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An assessment of the Greenland halibut stock in the Uummannaq fjord.

by

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Abstract

The stock of Greenland halibut in the Uummannaq fjord is of major importance to the local community, partly or solely supporting a substantial proportion of the population in the area and in Greenland in General. The fishery has increased gradually over 3 decades, with some signs of a decrease in the stock in the recent few years. Decreasing size of the land fish although at a slow rate, decreasing catch rate in longline logbooks from vessels and in factory landings data. However recent surveys indicates an increase in the number of pre fishery recruits. Particularly the 2015 year class, also seen in the Disko bay, seems dominant and appear also appear in the commercial catches in 2021 as smaller ~50 cm fish with a weight close to 1 kg.

This assessment document summarizes the data from received and collected from the commercial fishery (se **SCR 18/023,** SCR 22-024, SCR 22-029) and from a research gillnet survey research survey (SCR 21-010). For supporting tables and more information please see these original documents.

Introduction

The fishery in the Uummannaq fjord is traditionally performed with longline from small open boats or dog sledges through a hole in the sea ice. The first available catch statistics from the Uummannaq fjord is from 1954. In the 1980s, small vessels entered the fishery and the use of gillnets increased in the following years.

Catches and TAC
In Uummannaq, catches increased during the 1980s and peaked in 1999, at more than 8.000 tons (tab 1 and figure 1). Catch then decreased to around 6 000 t, whereafter the gradual increase started again. Since 2016, annual catches have been around 10 000 per year. The tragic Karrat fjord tsunami disaster leading to the closure of the settlements Nuugaatsiaq and Illorsuit, likely affected the fishery negatively in 2017 and 2018.

Description of the fishery and the area.

The fishery in Uummannaq is scattered all over the fjord near settlements (fig.1). Particular the deep South-eastern part of the fjord from Uummannaq and towards East where depths of more than 1500 meters are common. Greenland halibut can however be found in all areas of the fjord. The area is highly productive with 10 large iceberg producing glaciers where rinks Isbræ (karrat Fjord and “Store” (“Large” or “great”) are located are among the more remarkable.

Fisheries and Management

In the late 1990s, the first regulations limiting areas open to gillnet fishery and to the winter season.
Competence to regulate seasons and areas open to gillnet fishery, was transferred to municipalities in 2004, and areas open to gillnet fishery has expanded since then. In 2017, the minimum mesh-size in the Greenland halibut fishery was reduced to 95 mm, which catches Greenland halibut as small as 50 cm and have a maximal selection in the interval 55-70 cm
Licences requirements were introduced in 1998 and in 2008 TAC and quota regulations were introduced for the inshore fishery. A separate TAC is set for each area. Logbooks have been mandatory for vessels larger than 30^{ft} since 2008. In 2012, the TAC was split in two components with ITQ's for vessels and a shared quota for open boats. The ITQ system currently does not specify catch to a certain district which causes a discrepancy between the ITQ and total quota set for each district. In 2014, it was decided by the Government og Greenland, that only traditional fishing grounds should be taken from the Quota, whereas in other areas there should be "free fishery". In 2021 the "quota free" areas were finally abandoned and the TAC now applies to the whole area.

Data from commercial fisheries

Recent catch statistics (factory landing and logbooks) are available from a centralized database managed by the Greenland Fisheries License Control Authority (GFLK). Both logbook (haul by haul) and factory landings (daily individual landings) are reported as individual fishing events containing dates, field code or position, effort sorting categories and many more items.

Results

Commercial data

Length frequencies

Mean size in the landings. In **Uummannaq** there is not any major difference between summer and winter fishing grounds and only small differences in the summer and winter length distributions are observed. Only Gear is accounted for in the length sampling. Mean individual length in the commercial landings have gradually decreased since 1993 (Figure 3). In 2021 the Mean length in the landings decrease by 4 cm in just one year, from 57 cm in 2020 to 53 cm in 2021.

Recently, data from graders (sorting mashines weighing each individual fish in 2 or 5 gram intervals) have become available for the assessment. Grader data provided by the industry, from the Grader placed in Uummannaq estimate a mean length in the landings of 55,1 cm (recalculated from individual mean weights registered by the grader). However, this is without data from the last two months of longline fishery 2021 therefore biasing the estimate slightly upwards.

Age composition in the commercial catch

Age reading of Greenland halibut was suspended from 2011 to 2017 at GINR due to low quality of the age readings and lack of an internationally agreed method. However, in 2017 the ageing was reinitiated. An Age-Length-Key (ALK) is currently being constructed for every year back in time. For years prior to 2021, the ALK used to calculate CAA table, was created using age readings from whole frozen otoliths from all 3 inshore areas collected from 2008, 2009 and 2010. The 2021 CAA was constructed with individual years ALK from the Uummannaq gillnet survey and based on the new method. In spite of the ALK still being preliminary, the CAA indicates the dominance of the strong 2015 year class, also observed in the surveys in in the Disko Bay partly in Upernavik (figure 4). In Uummannaq the fish enter the fishery later than in the Disko Bay. This may be related to the greater depths in the Uummannaq fjord where and smaller fish remaining at intermediate depths.

Commercial CPUE

Three commercial CPUE indices are available for the stock. Two CPUE indices are based on longline logbooks (one for longline logbooks and one for Gillnet logbooks) and one CPUE index based factory landings data (longline). In the CPUE indices based on logbooks, a general linear model (GLM) with year, month and boat as factors is applied to the longline and gillnet fishery logbook data. For more information about the standardized logbook CPUE see SCR 18/023.
In the new CPUE based on factory landings, a general linear model (GLM) with year, month, vessel type and statistical catch square factors, is available from 2022 (SCR 22-024). The new CPUE covers almost all longline fishery,

Factory landings CPUE (longline)

A general linear model (GLM) with year, month and vessel type and catch area as factors was applied to the longline landings in the factory provided landing slips from 2013 to 2021 (See SCR 22-024). The new CPUE based on Factory landings data consists of more than 10 000 observations in all years and covers >90% all longline fishery (table 6). The CPUE shows a substantial decrease from 2013 to 2017 and gradually flattening out thereafter (figure 5).

Logbook CPUE (longline)

A general linear model (GLM) with year, month and boat as factors was applied to the longline fishery logbook data since 2006. The longline logbook catch in the first year was low and the initial value is uncertain (table 7). The CPUE initially increases from 2007 to 2011 but then gradually levels off until 2020. However in 2021 the CPUE index increases significantly (fig 6).

Logbook CPUE (Gillnet)

A general linear model (GLM) with year, month and boat as factors was applied to the longline fishery logbook data since 2008. Fewer observations is available in the first year 2008, and the initial value is uncertain. From 2009, the CPUE gradually increases and peaks in 2013 and again in 2018, whereafter it decreases until 2020. Some caution should be given when interpreting the CPUE after 2017 due to the allowed reduction from 110 mm gillnets to 95mm gillnets leading to a gradual transition to these gillnets selecting fish on average about 10 cm smaller (figure 8) (change from about 60 to 50 cm at first selection). The Increase prior to the regulation change should however not be affected by the reduction in mesh size. The increase in 2021, may partly be due to the 2015 year class starting to be selected by the 95 mm gillnets used in the fishery.

Research survey data

The Greenland institute of Natural resources annually conducts a gillnet survey in the Uummannaq fjord. The survey gradually replaced a poorly performing longline survey in 2015. A few experimental gillnet stations were set in the area 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. Indices of survey biomass and abundance are available in Table 7

From 2015 to 2017 both the both the NPUE and CPUE gradually decreased and were low in 2017 and 2018 (figure 2). However, since 2018 the NPUE has increased and the 2021 NPUE is the highest observed int the timeseries. The increase in the survey is distributed over the majority of the stations and unlikely related to changes in distribution of the stations.

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.

Age distribution in the surveys

The survey Catch At Age (table 3 and figure 5) was calculated with using the 2021 age length key (ALK) from Uummannaq to calculate the CAA for 2021 in Uummannaq. To calculate the CAA in the years prior to 2021 a the Backup ALK mostly with Disko Bay fish for the individual years was used. The survey bubbleplot reveals the presence of a new incoming year class of considerable size, most likely the 2015 yearclass also observed in the Disko Bay. Also later year calasses (2016 and 2017) are observed in the 2021 survey. The bubbleplot, also indicates the presence of older Greenland halibut (2008 or 2007 YC) dominating the fishery from 2013 to 2015 leading to the high survey CPUE in those years. However only 2021 and 2017 were based on actual readings of Uummannaq fish in those years. The remaining years were based on the backup (mostly Disko bay fish) from the individual years respectively. Some signs of unstable Mean weight at age is seen in 2017 and 2018 and conclusion of the CAA should be drawn with caution.

Conclusion

Biomass and abundance

The fishery has increased gradually over 4 decades, from a low level to more than 10 000 tonnes, followed by signs of changes in the composition of the stock. In a 2 decade long period, (1990's and 2000') mean size decreased gradually, but remained above 60 cm until 2016. After 2016, the size of the landed fish started to decrease implying a new period with dominance of younger fish in the stock.

The Gillnet survey selecting Greenland halibut >30cm has revealed an almost 3 fold increase in NPUE since the low values in 2018.

The large 2015, year class is currently close to 1 kg and 50 cm and therefore entering the fishery at a size far below the recent mean size in the landings. The sudden decrease of around 4 cm in the mean size, could be explained with a large cohord entering both the preferred commercial depths of the fishery and simultaneously growing into the commercial segment (partly from growing into the selection range of the commercial gillnets). Although the size of the landed fish decrease substantially from 2020 to 2021 the commercial CPUE's are stable or slightly increasing.

An unusual situation implying the presence of more fish in the longline fishery. Only the Commercial gillnet CPUE has decreased slightly in the recent two years. However, the gillnet CPUE has increased over the most recent decade and remain higher than in 2009. Some caution should be given when interpreting the commercial gillnet CPUE due to the reduction of the mesh size in the gillnets in 2017. This change should however not have impacted the index prior to 2007. Use of illegal gillnets in the Uummannaq area is currently undocumented and does not seem to have been prevailing before 2017 in Uummannaq.
The length distribution in the gillnet survey further supports the presence of both large fish in the interval between 50 and 60 cm in the area, but also a higher number of pre fishery recruits than previously observed.

Recruitment

The length distribution in the gillnet survey further supports the observation of, a higher number of pre fishery recruits in the area than previously observed. The many small fish in the survey implies good recruitment in the area in the recent years which fits with the 2015 year class and potentially more recent year classes also observed in the Disko bay.

Special comment

The slow but gradual decrease in the size of the landed fish during two decades, stabilizing at a level around 60 cm before starting to decrease again, may be a sign of the gradual removal of old fish that have reached Lmax. Greenland halibut show dimorphism where males are normally smaller than females. Male Greenland halibut are rarely seen larger than 80cm whereas females reach a size of up to 130 cm or more.

The survey indices of biomass show similar trends as the catches, but seem to predict the catch to some level. This provides promise for modelling.

The new ALK based on new age readings show promising results, revealing small signs of being able to track cohords.

References

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Riget and Nygaard (2017). An analyses of logbooks of Greenland Halibut Stock Component in NAFO Division 1A Inshore. NAFO SCR 18/023. Serial No N

Bjare and Nygaard (2022). A new longline based CPUE for Greenland halibut in NAFO division 1A inshore based on factory landing reports. NAFO SCR 12/024. Serial No N

Table 1. Catches (t) of Greenland halibut in Uummannaq by gear and year.

Year	Catch	Year	Catch	Year	Catch
1954	16	1981	1662	2008	5426
1955	76	1982	1210	2009	5451
1956	84	1983	966	2010	6226
1957	31	1984	1259	2011	6397
1958	177	1985	1833	2012	6204
1959	206	1986		2013	7008
1960		1987	2897	2014	8207
1961		1988	2920	2015	8244
1962		1989	2859	2016	10305
1963		1990	2779	2017	9049
1964	403	1991	3045	2018	8839
1965	688	1992	3067	2019	10162
1966	675	1993	3916	2020	10677
1967	593	1994	4004	2021	9609
1968	407	1995	7234		
1969	584	1996	4579		
1970	326	1997	6293		
1971	149	1998	6912		
1972	271	1999	8425		
1973		2000	7568		
1974		2001	6558		
1975	309	2002	5339		
1976		2003	5039		
1977	754	2004	5248		
1978	1144	2005	4856		
1979	835	2006	5984		
1980	1422	2007	5318		

Notes.
1998 License requirements introduced.
2002 Offshore shrimp trawlers equipped with grid separators.
2008 First Quota regulations introduced
2009 Logbooks mandatory for vessels larger than 30^{ft}.
2011 Inshore shrimp trawlers equipped with grid separators.
2012 Separate TAC set for vessels and small boats.
2014 Quota free areas outside TAC placed by the fisheries minister.
2017 Minimum mesh size in gillnets reduced from 110 halfmesh (220mm) to 95mm halfmesh (190mm).

Table 2. Mean length in the landings in the by month recalculated from weights from the Grader placed in Uummnannaq in 2021.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
W (g)	1764	1822	1690	2037	1530	1598	1620	1643	1641	1459	NA	NA
# obs	20899	13761	48620	55551	146335	177245	155751	153469	115541	79663	NA	NA
ML	56.54	57.29	55.93	59.42	54.11	54.74	54.98	55.2	55.24	53.45	NA	NA

Table 3. CAA – Catch at age for Greenland halibut in the Uummannaq district.

age/year	3	4	5	6	7	8	9	10	11	12	13	14	15+	16+	Total
1988	0	0	0	1	5	20	52	121	143	121	96	49	23	17	648
1989	0	0	0	0	2	9	35	98	120	99	76	38	19	20	516
1990	0	0	0	1	3	15	47	108	121	101	82	42	20	21	561
1991															
1992															
1993	0	0	0	9	45	200	202	142	138	104	158	93	28	20	1139
1994	0	0	0	24	105	226	271	346	139	105	34	12	0	3	1265
1995	0	0	0	6	217	564	601	413	414	219	138	49	28	22	2671
1996	0	1	0	6	76	308	279	286	232	142	69	28	11	15	1453
1997	0	0	0	0	69	377	793	702	460	206	75	32	10	6	2732
1998	0	0	0	0	0	235	566	657	586	355	138	39	15	5	2595
1999	0	8	70	218	554	596	690	789	526	295	131	42	12	4	3935
2000	0	0	19	86	357	441	543	669	487	311	170	68	24	8	3184
2001	0	0	65	113	674	507	315	492	303	178	121	60	28	12	2868
2002															
2003	0	0	3	21	127	360	321	235	220	158	78	145	150	94	1911
2004	0	0	1	10	105	197	249	198	163	118	82	103	78	59	1364
2005	0	1	17	101	108	192	142	115	109	74	58	80	67	50	1115
2006	0	1	32	12	47	243	70	284	127	324	49	108	9	9	1315
2007	0	3	40	181	221	340	273	192	149	94	64	82	71	56	1767
2008	0	4	46	203	249	381	304	213	166	104	71	91	79	63	1974
2009	0	3	9	25	238	525	470	415	243	157	90	42	20	11	2248
2010	0	1	8	77	484	822	459	458	235	128	79	32	21		2804
2011	0	0	11	94	465	743	432	441	242	141	91	43	26		2730
2012	0	0	6	61	347	627	393	422	260	168	114	57	37		2492
2013	0	1	9	72	397	730	494	531	302	173	108	49	31		2896
2014	0	1	20	120	622	1026	613	608	308	163	107	46	32		3667
2015	0	2	26	112	489	828	545	582	354	211	144	68	41		3403
2016	0	4	49	203	840	1290	736	727	386	211	132	58	40		4679
2017	2	28	204	424	924	1079	564	553	299	174	121	62	38		4473
2018	2	36	265	499	1036	1150	586	550	261	137	93	43	29		4687
2019	5	67	311	528	1171	1307	691	644	306	158	102	47	35		5372
2020	5	61	356	576	1225	1404	694	652	319	162	120	57	38		5668
2021	0	148	673	1408	1435	1088	719	405	175	129	27	33	5	18	6263

Note: 2009-2021 CAA is based on 2008,2009 and 2014 ALK'S. 2021 CAA is based on a new ALK for Uummannaq 2021.

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	82.31572277	0	0	3	12	8	21	12	9	9	6	2	0	0	0	2
2013	324.3703198	0	0	10	71	71	74	51	23	10	8	4	0	0	0	2
2014	124.6557115	0	0	5	32	56	18	10	0	4	0	0	0	0	0	0
2015	304.681072	0	0	4	31	34	83	71	41	23	10	2	2	1	1	2
2016	243.452864	0	1	9	26	50	52	50	29	16	6	1	1	0	0	1
2017	235.9728867	1	0	0	9	17	18	28	34	34	18	20	28	10	5	12
2018	137.9044983	0	2	8	14	26	24	20	10	9	10	4	2	6	1	2
2019	182.7095175	0	0	14	41	42	35	25	13	5	4	2	1	0	0	0
2020	339.7976932	0	6	63	114	73	51	21	8	3	2	0	0	0	0	0
2021	441.5503994	0	1	34	78	124	103	53	27	14	3	3	0	1	0	1

Table 5. Uumannaq logbook data (**longline**) for vessels >30ft.

Year	Logbook CPUE (longline)	Factory landings CPUE (longline)	Logbook CPUE (Gillnet)
UNIT	Kg/100 hooks	CPUE Kg/100 hooks	Kg/gillnet
2006	43		
2007	36.7		
2008	36.6		23.8
2009	37.9		53.7
2010	44.3		58.6
2011	49.8		65.8
2012	46.3		60.5
2013	42.4	74.7	85.8
2014	48.8	76.6	78.6
2015	41.2	69.6	71.6
2016	40.8	74.8	73.4
2017	34.2	57.5	77.7
2018	36.6	54.0	81.1
2019	34.7	52.3	74.2
2020	32.5	50.7	60
2021	37.2	51.5	67.5

Table 6. CPUE and NPUE from the Gillnet survey in Uummannaq

Year	Number of stations	CPUE	NPUE	Number of statiosn
2011	4	11.174	10.139	Few
2012				Few
2013	7	27.608	19.462	Few
2014	4	4.7414	7.4794	Few
2015	28	31.584	18.281	Intermediate
2016	50	21.06	14.332	Full program
2017	48	23.453	14.158	Full program
2018	54	10.909	8.2743	Full program
2019	44	11.735	10.963	Full program
2020	46	22.878	20.388	Full program
2021	52	30.385	26.493	Full program

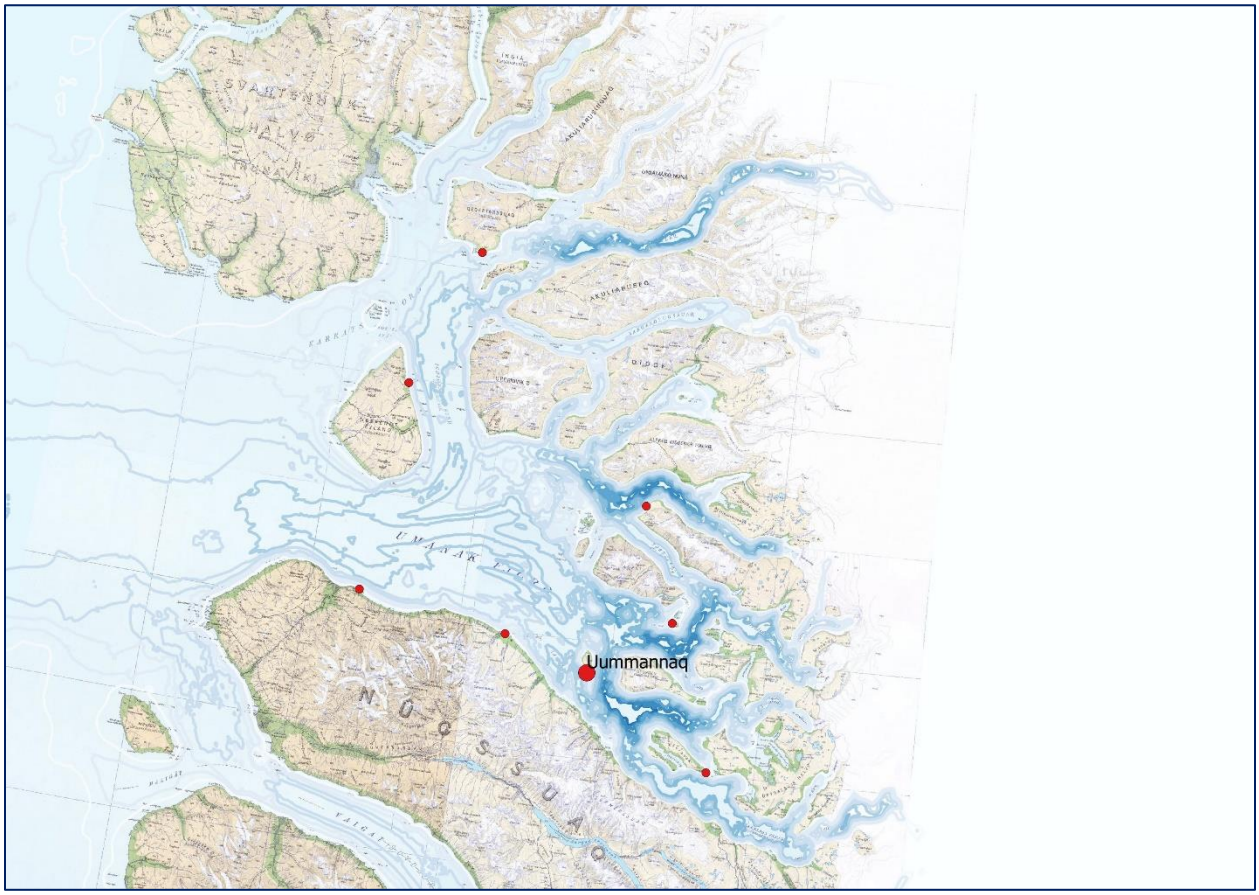

Figure 1. Map of the Uummannaq fjord.

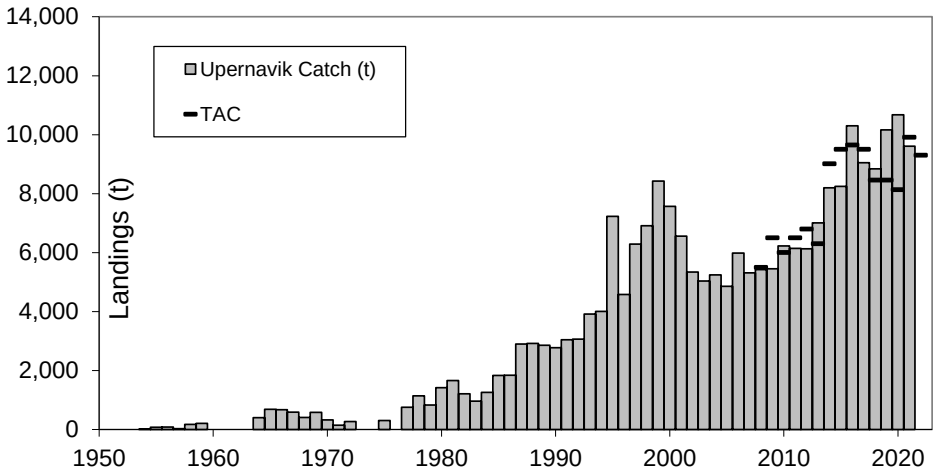

Figure 2. Catches of Greenland halibut in NAFO Subarea 1 Division 1Ainshore since 1954.

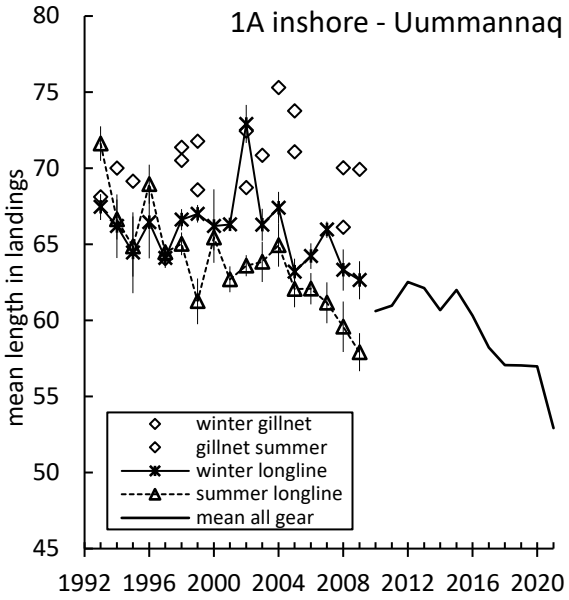

Figure 3. Uummannaq mean length in the landings: longline summer, longline winter, gillnet and overall mean weighted by area, season gear and amounts (after 2010).

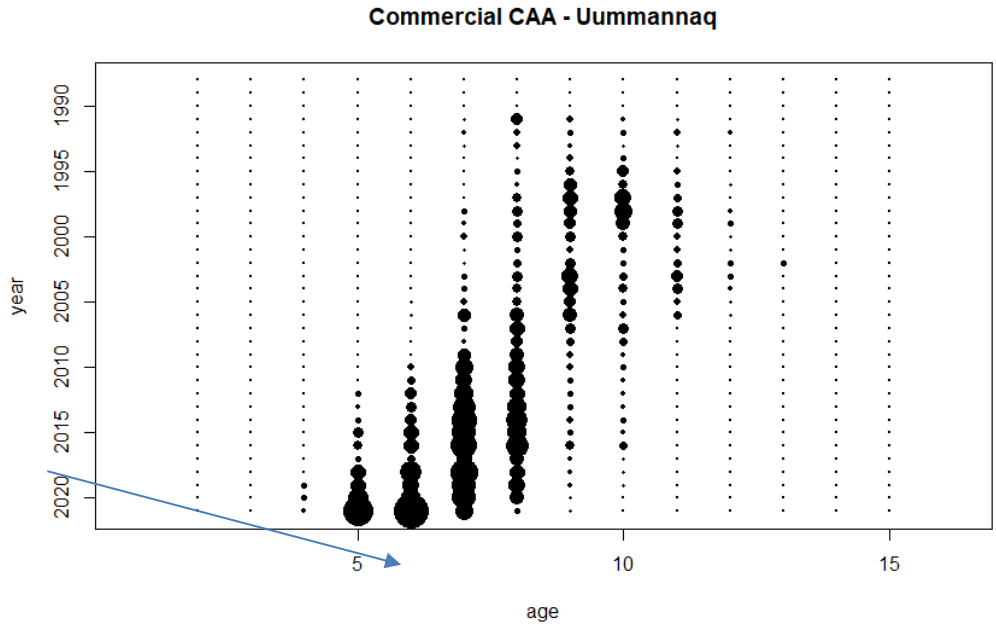

Figure 4. Catch At Age CAA bubble plot for the commercial landings in Uummannaq. Year 2021 have been recalculated by the new ALK from Uummannaq 2021.

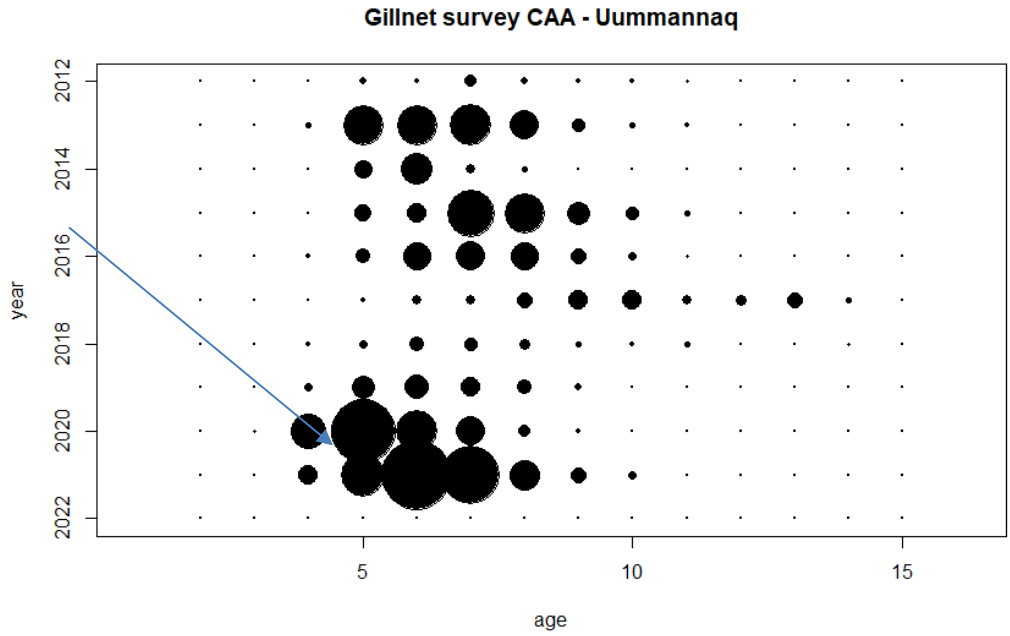

Figure 5. Survey Catch At Age (CAA) bubble plot from the Gillnet survey in the Uummannaq. The CAA is based on age readings with the new digital method in all years. However only 2021 and 2017 were based on acutal readings of Uummannaq fish in those years. The remaining years were based on the backup (mostly Disko bay fish) from the individual years respectively. Some signs of unstable Mean weight at age is seen in 2017 and 2018 and conclusion of the CAA should be drawn with caution.

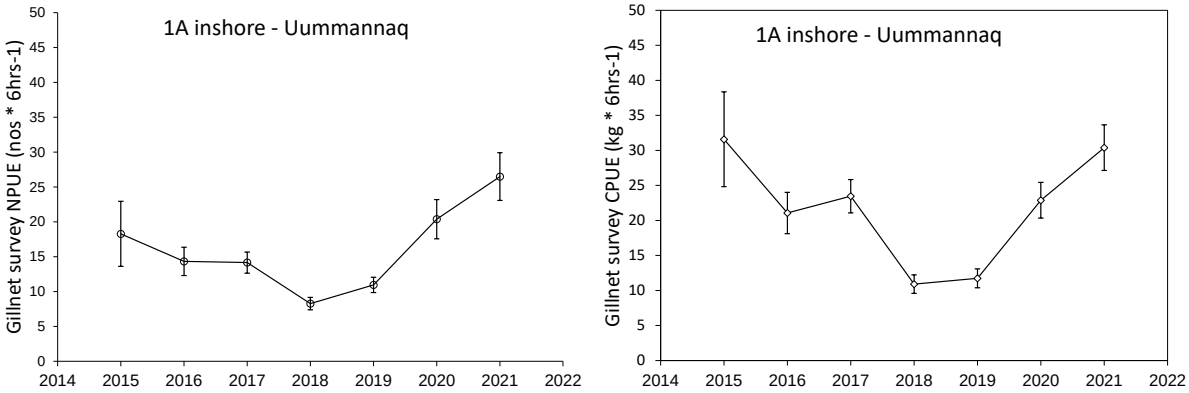

Figure 6. Greenland halibut survey NPUE (left) and CPUE (right) from the GINR gillnet survey in the Uummannaq fjord. Low number of stations before 2015.

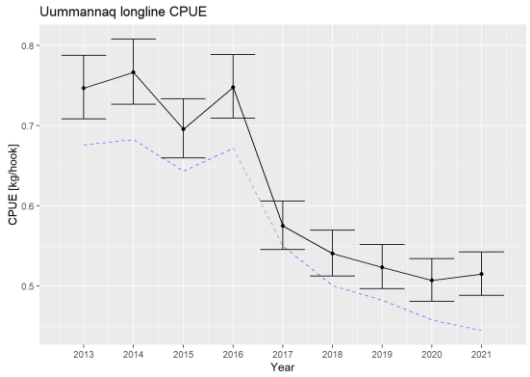

Figure 7. Commercial CPUE (Kg/hook) based on factory landing reports from all factories in Uummannaq.

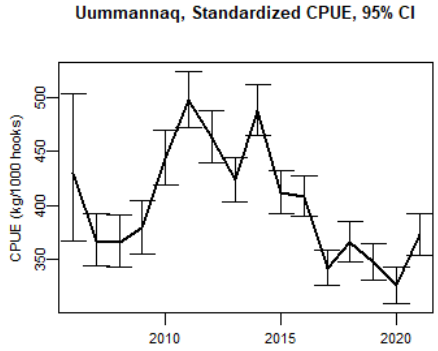

Figure 8. Standardized longline mean and 95% CI CPUE based on logbooks from vessels larger than 30ft in Uummannaq.

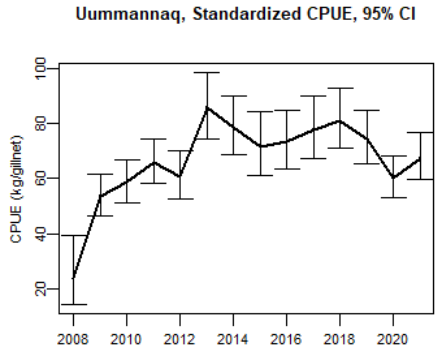

Figure 9. Gillnet Standardized mean and 95% CI CPUE based on logbooks from vessels larger than 30ft in Uummannaq.

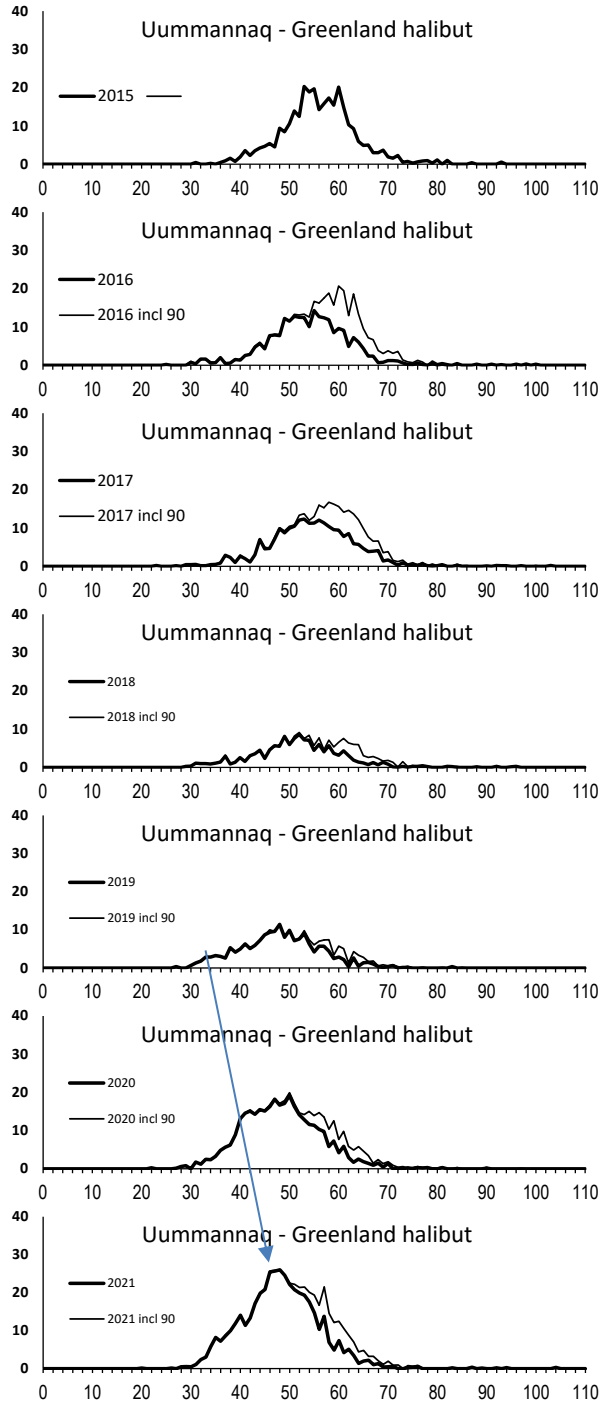

Figure 10. Uummannaq. Observed LF (N/100hr) for Greenland halibut (left).