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Survey results from the Uummannaq gillnet survey 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 Uummannaq Fjord located in NAFO division 1A. The Uummannaq fjord was previously surveyed with longline, but in 2015 the surveys was gradually changed to a gillnet survey. The gillnet survey was originally designed for the Disko Bay targeting prefishery recruits from 30-55 cm. In order to also survey larger commercially sized Greenland halibut a larger meshed section 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 Uummannaq, Greenland halibut is the most important targeted species. Other species like cod, redfish, spotted wolffish and rough head grenadier are taken as bycatch in the Greenland halibut fishery. Greenland halibut is therefore of major social and economic importance to the local communities.

The *Uummannaq* fjord is located in North West Greenland. The fjords in the three areas, and depths down to 1500 meters can be found in the South-eastern part, with slightly shallower depths towards glacier fronts (Figure 1). Several large iceberg producing glaciers are present with the more dominant glaciers located in the South Eastern part Qarajaq (store bræ) and North Eastern parts (Rinks isbræ). The central parts of the Uummannaq fjord is shallower and with smooth bottom contours at depths of 500-700m, connected to the Baffin Bay to the West.

Surveys have been conducted in the area since the mid 1970's, using different types of longlines. However, 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 are also challenging to Use in the Uummannaq Fjord. Trawls are difficult to use in the Uummannaq 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. To avoid gillnet being destroyed by Greenland sharks the area west of Uuummannaq is no longer surveyed.

Materials and methods

The survey is conducted with the GINR research vessel R/V Sanna. Stations are paired two and two, close to each other (0,5-1 NM) to allow for analysis of within station variability. The gillnets are composed of 60m long sections with mesh sizes 46, 55, 60 and 70 mm (knot to knot or half mesh). From 2016 and forward a 90mm section (halfmesh) was added to the gillnet survey to increase the number of large Greenland for halibut and also survey the commercial part of the stock. Sections are separated with a 2m open space to prevent catchability interactions. Soak time is approximately 6-18 hours and fishing takes place both day and night.

Biological sampling

Length, weight, gutted weight, otoliths and occasionally DNA samples are regularly collected during the surveys (Table 2). 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. 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 transects have been performed in 2 recent years the data is stored by the Greenland Climate Research Centre GCRC, located in Nuuk:

Results

A few experimental gillnet stations were set in Uummannaq from 2011 to 2014, but these are hardly representative of changes in the stock (table 1). From 2015 only Gillnet stations have been set and the survey has been completed in all years since then. From 2015 to 2017 both the both the NPUE and CPUE gradually decreased (Table 2 and figure 2). From 2018 to 2021 the NPUE increased to the highest observed int the timeseries. However in 2022 the indices decreas substantially compared to 2021. Greenland halibut are observed in all stations (figure 3).
The gradual decrease in CPUE from 2015 can also be seen as a as a gradual decrease in the larger Greenland halibut after 2016 (figure 4). This is also seen as lower number of Greenland halibut caught in the 90mm mesh targeting larger fish (figure 4).
The high NPUE observed in 2020 was mainly caused by unusually high numbers of small Greenland halibut around 40 cm in the survey (figure 4). In the length distribution, a shift to just below 50 cm can be see in 2021. Higher numbers of Greenland halibut are observed in 2020-2022 indicating good recruitment in recent years.
The survey Catch At Age also indicates a shift towards younger fish observe in the survey (table 4 and figure 5). However, only 34 Greenland halibut from Uummannaq were aged in 2022 and the unusually young fish may be an effect of dominance of Disko Bay fish in the ALK. 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. Mean-weight-At-Age shows some level of stability in the most resent years (Figure 6).
Cod, Redfish, Roughhead Grenadier, Arctic skate, thorny skate and spotted wolffish are also caught in the survey. CPUE's are not presented for these species currently.

From 2015 to 2018 large cod were caught in the survey in Uummannaq (figure 7).

Discussion

As in the Disko bay both the length distribution and the CAA implies unusually good recruitment in recent years. In the Uummannaq fjord gillnet survey smaller Greenland halibut around 30-40 cm are seen to a smaller degree. This may be related to the deeper location of the gillnet stations. It is possible that smaller Greenland halibut are present in at shallower water than the majority of the gillnet stations and that larger Greenland halibut seek to greater depths in some years.
The initial decrease in the CPUE was caused by the gradual disappearance of the largest individuals. This is recognizable in both the more gradual decrease in the CPUE compared to the NPUE, and in the length distribution. The bubble plot indicates an unusually large 2015 Year Class. The higher number of 4 year old Greenland halibut seen in both 2020 and 2021 indicates that also the 2016 and 2017 YC may be far greater than earlier YC's. Therefore, the recruitment seems to have been at a very high level in these years. The 2015 Year Class is currently entering the commercial fishery as a Greenland halibut close to 50 cm and just below 1 kg.

References

Boje, J. and Lyberth, B. (2005) Survey Calibration for Greenland Halibut in Division 1A Inshore. NAFO Scr. Doc.05/57 (N5143)

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 and Area.

Year	Longline	Gillnet	Vessel	Notes
1993	21	-	AJ	
1994	-	-	AJ	
1995	19	-	AJ	
1996	24	-	AJ	
1997	-	-	-	No survey
1998	23	-	AJ	
1999	10	-	AJ	
2000	-	-	-	No survey
2001	4	0	AJ	
2002	-	-	-	No survey
2003	-	-	-	No survey
2004	-	-	-	No survey
2005	21	0	AJ	
2006	16	0	AJ	
2007	21	0	AJ	
2008	-	-	-	No survey
2009	-	-	-	No survey
2010	-	-	-	No survey
2011	16	4	AJ	
2012	28	3	Sa	
2013	28	7	Sa	
2014	23	4	Sa	
2015	18	28	Sa	46,55,60,70 + 90 mm section added at some stations
2016	0	49	Sa	46,55,60,70,90
2017	0	48	Sa	46,55,60,70,90
2018	0	54	Sa	46,55,60,70,90
2019	0	44	Sa	46,55,60,70,90
2020	0	46	Sa	46,55,60,70,90
2021	0	52	Sa	46,55,60,70,90
2022	0	43	Sa	46,55,60,70,90

Research vessels: RV Adolf Jensen (AJ), RV Sanna (Sa).

Table 2. CPUE and NPUE from the Gillnet survey in Uummannaq

Year	Number of stations	CPUE	SE	NPUE	SE	Number of stations
2011	4	11.1	2.4	10.1	2.0	Few
2012	3					Few
2013	7	27.6	10.6	19.4	8.5	Few
2014	4	4.7	2.6	7.4	3.5	Few
2015	28	31.5	6.8	18.2	4.6	Intermediate
2016	50	21.0	2.9	14.3	2.0	Full program
2017	48	23.4	2.3	14.1	1.5	Full program
2018	54	10.9	1.3	8.2	0.9	Full program
2019	44	11.7	1.3	10.9	1.1	Full program
2020	46	22.8	2.5	20.3	2.8	Full program
2021	52	30.3	3.2	26.4	3.4	Full program
2022	43	16.7	1.8	15.7	1.6	Full program

Table 3. Number of Greenland halibut otoliths collected in the surveys.

Year	Area	Gillnet	Aged	Method
2004	Uummannaq	?	?	Not in Database
2005	Uummannaq	218	0	Dried
2006	Uummannaq	142	0	Dried
2007	Uummannaq	333	0	Dried
2008	Uummannaq	-	0	Frozen
2009	Uummannaq	-	0	Frozen
2010	Uummannaq	-	0	Frozen image
2011	Uummannaq	240	0	Frozen image
2012	Uummannaq	359	0	Frozen image
2013	Uummannaq	327	0	Frozen image
2014	Uummannaq	209	13	Frozen image
2015	Uummannaq	197	0	Frozen image
2016	Uummannaq	421	0	Frozen image
2017	Uummannaq	585	160	Frozen image
2018	Uummannaq	395	0	Frozen image
2019	Uummannaq	399	0	Frozen image
2020	Uummannaq	436	0	Frozen image
2021	Uummannaq	592	580	Frozen image
2022	Uummannaq	483	34	Frozen image

Table 4. Catch At Age table for the gillnet survey.

Year	Index val	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
2012	82.3	0	0	3	12	8	21	12	9	9	6	2	0	0	0	2
2013	324.4	0	0	10	71	71	74	51	23	10	8	4	0	0	0	2
2014	124.7	0	0	5	32	56	18	10	0	4	0	0	0	0	0	0
2015	304.7	0	0	4	31	34	83	71	41	23	10	2	2	1	1	2
2016	243.5	0	1	9	26	50	52	50	29	16	6	1	1	0	0	1
2017	236.0	1	0	0	9	17	18	28	34	34	18	20	28	10	5	12
2018	137.9	0	2	8	14	26	24	20	10	9	10	4	2	6	1	2
2019	182.7	0	0	14	41	42	35	25	13	5	4	2	1	0	0	0
2020	339.8	0	6	63	114	73	51	21	8	3	2	0	0	0	0	0
2021	441.6	0	1	34	78	124	103	53	27	14	3	3	0	1	0	1
2022	262.1	0	3	24	140	62	15	11	5	1	0	0	0	0	0	0

Table 5. Length-Weight relationship for Greenland halibut.

Year	Area	Number fish	Log a	b	R^2
2012	Uummannaq	357	-12.708	3.259	0.984
2013	Uummannaq	313	-12.666	3.252	0.983
2014	Uummannaq	209	-12.692	3.251	0.992
2015	Uummannaq	197	-13.093	3.37	0.982
2016	Uummannaq	421	-12.73	3.262	0.991
2017	Uummannaq	581	-12.916	3.326	0.975
2018	Uummannaq	393	-12.54	3.224	0.988
2019	Uummannaq	397	-12.17	3.137	0.986
2020	Uummannaq	432	-12.534	3.235	0.991
2021	Uummannaq	591	-12.825	3.311	0.988
2022	Uummannaq	482	-12.760	3.283	0.988

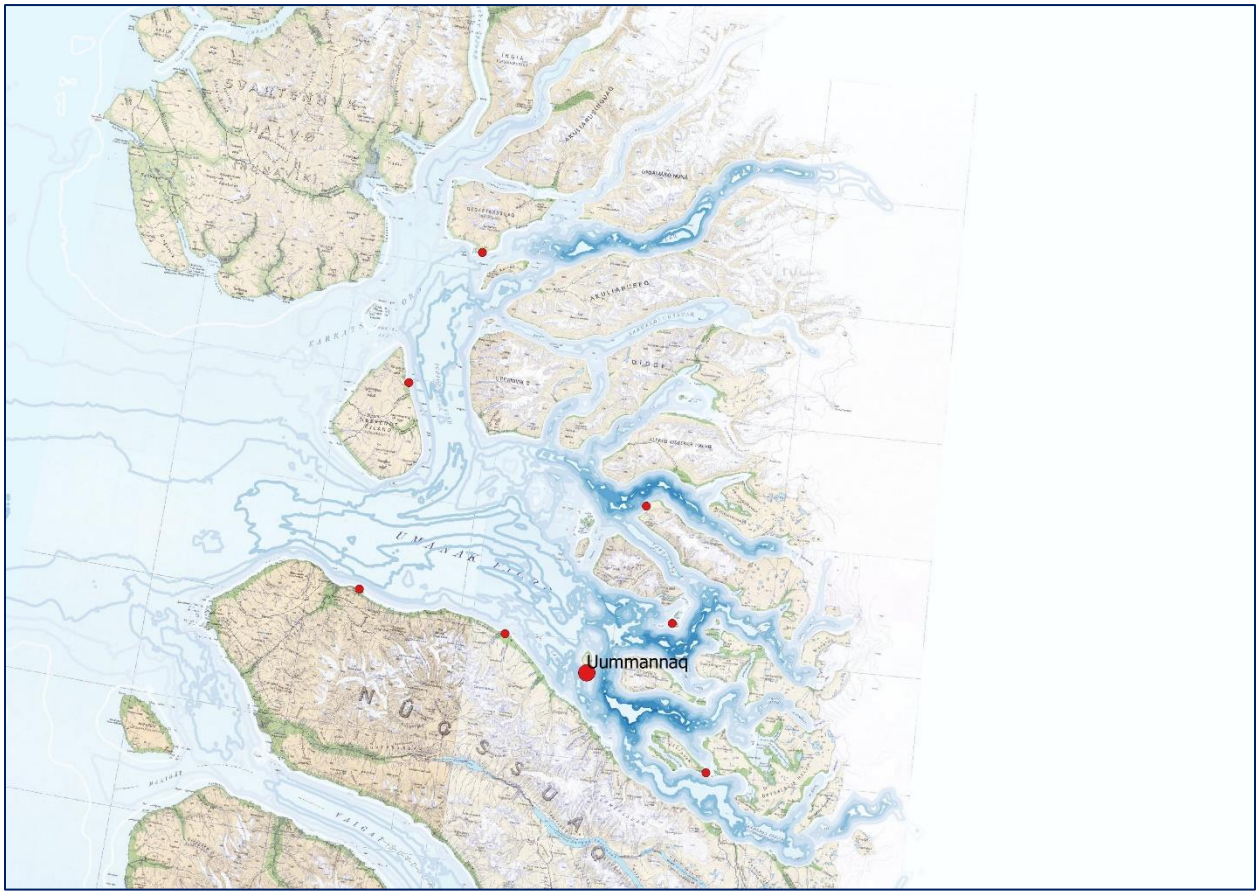

Figure 1. Map of the Uummannaq fjord.

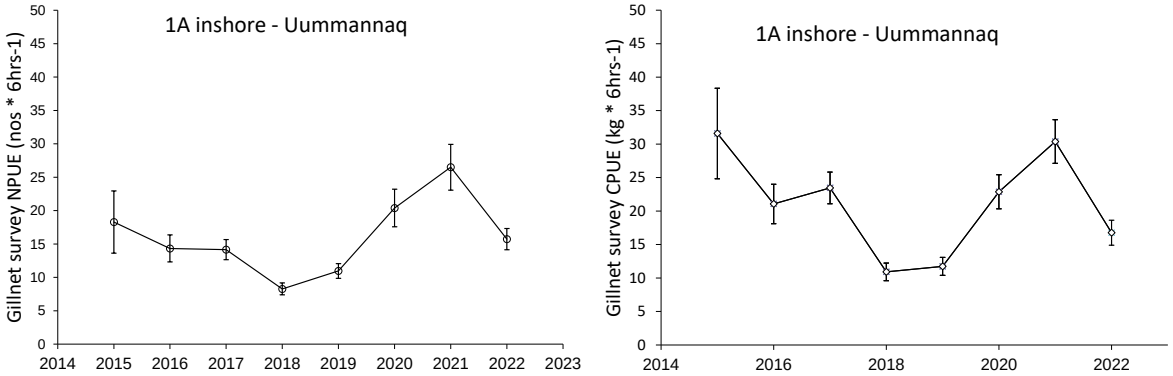

Figure 2. Greenland halibut survey NPUE (left) and CPUE (right) from the GINR gillnet survey in the Uummannaq fjord. Low number of stations before 2015.

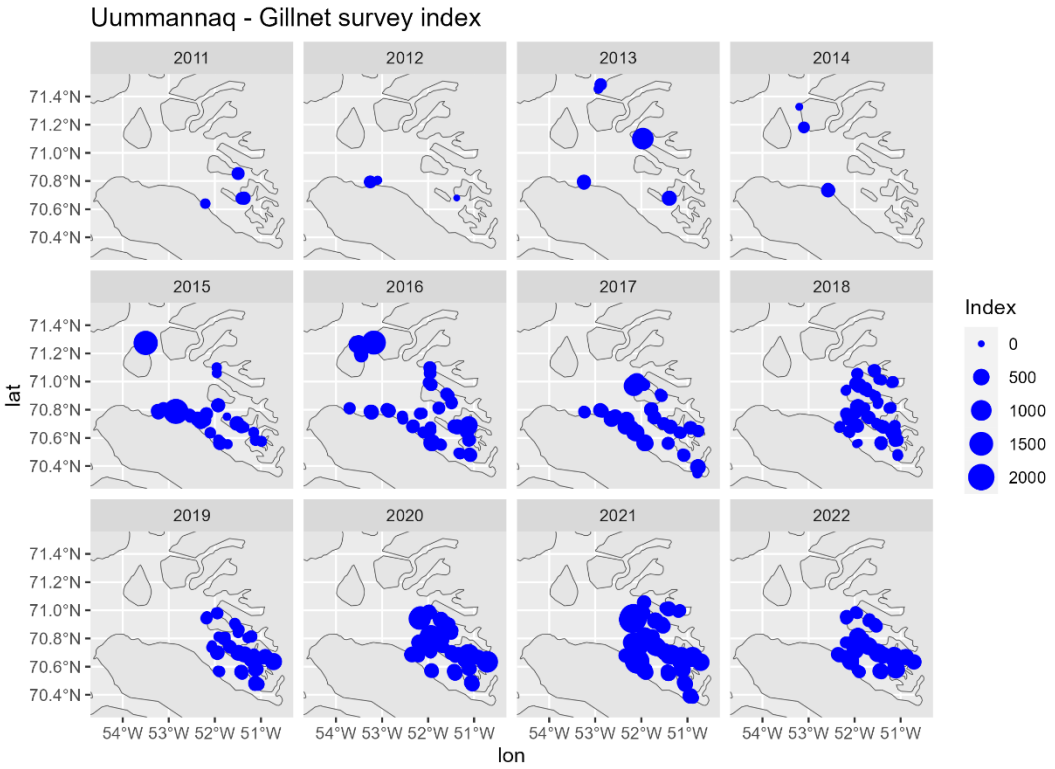

Figure 3. NPUE index per station in the Uummannaq survey.

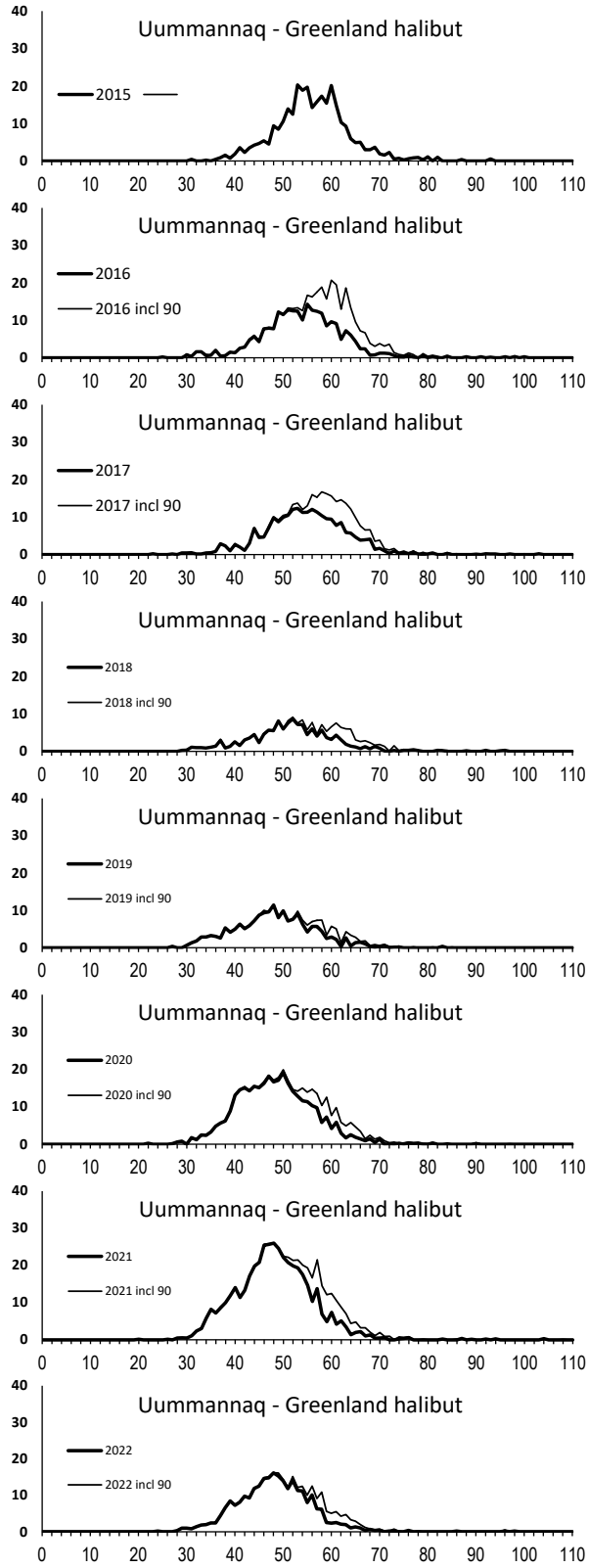

Figure 4. Uummannaq. Observed LF (N/100hr) for Greenland halibut (left).

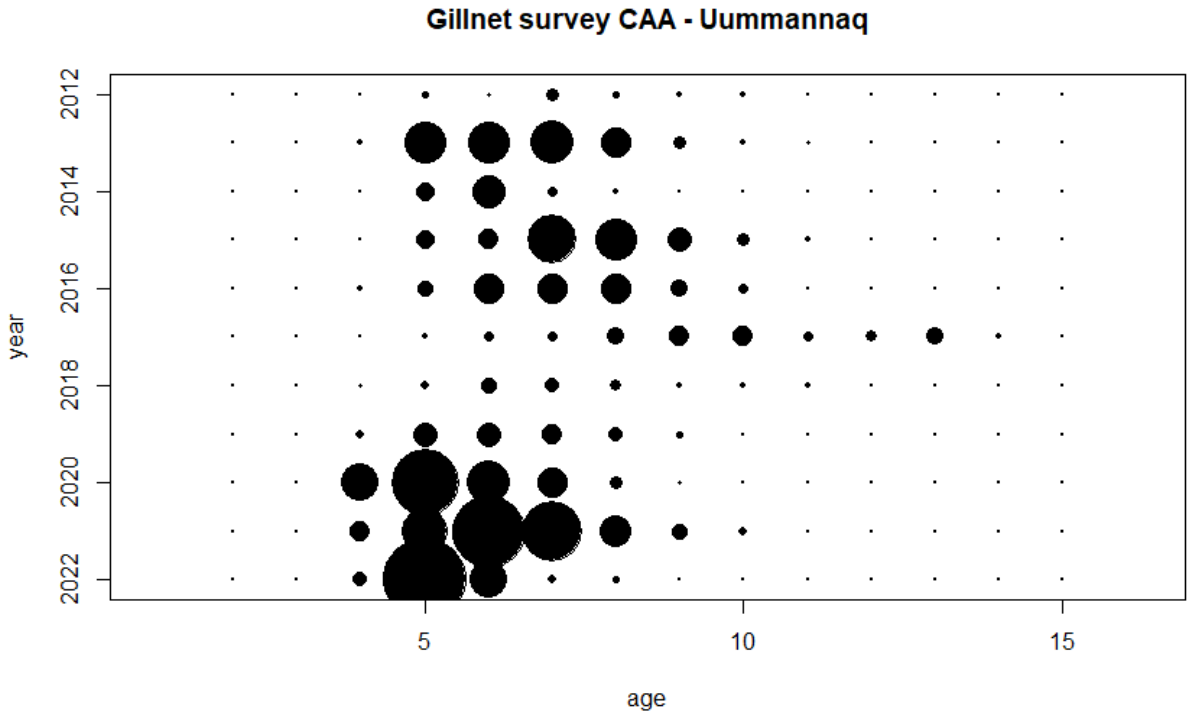

Figure 5. **Uummannaq** survey CAA bubble plot.

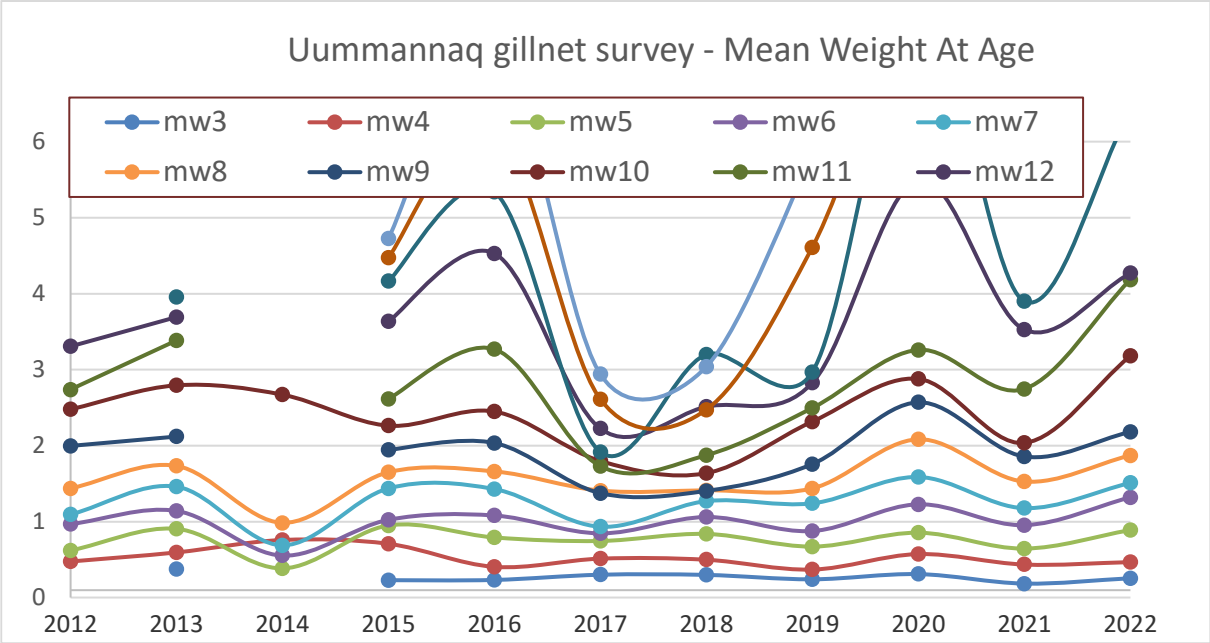

Figure 6. Estimated Mean Weight At Age for the Uummannaq gillnet survey. Years 2017 and 2021 based on agereadings from the Uummannaq survey. Other years based on the ALKbackup for the individual years from either Disko Bay or Upernavik.

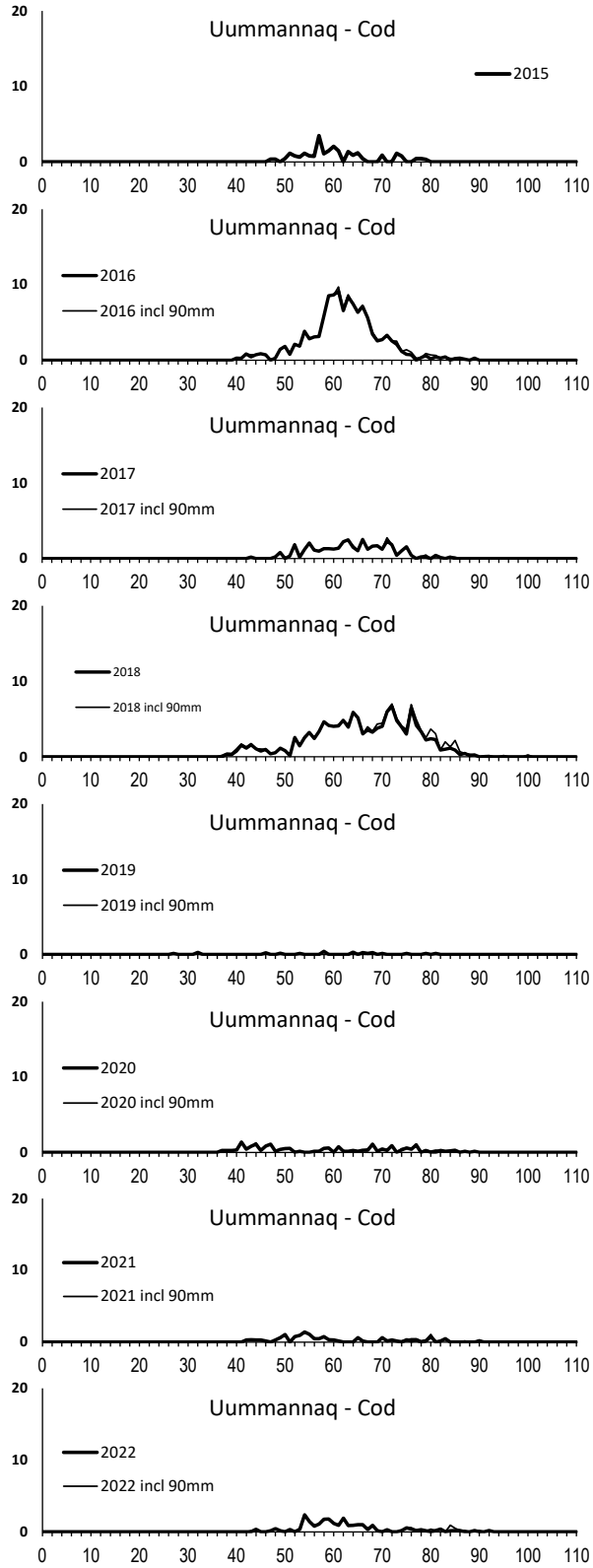

Figure 7. Uummannaq. Observed LF (N/100hr) for cod.