimates from Div. 0B with S.E. by year. 2001 was incomplete.

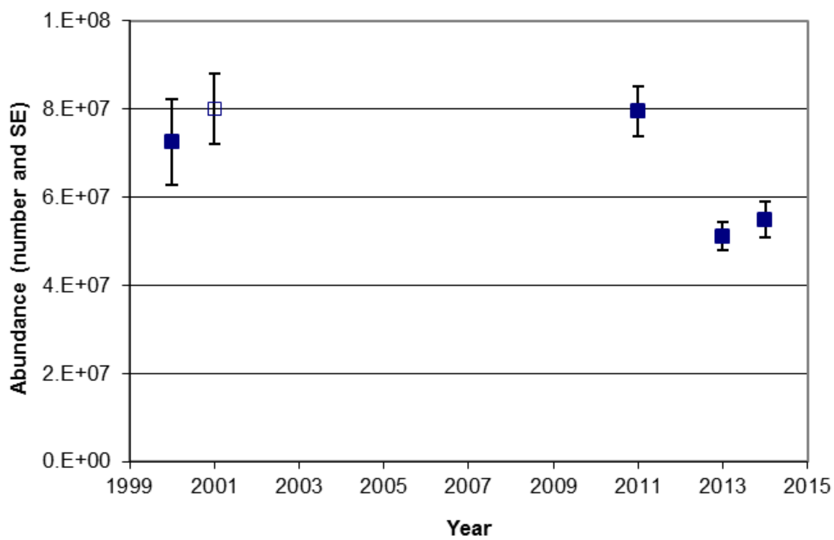

Fig. 2j. Biomass estimates from Div. 0B with S.E. by year. 2001 was incomplete.

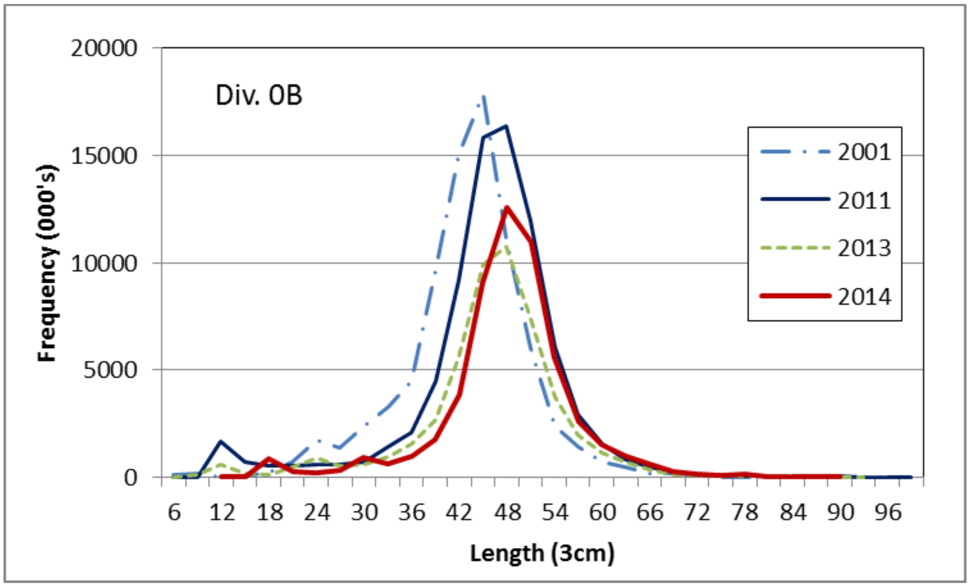

Fig. 2k. Overall length distribution from Div. 0B weighted by area and year.

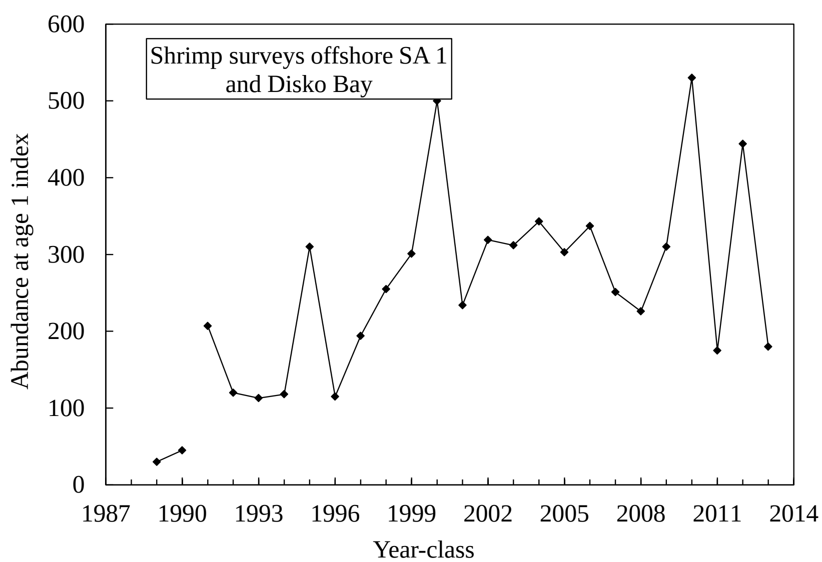

Fig. 3. Abundance of age-one Greenland halibut in the entire area covered by the Greenland shrimp survey including inshore Disko Bay and Div. 1AN (North of 70°37.5′N) adjusted for change in survey gear in 2005.

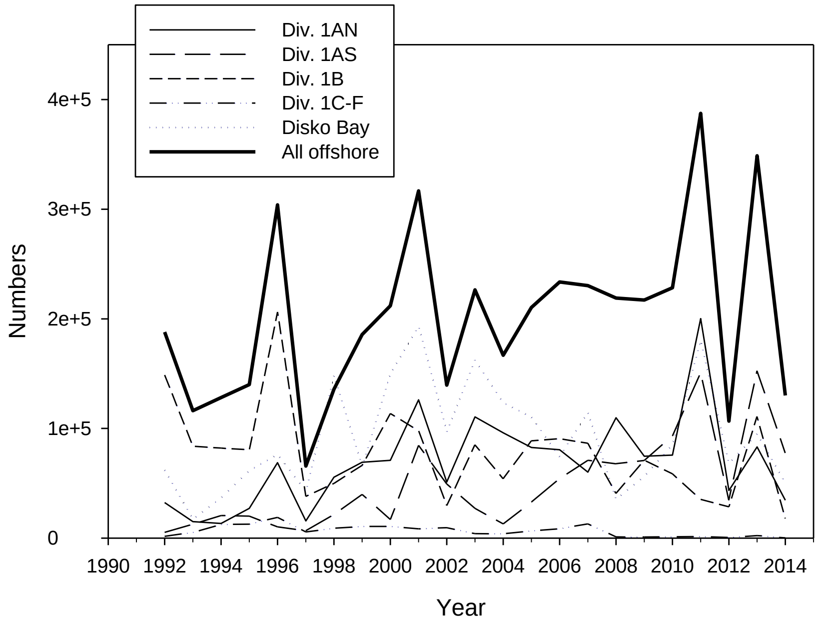

Fig 4. Number of one-year old Greenland halibut by division and year.

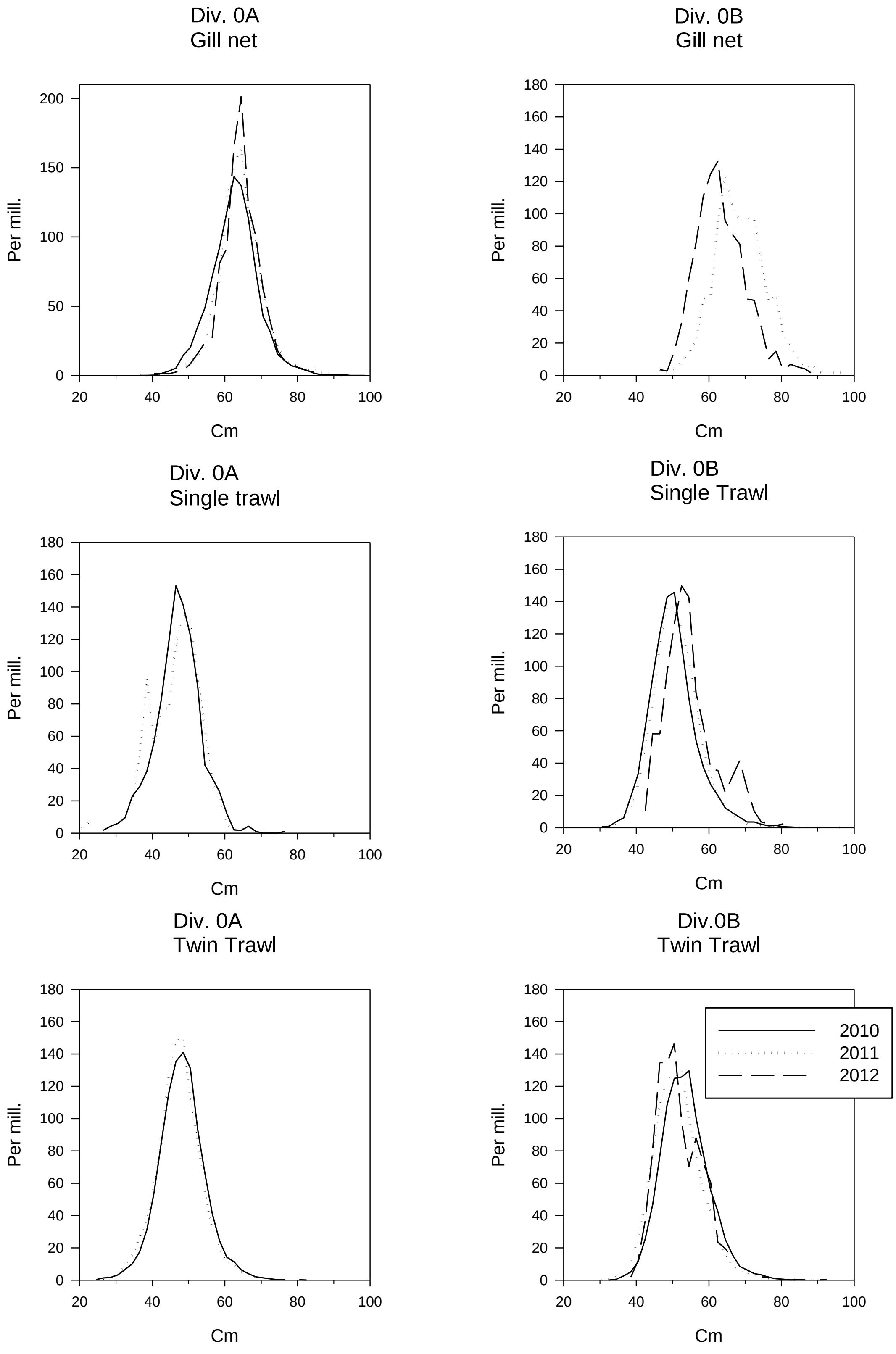

Fig. 5. Length distribution from the fishery in Subarea 0 in 2010-2012 in per mill., 2 cm groups. No data from the trawl fishery in Div. 0A in 2012. No data from 2013 and 2014.

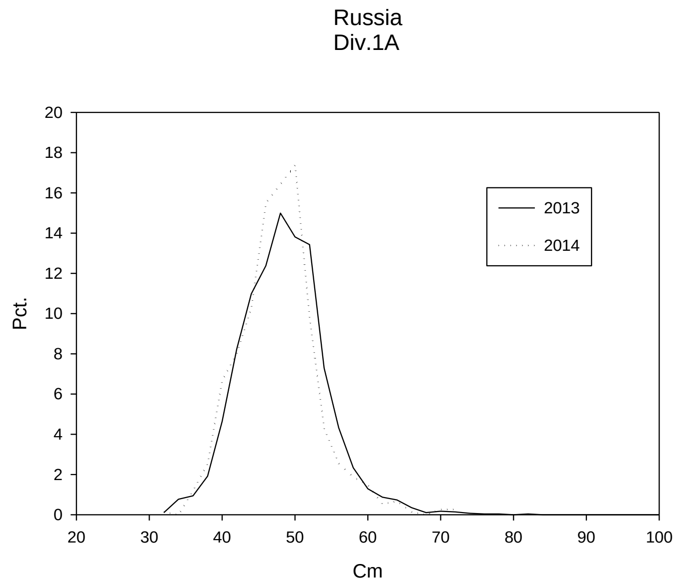

Fig. 6. Length distribution in the Russian trawl fishery in Div. 1A in 2013 and 2014 in percent, 2-cm groups. No data from 2012.

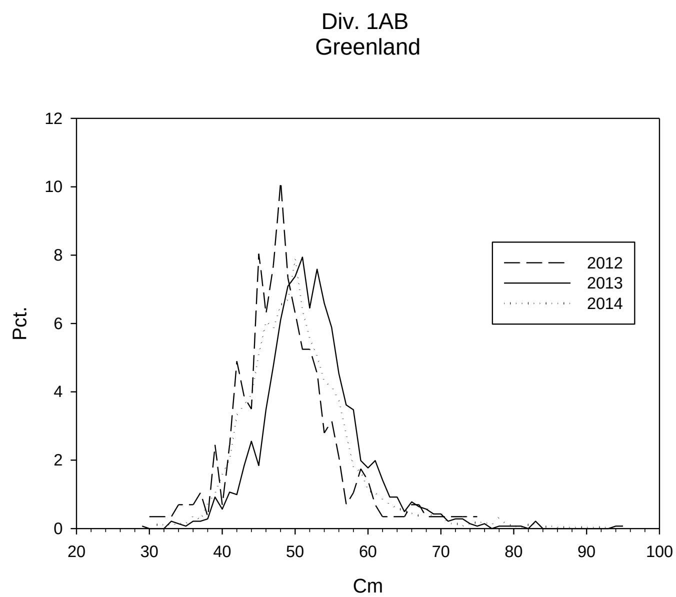

Fig. 7. Length distribution in the Greenland trawl fishery in Div. 1A in 2012-2014 in percent, 1-cm groups.

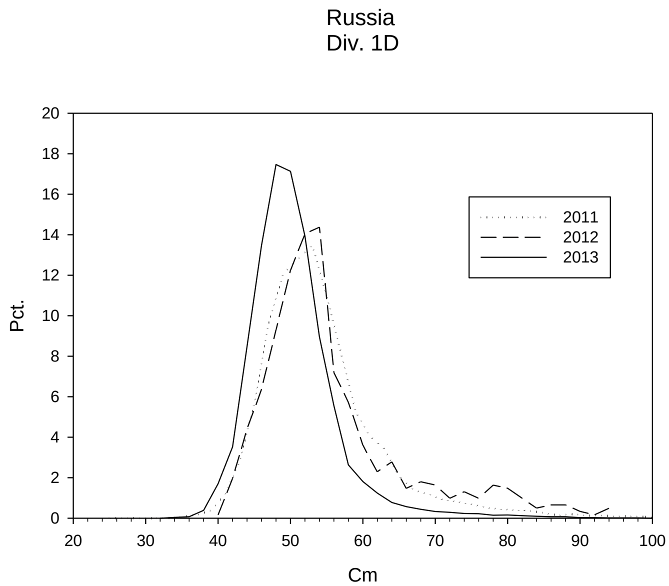

Fig. 8. Length distribution in the Russian trawl fishery in Div. 1D in 2011-2013 in percent, 2-cm groups. No data from 2014.

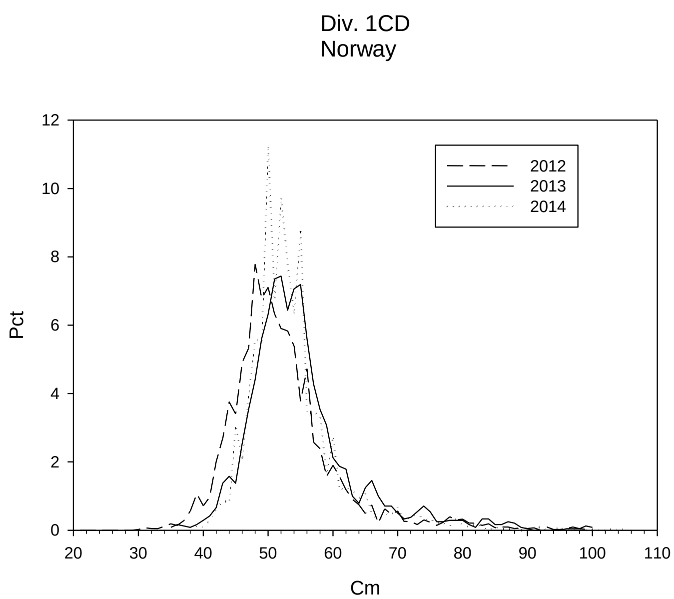

Fig. 9. Length distribution from the Norwegian Trawl fishery in Div. 1D in 2012-2014 in percent, 1-cm groups.

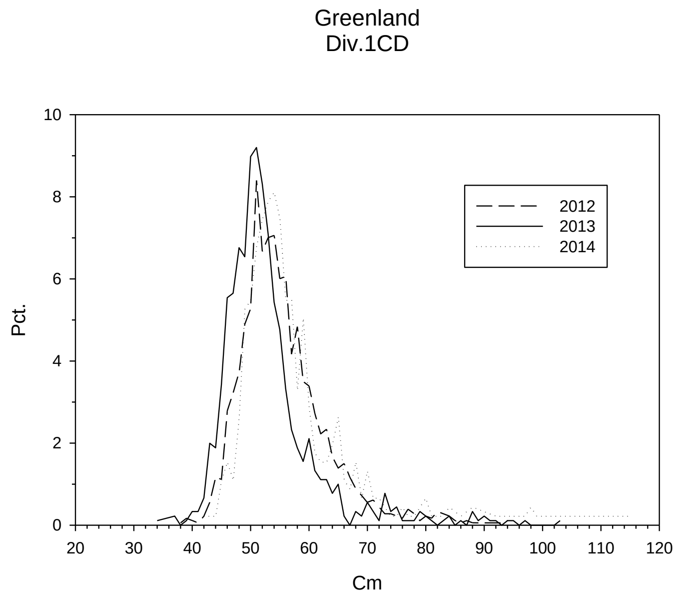

Fig. 10. Length distribution from the Greenland trawl fishery in Div. 1D in 2012-2014 in pct., 1-cm groups..

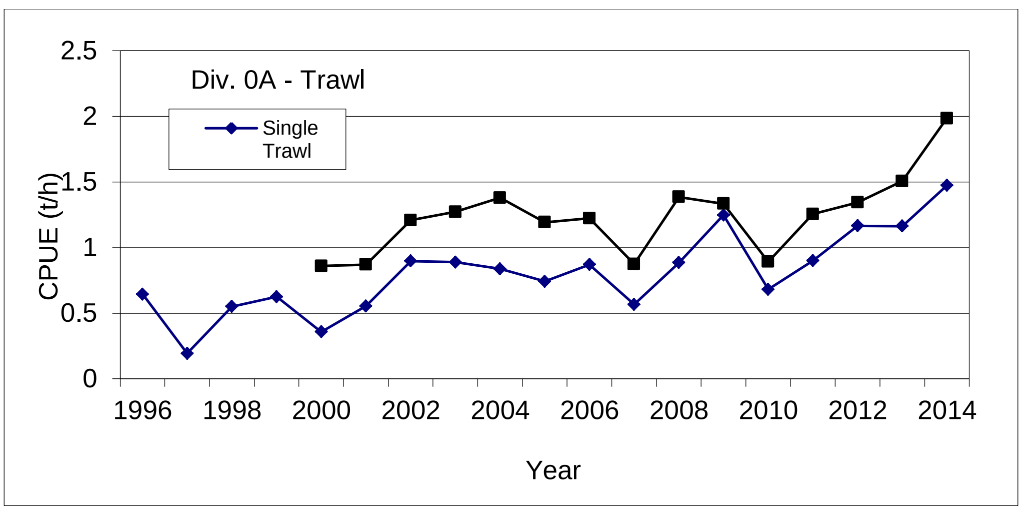

Fig. 11a. Un-standardized CPUE from the trawl fishery in Div. 0A.

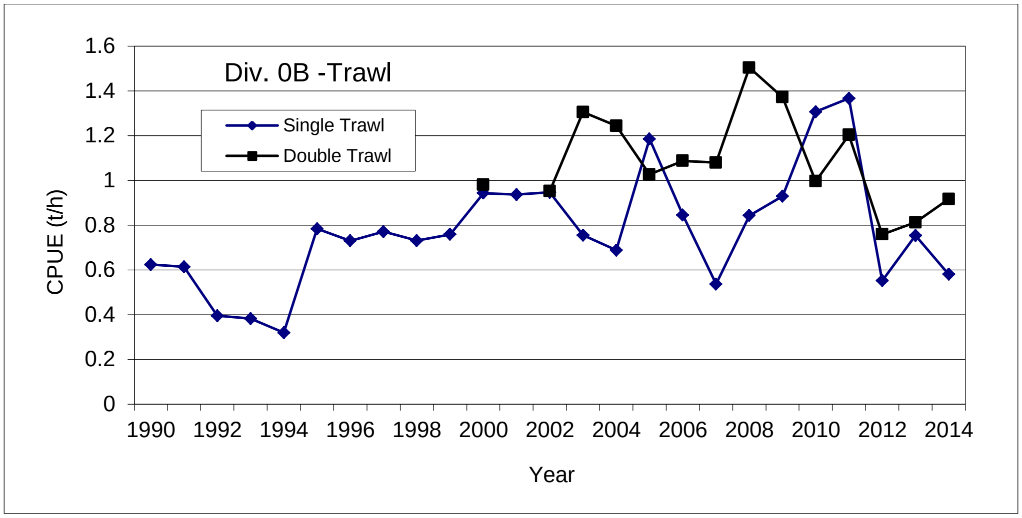

Fig. 11b. Un-standardized CPUE from the trawl fishery in Div. 0B.

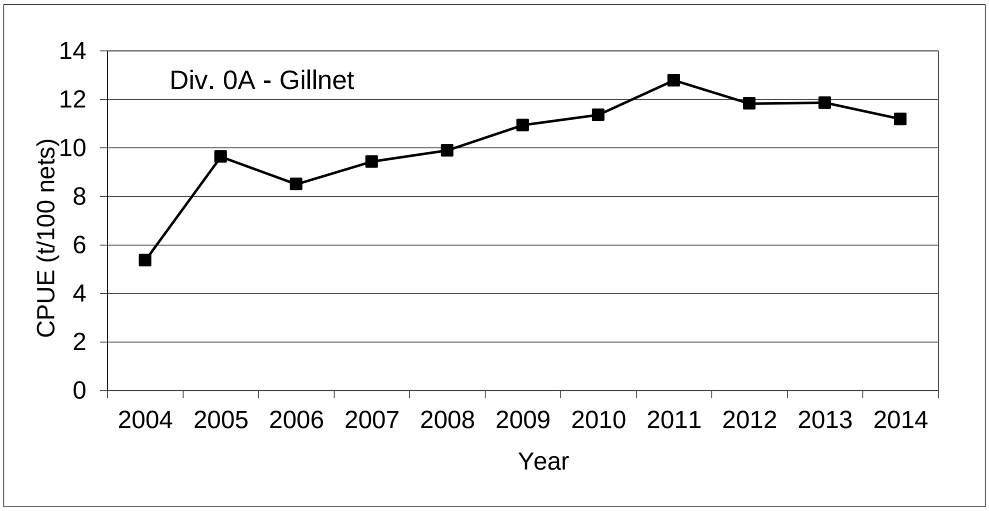

Fig. 11c. Un-standardized CPUE from the gillnet fishery in Div. 0A.

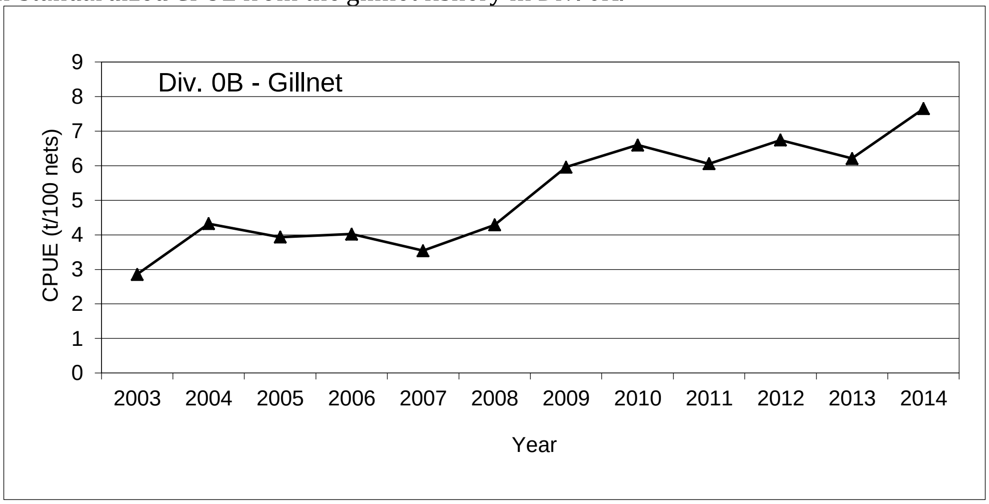

Fig. 11d. Unstandardized CPUE from the gillnet fishery in Div. 0B.

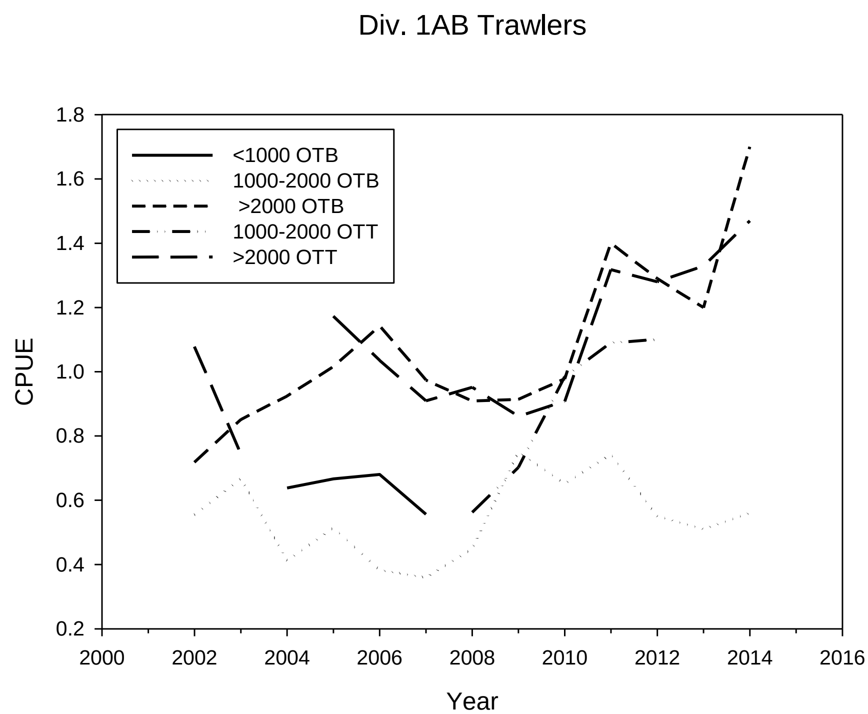

Fig. 11e. Unstandardized trawl CPUE series from Div. 1AB.

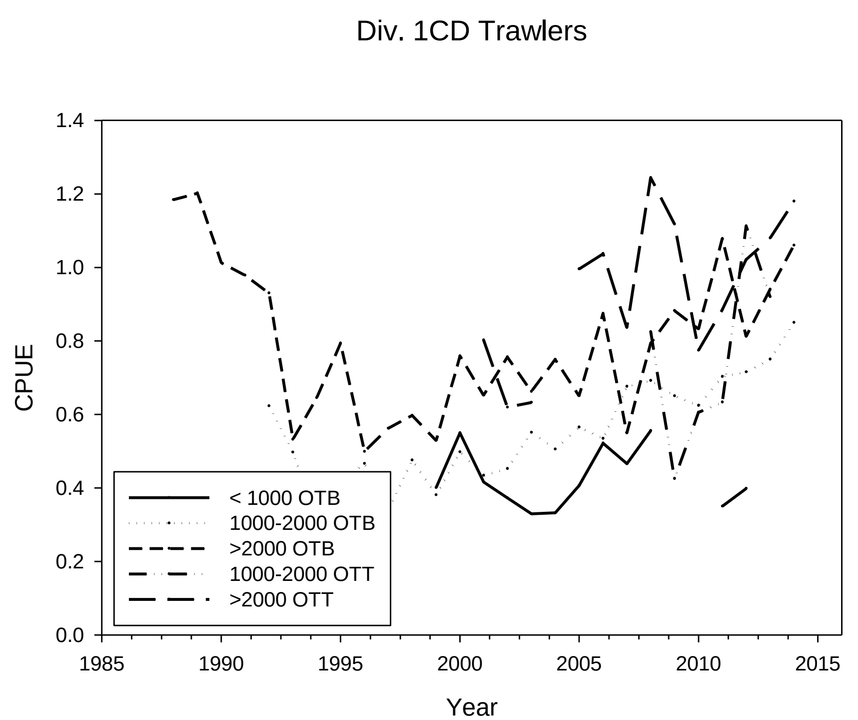

Fig. 11f. Unstandardized catch rates from all fleets fishing in Div. 1CD.

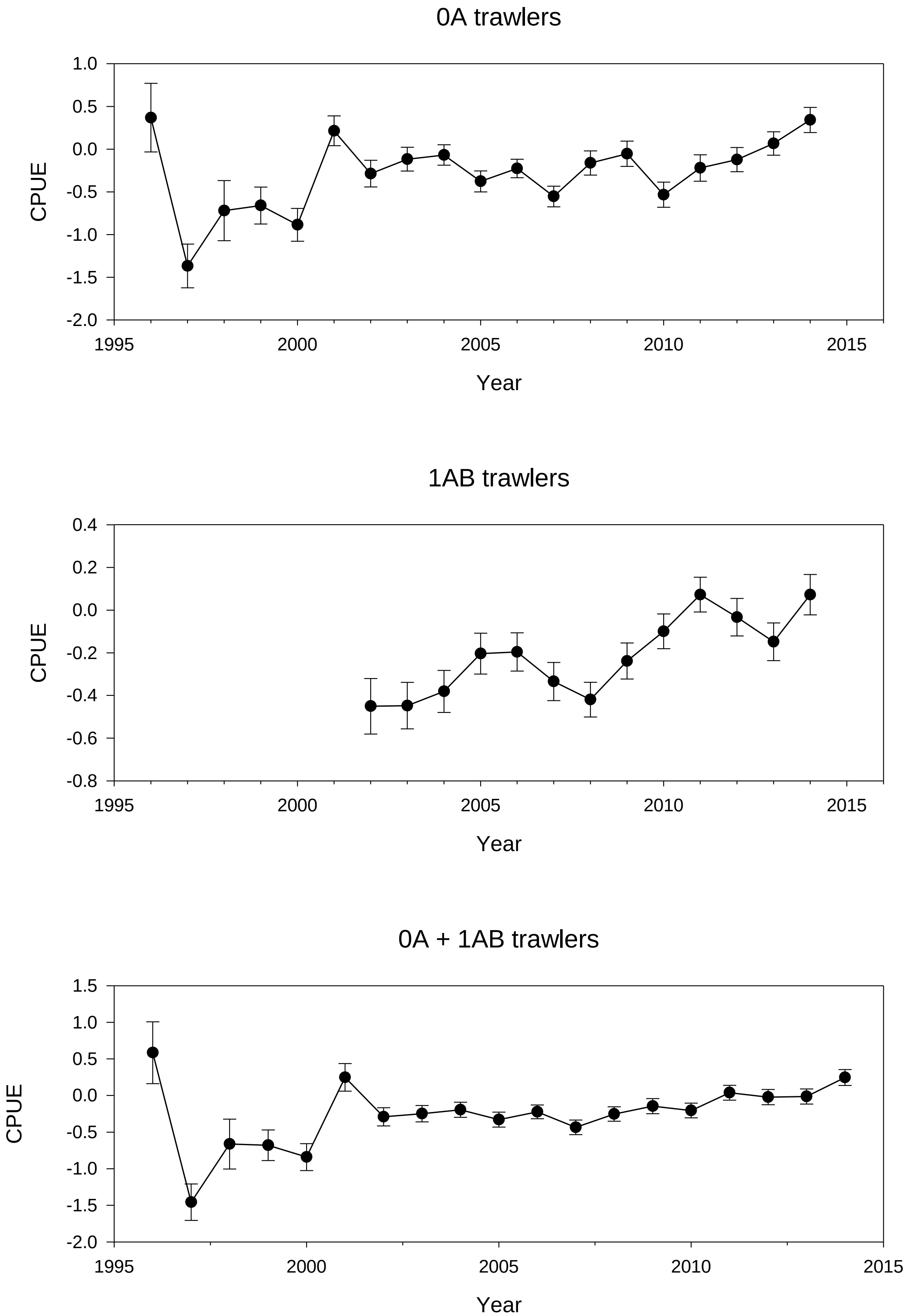

Fig. 12a. Standardized CPUE series from trawlers in 0A, Div. 1AB and 0B+1AB combined with +/- S.E.

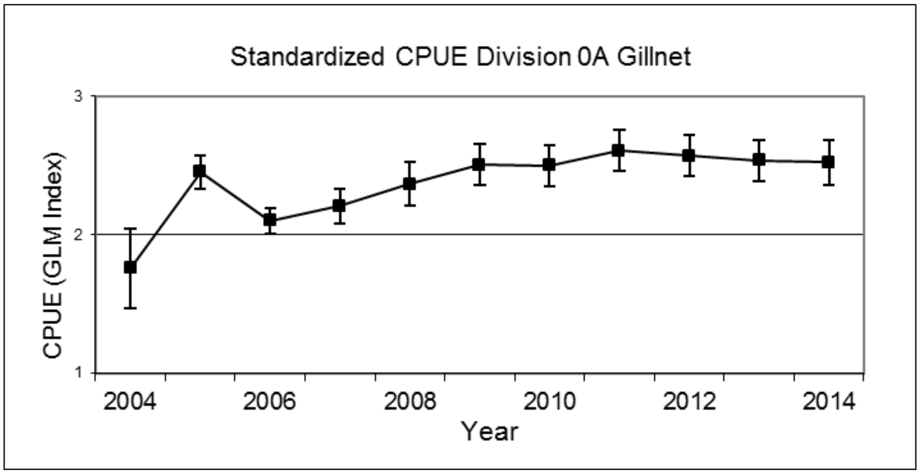

Fig 12b. Standardized CPUE series from gill net in Div. 0A with +/- S.E

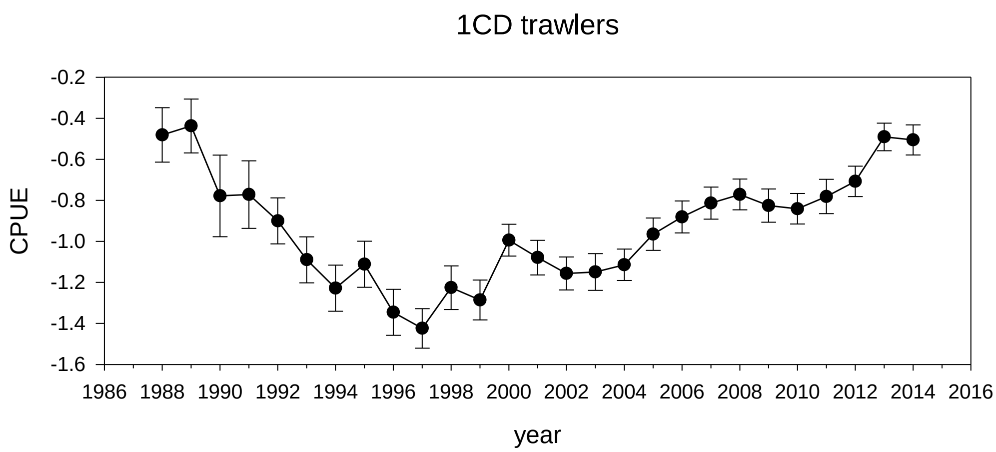

Fig. 12c. Standardized trawl CPUE index from trawlers in Div. 1CD with +/- S.E..

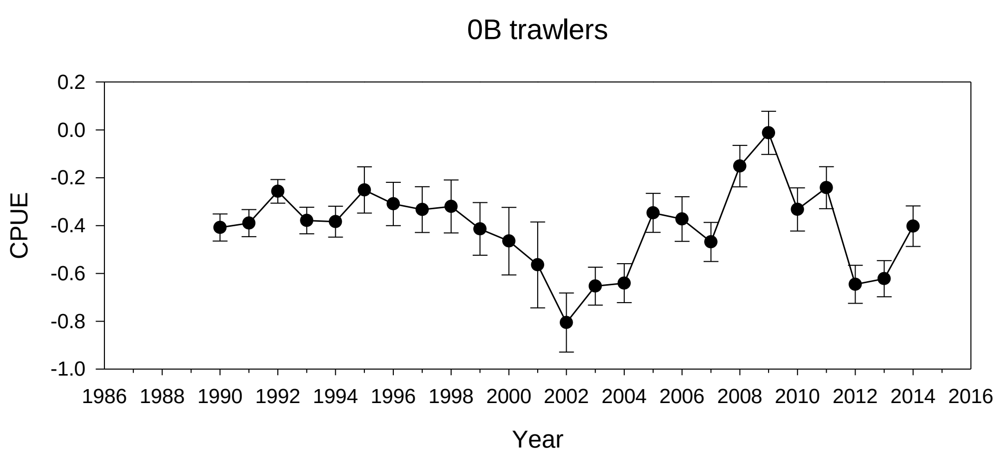

Fig 12d. Standardized CPUE series from trawlers in Div. 0B with +/- S.E.

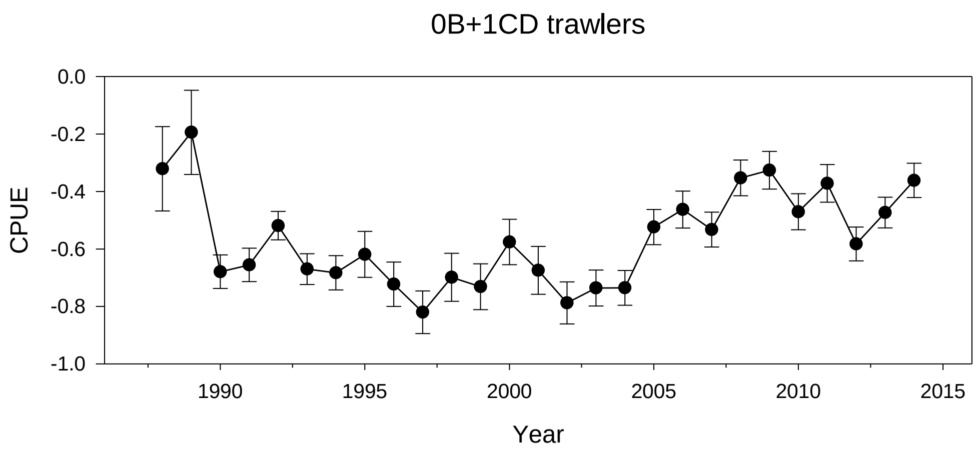

Fig. 12e. Combined standardized trawl CPUE index from trawlers in Div. 0B +1CD with +/- S.E.

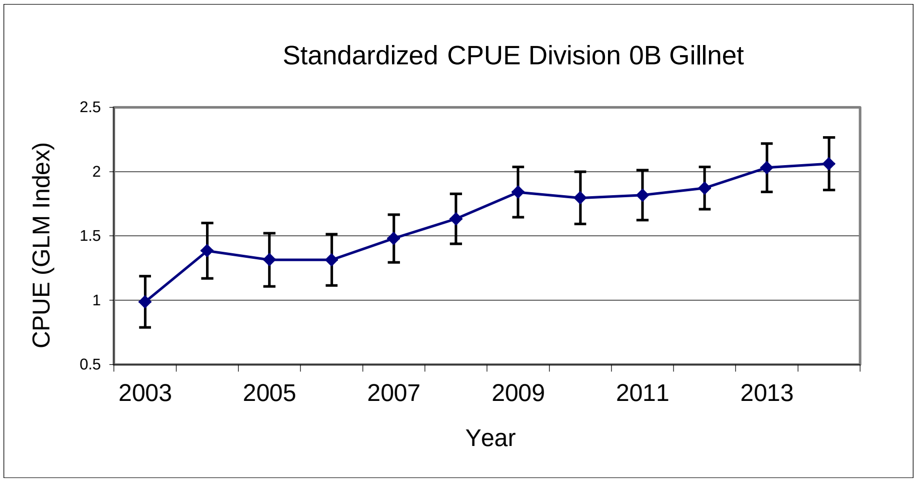

Fig 12f. Standardized CPUE series from gill net in Div. 0B with +/- S.E

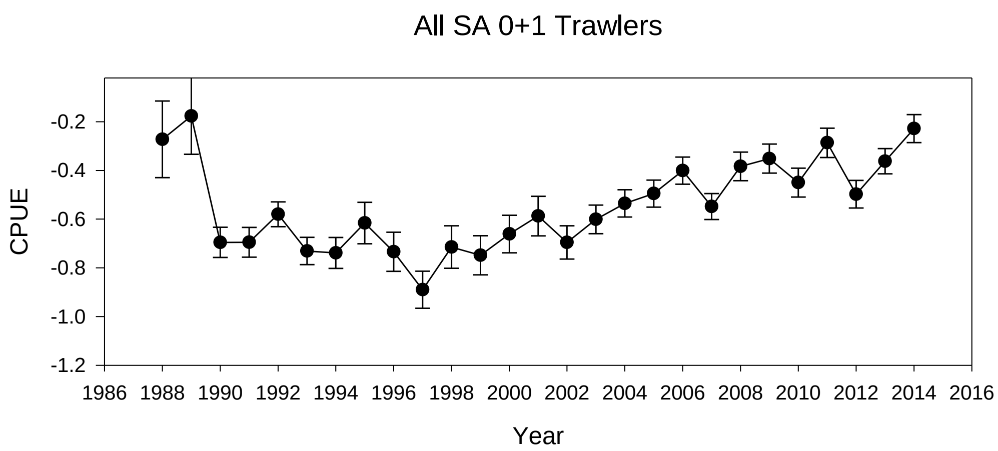

Fig. 12g. Combined standardized trawl CPUE index from trawlers in SA 0+1with +/- S.E

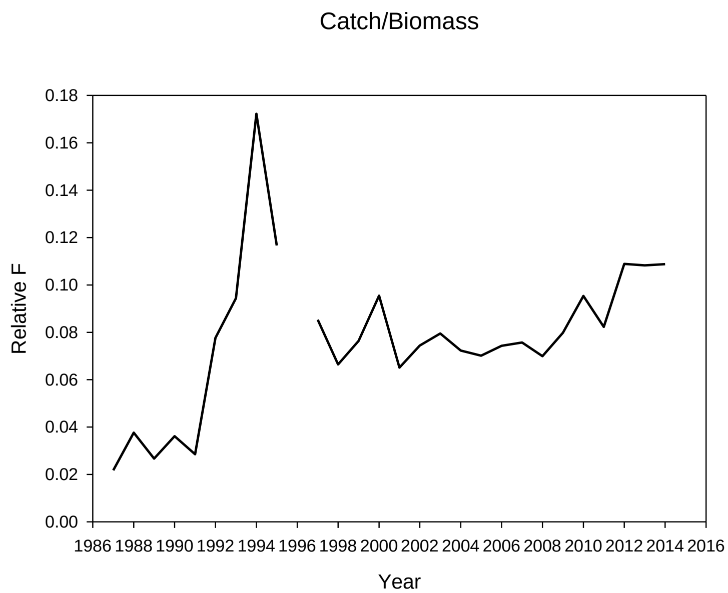

Fig 13. Relative F (off shore catch/swept area biomass) in Div.1CD.

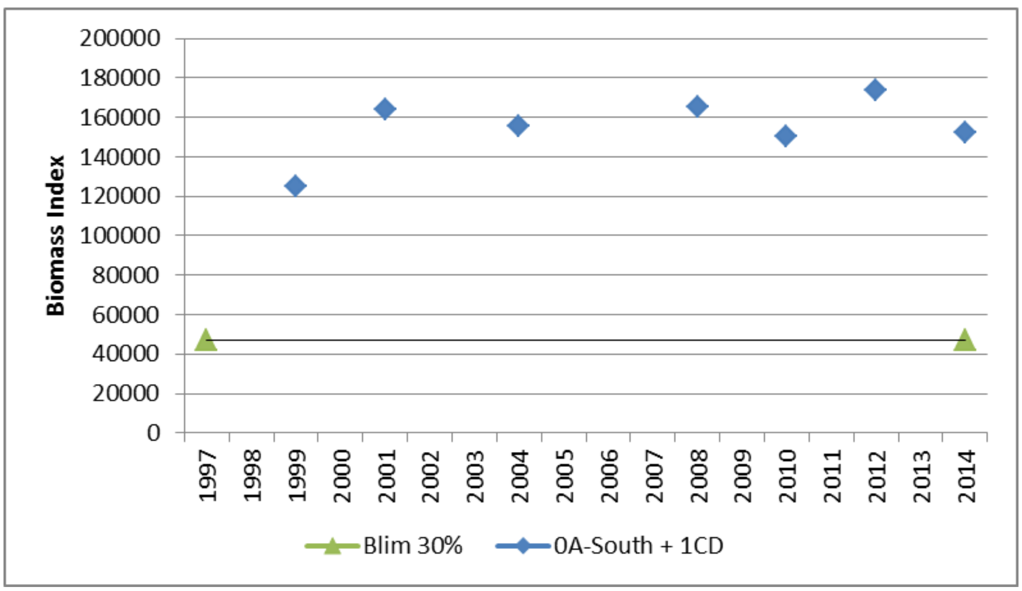

Fig. 14. Biomass trends in Div. 0A + Div. 1CD and $B_{lim.}$

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

Greenland halibut, 0A trawlers

The GLM Procedure

Class Level Information

Class	Levels	Values
Year	19	1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
md	5	7 8 9 10 11
kode	5	2126 2127 5127 21926 21927

Number of Observations Read	161
Number of Observations Used	161

Greenland halibut, 0A trawlers 17:58 Saturday, May 30, 2015 11

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	26	22.99013000	0.88423577	7.83	<.0001
Error	134	15.13352098	0.11293672		
Corrected Total	160	38.12365098			

R-Square	Coeff Var	Root MSE	lcph Mean
0.603041	-2606.609	0.336061	-0.012893

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	18	14.93448200	0.82969344	7.35	<.0001
md	4	3.14948315	0.78737079	6.97	<.0001
kode	4	4.90616486	1.22654121	10.86	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	18	12.63155561	0.70175309	6.21	<.0001
md	4	2.32481724	0.58120431	5.15	0.0007
kode	4	4.90616486	1.22654121	10.86	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.495492067	B	0.13844890	3.58	0.0005
Year	1996	0.026823324	B	0.48037641	0.06	0.9556
Year	1997	-1.708719195	B	0.27515177	-6.21	<.0001
Year	1998	-1.061296530	B	0.36238681	-2.93	0.0040
Year	1999	-1.002227502	B	0.23214497	-4.32	<.0001
Year	2000	-1.227159848	B	0.20922036	-5.87	<.0001
Year	2001	-0.127524718	B	0.23089179	-0.55	0.5817
Year	2002	-0.628672740	B	0.17726268	-3.55	0.0005
Year	2003	-0.459590050	B	0.16936086	-2.71	0.0075
Year	2004	-0.410835542	B	0.16239811	-2.53	0.0126
Year	2005	-0.719276032	B	0.16067071	-4.48	<.0001
Year	2006	-0.568363412	B	0.14592894	-3.89	0.0002
Year	2007	-0.896240801	B	0.14656713	-6.11	<.0001
Year	2008	-0.504548042	B	0.16400370	-3.08	0.0025
Year	2009	-0.395744096	B	0.16976675	-2.33	0.0212
Year	2010	-0.875025533	B	0.16836599	-5.20	<.0001
Year	2011	-0.562521881	B	0.17456471	-3.22	0.0016
Year	2012	-0.464519426	B	0.16345430	-2.84	0.0052
Year	2013	-0.275100877	B	0.15964658	-1.72	0.0872
Year	2014	0.000000000	B	.	.	.
md	7	0.326046430	B	0.10880293	3.00	0.0033
md	8	0.184298667	B	0.09305401	1.98	0.0497
md	9	0.247918068	B	0.08501299	2.92	0.0042
md	10	0.349392717	B	0.08109541	4.31	<.0001
md	11	0.000000000	B	.	.	.
kode	2126	-0.379345578	B	0.10884646	-3.49	0.0007
kode	2127	-0.279079577	B	0.06227390	-4.48	<.0001
kode	5127	-1.280852580	B	0.39554674	-3.24	0.0015
kode	21926	0.064976452	B	0.11546906	0.56	0.5746
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.

Greenland halibut, 0A trawlers 17:58 Saturday, May 30, 2015 12

The GLM Procedure
Least Squares Means

Year	lcph LSMEAN	Standard Error	Pr > |t|
1996	0.36898631	0.40171647	0.3600
1997	-1.36655621	0.25608508	<.0001
1998	-0.71913354	0.35189723	0.0430
1999	-0.66006452	0.21642521	0.0028
2000	-0.88499686	0.19210943	<.0001
2001	0.21463827	0.17451461	0.2209
2002	-0.28650975	0.15600618	0.0685
2003	-0.11742706	0.13952399	0.4015
2004	-0.06867256	0.11960549	0.5668
2005	-0.37711305	0.12235654	0.0025
2006	-0.22620042	0.10804266	0.0382
2007	-0.55407781	0.12080685	<.0001
2008	-0.16238506	0.14170869	0.2539
2009	-0.05358111	0.14786039	0.7176
2010	-0.53286255	0.14702229	0.0004
2011	-0.22035889	0.15444421	0.1560
2012	-0.12235644	0.14142884	0.3885
2013	0.06706211	0.13721716	0.6258
2014	0.34216299	0.14720967	0.0216

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

Greenland halibut, 1AB trawlers 09:13 Tuesday, May 26, 2015 4

The GLM Procedure

Class Level Information

Class	Levels	Values
year	13	2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
MD	8	1 6 7 8 9 10 11 12
kode	5	6125 6126 6127 61926 61927

Number of Observations Read	167
Number of Observations Used	167

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	23	19.06096417	0.82873757	12.51	<.0001
Error	143	9.47134891	0.06623321		
Corrected Total	166	28.53231308			

R-Square	Coeff Var	Root MSE	lcph Mean
0.668048	-128.5999	0.257358	-0.200123

Source	DF	Type I SS	Mean Square	F Value	Pr > F
year	12	3.62893627	0.30241136	4.57	<.0001
MD	7	2.39905929	0.34272276	5.17	<.0001
kode	4	13.03296861	3.25824215	49.19	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
year	12	4.32990645	0.36082554	5.45	<.0001
MD	7	3.46125507	0.49446501	7.47	<.0001
kode	4	13.03296861	3.25824215	49.19	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.5406437993	B	0.28219453	1.92	0.0574
year	2002	-.5229896333	B	0.13837084	-3.78	0.0002
year	2003	-.5202767553	B	0.11836154	-4.40	<.0001
year	2004	-.4532542810	B	0.11263315	-4.02	<.0001
year	2005	-.2763014307	B	0.11060199	-2.50	0.0136
year	2006	-.2684326111	B	0.10800380	-2.49	0.0141
year	2007	-.4069909651	B	0.10408548	-3.91	0.0001
year	2008	-.4920168536	B	0.10278754	-4.79	<.0001
year	2009	-.3107995841	B	0.09951259	-3.12	0.0022
year	2010	-.1717376189	B	0.09924630	-1.73	0.0857
year	2011	0.0002971816	B	0.10393890	0.00	0.9977
year	2012	-.1051884392	B	0.10263976	-1.02	0.3072
year	2013	-.2206993455	B	0.10012977	-2.20	0.0291
year	2014	0.0000000000	B	.	.	.
MD	1	0.1267956869	B	0.38122597	0.33	0.7399
MD	6	-.3503129728	B	0.33027248	-1.06	0.2906
MD	7	-.5632595596	B	0.27659486	-2.04	0.0436
MD	8	-.2797828672	B	0.27215678	-1.03	0.3057
MD	9	-.2425251213	B	0.27115839	-0.89	0.3726
MD	10	-.1010231848	B	0.27122383	-0.37	0.7101
MD	11	-.0537449983	B	0.27275120	-0.20	0.8441
MD	12	0.0000000000	B	.	.	.
kode	6125	-.4375873435	B	0.08422286	-5.20	<.0001
kode	6126	-.6830669022	B	0.05742871	-11.89	<.0001
kode	6127	-.0184452563	B	0.05628152	-0.33	0.7436
kode	61926	-.2872085066	B	0.08145471	-3.53	0.0006
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.

Greenland halibut, 1A trawlers 09:13 Tuesday, May 26, 2015 6

The GLM Procedure

Least Squares Means

year	lcph LSMEAN	Standard Error	Pr > |t|
2002	-0.45058906	0.13015283	0.0007
2003	-0.44787618	0.10878616	<.0001
2004	-0.38085371	0.09885031	0.0002
2005	-0.20390086	0.09620349	0.0358
2006	-0.19603204	0.08994098	0.0309
2007	-0.33459039	0.08954284	0.0003
2008	-0.41961628	0.08156460	<.0001
2009	-0.23839901	0.08449774	0.0055
2010	-0.09933705	0.08126617	0.2236
2011	0.07269775	0.08130874	0.3728
2012	-0.03278787	0.08781059	0.7094
2013	-0.14829878	0.08818905	0.0948
2014	0.07240057	0.09424280	0.4436

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

Greenland halibut, 0A1A trawlers 17:58 Saturday, May 30, 2015 25

The GLM Procedure

Class Level Information

Class	Levels	Values
year	19	1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
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	328
Number of Observations Used	328

Greenland halibut, 0A1A trawlers 17:58 Saturday, May 30, 2015 26

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	34	38.08198887	1.12005850	10.44	<.0001
Error	293	31.44754335	0.10732950		
Corrected Total	327	69.52953222			

R-Square	Coeff Var	Root MSE	lcph Mean
0.547710	-302.7267	0.327612	-0.108220

Source	DF	Type I SS	Mean Square	F Value	Pr > F
year	18	13.12242994	0.72902389	6.79	<.0001
MD	7	2.49205990	0.35600856	3.32	0.0021
kode	9	22.46749904	2.49638878	23.26	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
year	18	14.15336527	0.78629807	7.33	<.0001
MD	7	2.36312237	0.33758891	3.15	0.0032
kode	9	22.46749904	2.49638878	23.26	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.570419042	B	0.34961934	1.63	0.1039
year	1996	0.338356081	B	0.45550872	0.74	0.4582
year	1997	-1.703437613	B	0.24924486	-6.83	<.0001
year	1998	-0.909227935	B	0.34004712	-2.67	0.0079
year	1999	-0.925788863	B	0.20764115	-4.46	<.0001
year	2000	-1.087083251	B	0.18272516	-5.95	<.0001
year	2001	0.000735953	B	0.20589655	0.00	0.9972
year	2002	-0.536778013	B	0.12129511	-4.43	<.0001
year	2003	-0.494634596	B	0.11022010	-4.49	<.0001
year	2004	-0.441200366	B	0.10467827	-4.21	<.0001
year	2005	-0.575782756	B	0.10289386	-5.60	<.0001
year	2006	-0.470327147	B	0.09596456	-4.90	<.0001
year	2007	-0.681273772	B	0.09588566	-7.11	<.0001
year	2008	-0.499532352	B	0.10117674	-4.94	<.0001
year	2009	-0.391391556	B	0.10003738	-3.91	0.0001
year	2010	-0.451506670	B	0.09970559	-4.53	<.0001
year	2011	-0.208157492	B	0.10421438	-2.00	0.0467
year	2012	-0.268099711	B	0.10092237	-2.66	0.0083
year	2013	-0.259831309	B	0.09845231	-2.64	0.0088
year	2014	0.000000000	B	.	.	.
MD	1	0.282276855	B	0.47922161	0.59	0.5563
MD	6	-0.191703195	B	0.41471090	-0.46	0.6442
MD	7	-0.263771576	B	0.34255015	-0.77	0.4419
MD	8	-0.182911265	B	0.33993107	-0.54	0.5909
MD	9	-0.136642497	B	0.33933919	-0.40	0.6875
MD	10	-0.006089326	B	0.33942682	-0.02	0.9857
MD	11	-0.186749218	B	0.34034360	-0.55	0.5836
MD	12	0.000000000	B	.	.	.
kode	2126	-0.155096426	B	0.10276120	-1.51	0.1323
kode	2127	-0.121514582	B	0.06810272	-1.78	0.0754
kode	5127	-1.297291008	B	0.38698714	-3.35	0.0009
kode	6125	-0.355892061	B	0.10044858	-3.54	0.0005
kode	6126	-0.659868639	B	0.07244127	-9.11	<.0001
kode	6127	-0.040705000	B	0.07058198	-0.58	0.5646
kode	21926	0.301392138	B	0.10699528	2.82	0.0052
kode	21927	0.164198359	B	0.06616506	2.48	0.0136
kode	61926	-0.219060751	B	0.10062339	-2.18	0.0303
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.

Greenland halibut, 0A1A trawlers 17:58 Saturday, May 30, 2015 27

The GLM Procedure
Least Squares Means

year	lcph LSMEAN	Standard Error	Pr > |t|
1996	0.58469255	0.42269500	0.1676
1997	-1.45710115	0.24869451	<.0001
1998	-0.66289147	0.34057785	0.0526
1999	-0.67945240	0.20905737	0.0013
2000	-0.84074678	0.18400375	<.0001
2001	0.24707242	0.18859799	0.1912
2002	-0.29044155	0.12446064	0.0203
2003	-0.24829813	0.11264535	0.0283
2004	-0.19486390	0.10300317	0.0595
2005	-0.32944629	0.10240455	0.0014
2006	-0.22399068	0.09422221	0.0181
2007	-0.43493731	0.09927755	<.0001
2008	-0.25319589	0.09899001	0.0110
2009	-0.14505509	0.10380119	0.1633
2010	-0.20517020	0.10081000	0.0427
2011	0.03817897	0.10084439	0.7053
2012	-0.02176324	0.10433790	0.8349
2013	-0.01349484	0.10374082	0.8966
2014	0.24633647	0.10857229	0.0240

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	11	2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Month	5	7 8 9 10 11
CGT	3	40413 40414 40415

Number of Observations Read	59
Number of Observations Used	59

Greenland halibut, 0A gillnets

The GLM Procedure

Dependent Variable: lcpue

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	16	2.08498899	0.13031181	1.88	0.0520
Error	42	2.91621033	0.06943358		
Corrected Total	58	5.00119931			

R-Square	Coeff Var	Root MSE	lcpue Mean
0.416898	11.58312	0.263503	2.274885

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	10	1.22428314	0.12242831	1.76	0.0981
Month	4	0.59074957	0.14768739	2.13	0.0943
CGT	2	0.26995627	0.13497814	1.94	0.1558

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	10	1.66859298	0.16685930	2.40	0.0232
Month	4	0.52209122	0.13052280	1.88	0.1318
CGT	2	0.26995627	0.13497814	1.94	0.1558

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	2.366663489	B	0.18157818	13.03	<.0001
Year 2004	-0.765285895	B	0.30142769	-2.54	0.0149
Year 2005	-0.069321509	B	0.17220964	-0.40	0.6893
Year 2006	-0.421868700	B	0.17067314	-2.47	0.0176
Year 2007	-0.315668013	B	0.17194486	-1.84	0.0735
Year 2008	-0.154866759	B	0.18632442	-0.83	0.4106
Year 2009	-0.017962195	B	0.17838233	-0.10	0.9203
Year 2010	-0.024005314	B	0.17838233	-0.13	0.8936
Year 2011	0.083229142	B	0.17838233	0.47	0.6432
Year 2012	0.045698672	B	0.17838233	0.26	0.7991
Year 2013	0.014935405	B	0.17838233	0.08	0.9337
Year 2014	0.000000000	B	.	.	.

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

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The GLM Procedure

Class Level Information

Class	Levels	Values
Year	25	1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
md	10	1 4 5 6 7 8 9 10 11 12
kode	12	2126 2127 3125 5126 5127 14124 15126 15127 20126 20127 21926 21927

Number of Observations Read 625
Number of Observations Used 625

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The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	44	176.8484078	4.0192820	46.19	<.0001
Error	580	50.4676909	0.0870133		
Corrected Total	624	227.3160987			

R-Square	Coeff Var	Root MSE	lcph Mean
0.777985	-52.95236	0.294980	-0.557067

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	24	109.5860662	4.5660861	52.48	<.0001
md	9	20.0706136	2.2300682	25.63	<.0001
kode	11	47.1917280	4.2901571	49.30	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	24	10.76865448	0.44869394	5.16	<.0001
md	9	17.88711708	1.98745745	22.84	<.0001
kode	11	47.19172797	4.29015709	49.30	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.210199791 B	0.08239237	2.55	0.0110
Year	1990	-0.005029331 B	0.10342591	-0.05	0.9612
Year	1991	0.013138605 B	0.10490353	0.13	0.9004
Year	1992	0.145909356 B	0.09901516	1.47	0.1411
Year	1993	0.023991165 B	0.10362443	0.23	0.8170
Year	1994	0.018963531 B	0.10948448	0.17	0.8625
Year	1995	0.151507319 B	0.12987448	1.17	0.2439
Year	1996	0.093359664 B	0.11961291	0.78	0.4354
Year	1997	0.069812419 B	0.11950969	0.58	0.5593
Year	1998	0.082542088 B	0.12572701	0.66	0.5118
Year	1999	-0.011059711 B	0.12190449	-0.09	0.9277
Year	2000	-0.062136401 B	0.15245008	-0.41	0.6837
Year	2001	-0.161531121 B	0.18773576	-0.86	0.3899
Year	2002	-0.402487802 B	0.13453900	-2.99	0.0029
Year	2003	-0.250315975 B	0.09664044	-2.59	0.0098
Year	2004	-0.237780056 B	0.09877107	-2.41	0.0164
Year	2005	0.055912061 B	0.09925394	0.56	0.5734
Year	2006	0.029992986 B	0.11757052	0.26	0.7987
Year	2007	-0.065442287 B	0.10866603	-0.60	0.5473
Year	2008	0.251435335 B	0.09734868	2.58	0.0100
Year	2009	0.390245926 B	0.10047379	3.88	0.0001
Year	2010	0.070334551 B	0.10124625	0.69	0.4875
Year	2011	0.161224671 B	0.09978364	1.62	0.1067
Year	2012	-0.242683776 B	0.09164683	-2.65	0.0083
Year	2013	-0.219313570 B	0.09214259	-2.38	0.0176
Year	2014	0.000000000 B	.	.	.
md	1	0.025446259 B	0.10653893	0.24	0.8113
md	4	0.186581296 B	0.09165434	2.04	0.0422
md	5	0.441128784 B	0.06660597	6.62	<.0001
md	6	-0.111642460 B	0.06495269	-1.72	0.0862
md	7	-0.370326046 B	0.05856169	-6.32	<.0001
md	8	-0.269608075 B	0.05719408	-4.71	<.0001
md	9	-0.328740889 B	0.05533918	-5.94	<.0001
md	10	-0.362920755 B	0.05245891	-6.92	<.0001
md	11	-0.245805335 B	0.05298647	-4.64	<.0001
md	12	0.000000000 B	.	.	.
kode	2126	-0.598784087 B	0.09159737	-6.54	<.0001
kode	2127	-0.352595525 B	0.04190303	-8.41	<.0001
kode	3125	-1.149401990 B	0.10896850	-10.55	<.0001
kode	5126	-0.502113870 B	0.14275329	-3.52	0.0005
kode	5127	-0.259240815 B	0.08719706	-2.97	0.0031
kode	14124	-0.795618466 B	0.09556132	-8.33	<.0001
kode	15126	-0.036841413 B	0.09806062	-0.38	0.7073
kode	15127	-0.062102950 B	0.12223864	-0.51	0.6116
kode	20126	-1.108903625 B	0.07906353	-14.03	<.0001
kode	20127	-1.125943505 B	0.09020495	-12.48	<.0001
kode	21926	-0.119773547 B	0.13755133	-0.87	0.3842
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.

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The GLM Procedure
Least Squares Means

Year	lcph LSMEAN	Standard Error	Pr > |t|
1990	-0.40769491	0.05673859	<.0001
1991	-0.38952698	0.05661283	<.0001
1992	-0.25675622	0.04934502	<.0001
1993	-0.37867442	0.05533841	<.0001
1994	-0.38370205	0.06452596	<.0001
1995	-0.25115826	0.09665864	0.0096
1996	-0.30930592	0.09040422	0.0007
1997	-0.33285316	0.09567575	0.0005
1998	-0.32012349	0.11060908	0.0039
1999	-0.41372529	0.11022330	0.0002
2000	-0.46480198	0.14098906	0.0010
2001	-0.56419670	0.17969378	0.0018
2002	-0.80515338	0.12338052	<.0001
2003	-0.65298156	0.07908231	<.0001
2004	-0.64044564	0.08112925	<.0001
2005	-0.34675352	0.08146036	<.0001
2006	-0.37267259	0.09331236	<.0001
2007	-0.46810787	0.08181453	<.0001
2008	-0.15123024	0.08641715	0.0806
2009	-0.01241965	0.09041422	0.8908
2010	-0.33233103	0.09003475	0.0002
2011	-0.24144091	0.08794257	0.0062
2012	-0.64534936	0.07977388	<.0001
2013	-0.62197915	0.07572594	<.0001
2014	-0.40266558	0.08464737	<.0001

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

Greenland halibut, 1CD trawlers 09:13 Tuesday, May 26, 2015

The GLM Procedure

Class Level Information

Class	Levels	Values
year	27	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 2013 2014
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	331
Number of Observations Used	331

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	42	58.22107022	1.38621596	18.91	<.0001
Error	288	21.11197564	0.07330547		
Corrected Total	330	79.33304586			

R-Square	Coeff Var	Root MSE	lcph Mean
0.733882	-58.38803	0.270750	-0.463708

Source	DF	Type I SS	Mean Square	F Value	Pr > F
year	26	27.79326951	1.06897190	14.58	<.0001
MD	11	7.81204502	0.71018591	9.69	<.0001
kode	5	22.61575569	4.52315114	61.70	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
year	26	18.07262482	0.69510095	9.48	<.0001
MD	11	5.46387039	0.49671549	6.78	<.0001
kode	5	22.61575569	4.52315114	61.70	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.377317609 B	0.08362899	4.51	<.0001
year	1988	0.024220078 B	0.14640836	0.17	0.8687
year	1989	0.067820023 B	0.13987385	0.48	0.6281
year	1990	-0.272654203 B	0.20366420	-1.34	0.1817
year	1991	-0.266370835 B	0.17029970	-1.56	0.1189
year	1992	-0.394963030 B	0.12079876	-3.27	0.0012
year	1993	-0.584898443 B	0.12131896	-4.82	<.0001
year	1994	-0.723084766 B	0.12093441	-5.98	<.0001
year	1995	-0.606486909 B	0.12116984	-5.01	<.0001
year	1996	-0.841011406 B	0.12071061	-6.97	<.0001
year	1997	-0.919022684 B	0.10636967	-8.64	<.0001
year	1998	-0.720680953 B	0.11534251	-6.25	<.0001
year	1999	-0.780661549 B	0.10790032	-7.24	<.0001
year	2000	-0.489033294 B	0.10158228	-4.81	<.0001
year	2001	-0.574055358 B	0.09692035	-5.92	<.0001
year	2002	-0.651296099 B	0.09377811	-6.95	<.0001
year	2003	-0.644533137 B	0.10085434	-6.39	<.0001
year	2004	-0.609381594 B	0.09327854	-6.53	<.0001
year	2005	-0.459951593 B	0.09363831	-4.91	<.0001
year	2006	-0.375464423 B	0.09206265	-4.08	<.0001
year	2007	-0.308248535 B	0.09394155	-3.28	0.0012
year	2008	-0.266087811 B	0.09003185	-2.96	0.0034
year	2009	-0.320153733 B	0.09406475	-3.40	0.0008
year	2010	-0.335558765 B	0.08792863	-3.82	0.0002
year	2011	-0.276050615 B	0.09588430	-2.88	0.0043
year	2012	-0.202229908 B	0.08838512	-2.29	0.0229
year	2013	0.014343522 B	0.08521695	0.17	0.8665
year	2014	0.000000000 B	.	.	.
MD	1	-0.300234648 B	0.08765995	-3.42	0.0007
MD	2	-0.680385824 B	0.10139626	-6.71	<.0001
MD	3	-0.683387417 B	0.17149616	-3.98	<.0001
MD	4	-0.333241783 B	0.21132336	-1.58	0.1159
MD	5	-0.171401644 B	0.11759223	-1.46	0.1460
MD	6	-0.326647538 B	0.08569047	-3.81	0.0002
MD	7	-0.334708501 B	0.07266300	-4.61	<.0001
MD	8	-0.289006602 B	0.06548003	-4.41	<.0001
MD	9	-0.168744508 B	0.06048453	-2.79	0.0056
MD	10	-0.169763739 B	0.05644958	-3.01	0.0029
MD	11	-0.103815287 B	0.05625229	-1.85	0.0660
MD	12	0.000000000 B	.	.	.
kode	6124	-2.479807775 B	0.18193279	-13.63	<.0001
kode	6125	-0.553051856 B	0.06489507	-8.52	<.0001
kode	6126	-0.355970394 B	0.05310920	-6.70	<.0001
kode	6127	-0.041812623 B	0.05501880	-0.76	0.4479
kode	61926	-0.083164720 B	0.09887395	-0.84	0.4010
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.

Greenland halibut, 1CD trawlers 09:13 Tuesday, May 26, 2015 12

The GLM Procedure
Least Squares Means

year	lcph LSMEAN	Standard Error	Pr > |t|
1988	-0.48087500	0.13290304	0.0004
1989	-0.43727505	0.13116167	0.0010
1990	-0.77774928	0.19872234	0.0001
1991	-0.77146591	0.16455480	<.0001
1992	-0.90005811	0.11261158	<.0001
1993	-1.08999352	0.11231260	<.0001
1994	-1.22817984	0.11232200	<.0001
1995	-1.11158199	0.11237780	<.0001
1996	-1.34610648	0.11209632	<.0001
1997	-1.42411776	0.09628164	<.0001
1998	-1.22577603	0.10620057	<.0001
1999	-1.28575663	0.09719076	<.0001
2000	-0.99412837	0.07805951	<.0001
2001	-1.07915043	0.08457369	<.0001
2002	-1.15639118	0.08041119	<.0001
2003	-1.14962821	0.08953926	<.0001
2004	-1.11447667	0.07619030	<.0001
2005	-0.96504667	0.07957927	<.0001
2006	-0.88055950	0.07795841	<.0001
2007	-0.81334361	0.07820330	<.0001
2008	-0.77118289	0.07508496	<.0001
2009	-0.82524881	0.08091007	<.0001
2010	-0.84065384	0.07417600	<.0001
2011	-0.78114569	0.08346965	<.0001
2012	-0.70732498	0.07381125	<.0001
2013	-0.49075155	0.06703301	<.0001
2014	-0.50509508	0.07318559	<.0001

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

Greenland halibut, 0B1CD trawlers 17:58 Saturday, May 30, 2015 22

The GLM Procedure

Class Level Information

Class	Levels	Values
year	27	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 2013 2014
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
kode	18	2126 2127 3125 5126 5127 6124 6125 6126 6127 14124 15126 15127 20126 20127 21926 21927 61926 61927

Number of Observations Read 956
Number of Observations Used 956

Greenland halibut, 0B1CD trawlers 17:58 Saturday, May 30, 2015 23

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	54	220.2911261	4.0794653	41.65	<.0001
Error	901	88.2441167	0.0979402		
Corrected Total	955	308.5352428			

R-Square	Coeff Var	Root MSE	lcph Mean
0.713990	-59.63950	0.312954	-0.524743

Source	DF	Type I SS	Mean Square	F Value	Pr > F
year	26	106.5492228	4.0980470	41.84	<.0001
MD	11	28.4680952	2.5880087	26.42	<.0001
kode	17	85.2738080	5.0161064	51.22	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
year	26	13.87697689	0.53372988	5.45	<.0001
MD	11	18.40915065	1.67355915	17.09	<.0001
kode	17	85.27380804	5.01610636	51.22	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.239167907 B	0.07674399	3.12	0.0019
year	1988	0.040481851 B	0.15353357	0.26	0.7921
year	1989	0.167311881 B	0.15225865	1.10	0.2721
year	1990	-0.317939653 B	0.08033249	-3.96	<.0001
year	1991	-0.293878234 B	0.08076332	-3.64	0.0003
year	1992	-0.157276567 B	0.07331425	-2.15	0.0322
year	1993	-0.308567077 B	0.07633963	-4.04	<.0001
year	1994	-0.321517437 B	0.08088479	-3.98	<.0001
year	1995	-0.257443638 B	0.09437700	-2.73	0.0065
year	1996	-0.361324596 B	0.09061532	-3.99	<.0001
year	1997	-0.459135197 B	0.08744591	-5.25	<.0001
year	1998	-0.337150912 B	0.09379214	-3.59	0.0003
year	1999	-0.370128748 B	0.08938109	-4.14	<.0001
year	2000	-0.214141233 B	0.09259817	-2.31	0.0210
year	2001	-0.313152755 B	0.09271338	-3.38	0.0008
year	2002	-0.426462561 B	0.08408120	-5.07	<.0001
year	2003	-0.374634403 B	0.07542571	-4.97	<.0001
year	2004	-0.374150843 B	0.07432649	-5.03	<.0001
year	2005	-0.162297804 B	0.07500399	-2.16	0.0307
year	2006	-0.101379581 B	0.07865556	-1.29	0.1978
year	2007	-0.171087082 B	0.07732321	-2.21	0.0272
year	2008	0.008741695 B	0.07308687	0.12	0.9048
year	2009	0.035506895 B	0.07600189	0.47	0.6405
year	2010	-0.109104509 B	0.07360204	-1.48	0.1386
year	2011	-0.010323909 B	0.07612879	-0.14	0.8922
year	2012	-0.220902738 B	0.07025571	-3.14	0.0017
year	2013	-0.111735654 B	0.06912620	-1.62	0.1064
year	2014	0.000000000 B	.	.	.
MD	1	-0.154819036 B	0.07280899	-2.13	0.0337
MD	2	-0.595421964 B	0.10876707	-5.47	<.0001
MD	3	-0.436638473 B	0.19076229	-2.29	0.0223
MD	4	0.071543705 B	0.08684227	0.82	0.4103
MD	5	0.328893367 B	0.05996778	5.48	<.0001
MD	6	-0.192436193 B	0.05532530	-3.48	0.0005
MD	7	-0.346073439 B	0.04841998	-7.15	<.0001
MD	8	-0.247365023 B	0.04608279	-5.37	<.0001
MD	9	-0.253052013 B	0.04390422	-5.76	<.0001
MD	10	-0.273458267 B	0.04160326	-6.57	<.0001
MD	11	-0.178538472 B	0.04205197	-4.25	<.0001
MD	12	0.000000000 B	.	.	.
kode	2126	-0.402254203 B	0.09653208	-4.17	<.0001
kode	2127	-0.197909202 B	0.05943029	-3.33	0.0009
kode	3125	-1.081632283 B	0.11256695	-9.61	<.0001
kode	5126	-0.087739339 B	0.14218979	-0.62	0.5374
kode	5127	0.035389268 B	0.08280948	0.43	0.6692
kode	6124	-2.528975060 B	0.20375160	-12.41	<.0001
kode	6125	-0.687966579 B	0.07138436	-9.64	<.0001
kode	6126	-0.414928300 B	0.05988342	-6.93	<.0001
kode	6127	-0.092099519 B	0.06163603	-1.49	0.1355
kode	14124	-0.561933835 B	0.09284614	-6.05	<.0001
kode	15126	0.177325070 B	0.09774381	1.81	0.0700
kode	15127	0.151125180 B	0.12380558	1.22	0.2225

kode	20126	-0.873150944 B	0.07467428	-11.69	<.0001
kode	20127	-0.881638319 B	0.08534915	-10.33	<.0001
kode	21926	0.046701503 B	0.14242764	0.33	0.7431
kode	21927	0.107649134 B	0.06262967	1.72	0.0860
kode	61926	-0.100092918 B	0.11232565	-0.89	0.3731
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	-0.32080463	0.14687509	0.0292
1989	-0.19397460	0.14659725	0.1861
1990	-0.67922614	0.05868845	<.0001
1991	-0.65516472	0.05800355	<.0001
1992	-0.51856305	0.04940644	<.0001
1993	-0.66985356	0.05348484	<.0001
1994	-0.68280392	0.06011644	<.0001
1995	-0.61873012	0.08002006	<.0001
1996	-0.72261108	0.07745186	<.0001
1997	-0.82042168	0.07432334	<.0001
1998	-0.69843740	0.08387191	<.0001
1999	-0.73141523	0.07981885	<.0001
2000	-0.57542772	0.07905276	<.0001
2001	-0.67443924	0.08354623	<.0001
2002	-0.78774905	0.07333798	<.0001
2003	-0.73592089	0.06288568	<.0001
2004	-0.73543733	0.06083771	<.0001
2005	-0.52358429	0.06141973	<.0001
2006	-0.46266607	0.06438927	<.0001
2007	-0.53237357	0.06068105	<.0001
2008	-0.35254479	0.06211545	<.0001
2009	-0.32577959	0.06541395	<.0001
2010	-0.47039099	0.06265547	<.0001
2011	-0.37161039	0.06566120	<.0001
2012	-0.58218922	0.05885387	<.0001
2013	-0.47302214	0.05327156	<.0001
2014	-0.36128649	0.05962455	<.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	12	2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Month	7	5 6 7 8 9 10 11
CGT	2	40413 40414

Number of Observations Read	101
Number of Observations Used	101

Greenland halibut, 0B gillnets

The GLM Procedure

Dependent Variable: lcpue

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	18	12.67606628	0.70422590	7.57	<.0001
Error	82	7.62698116	0.09301197		
Corrected Total	100	20.30304744			

R-Square	Coeff Var	Root MSE	lcpue Mean
0.624343	17.57501	0.304979	1.735297

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	11	9.29160476	0.84469134	9.08	<.0001
Month	6	3.37305848	0.56217641	6.04	<.0001
CGT	1	0.01140304	0.01140304	0.12	0.7271

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	11	8.79050972	0.79913725	8.59	<.0001
Month	6	3.34255579	0.55709263	5.99	<.0001
CGT	1	0.01140304	0.01140304	0.12	0.7271

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	1.943189423	B	0.20042427	9.70	<.0001
Year 2003	-1.073552321	B	0.16682051	-6.44	<.0001
Year 2004	-0.676478553	B	0.17955453	-3.77	0.0003
Year 2005	-0.746764458	B	0.17184028	-4.35	<.0001
Year 2006	-0.747821065	B	0.16682051	-4.48	<.0001
Year 2007	-0.580265495	B	0.14879935	-3.90	0.0002
Year 2008	-0.427870597	B	0.15581461	-2.75	0.0074
Year 2009	-0.220146311	B	0.15539809	-1.42	0.1604
Year 2010	-0.264974959	B	0.16503076	-1.61	0.1122
Year 2011	-0.243505312	B	0.15477229	-1.57	0.1195
Year 2012	-0.188914090	B	0.15012751	-1.26	0.2118
Year 2013	-0.029524482	B	0.14938072	-0.20	0.8438
Year 2014	0.000000000	B	.	.	.
Month 5	0.485699148	B	0.17521869	2.77	0.0069
Month 6	0.098630130	B	0.17410301	0.57	0.5726
Month 7	-0.072452337	B	0.17452989	-0.42	0.6791
Month 8	0.281035477	B	0.17719705	1.59	0.1166
Month 9	0.257413867	B	0.17700051	1.45	0.1497
Month 10	0.170965916	B	0.19201744	0.89	0.3759
Month 11	0.000000000	B	.	.	.
CGT 40413	-0.113789727	B	0.32498411	-0.35	0.7271
CGT 40414	0.000000000	B	.	.	.

Note: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the n

Greenland halibut, 0B gillnets

The GLM Procedure

Least Squares Means

Year	lcpue LSMEAN	Standard Error	Pr > |t|
2003	0.98721255	0.19922623	<.0001
2004	1.38428632	0.21516453	<.0001
2005	1.31400042	0.20597319	<.0001
2006	1.31294381	0.19922623	<.0001
2007	1.48049938	0.18529676	<.0001
2008	1.63289428	0.19417174	<.0001
2009	1.84061856	0.19545131	<.0001
2010	1.79578991	0.20368790	<.0001
2011	1.81725956	0.19533462	<.0001
2012	1.87185078	0.16429197	<.0001
2013	2.03124039	0.18869863	<.0001
2014	2.06076487	0.20426657	<.0001

Appendix 9. Standardized CPUE index for trawlers in SA 0+1.

The GLM Procedure

Class Level Information

Class	Levels	Values
year	27	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 2013 2014
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
kode	18	2126 2127 3125 5126 5127 6124 6125 6126 6127 14124 15126 15127 20126 20127 21926 21927 61926 61927

Number of Observations Read 1176
Number of Observations Used 1176

The GLM Procedure

Dependent Variable: lcph

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	54	268.6670531	4.9753158	43.82	<.0001
Error	1121	127.2691151	0.1135318		
Corrected Total	1175	395.9361682			

R-Square	Coeff Var	Root MSE	lcph Mean
0.678562	-78.75999	0.336945	-0.427812

Source	DF	Type I SS	Mean Square	F Value	Pr > F
year	26	146.4370093	5.6321927	49.61	<.0001
MD	11	18.8991761	1.7181069	15.13	<.0001
kode	17	103.3308677	6.0782863	53.54	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
year	26	18.8018659	0.7231487	6.37	<.0001
MD	11	13.3646667	1.2149697	10.70	<.0001
kode	17	103.3308677	6.0782863	53.54	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.326874078 B	0.06971541	4.69	<.0001
year	1988	-0.044308750 B	0.16280430	-0.27	0.7855
year	1989	0.051120601 B	0.16154163	0.32	0.7517
year	1990	-0.467379063 B	0.08123289	-5.75	<.0001
year	1991	-0.467188876 B	0.08165584	-5.72	<.0001
year	1992	-0.352089668 B	0.07184483	-4.90	<.0001
year	1993	-0.502909538 B	0.07632029	-6.59	<.0001
year	1994	-0.510733819 B	0.08180675	-6.24	<.0001
year	1995	-0.387997953 B	0.09755913	-3.98	<.0001
year	1996	-0.505988973 B	0.09204102	-5.50	<.0001
year	1997	-0.661840175 B	0.08738594	-7.57	<.0001
year	1998	-0.486635325 B	0.09519937	-5.11	<.0001
year	1999	-0.520355780 B	0.08773147	-5.93	<.0001
year	2000	-0.433133475 B	0.08865504	-4.89	<.0001
year	2001	-0.359435157 B	0.08864136	-4.05	<.0001
year	2002	-0.467873341 B	0.07706518	-6.07	<.0001
year	2003	-0.373010125 B	0.07003887	-5.33	<.0001
year	2004	-0.307498939 B	0.06911153	-4.45	<.0001
year	2005	-0.267151822 B	0.06789461	-3.93	<.0001
year	2006	-0.172989035 B	0.06782416	-2.55	0.0109
year	2007	-0.320420287 B	0.06632549	-4.83	<.0001
year	2008	-0.155476860 B	0.06773092	-2.30	0.0219
year	2009	-0.123401431 B	0.06881544	-1.79	0.0732
year	2010	-0.221803100 B	0.06851897	-3.24	0.0012
year	2011	-0.058410953 B	0.06932558	-0.84	0.3997
year	2012	-0.269634395 B	0.06595496	-4.09	<.0001
year	2013	-0.134168921 B	0.06504266	-2.06	0.0394
year	2014	0.000000000 B	.	.	.
MD	1	-0.147997639 B	0.07758311	-1.91	0.0567
MD	2	-0.575343480 B	0.11519379	-4.99	<.0001
MD	3	-0.434366528 B	0.20257313	-2.14	0.0322
MD	4	-0.011344592 B	0.09245605	-0.12	0.9024
MD	5	0.282811713 B	0.06371370	4.44	<.0001
MD	6	-0.209050187 B	0.05875135	-3.56	0.0004
MD	7	-0.271958344 B	0.04894569	-5.56	<.0001
MD	8	-0.160830900 B	0.04555007	-3.53	0.0004
MD	9	-0.140281462 B	0.04347973	-3.23	0.0013
MD	10	-0.144294269 B	0.04228719	-3.41	0.0007
MD	11	-0.160380864 B	0.04313775	-3.72	0.0002
MD	12	0.000000000 B	.	.	.
kode	2126	-0.269454140 B	0.07463832	-3.61	0.0003
kode	2127	-0.191996123 B	0.04949941	-3.88	0.0001
kode	3125	-1.116553781 B	0.11348080	-9.84	<.0001
kode	5126	-0.032632240 B	0.14759640	-0.22	0.8251
kode	5127	0.014463211 B	0.07913019	0.18	0.8550
kode	6124	-2.484386377 B	0.21305557	-11.66	<.0001
kode	6125	-0.638550148 B	0.06467953	-9.87	<.0001
kode	6126	-0.474364264 B	0.05330949	-8.90	<.0001
kode	6127	-0.095362622 B	0.05421226	-1.76	0.0788
kode	14124	-0.552163448 B	0.09198983	-6.00	<.0001
kode	15126	0.165477012 B	0.09753055	1.70	0.0900
kode	15127	0.158942002 B	0.12754909	1.25	0.2130

kode	20126	-0.862455549 B	0.06954253	-12.40	<.0001
kode	20127	-0.874558980 B	0.08271221	-10.57	<.0001
kode	21926	0.258362299 B	0.08765137	2.95	0.0033
kode	21927	0.131525128 B	0.05056932	2.60	0.0094
kode	61926	-0.165807999 B	0.08467752	-1.96	0.0505
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	-0.27238305	0.15724019	0.0835
1989	-0.17695370	0.15702796	0.2600
1990	-0.69545337	0.06178744	<.0001
1991	-0.69526318	0.06117544	<.0001
1992	-0.58016397	0.05091091	<.0001
1993	-0.73098384	0.05608752	<.0001
1994	-0.73880812	0.06359818	<.0001
1995	-0.61607226	0.08531630	<.0001
1996	-0.73406327	0.08048894	<.0001
1997	-0.88991448	0.07596219	<.0001
1998	-0.71470963	0.08710952	<.0001
1999	-0.74843008	0.08004213	<.0001
2000	-0.66120778	0.07704980	<.0001
2001	-0.58750946	0.08100068	<.0001
2002	-0.69594764	0.06830362	<.0001
2003	-0.60108443	0.05893524	<.0001
2004	-0.53557324	0.05605220	<.0001
2005	-0.49522612	0.05532857	<.0001
2006	-0.40106334	0.05575446	<.0001
2007	-0.54849459	0.05335977	<.0001
2008	-0.38355116	0.05858851	<.0001
2009	-0.35147573	0.05967080	<.0001
2010	-0.44987740	0.05948941	<.0001
2011	-0.28648525	0.06028302	<.0001
2012	-0.49770870	0.05665249	<.0001
2013	-0.36224322	0.05184899	<.0001
2014	-0.22807430	0.05752489	<.0001