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Trawl, gillnet and longline survey results from surveys conducted by the Greenland Institute og Natural Resources in NAFO Division 1A Inshore

by

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Abstract

This paper presents the updated indices for the surveys performed by the Greenland Institute of Natural resources (GINR) in the Disko Bay, Uummannaq and Upernavik districts, all part of the North-West Greenland inshore areas located in NAFO subarea 1. The Disko bay has traditionally been part of the trawl survey targeting shrimp and fish species offshore in West Greenland (SFW) since 1992. The Disko Bay has previously also been covered with a longline survey. In 2001 this survey was changed to a scientific gillnet survey in 2001. The Uummannaq and Upernavik districts have per normally been covered by longline surveys due to the bottom topography and ice conditions, which limits the potential use of trawl or gillnets.

Introduction

Greenland halibut is a dominant fish species in the North-west Greenlandic fjords and of major importance to the people living in the area. Besides Greenland halibut and shrimp and cod in the Disko bay, few other fish species of commercial interest are available. Other species are mostly taken as by-catch in the fishery targeting Greenland halibut and includes spotted wolffish, redfish arctic and thorny skate and roughhead grenddier. The area is characterized with deep fjords and massive glaciers in the eastern parts and typically decreasing depths towards the mouths of the fjords. The Disko Bay is characterized by areas of smooth bottom and depths are mostly less than 600 meters. Glaciers are located in the North-eastern part of the bay (Torssukattak) and in the central eastern part (Kangia). The Uummannaq fjord is by far the deepest of the three areas, and depths down to 1500 meters can be found in the South-eastern part of Uummannaq fjord. The Upernavik area is characterized by several iceberg producing glaciers which extend into deep fjords with depths of more than 900 m north of Upernavik. Two of the more important fishing grounds are located in the Upernavik Icefjord and Gieskes Icefjord (Gulteqarffik).

The surveys

The Disko bay is today of major importance for the Greenlandic shrimp fishery. The trawl survey in the Disko bay and along the West coast of Greenland was initiated in 1990 and has throughout the time series been conducted with the 722 GRT stern trawler M/Tr 'Pâmiut'. In 2005 the gear was changed in this survey, but since then the area coverage and the trawl and its rigging has been unchanged See SCR 14/03 for details.

Longlines has been the preferred commercial gear in the area since the introduction in 1910, but gillnets are also used during the winter season. Longline surveys have been conducted in the area for more than five decades, but the longline and equipment has changed several times. Prior to 1993 various longline exploratory surveys were conducted with research vessels. Due to variable survey design and gear, these surveys are not included. In 1993 a longline survey for Greenland halibut was initiated for the inshore areas of Disko Bay, Uummannaq and Upernavik. The survey was conducted annually covering two of three areas alternately, with approximately 30 fixed stations in each area (for further details see Simonsen *et al*. 2000).

The main objective for using gillnets is a well-estimated selectivity and the possibility for targeting pre-fishery sized Greenland halibut, i.e. less than 50 cm. The location is chosen due to the known presence of pre-fishery recruits in combination with bottom topography (approx. 3-400 m depth of even clay bottom) that allows fishing with gillnets. Only 8 stations were fished in the first survey year in 2001, thereafter the number increased to about 50-60 (see Table 2). The surveyed area covers the proposed young fish areas in Disko Bay, off Ilulissat and the Icefjord and off the northern icefjord Torssukattak (table 2 and fig 11). Mesh sizes 46, 55, 60 and 70 mm (knot to knot) with twines 0.28, 0.40, 0.40 and 0.50 mm correspondingly, were used to target the fish size groups approximately 30 – 50 cm. Multi-gang gillnets being approx. 300 m were composed of 4 sections, one of each meshsize, with 2 m space between each section to prevent catchability interactions between sections. Soaktime is approx. 10 hours and fishing occurred both day and night. Stations were paired two and two, close to each other to allow for analysis of within station variability. The survey uses fixed positions of stations, but the stations often vary from year to year due to variable ice conditions. Gillnet selection curves are well-known to be skew and not characterized by a normal distribution. In order to account for catch of larger fish a bi-modal (Wilemanns wings) with a fixed selectivity on larger fish approach was chosen. The mesh sizes 46, 55, 60 and 70 mm was chosen in order to select fish in the length range 30 – 50 cm, i.e. pre-fishery recruits. The resulting selection curve is nearly 100% in that length interval, thus it is assumed that the catches in this length range will reflect the fished population. When estimating the underlying relative population this selectivity curve is assumed.

Greenland halibut larger than 50 cm seem to concentrate at the commercial fishing grounds within and off Kangia and Torsukattak in the north. The gillnet survey only covers the boundary of those commercial fishing grounds. Greenland halibut smaller than 30 cm are thought to perform a stepwise migration towards the main commercial fishing grounds near the icefjords.

Results

The Disko Bay trawl survey

Trawl survey indicated increasing abundance during the 1990s and until the gear change in the survey (fig 1). In 2005, a new gear was introduced making the tow time series less comparable.

However, trawl calibration experiments indicated that the difference in catchability between the gears was length dependant for Greenland halibut and was at equilibrium at lengths around 12 cm but twice as high at 40 cm. Since the abundance is highly driven by 1 year recruits (15 cm) but the biomass by larger individuals, there seem to be a small impact on the gearchange on the abundance index and great impact on the biomass index. From 2005 the abundance decreased to low levels in 2008 and 2009. However, since then the abundance has returned to the previous high levels, mainly driven by large 2010 and 2012 YC (fig 2). The biomass indices in the trawl survey indicate a steadily increase during the 1990s, but heavily increasing biomass after 2002 and until the gear change (fig 1). The new gear indicated an initial decrease but since 2006 the biomass index has been stable. The 2013 biomass estimate indicates a decrease, but this is not seen in the slightly more correct estimate by the original shrimp strata (See SCR 14/03). Therefore the biomass indices in the Disko Bay trawl survey seems stable during the past decade.

The Disko bay gillnet survey

The gillnet survey in the Disko bay targets pre fishery recruits of Greenland halibut at lengths of 30-50 cm. Since the survey uses gillnets with narrow selection curves there is not a major difference between the trends of the CPUE and NPUE indices (fig 3). If comparing the gillnet NPUE (all sizes) to the trawlsurvey indices of Greenland halibut larger than 35 cm, an unusually high agreement between the surveys (fig 3, right) leading to increased credibility in the indices of both surveys. Indices between the gillnet and trawl surveys are also in high agreement in comparing NPUE of Greenland halibut less than 50 cm in the gillnet survey to the indices of Greenland halibut of 35-50 cm in the trawl survey (fig 4). The gillnet survey however performs poorly when tracking individuals less than 35 cm and the agreement between the surveys no longer exists if comparing the gillnet indices of fish less than 35 cm to trawlsurvey indices of fish between 28 and 35 cm. (fig 5).
The gillnet survey CPUE and NPUE also indicated low levels of prefishery recruits in 2006 and 2007, but returned to average levels in 2008. The increase in 2011 NPUEs is seen to derive mainly from the northern area of the Bay, while in the main fishing grounds at the Icefjord bank around Ilulissat the NPUEs have remained low (fig 6). The high numbers of larger fish in 2011 seem not to have any origin in the previous year estimated populations. This may either be due to migration/movements of the larger fish in the area or more likely reflecting the uncertainty of the estimates. The low estimate observed in the 2012 gillnet survey was mainly caused by defect 60 mm gillnet section which can also be observed in the residual plot for 2012 (fig 7).
From the estimated underlying population (fig 8), there is no obvious cohort trend, which is likely due to already size overlapping year-classes.

The Uummannaq Longline and gillnet survey.

The longline survey was continued in 2012 in both Uummannaq (Table 1, fig 9). However the longline was changed from a 7mm thick mainline to a thinner type of longline also used by professional fishermen (5,5mm) in 2012. In general, professional fishermen prefers as thin a longline as possible and during the winter fishery they often use longlines as thin as 2 mm. Professionals also have a far higher CPUE than observed in the survey (.5-1 kg/hook). The new longline and circlehooks used in 2012 survey led to a significant increase in CPUE. The CPUE however dropped in 2013 which could be due to dull hooks used already in 2011. In general

professional fishermen renew their gear several times during the season although looking like new. Results from the longline surveys are therefore not easily interpreted, but the longlines still has advantages compared to the trawl and gillnet surveys. The longline surveys are better at targeting large individuals and provide independent observations of the size distribution in catches and potential by-catch in the landings. In an attempt to improve the surveys in the area, few scientific gillnet settings has been performed in Uummannaq in 2011 and 2013 (fig 10). The aim was to gain knowledge about the stock and pre fishery recruitment in the area. The gillnet stations indicate and that CPUE and NPUE at a similar or higher level than observed in the disko bay. However the gillnet stations also indicate that prefishery recruits can be found in the area (fig 11 left) and that there is an overweight of large individuals compared to the Disko bay (fig 11, right), However some caution should be given in interpreting these few randomly placed station.

The Upernavik longline and gillnet survey.

The longline survey in the Upernavik district was suspended for a long period, but reinitiated in 2010. Like in Uummannaq, the introduction of the new longline led to an increased CPUE in 2012 than dropped back to pre 2012 levels in 2013 (fig 12). The CPUE is however at same level as observed in Uummannaq. In 2012 and 2013 a greater number of stations in Upernavik was allocated to gillnet in an attempt to improve the knowledge gained from the survey (table 1). The stations were placed at random particularly in the central part of the area which holds depths and ice-conditions more suitable for gillnet settings than the deep icefjords. The gillnet stations indicate CPUE and NPUE comparable to the level observed in the Disko Bay (fig 13) and the presence of prefishery recruits at sizes rarely observed in landings from the Upernavik area.

Discussion

The high correlation between the abundance of Greenland halibut larger than 35 cm in the trawl survey and the NPUE indices from the gillnet survey, provides an increased credibility in the survey indices of both surveys. The surveys generally occur separated by a month or less and in the same overall areas at the same depth intervals. The trawl survey covers most of the bay and relies on randomly distributed stations, whereas the gillnet survey relies on fixed stations. The correlation between the surveys could be caused by an evenly distributed stock with a high overlap in size selectivity of the two very different gears in relation to the present length distribution of the stock. Still both surveys show some inter-annual variation which could be due to shifts in the distribution of the stock in and out of areas that are not covered by the surveys. It seems unlikely that the years with large changes in the indices, indicate a proportional change in the total biomass of the stock. Therefore the surveys should only be interpreted as indices and indicators of the overall development of the stock.

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Table 1 . Number of stations by gear and Area (Under construction)

	Disko Bay		Disko Bay			Uummannaq			Upernavik		
Year	Trawl	vessel	Longline	Gillnet	Vessel	Longline	Gillnet	Vessel	Longline	Gillnet	Vessel
1990	*	Pa			AJ						
1991	41	Pa			AJ						
1992	39	Pa			AJ						
1993	31	Pa	11		AJ						
1994	27	Pa	8		AJ						
1995	33	Pa									
1996	33	Pa	17		AJ						
1997	34	Pa	24		AJ						
1998	33	Pa									
1999	34	Pa	12		AJ						
2000	23	Pa	10		AJ						
2001	23	Pa	1	8	AJ						
2002	22	Pa		55	AJ						
2003	19	Pa		56	AJ						
2004	14	Pa	8	50	AJ						
2005	16	Pa	1	47	AJ						
2006	21	Pa		44	AJ						
2007	18	Pa		30	AJ						
2008	16	Pa		35	CH						
2009	24	Pa		-							
2010	25	Pa		48	AJ						
2011	26	Pa		50	AJ		4	AJ			AJ
2012	21	Pa		41	SA		3	SA		21	SA
2013	17	Pa		27	SA		7	SA		19	SA

NOTES:

2012 – Disko bay gillnet survey had defect 60 mm gillnet section.

2013 – Disko bay gillnet survey had stations with large catches of cod (fishing effect may have been decreased)

Table 2 . Number of gillnet settings by stat. square in gillnet survey in Disko Bay since 2001.

Square	Year												
	2001	2002	2003	2004	2005	2006	2007	2008	2010	2011	2012	2013	Total
LD027			2	2					2	2	2	2	12
LE027			2	2					2	2	2	2	12
LF027			2	2		2	2						8
LF028			2	2		2		2	2	1	2	2	15
LG024			2	1									3
LG025				3		2				1	2	2	10
LG026		1		2		2				2	2	2	11
LG027	4	7	6	5	6	5	4	6	6	4	4	1	58
LG028	2	2	1	1	1	3	1		1	1			13
LH026		2	1		1	1		2	2	2	2	1	14
LH027		5	3	3	3	3		3	3	4	3		30
LH028	2	1	9	6	8	4	1	7	9	6	2		55
LJ026		3	2	2		4	2	3	2	3	3		24
LJ028		5	3	5	4	4	4	4	4	4	2	2	41
LK029		5	4	2	4	2	4		2	2	2	2	29
LL029		1	1		2		1						5
LM027								1					1
LM029		2	2		2								6
LM030		2	2		2								6
LM031		2	2		2								6
LN024		2	2	2	2	2			2	2	2	2	18
LN025		5	3	4	3	4	4	1	4	4	3	2	37
LN026		4	2	2	3	2	5	3	3	5	5	3	37
LN027		2	2	2	2	2		1	2	1	1	2	17
LN028		2	1	2	2			2		2	2	2	15
LP024		2					2		2	2			8
Total	8	55	56	50	47	44	30	35	48	50	41	27	491

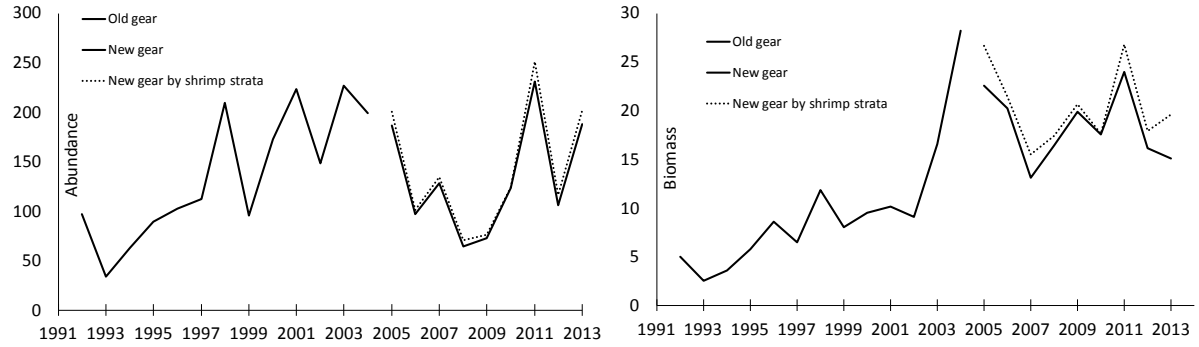

Fig. 1. Trawl survey (SFW): Abundance (left) and biomass (right) indices from the Greenland shrimp and fish trawl survey part (right) in the Disko bay.

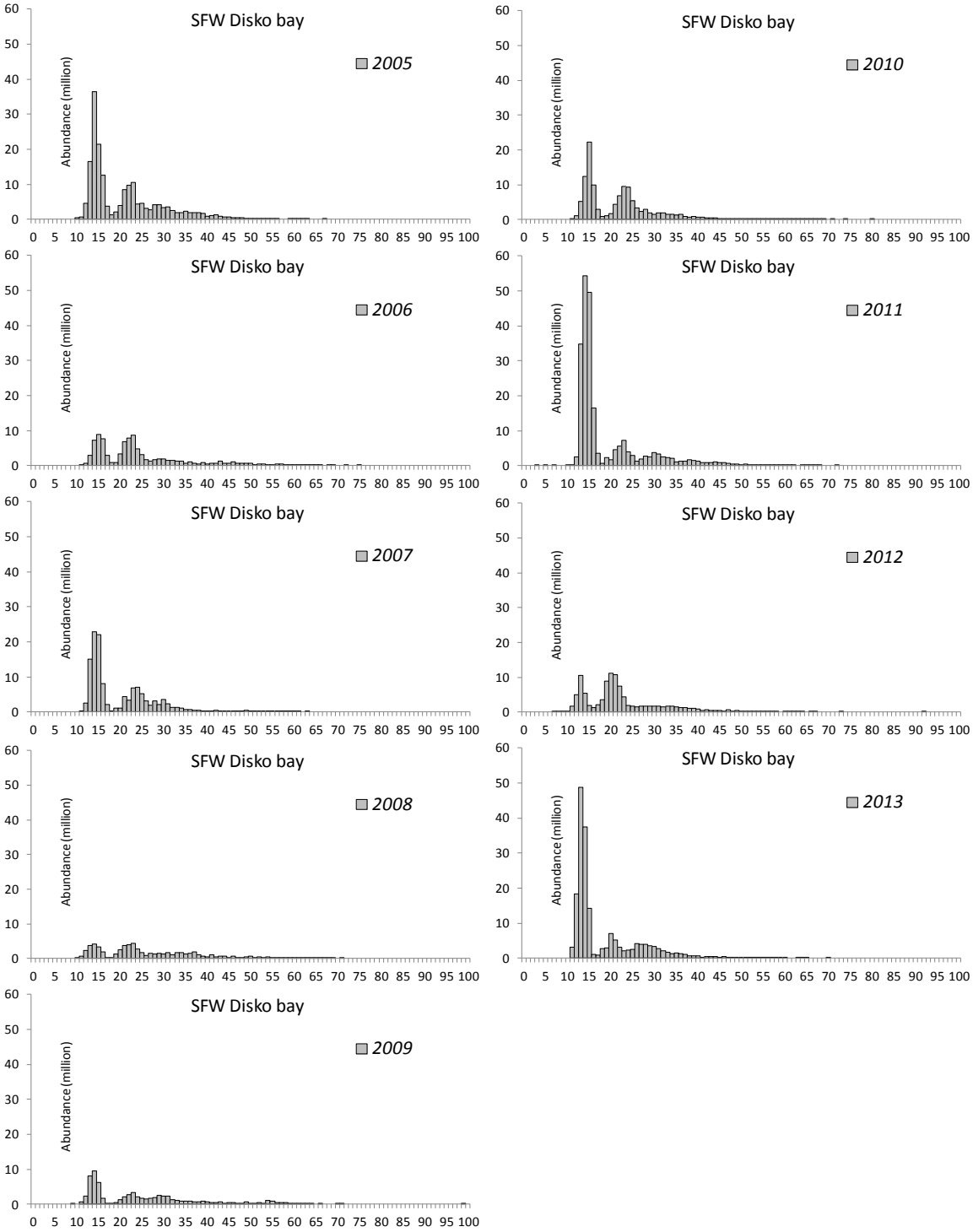

Fig 2 Greenland halibut length frequencies from the Greenland shrimp and fish trawl survey (SFW) in the Disko Bay since 2005.

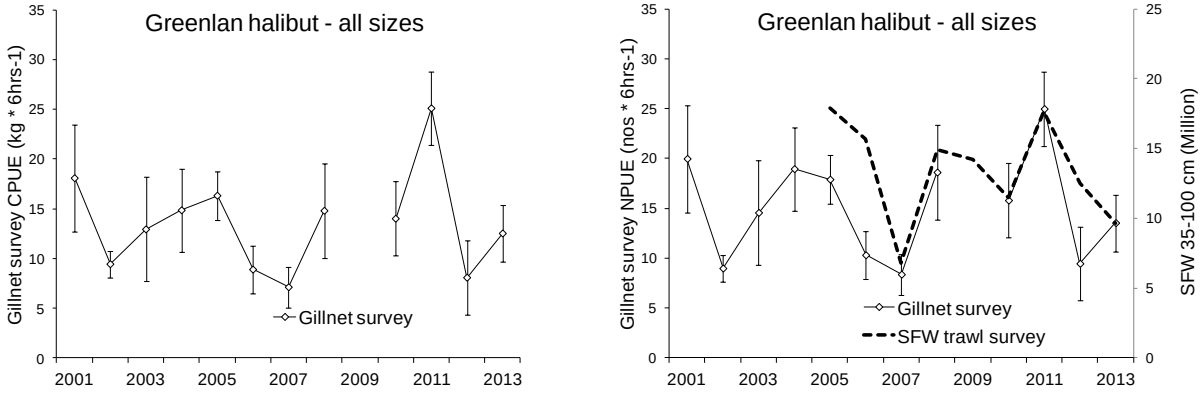

Fig. 3. Disko Bay longline and gillnet survey CPUE (left) and NPUE (right) of Greenland halibut (all sizes) and abundance estimates for the Disko Bay part of the Greenland shrimp and fish survey (right) of halibut larger than 35 cm.

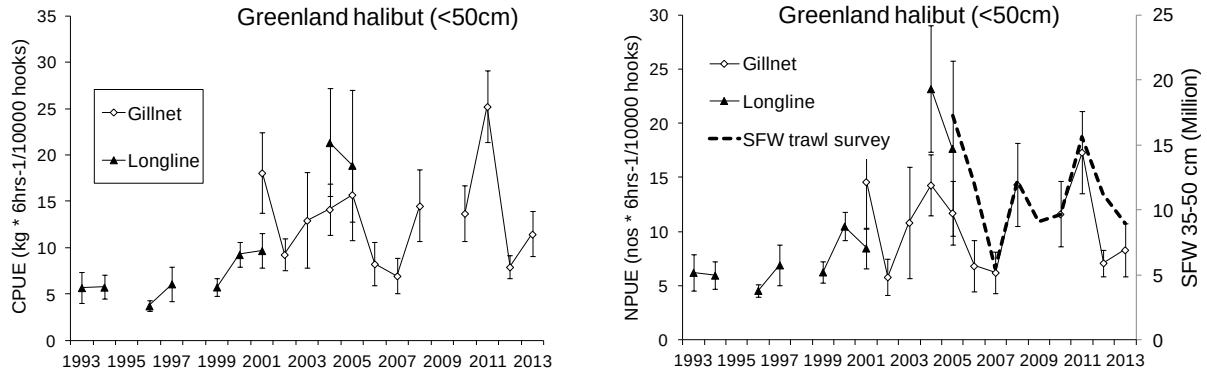

Fig. 4. Disko Bay longline and gillnet survey CPUE (left) and NPUE (right) of Greenland halibut (< 50cm) and abundance estimates for the Disko Bay part of the Greenland shrimp and fish survey (right) of halibut (35-50 cm.).

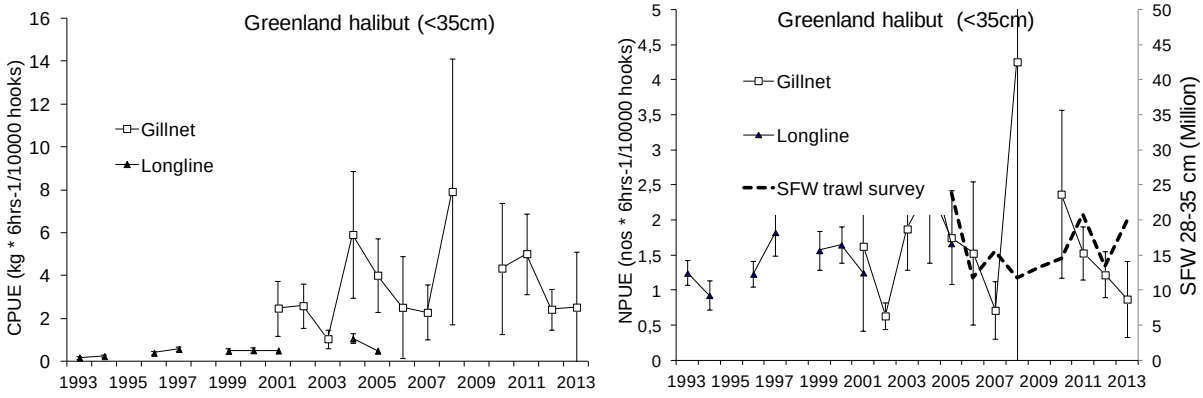

Fig. 5. Disko Bay longline and gillnet survey CPUE (left) and NPUE (right) of Greenland halibut (< 50cm) and abundance estimates for the Disko Bay part of the Greenland shrimp and fish survey (right) of halibut (28-35 cm.).

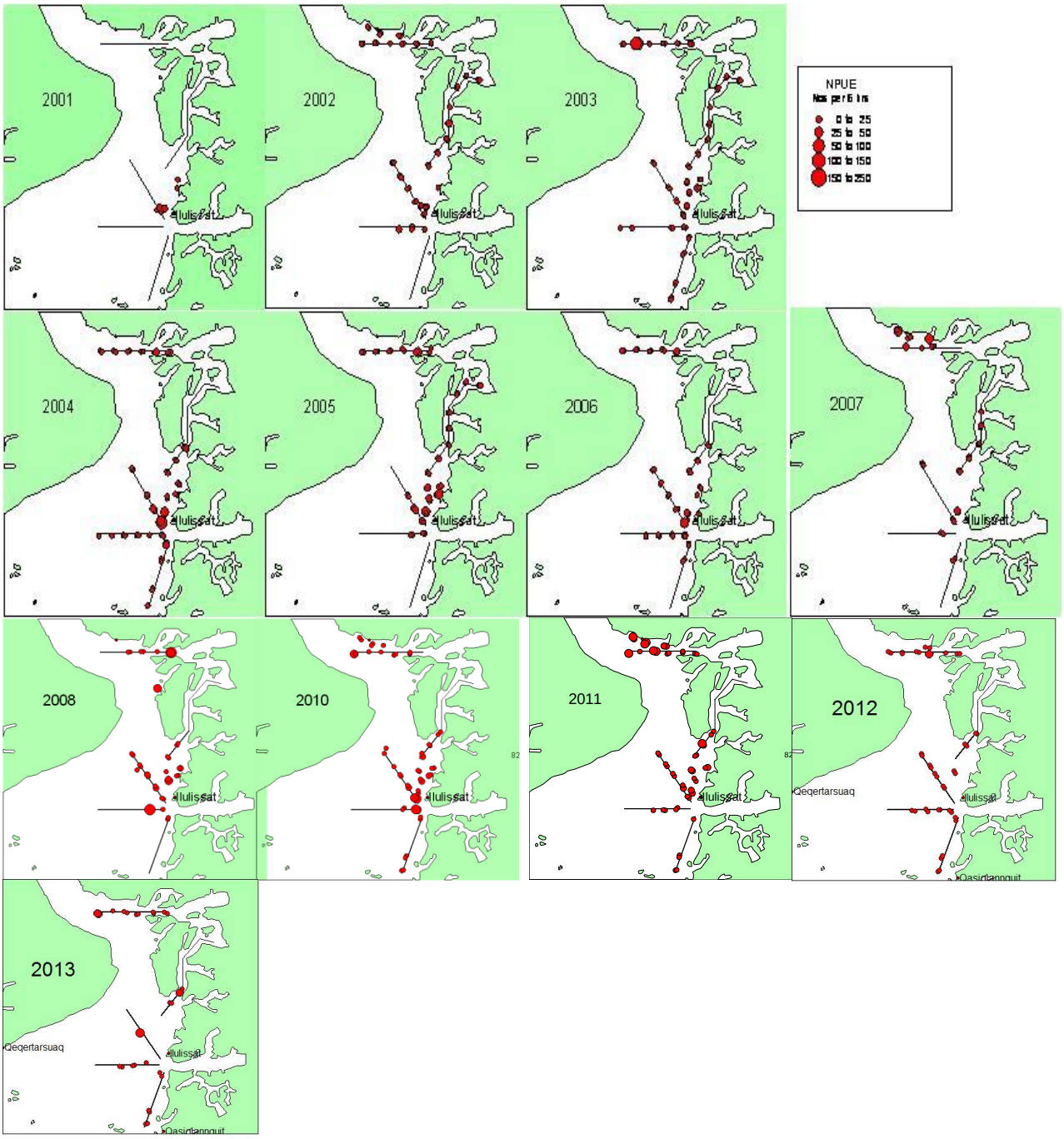

Fig. 6. Gillnet survey in Disko Bay by year. Lines indicate transects and dots the distribution of NPUE (Nos G.halibut per 6 hrs of setting).

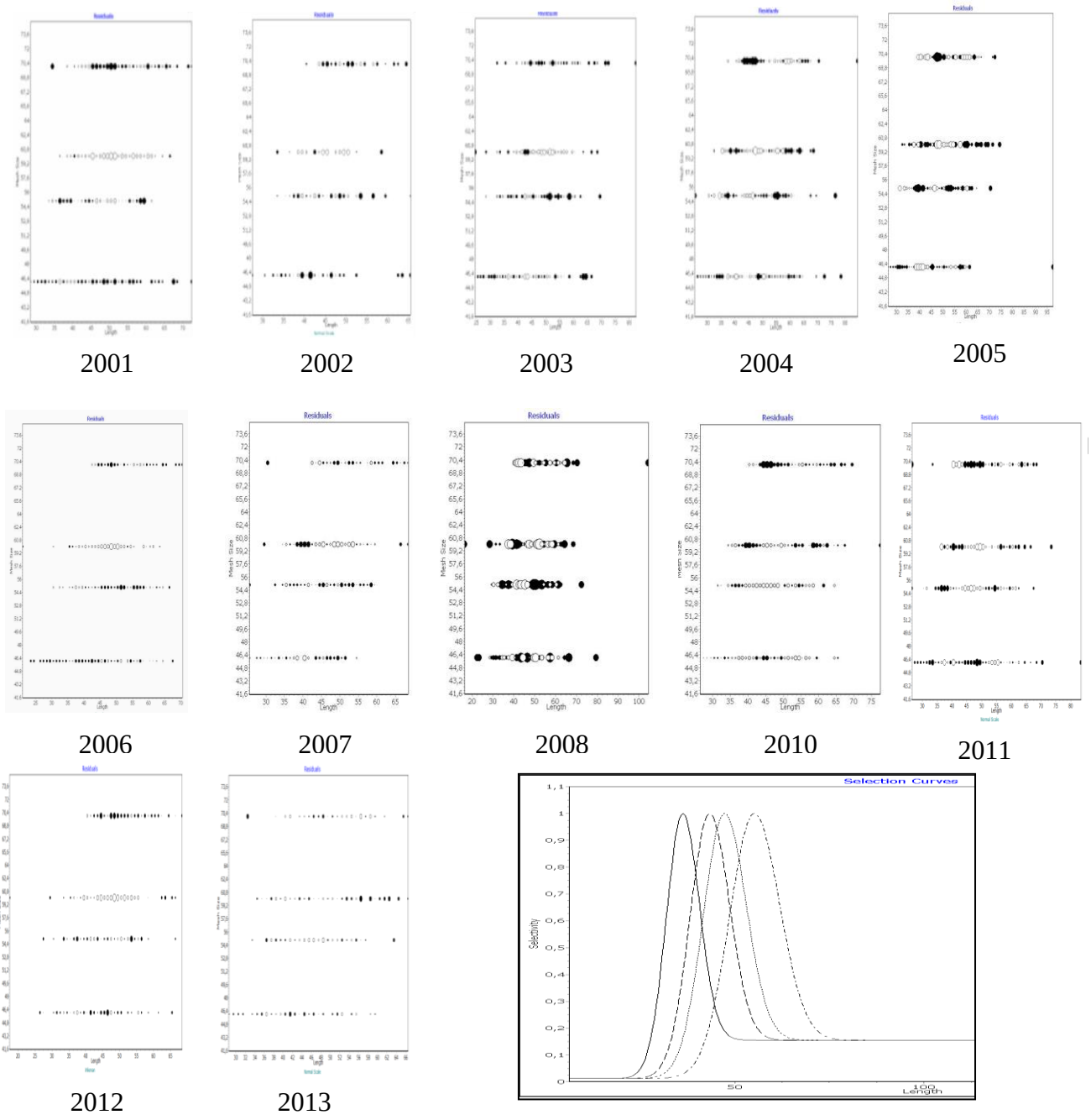

Fig. 7. Residuals for each meshsize (y-axis) by length (x-axis) from the selectivity model (Wilemans Wings) 2001-2012.

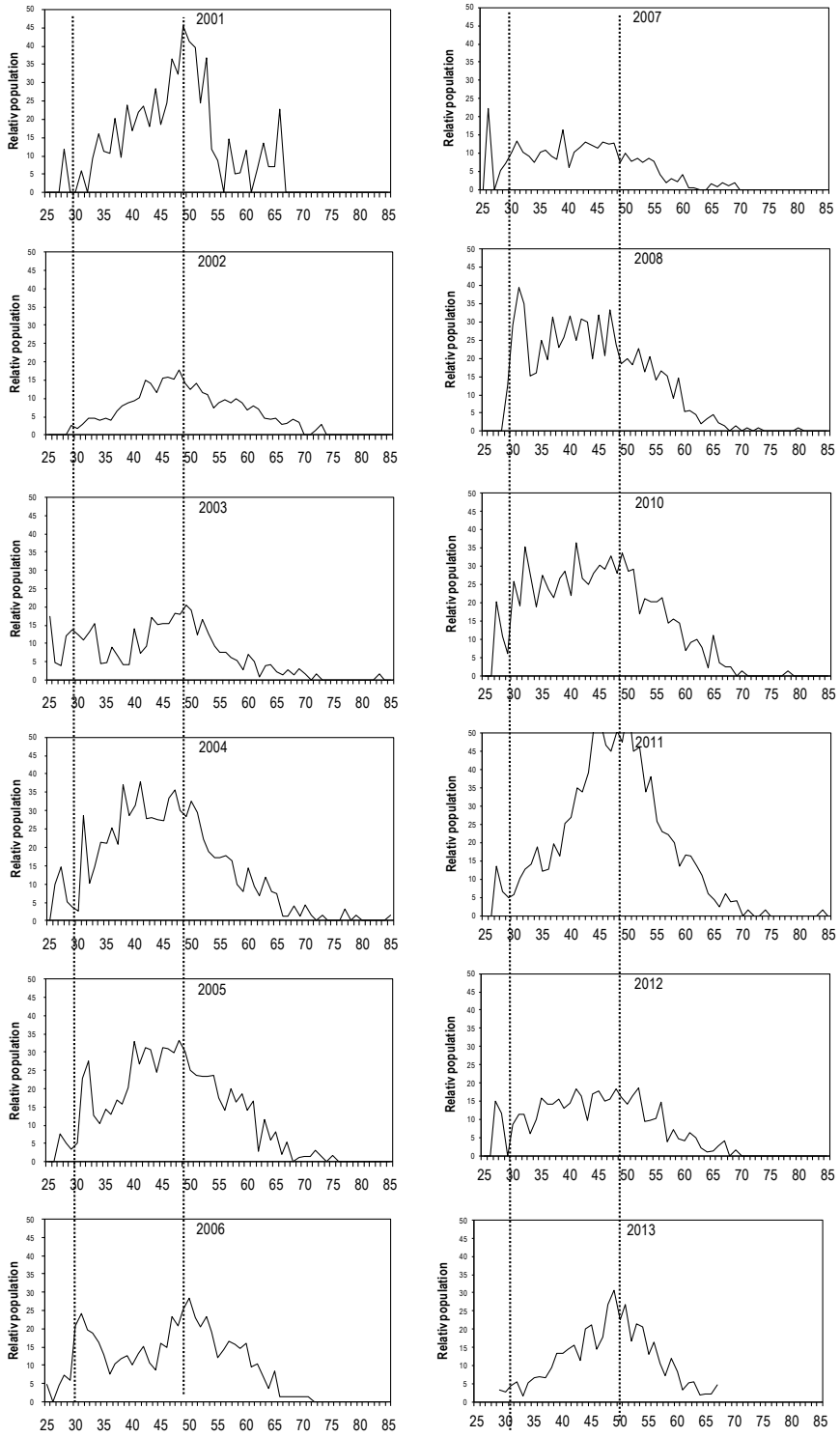

Fig 8 Gillnet survey in Disko bay. Estimated relative population assuming a Wilemans Wings selectivity curve in 2001 to 2011. The dashed lines indicate the length interval 30-50 cm where fully selection is assumed.

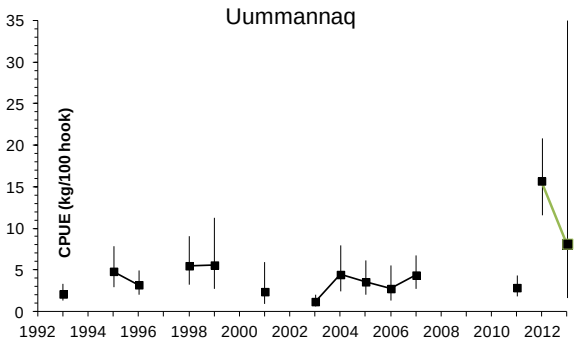

Fig. 9. Longline survey indices with CI for Uummannaq (left) and Upernavik (right). New survey logline introduced in 2012.

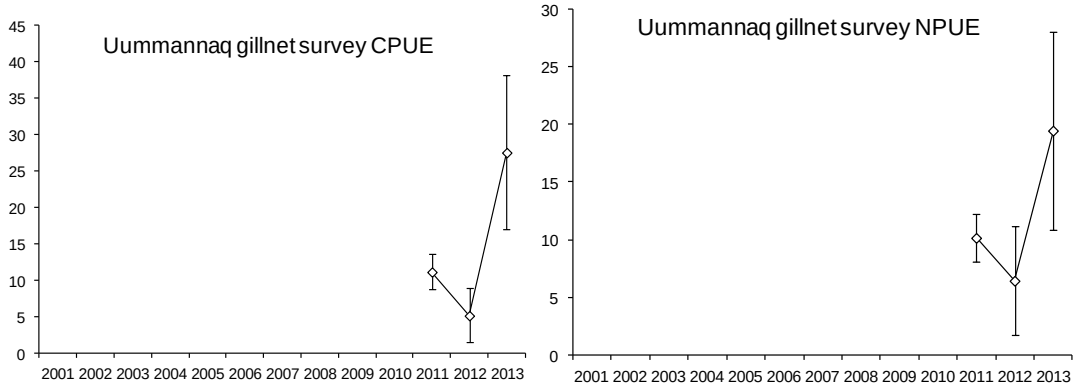

Fig. 10. Uummannaq gillnet survey CPUE (left) and NPUE (right) of Greenland halibut (all sizes).

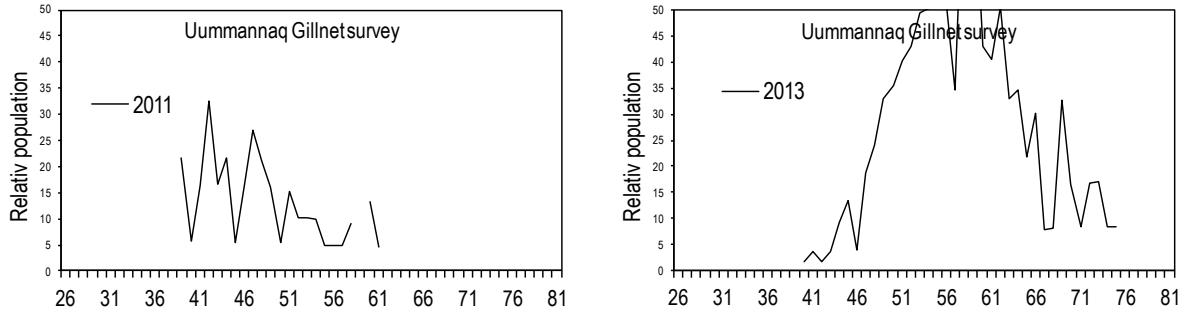

Fig 11 Gillnet survey in Disko bay. Estimated relative population assuming a Wilemans Wings selectivity curve in 2011 and 2012. Full selection is assumed for 30-50 cm Greenland halibut.

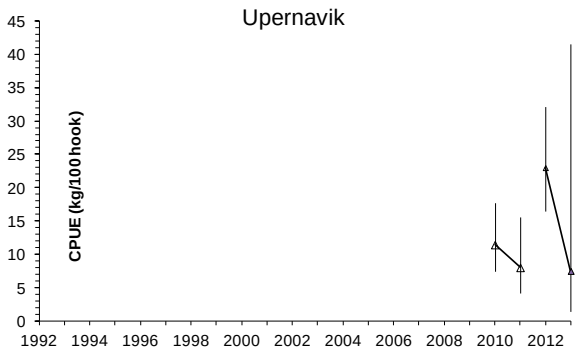

Fig. 12. Longline survey indices with CI for Uummannaq (left) and Upernavik (right). New survey logline introduced in 2012.

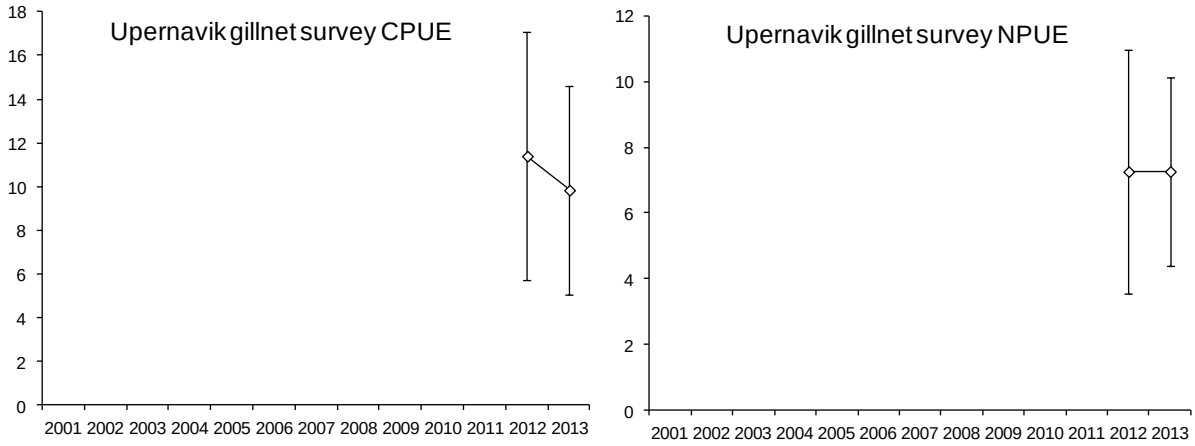

Fig. 13. Upernavik gillnet survey CPUE (left) and NPUE (right) of Greenland halibut (all sizes).

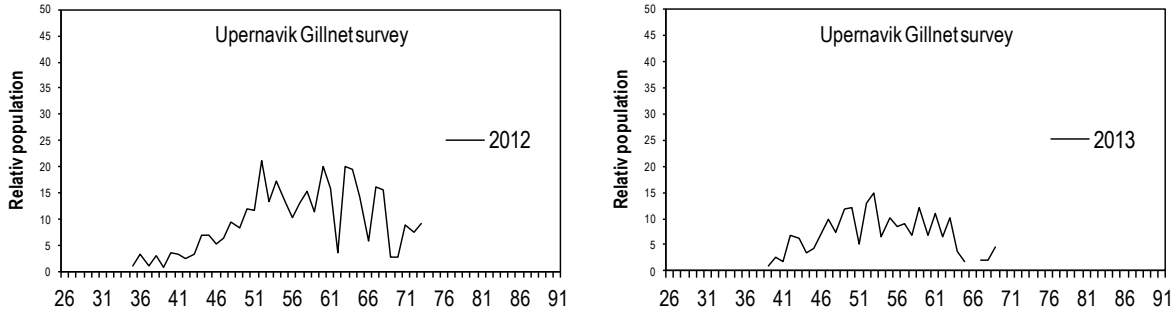

Fig 14. Gillnet survey in Disko bay. Estimated relative population assuming a Wilemans Wings selectivity curve in 2001 to 2011. The dashed lines indicate the length interval 30-50 cm where fully selection is assumed.

Appendix I

Length frequencies and species list of other species caught inshore (under construction)