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Survey results from the Upernavik Gillnet survey, NAFO Division 1Ainshore.

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 fjords near Upernavik, part of the NAFO division 1A (inshore). The fords near Upernavik were previously surveyed with longline, but from 2011 to 2015 the surveys were gradually changed to gillnet surveys. Since 2016, gillnet have been fully implemented in the areas. The gillnet survey was originally designed for the Disko Bay and targting prefishery recruits from 30-55 cm. In order to survey commercially sized Greenland halibut a larger meshed section (90mm halfmesh) was added in 2016.

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. In Upernavik, Greenland halibut is the only important targeted species. Other species taken mostly as bycatch include Spotted wolffish, but these are often discarded or used locally and rarely landed. Greenland halibut is therefore of major social and economic importance to the local communities.

Survey area

The fjords near *Upernavik* are characterized by several large iceberg producing glaciers, which extend into deep narrow fjords with depths of more than 900 m (Figure 1). Two of the more important fishing grounds are located in the Upernavik ice fjord and Gieskes ice fjord (Gulteqarffik). Although the main fishing grounds in the Upernavik area are located in the deep ice fjords, the branching fjord systems between the ice fjords are easier to access and survey. The branching side fjords have more suitable depths 0-700m and have smaller icebergs and lesser summer glacier ice than the Upernavik Isfjord and Gieskes icefjord, which are rarely accessible to the research vessels in the available timeframe. Therefore, the survey is limited to the fjord areas between the larger icefjords and only partly covering the commercial fishing grounds in the area. The management area extends to 75 N, and little to no fishery exists further north until the Qaanaaq fjord.

Materials and methods

The survey is conducted with the GINR research vessel R/V Sanna. Surveys have been conducted in the area since the mid 1970's sporadically even longer, using different types of longlines. However, in most years the longline surveys performed poorly, with high year to year variability and CPUE's far below commercial CPUEs observed in logbooks from the commercial fleet. The low CPUE could be caused by anything from poor bait quality (squid vs fresh capelin) to doll hooks or heavier auto longlines used in the survey, than used by the smaller vessels and dinghies operating using hand baited light longlines. Furthermore, unlike Gillnets and Trawls, the longline has the downside of being saturated both thereby gradually loosing fishing effort as fish

compete for the baits. The saturation effect is further impacted by abundance of other species. Gillnets and trawls are impacted to a lesser degree influenced by saturation of the gear. Although appealing these gears would be challenging to use in the Upernavik area. Trawls are difficult to use in the fjords fjord due to both bottom contours and in some areas very silty and soft bottom. Gillnets have the challenges of summer glacier ice, great depths and Greenland sharks all in combination with fine meshed survey gillnets.

Biological samples

Length, weight, gutted weight, otoliths and occasionally DNA samples are regularly collected during the surveys. Otoliths are collected from individual Greenland halibut and frozen in a plastic bag with a printed plastic label with individual information and an automatically created number. At the GINR, otoliths are read after a method developed in Norway. In the Lab otoliths are photographed with translucent light with a Leica S9i stereomicroscope in a 5 MP TIF image. After imaging the otoliths are archived. Digitally archived Images are then "read on screen" using ImageJ. In ImageJ both contrast and brightness can easily be adjusted and a calibration beam allows for digital measurements of proportions of the otolith. Images are standardized and attempts for automated digital reading are being tested.

ALK
An Age Length Key is produced from the aged otoliths for each cm group. If the ALK is incomplete for certain lengths, a backup ALK is used for the missing length combinations from the same year but combined inshore areas. The backup-ALK produced from all inshore areas in a given year, is screened for the missing length-age combinations. To produce a complete backup-ALK, missing ages for certain lengths are estimated from the von bertalanffy growth equation.

Climatic conditions

Temperature and depth loggers are attached to the majority of the gillnet, measuring the bottom temperature and revealing the sinking rate of the gillnets. The index is currently not corrected for sinking time which is increases with depth. Sinking time varies from 20 min at shallow depth to almost 60 min in deep stations (+900m). CTD stations have been performed in some years (increasing effort) and the data is stored by the Greenland Climate Research Centre GCRC, located in Nuuk:

Results

In the initial experimental years the number of stations in the gillnet survey was low. Between 13 and 21 gillnet stations were made annually in the initial years of the survey. An overview of the most recent surveys and stations by year, vessel and gear is given in table 1.

From 2015 to 2019, survey NPUE remained at a stable level whereas the CPUE decreased slightly (fig 2). In 2020 a substantial increase in both NPUE and CPUE was observed. The increase was observed across stations with particularly the last two stations in the survey having extremely high catches (figure 3). The increase is mainly caused by higher numbers of Greenland halibut from 40 to 55cm (figure 4). Also higher than usual numbers of 30 cm Greenland halibut (around 3 years) was observed in 2020 (figure 4). The slow decrease in the CPUE from 2015 to 2019 is also seen as a small decrease in the size of the fish in the survey (figure 4). The recent increase in the NPUE and CPUE are caused by higher than usual numbers of small Greenland halibut.

The survey Catch At Age (table 3 and figure 5) was calculated with using the age length key (ALK) from Upernavik (according to table 3) calculate the CAA for Upernavik. In years with missing ALK for Uperanvik the Backup ALK based on all inshore areas in division 1A inshore from individual years. The Backup ALK was made with the individual years Age readings from all inshore areas in division 1A and therefore mainly the Disko bay individual years.

Ageing of the otoliths was in the past done by looking at the dried otolith through a stereomicroscope. However from 2007 to 2009 the method changed to looking at fresh frozen otoliths through a stereomicroscope.

Uncertainty about the method however led to a lack of reading until 2017. All ages since 2010 in the CAA are based on newer agereadings done after 2017 with increasing quality.

The first initial years with untrained readers show unrealistic Mean-weight-At-Age (Figure 6). However, the newest readings for the 2010, 2019 and 2021) all analyzed in 2021 have a relative stability in the MWAA for most cohords until around age 10.

LW relationship for the sampled Greenland halibut since 2010 is provided in table 4.

Cod, Redfish, Arctic skate, thorny skate and spotted wolffish are also caught in the survey. CPUE's are not presented for these species currently. Length frequencies for Cod is given in figure 5.

Discussion

Since only part of the commercial area is covered by the survey and also excluding the most important fishing grounds due to glacier ice, the survey should be considered an index only. The increase in the NPUE and CPUE in 2020 and 2021 (above previous years) corresponds well with the observations of increased recruitment observed in the Disko Bay and the Uummannaq fjord. With the new ALK keys the MWAA seems more stable when using the majority of otoliths from Upernavik which should include far larger fish than in the Disko Bay. Furthermore, it looks like a 2010 yearclass is visible in the bubble plot. If this is indeed the case this would fit with the larger than usual numbers of age 1 observed in 2011 (2010 YC) observed in Greenland shrimp and fish survey which includes the offshore recruitment area just west Uummannaq and Upernavik. Also the 2015 yearclass also observed as large in Uummannaq and Uperanvik is clearly visible.

References

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Nygaard, R. and Nogueira 2021. Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated from the Greenland Shrimp and Survey, 1988-2018. NAFO Scr. doc.21/014.

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

Table 1. Number of stations by gear (Table is incomplete)

Year	Longline	Gillnet	Vessel	Notes
1994	30	-	AJ	
1995	32	-	AJ	
1996	-	-	-	
1997	-	-	-	
1998	31	-	AJ	
1999	-	-	-	
2000	30	-	AJ	
2001				
2002				
2003				
2004				
2005	-	-	-	
2006	-	-	-	
2007	-	-	-	
2008	-	-	-	
2009	-	-	-	
2010	15	-	AJ	
2011	13	-	AJ	
2012	7	21	Sa	46,55,60,70
2013	16	19	Sa	46,55,60,70
2014	16	13	Sa	46,55,60,70
2015	0	48	Sa	46,55,60,70,90
2016	0	47	Sa	46,55,60,70,90
2017	0	41	Sa	46,55,60,70,90
2018	0	52	Sa	46,55,60,70,90
2019	0	31	Sa	46,55,60,70,90
2020	0	46	Sa	46,55,60,70,90
2021	0	49	Sa	46,55,60,70,90

Research vessels: Adolf Jensen (AJ), R/V Sanna (Sa).

Table 2. Number of otoliths collected and aged from the gillnet survey in Upernavik.

Year	Area	Otoliths	Aged	Ageing method
2010	Upernavik	343	60	Frozen image
2011	Upernavik	491	0	Frozen image
2012	Upernavik	267	0	Frozen image
2013	Upernavik	296	0	Frozen image
2014	Upernavik	333	13	Frozen image
2015	Upernavik	407	8	Frozen image
2016	Upernavik	453	0	Frozen image
2017	Upernavik	361	0	Frozen image
2018	Upernavik	378	46	Frozen image
2019	Upernavik	326	293	Frozen image
2020	Upernavik	407	0	Frozen image
2021	Upernavik	529	516	Frozen image

Table 3. Catch At Age table for the gillnet survey in Upernavik

Year	Index val	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
2012	119.5947863	0	0	4	9	16	23	32	14	10	7	3	0	1	0	0
2013	121.0643464	0	0	8	30	27	24	16	8	3	2	0	0	1	1	1
2014	213.9250592	0	0	7	7	23	60	68	40	7	0	1	0	1	0	0
2015	274.1301119	1	1	29	81	44	51	28	23	9	3	2	1	0	0	1
2016	238.265859	0	1	19	52	68	45	31	11	6	2	1	1	0	0	0
2017	271.9163809	0	1	2	35	61	62	43	25	20	6	5	6	2	1	2
2018	271.4841734	1	5	23	40	48	51	34	18	16	20	4	2	8	2	2
2019	212.9902713	0	0	12	52	62	44	25	10	4	2	0	0	0	0	0
2020	432.2359051	0	11	89	180	91	43	13	4	1	1	0	0	0	0	0
2021	373.6783955	0	2	35	126	123	66	12	6	2	1	1	0	0	0	0

Table 4. modelled Length-Weight relationship for Greenland halibut.

Year	Area	Number fish	Log a	b	R^2
2012	Upernavik	267	-13.326	3.431	0.985
2013	Upernavik	294	-12.853	3.299	0.988
2014	Upernavik	333	-12.978	3.33	0.984
2015	Upernavik	407	-12.696	3.267	0.991
2016	Upernavik	453	-12.607	3.255	0.984
2017	Upernavik	361	-12.445	3.216	0.985
2018	Upernavik	378	-12.722	3.283	0.989
2019	Upernavik	326	-12.421	3.205	0.986
2020	Upernavik	407	-12.454	3.227	0.99
2021	Upernavik	528	-12.862	3.323	0.988

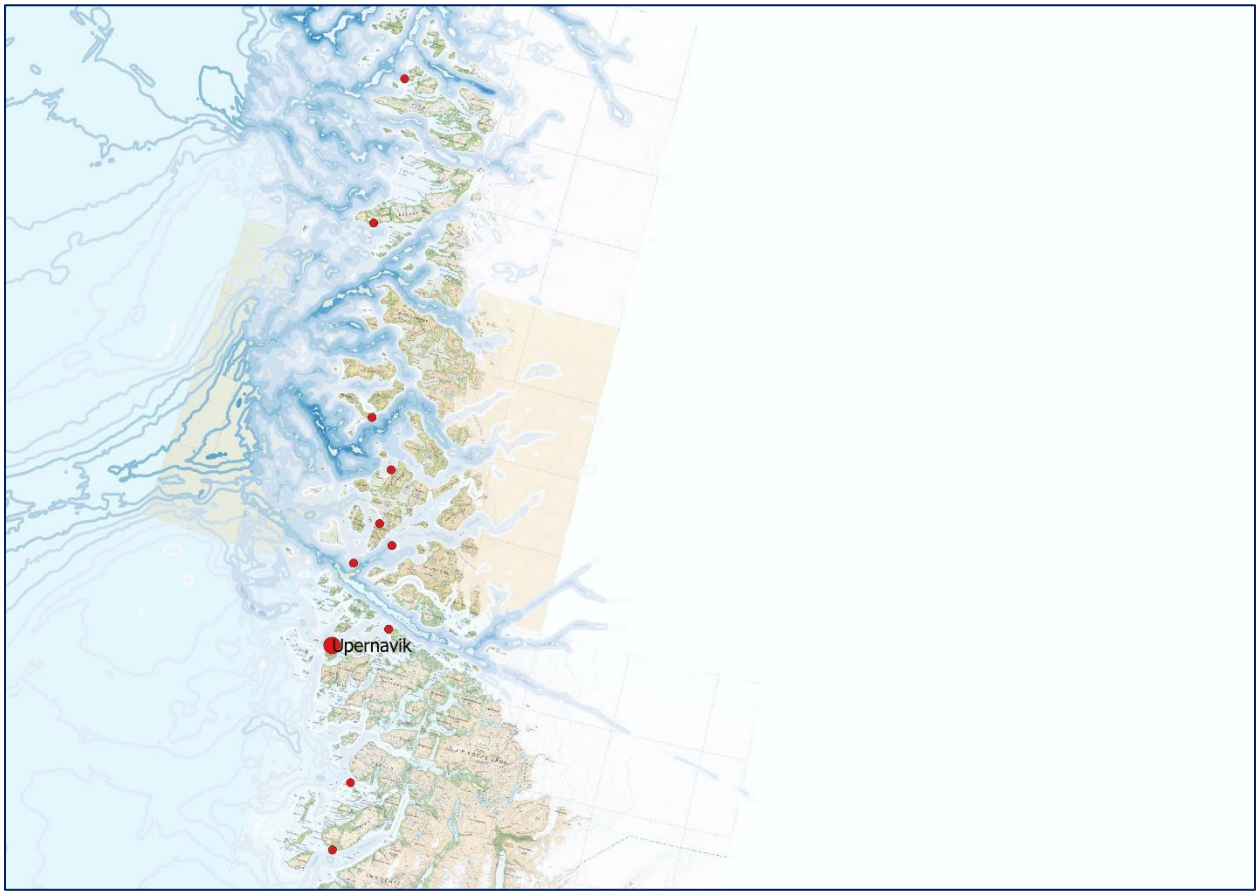

Figure 1. Map of the Upernavik area. Scale 1:2000000

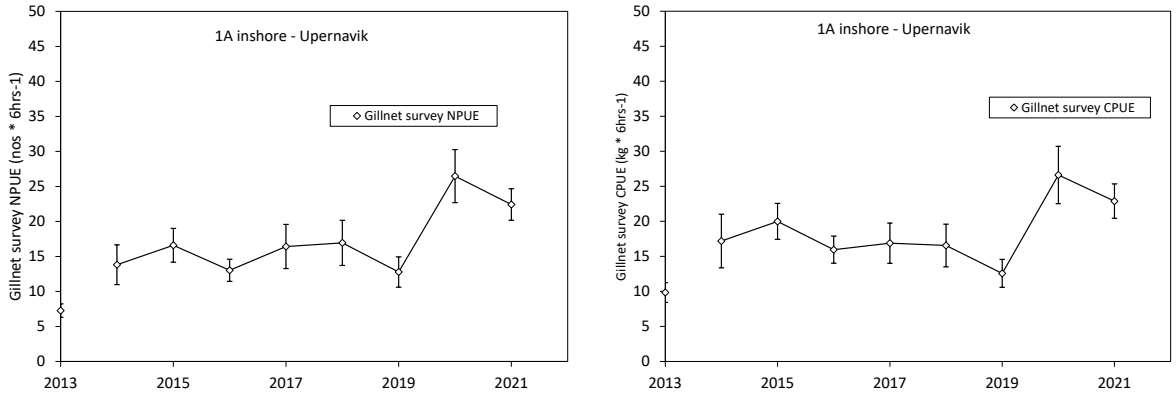

Figure 2. Upernavik gillnet survey NPUE (left) and CPUE (right) and of Greenland halibut (all sizes).

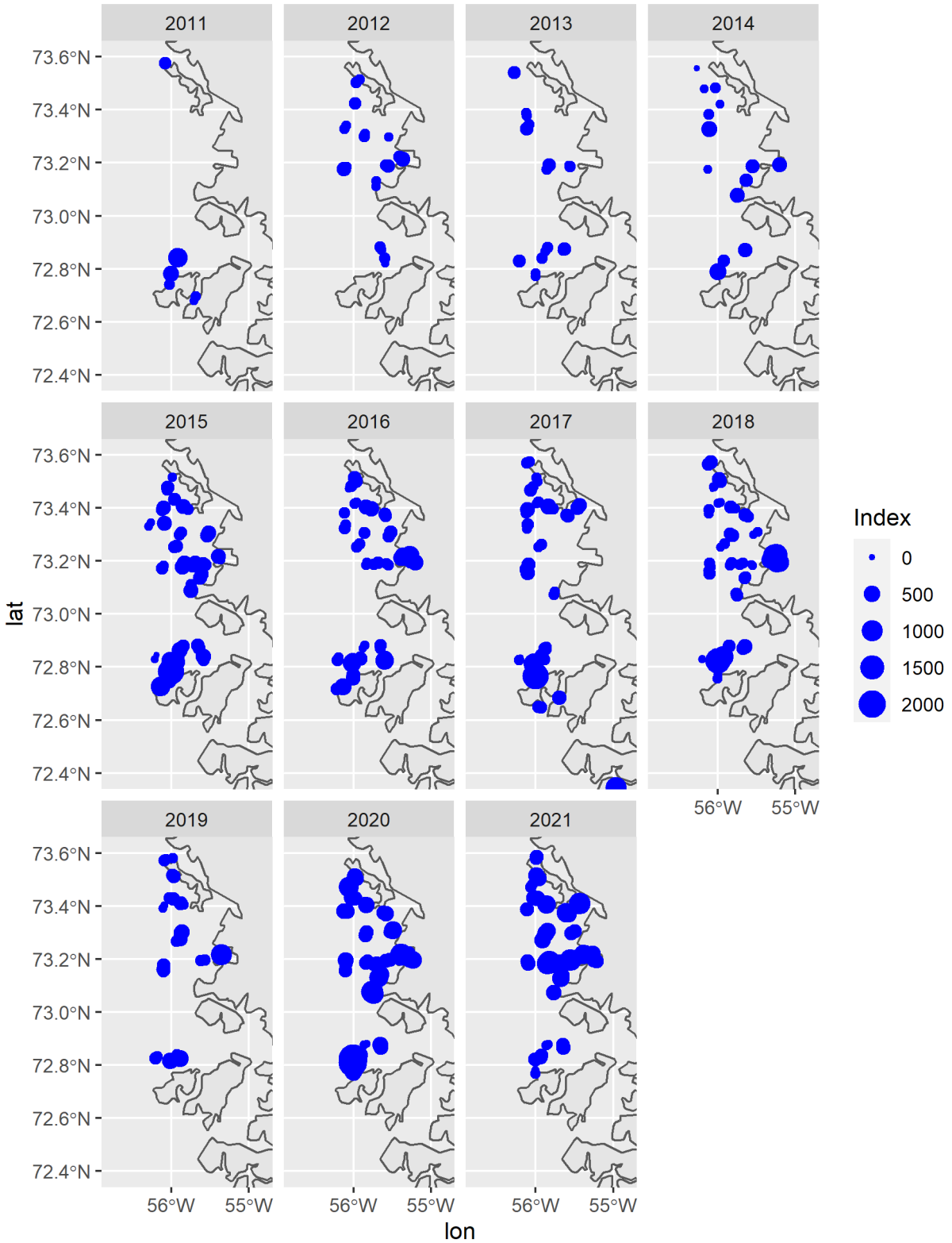

Figure 3. NPUE index by station. (numbers per 100 hrs) Note map missing islands.

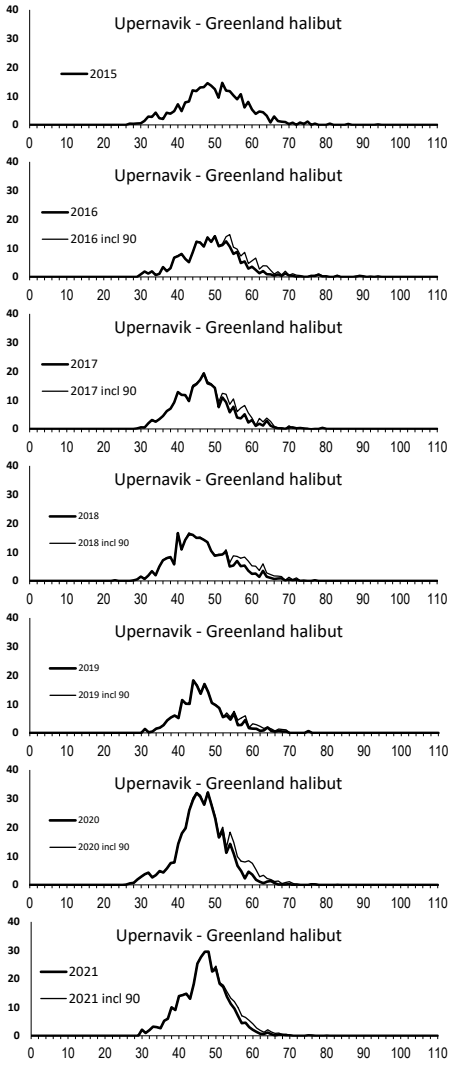

Figure 4. Upernavik: Observed LF (N/100hr) for Greenland halibut.

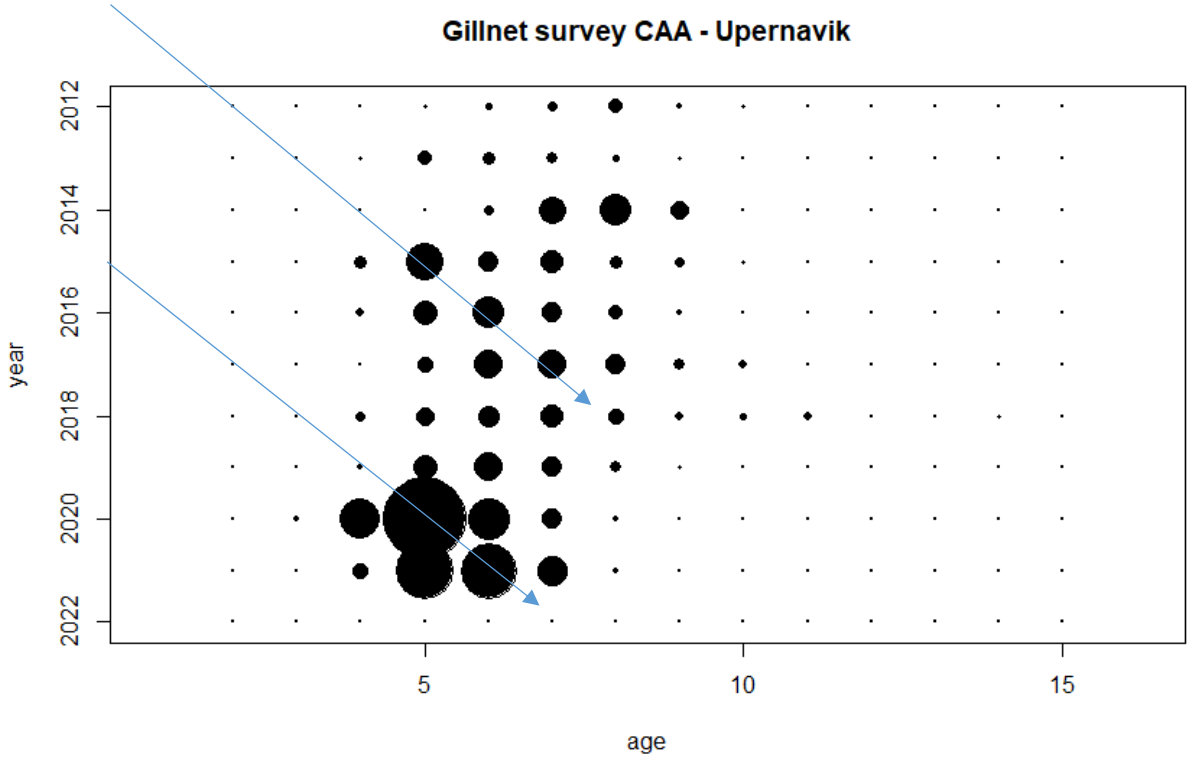

Figure 5. Upernavik survey Catch At Age CAA for the Upernavik gillnet survey.

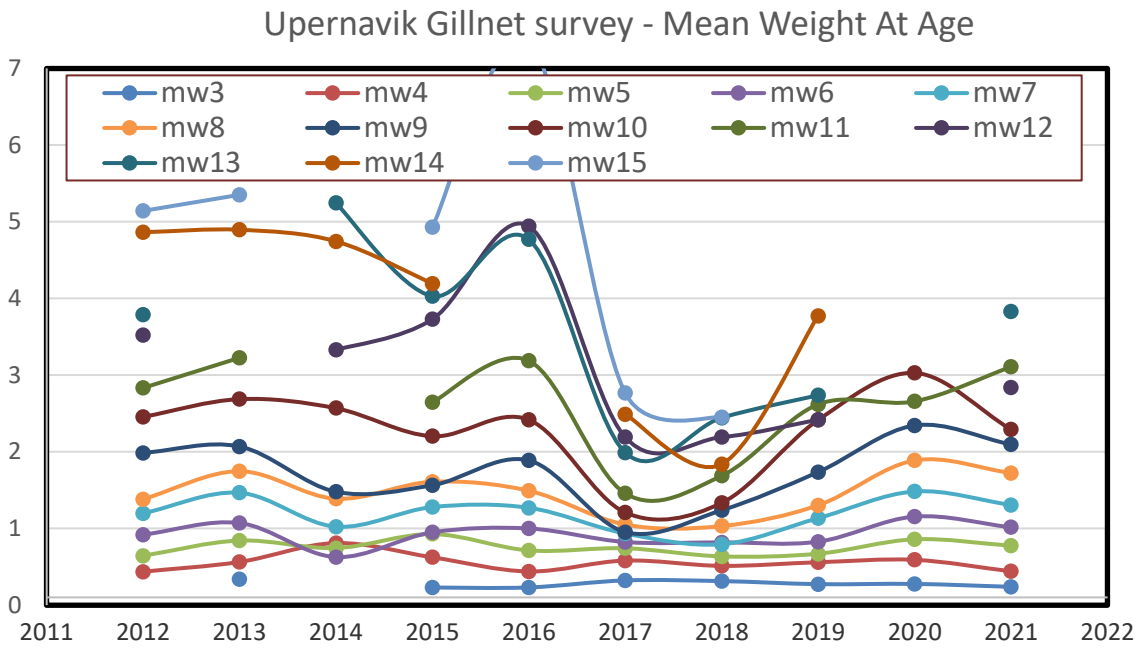

Figure 6. Estimated Mean Weight At Age for the Upernavik gillnet survey. Note that 2010 2019 and 2021 (see table 2) shows some level of stability in the MWAA

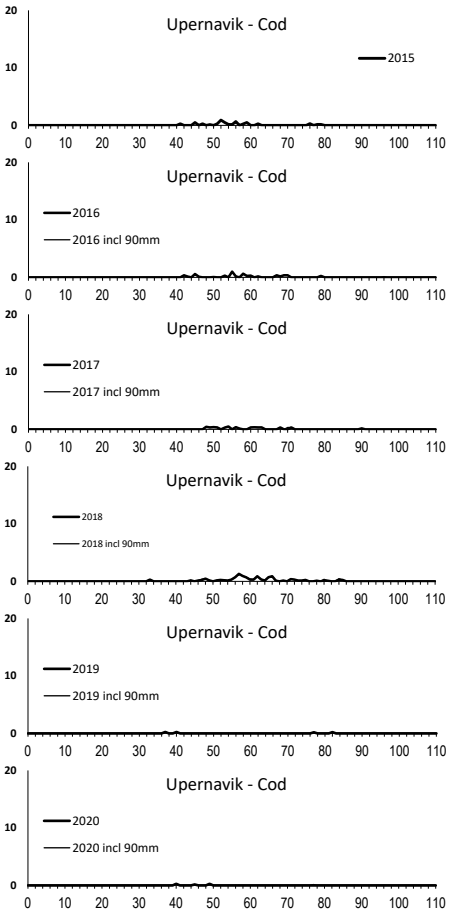

Figure 7. Upernavik: Observed LF (N/100hr) for Atlantic cod.