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Commercial data for the Greenland halibut fishery in Uummannaq

by

Rasmus Nygaard

Greenland Institute of Natural Resources, P.O. Box 570, 3900 Nuuk, Greenland

**Abstract**

Although the commercial fishery in for Greenland halibut started around 1910 the first available catch statistics from the Uummannaq area, is from the 1950's. The fishery is traditionally performed with longline from small open boats or dog sledges through a hole in the sea ice. This document presents catch statistics combined from various resources from the Uummannaq fjord. The document includes statistics of commercial sampling effort done by the GINR and calculations of mean size in the landings and a preliminary CAA. Also provided are 3 indices of CPUE. Two based on logbooks (one longline fishery and one gillnets fishery) and one on factory landings data (longline).

**Introduction**

The first available catch statistics from the Uummannaq fjord is from 1954. The fishery is traditionally performed with longline from small open boats or dog sledges through a hole in the sea ice. In the 1980s, small vessels entered the fishery and the use of gillnets increased in the following years. In the late 1990s, the first regulations limiting areas restricting the gillnet fishery 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. The minimum mesh-size in the gillnets was 110 mm (half meshes or knot to knot) until 2017 when the meshsize was reduced to 95 mm halfmesh. In general, gillnets have narrow selection curves and targeting fish at certain size intervals. Theoretical selection curves and factory landings show that 110 mm gillnets catches Greenland halibut from 55 cm and has maximal selectivity in the size interval 65-85 cm. 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<sup>ft</sup> 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 of 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.

**Materials and methods**

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. Catch can practically be broken in any thinkable way.

### Commercial sampling

Commercial samples are collected by the GINR. During surveys or in sampling campaigns factories are visited and the size of the landed fish by species and gear is registered. However due to the logistic challenges in Greenland (size of Greenland and mainly transport by air or sea), sampling catch is challenging. To ensure sufficient length information from the commercial catches, GINR do commercial length measurements in factories during the winter months (Jan-April). However, in Uummannaq there is not the same great difference in the distribution of the fishery between summer and winter as seen in the Disko Bay, and sampling is less dependant on season. Commercial sampling is only separated by gear (longline or gillnet) and if possible also summer and winter.

### ALK

Age information is occasionally obtained from commercial landings, but the majority of otoliths collected in the area is through biological surveys with the GINR research vessel R/V Sanna during summer gillnet surveys (See SCR 22-010 for details).

### Logbook CPUE calculation

A general linear model (GLM) with year, month and boat as factors is applied to the longline and gillnet fishery logbook data since 2008. Only longline setting with more than 200 hooks and gillnets with catches between 0 and 1001 kg/gillnet are included to omit obvious outlier values and limit the influence of data potential errors on the analysis. CPUE observations are log-transformed prior to the GLM analysis. Least-mean square estimates were used as standardized CPUE series. For more information about the standardized logbook CPUE see SCR 18/023. In 2022, a new CPUE based on factory landings data from longline fishery calculated in the same way as the logbook CPUE, but from a different source of statistics (SCR 22-024) Another difference is that due to the high number of small boat fishermen and diverse types of fishery all using the same standard gear (longlines from either logbook vessels, small open boats or directly from the sea ice) the model use year, vessel type (vessel, boat, dog sledge or snowmobile) and statistical catch square

## Results

### Catches

The inshore fishery targeting Greenland halibut started in the beginning of the 1900 century with the introduction of the longline in Greenland. The fishery started in the Disko Bay and gradually spread to South Greenland and later the Uummannaq fjord and Upernavik districts. First available catch statistics is from 1954. The fishery is traditionally performed with longline from small open boats or dog sledges through a hole in the sea ice.

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.

### Distribution of catch

The fishery in Uummannaq is scattered all over the fjord near settlements (fig.2). Particular in 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 in 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.

#### Breakdown of catch

The catch by gear (longline or gillnet) and month is combined with the length frequencies from the commercial landings (table 3) to calculate mean size in the landings and the CAA. Due to the logistical challenges in Greenland not all months have commercial length information (table 3). Nevertheless, in most years the sampling covers the 3 different categories (Uummannaq longline winter, Uummannaq gillnet winter and Uummannaq longline summer)

#### 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. Grader data kindly 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.

#### *ALK – Age Length Key*

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 GINR 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 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.

#### 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.

### References

Riget, F. and J. Boje (1989). Fishery and some biological aspects of Greenland halibut (*Reinhardtius hippoglossoides*) in West Greenland waters. NAFO Sci.Council Studies(13): 41-52.

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	Uummannaq		Catch	Notes
	Longline	Gillnet		
1954			16	
1955			76	
1956			84	
1957			31	
1958			177	
1959			206	
1960				
1961				
1962				
1963				
1964			403	
1965			688	
1966			675	
1967			593	
1968			407	
1969			584	
1970			326	
1971			149	
1972			271	
1973				
1974				
1975			309	
1976				
1977			754	
1978			1144	
1979			835	
1980			1422	
1981			1662	
1982			1210	
1983			966	
1984			1259	
1985			1833	
1986				
1987			2897	
1988			2920	
1989			2859	
1990			2779	
1991			3045	
1992			3067	

1993			3916	
1994			4004	
1995			7234	
1996	3176	1437	4579	
1997			6293	
1998			6912	
1999			8425	
2000	7103	465	7568	
2001	6185	375	6558	
2002			5339	
2003	3924	1115	5039	
2004	4140	1101	5248	
2005	1947	2908	4856	
2006			5984	
2007	4460	858	5318	
2008			5426	
2009			5451	
2010	5617	610	6226	
2011	5046	1179	6397	
2012	5847	357	6204	Good data quality
2013	6639	369	7008	Good data quality
2014	7800	407	8207	Good data quality
2015	7279	962	8244	Good data quality
2016	9512	792	10305	Good data quality
2017	8261	788	9049	Good data quality
2018	7505	1334	8839	Good data quality
2019	8142	2021	10162	Good data quality
2020	8880	1797	10677	Good data quality
2021	8479	1130	9609	Good data quality

## 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<sup>ft</sup>.

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.** Uummannaq Landings of Greenland halibut (t) by gear and month.

	Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OKT	NOV	DEC	Total
	Longline	2011	169	156	306	560	357	772	1298	736	98	585	9	0
2012		387	614	625	158	217	1023	1140	957	301	184	207	35	5847
2013		197	354	482	357	547	1128	1352	934	609	424	216	38	6639
2014		172	351	667	572	347	965	1420	1201	1032	532	415	126	7800
2015		173	462	701	598	211	494	1428	1068	1060	657	314	113	7281
2016		598	731	585	469	871	1405	1540	1324	1129	519	217	127	9512
2017		432	563	732	521	311	900	1340	1167	921	885	291	197	8261
2018		157	370	508	564	427	1173	1455	1017	876	708	134	118	7505
2019		443	409	440	466	666	1321	1398	1036	663	865	234	200	8142
2020		193	470	455	440	537	1692	1597	1210	1102	760	183	241	8880
2021		161	297	350	176	814	1632	1364	1208	1160	945	208	164	8479
Gillnet	2011	158	293	8	0	140	531	50	0	0	0	0	0	1179
	2012	90	37	60	14	0	3	0	0	0	9	57	85	357
	2013	66	56	54	77	28	0	0	1	0	0	57	30	369
	2014	83	76	42	62	0	1	0	0	0	0	40	104	407
	2015	74	38	59	43	1	0	617	95	2	0	23	10	963
	2016	20	40	44	115	38	0	0	67	180	120	86	82	792
	2017	46	18	27	33	24	37	46	3	32	131	158	233	788
	2018	163	76	270	316	3	14	3	0	0	0	320	169	1334
	2019	207	509	362	263	8	1	1	3	1	1	250	414	2021
	2020	229	324	380	284	3	4	4	2	3	13	261	288	1797
	2021	241	55	104	207	59	6	0	0	0	0	85	373	1130
Total	2011													
	2012	477	651	685	172	217	1026	1140	957	301	193	265	120	6204
	2013	263	410	537	434	575	1128	1352	935	609	424	273	68	7008
	2014	256	427	710	633	347	965	1420	1201	1032	532	455	230	8207
	2015	247	500	761	640	212	494	2045	1163	1063	657	337	124	8244
	2016	618	772	629	584	908	1405	1540	1391	1309	638	303	208	10305
	2017	478	581	760	554	335	938	1386	1169	953	1016	449	430	9049
	2018	320	445	778	880	430	1187	1458	1017	876	708	454	287	8839
	2019	650	918	802	730	674	1322	1400	1039	664	866	484	614	10162
	2020	423	794	835	725	540	1696	1601	1212	1105	773	444	528	10677
	2021	402	352	454	383	873	1638	1364	1208	1160	946	293	536	9609

**Table 3** Number of length measured Greenland halibut by gear, division and month from the inshore areas in 2019. Blocks indicates the use of length distributions in the CAA calculation.

Longline	Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
	2010	-	3047	1583	-	-	-	-	-	-	854	2673	-	-
	2011	-	287	3265	1853			2973	2328	988	-	5124	-	-
	2012	-	-	2416	-	-	-	-	-	1469	-	-	-	-
	2013	-	484	3068	-	-	-	-	-	287	1485	-	-	-
	2014	-	4390	-	-	-	-	-	-	1690	-	-	-	-
	2015	-	5972	-	-	-	-	-	864	821	-	-	-	-
	2016	-		5940	-	-	-	-	777		-	-	-	-
	2017	-	5126	3858	-	-	-	-	-	4208	-	-	-	-
	2018	-	732	4770	-	-	-	-	3239	-	-	-	-	-
	2019	-	3653	-	-	-	-	-	204	3250	-	-	-	-
	2020	-	3955	-	-	-	-	453	-	2031	1334	-	-	-
	2021	-	821	2259	-	-	-	-	-	3232		-	-	-

Gillnet	Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
	2010	-	127		-	-	-	-	-	-	-	-	-	-
	2011	-	632	1454	-	-	-	-	-	-	-	-	-	-
	2012	-	-	-	-	-	-	-	-	-	-	-	-	-
	2013	-	45	-	-	-	-	-	-	-	-	-	-	-
	2014	-	-	-	-	-	-	-	-	-	-	-	-	-
	2015	-	185	-	-	-	-	-	-	-	-	-	-	-
	2016	-	-	487	-	-	-	-	-	-	-	-	-	-
	2017	-	102	-	-	-	-	-	-	-	-	-	-	-
	2018	-	331	91	-	-	-	-	-	-	-	-	-	-
	2019	-	1902	-	-	-	-	-	-	-	-	-	-	-
	2020	1744	2753	-	-	-	-	-	-	-	-	-	-	-
	2021	-	163	-	-	-	-	-	-	-	-	-	-	-

**Table 4** Uummannaq grader data: W is the mean weight (g) of the individual weights registered by the grader. # obs is the number of Greenland halibut passing the grader in Uummannaq in 2021. ML is the Mean of the lengths estimated from a LW relationship and the individual W (g). Raw data kindly provided by the Greenland fishing industry.

	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 5.** 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: The CAA is based on age-readings from 2008,2009 and 2014 from 2009-2020. Only 2021 is recalculated and based on a new ALK for Uummannaq 2021.

**Table 6** Uummannaq Factory landings (longline only) used to calculate longline CPUE for all longline fishery.

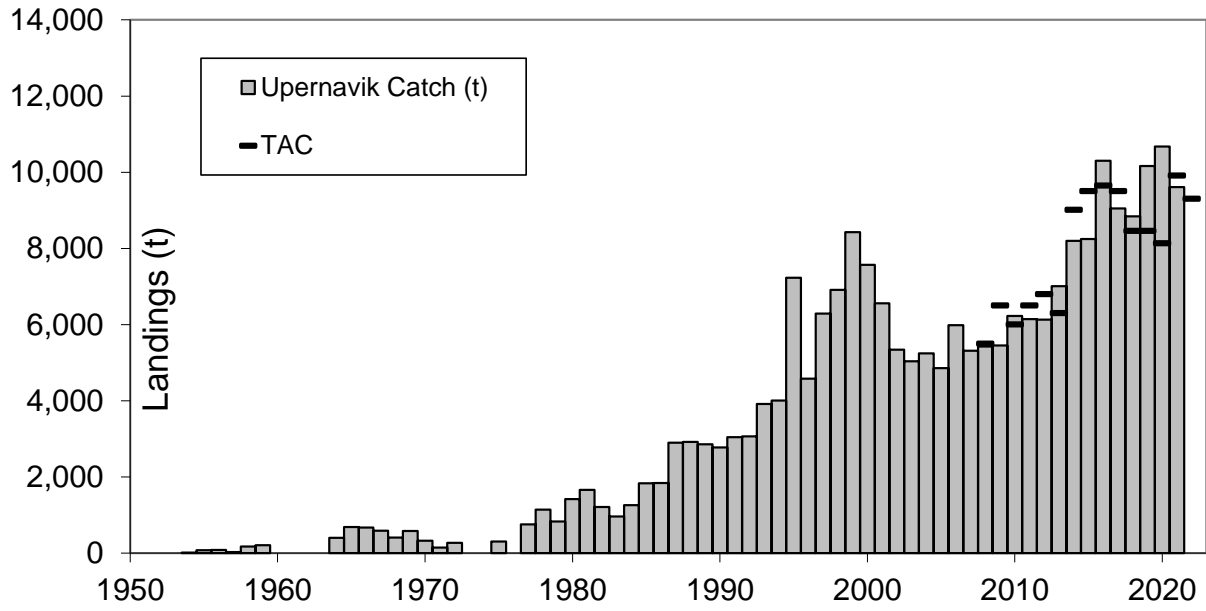
Year	No of OBS in the dataset	Total longline catch (t)	Available for CPUE calculation	% of total longline fishery covered	CPUE Kg/hook
2013	12062	6639	5977	90	74.7
2014	11865	7800	6121	78	76.6
2015	13126	7279	6546	90	69.6
2016	14892	9512	8623	91	74.8
2017	16564	8261	7455	90	57.5
2018	17002	7505	6780	90	54.0
2019	17588	8142	7344	90	52.3
2020	17645	8880	8023	90	50.7
2021	14839	8479	7663	90	51.5

**Table 7.** Uumannaq logbook data (**longline**) for vessels >30ft.

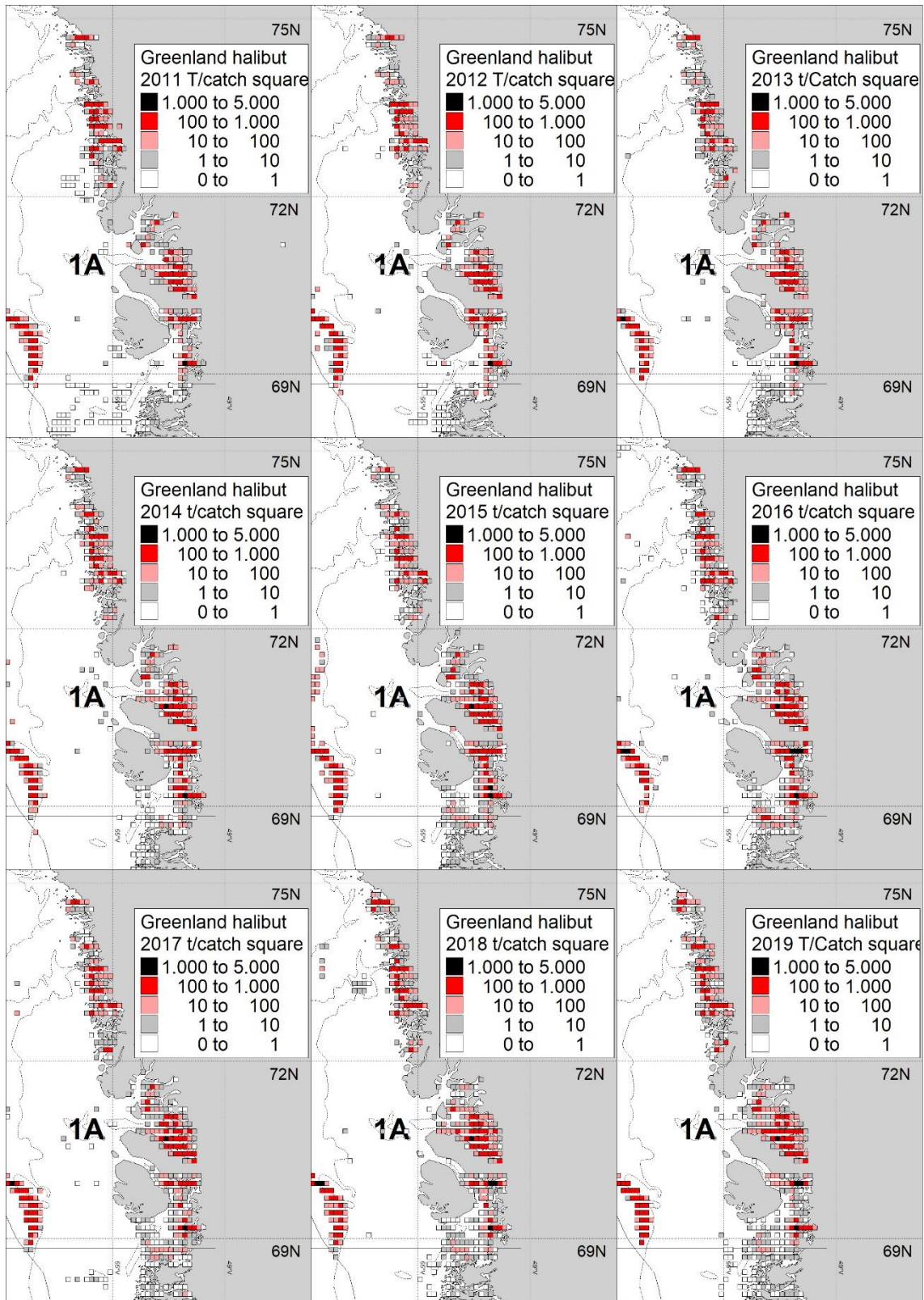
Year	Number of observations in the dataset	Total Longline catch (t)	longline logbook (t)	% of total longline fishery covered.	CPUE Kg/hook logbook
2006	57		46		43
2007	409		302		36.7
2008	390		353		36.6
2009	356		290		37.9
2010	466	5617	389	7	44.3
2011	691	5046	762	15	49.8
2012	871	5847	969	17	46.3
2013	1254	6639	1140	17	42.4
2014	1190	7800	1312	17	48.8
2015	1179	7279	1055	14	41.2
2016	1401	9512	1432	15	40.8
2017	1259	8261	1058	13	34.2
2018	923	7505	804	11	36.6
2019	1228	8122	1060	13	34.7
2020	1082	8880	1031	12	32.5
2021	860	8479	876	10	37.2

**Table 8.** Uumannaq logbook data (**gillnet**) for vessels >30ft.

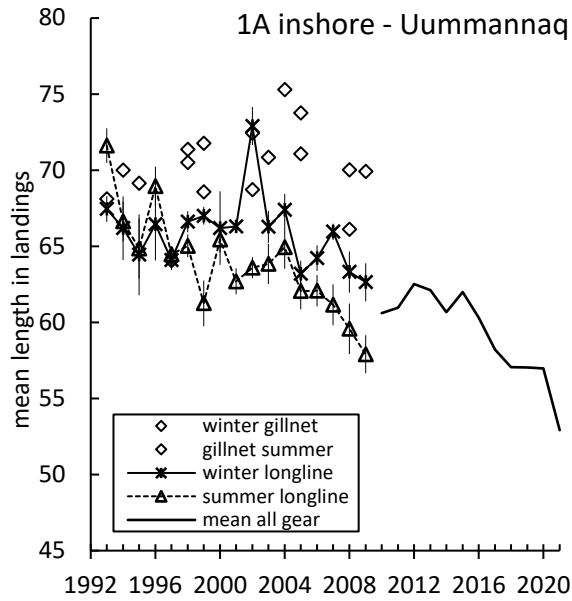
Year	No of gillnet settings	Total gillnet catch (t)	Logbook reported catch (t)	% of gillnet fishery covered.	CPUE Kg/gillnet
2008	6		2		23.8
2009	235		196		53.7
2010	547	610	495	81	58.6
2011	911	1179	856	73	65.8
2012	174	357	192	54	60.5
2013	197	369	218	59	85.8
2014	200	407	258	63	78.6
2015	83	962	93	10	71.6
2016	176	792	167	21	73.4
2017	175	788	242	31	77.7
2018	284	1334	370	28	81.1
2019	448	2121	583	27	74.2
2020	653	1797	657	37	60
2021	546	1130	682	60	67.5



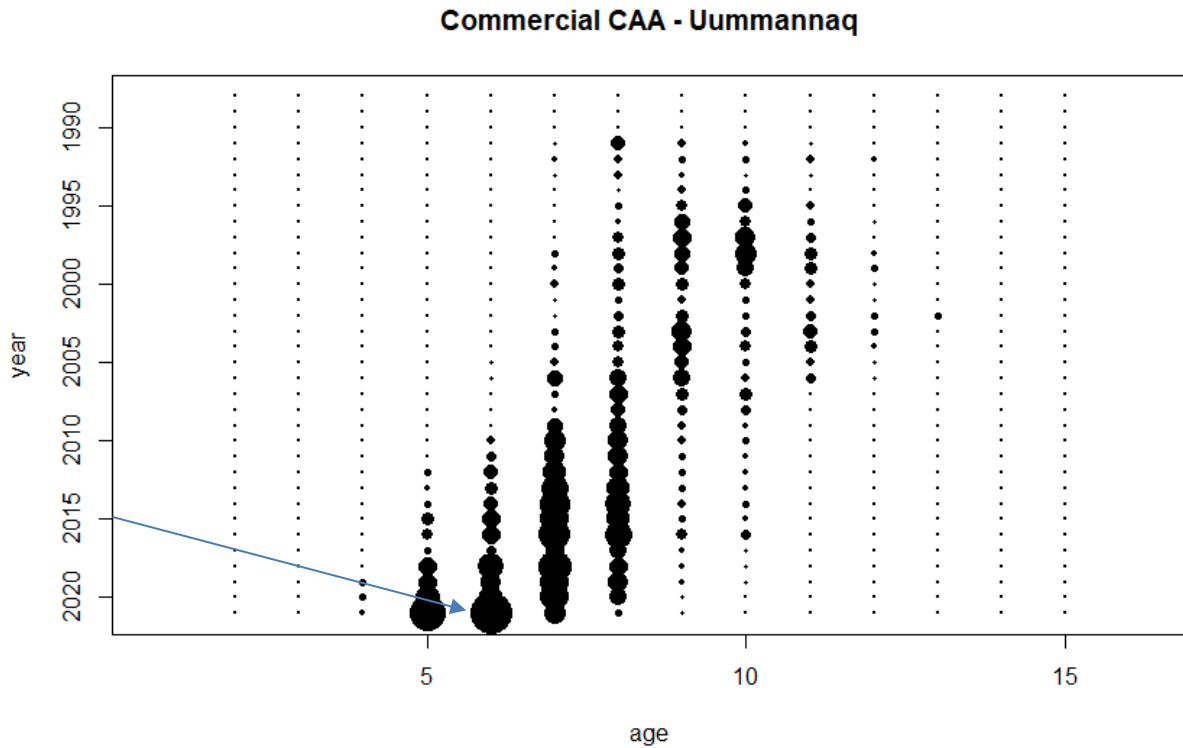
**Figure 1.** Catches of Greenland halibut in NAFO Subarea 1 Division 1A inshore since 1954.



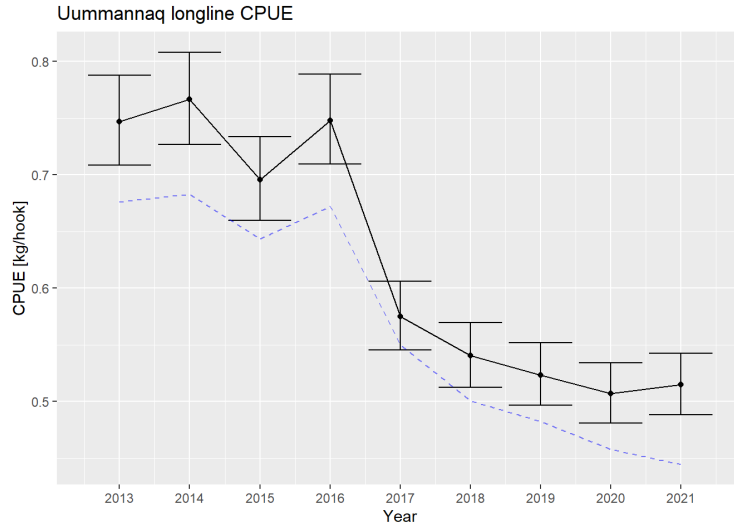
**Figure 2.** Greenland halibut catch by statistical square in the Disko Bay.



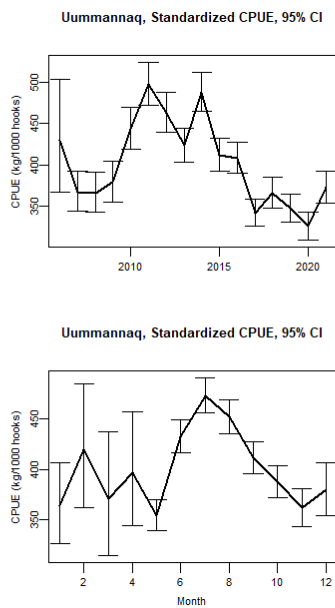
**Figure 3.** Uummannaq mean length in the landings: longline summer, longline winter, gillnet and overall mean weighted by area, season gear and amounts (after 2010).



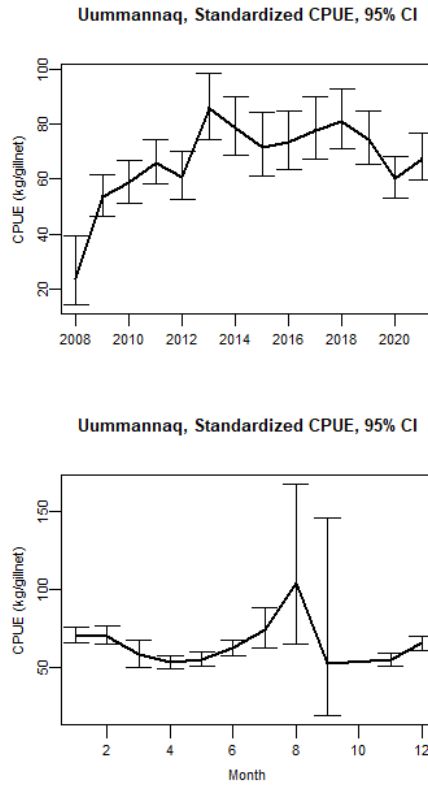
**Figure 4.** Catch At Age CAA bubble plot for the commercial landings in Uummannaq. Year 2021 have been recalculated by the new ALK from Uummannaq 2021.



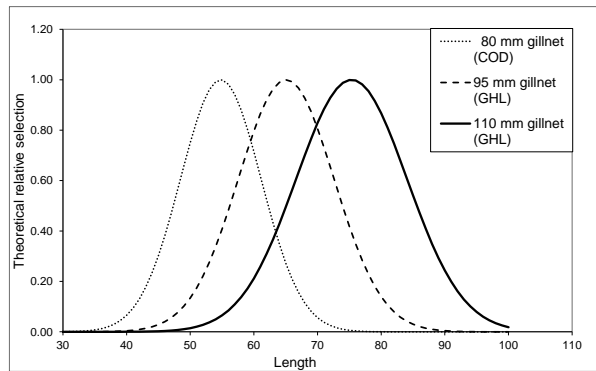
**Figure 5.** Commercial CPUE (Kg/hook) based on factory landing reports from all factories in Uummannaq.



**Figure 6.** Standardized longline mean and 95% CI CPUE based on logbooks from vessels larger than 30ft in Uummannaq.



**Figure 7.** Gillnet Standardized mean and 95% CI CPUE based on logbooks from vessels larger than 30ft in Uummannaq.



**Figure 8.** Relative selection curves for Greenland halibut with the most recently used gillnets. After a period with increasing use of illegal use of cod gillnets in the Disko bay used to target Greenland halibut, the legal meshsize was changed from 110 mm halfmesh to 95mm halfmesh in 2017.

\*\*\*\*\*  
 UUMMANNAQ LONGLINE LOGBOOK CPUE  
 \*\*\*\*\*

lm(formula = lcpue ~ Year + Month + Boat)

Residuals:

Min 1Q Median 3Q Max  
 -4.6686 -0.2535 0.0237 0.2805 2.8565

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	6.3412263	0.1088027	58.282	< 2e-16 ***
Year2007	-0.1579641	0.0774819	-2.039	0.041497 *
Year2008	-0.1609881	0.0824008	-1.954	0.050755 .
Year2009	-0.1271457	0.0828434	-1.535	0.124863
Year2010	0.0306161	0.0822452	0.372	0.709709
Year2011	0.1467619	0.0806487	1.820	0.068816 .
Year2012	0.0738393	0.0801986	0.921	0.357221
Year2013	-0.0149148	0.0795249	-0.188	0.851234
Year2014	0.1270927	0.0797095	1.594	0.110859
Year2015	-0.0437463	0.0797389	-0.549	0.583276
Year2016	-0.0516513	0.0795413	-0.649	0.516113
Year2017	-0.2290854	0.0797348	-2.873	0.004071 **
Year2018	-0.1610835	0.0801142	-2.011	0.044380 *
Year2019	-0.2145702	0.0801708	-2.676	0.007450 **
Year2020	-0.2796485	0.0804604	-3.476	0.000511 ***
Year2021	-0.1438202	0.0810511	-1.774	0.076013 .
Month2	0.1388233	0.0891509	1.557	0.119453
Month3	0.0173481	0.0976159	0.178	0.858947
Month4	0.0835560	0.0873171	0.957	0.338622
Month5	-0.0287846	0.0556118	-0.518	0.604747
Month6	0.1708547	0.0542803	3.148	0.001650 **
Month7	0.2593935	0.0540583	4.798	1.62e-06 ***
Month8	0.2146020	0.0542073	3.959	7.57e-05 ***
Month9	0.1205056	0.0546377	2.206	0.027433 *
Month10	0.0612774	0.0546498	1.121	0.262191
Month11	-0.0073255	0.0573164	-0.128	0.898303
Month12	0.0398780	0.0615837	0.648	0.517292
BoatAGGU S	0.1120680	0.0591364	1.895	0.058104 .
BoatAJO	-0.2276817	0.2796137	-0.814	0.415503
BoatAKA	-1.6109541	0.4767541	-3.379	0.000730 ***
BoatAKKA AQQALU	-0.5143554	0.0764543	-6.728	1.79e-11 ***
BoatAKKAANGUAG ZEEB	-0.3670226	0.0613488	-5.983	2.25e-09 ***
BoatANE-ANNA	-0.3112163	0.0623101	-4.995	5.97e-07 ***
BoatANGAJE-NUKA	-0.3490004	0.0777047	-4.491	7.14e-06 ***



BoatANGAJOORA -0.7314892 0.0778069 -9.401 < 2e-16 \*\*\*  
 BoatANGAJOORAQ -0.3587568 0.0641657 -5.591 2.30e-08 \*\*\*  
 BoatANGAANNGU -0.2167667 0.0594749 -3.645 0.000269 \*\*\*  
 BoatANITSI 0.0228892 0.0592724 0.386 0.699378  
 BoatAPUTSIAQ -0.2392635 0.0936729 -2.554 0.010653 \*  
 BoatARNARISSOQ -0.4920313 0.1227952 -4.007 6.18e-05 \*\*\*  
 BoatARNAALUK MALIK -0.4552244 0.1767122 -2.576 0.010003 \*  
 BoatAVALERAQ -0.2581511 0.0635605 -4.062 4.90e-05 \*\*\*  
 BoatAVATAQ -0.6079303 0.0828956 -7.334 2.37e-13 \*\*\*  
 BoatBASSI -0.2032183 0.1604369 -1.267 0.205300  
 BoatBETA 0.0462896 0.2432706 0.190 0.849092  
 BoatBJ. NUKARLEQ -0.1494211 0.0593318 -2.518 0.011800 \*  
 BoatDORTINNGUAQ -0.0733459 0.0595764 -1.231 0.218298  
 BoatFALIK L -0.2577613 0.0688934 -3.741 0.000184 \*\*\*  
 BoatGAABA -1.0412691 0.2450346 -4.249 2.16e-05 \*\*\*  
 BoatLULIAQ -0.3516988 0.2442492 -1.440 0.149914  
 BoatINUNNGUA -0.1600885 0.0576736 -2.776 0.005515 \*\*  
 BoatIPIUTAQ -1.6540885 0.1546621 -10.695 < 2e-16 \*\*\*  
 BoatITATTAQ -0.0619637 0.0875177 -0.708 0.478949  
 BoatIVALU -0.4534553 0.2433458 -1.863 0.062425 .  
 BoatJENS HENRIK -0.0412673 0.0734752 -0.562 0.574364  
 BoatJESS -0.6728238 0.1312401 -5.127 2.99e-07 \*\*\*  
 BoatJOHANSEN -0.9271929 0.2193145 -4.228 2.38e-05 \*\*\*  
 BoatJOLLE-000017589 0.1976181 0.2789509 0.708 0.478688  
 BoatJULIA NADUK -0.2868923 0.0743054 -3.861 0.000113 \*\*\*  
 BoatJULIANE -0.3232080 0.0663464 -4.872 1.12e-06 \*\*\*  
 BoatJUUKA -0.0214914 0.0587420 -0.366 0.714475  
 BoatJUULUNNGUAQ -0.0523172 0.2787261 -0.188 0.851114  
 BoatJAAKU-MALIK -0.4938003 0.4763930 -1.037 0.299969  
 BoatKABENA -0.3180358 0.1171230 -2.715 0.006628 \*\*  
 BoatKAMMA -0.3583401 0.0649049 -5.521 3.43e-08 \*\*\*  
 BoatKARO -0.1915801 0.0820696 -2.334 0.019591 \*  
 BoatKATRI -0.2371168 0.1264514 -1.875 0.060792 .  
 BoatKATTANNGUAQ -0.7154693 0.4761132 -1.503 0.132932  
 BoatKRISTINA -0.0193937 0.0739162 -0.262 0.793037  
 BoatKUNUK -0.3270844 0.0910437 -3.593 0.000329 \*\*\*  
 BoatKUTUK -0.3101347 0.2791260 -1.111 0.266549  
 BoatKUJJUK -0.6648020 0.0988448 -6.726 1.82e-11 \*\*\*  
 BoatKAAKA-AQQALU -0.0738600 0.0753245 -0.981 0.326829  
 BoatKAALEERAQ -0.2243684 0.0759839 -2.953 0.003154 \*\*  
 BoatL. CHRISTINA -0.3915107 0.0826089 -4.739 2.17e-06 \*\*\*  
 BoatL.CHRISTINA -0.2127642 0.0974430 -2.183 0.029018 \*  
 BoatLAILA S. -0.2473876 0.0626348 -3.950 7.87e-05 \*\*\*  
 BoatLENE BOHM -0.3521461 0.0767271 -4.590 4.48e-06 \*\*\*  
 BoatLINDENHANN -0.0002579 0.2441110 -0.001 0.999157  
 BoatLINE -3.0935994 0.4760556 -6.498 8.40e-11 \*\*\*

BoatLAARSEERAQ LARSEN -0.1900184 0.1276774 -1.488 0.136703  
 BoatM.A.FRENA -0.4949314 0.1163268 -4.255 2.11e-05 \*\*\*  
 BoatMALAMUK -0.2946037 0.0834851 -3.529 0.000419 \*\*\*  
 BoatMALIGIAQ S -0.6902419 0.0798814 -8.641 < 2e-16 \*\*\*  
 BoatMASIK -0.3417447 0.0577618 -5.916 3.37e-09 \*\*\*  
 BoatMIILU 0.1567182 0.1480124 1.059 0.289702  
 BoatMIILU-PALU -0.4059789 0.1313221 -3.091 0.001996 \*\*  
 BoatMINA -0.5421281 0.1072521 -5.055 4.37e-07 \*\*\*  
 BoatMINOU II -0.4737456 0.3390221 -1.397 0.162320  
 BoatNĂ,LO -1.3644921 0.1432035 -9.528 < 2e-16 \*\*\*  
 BoatNAJANNGUAQ -0.3295380 0.1184947 -2.781 0.005426 \*\*  
 BoatNAJATTAQ -0.9970660 0.1427559 -6.984 2.99e-12 \*\*\*  
 BoatNANOQ 0.0361126 0.0922205 0.392 0.695367  
 BoatNANUVIK -0.2550314 0.1145367 -2.227 0.025988 \*  
 BoatNEQITAQ -0.3462819 0.0602437 -5.748 9.22e-09 \*\*\*  
 BoatNIELS -0.5181888 0.0687705 -7.535 5.19e-14 \*\*\*  
 BoatNIISE -0.6510638 0.1766262 -3.686 0.000229 \*\*\*  
 BoatNIISIKA PAALU -0.4722206 0.1767572 -2.672 0.007559 \*\*  
 BoatNIKULIINA -0.1143124 0.2791434 -0.410 0.682171  
 BoatNILAK 0.1308776 0.0952241 1.374 0.169335  
 BoatNIVI K. -0.4042108 0.0777950 -5.196 2.07e-07 \*\*\*  
 BoatNONO -0.7501964 0.1307826 -5.736 9.89e-09 \*\*\*  
 BoatNORSAQ -0.3226087 0.0635498 -5.076 3.90e-07 \*\*\*  
 BoatNUKA 0.4894365 0.3390596 1.444 0.148900  
 BoatNUKANU S 0.0287744 0.0748701 0.384 0.700745  
 BoatNUKARIIT III -0.2223739 0.1058085 -2.102 0.035601 \*  
 BoatNUKARIIT IV -0.2944498 0.0892647 -3.299 0.000974 \*\*\*  
 BoatNUKARLEQ -0.3504015 0.0867360 -4.040 5.38e-05 \*\*\*  
 BoatNUUNI -0.2370947 0.0905794 -2.618 0.008867 \*\*  
 BoatNUUNU -0.3205647 0.2432987 -1.318 0.187668  
 BoatOVE -0.5243815 0.0726368 -7.219 5.51e-13 \*\*\*  
 BoatPANITUAQ -1.0056903 0.0767853 -13.097 < 2e-16 \*\*\*  
 BoatPAPEROQ -0.3046663 0.1876045 -1.624 0.104403  
 BoatPINIARTOQ -0.0694114 0.0885608 -0.784 0.433188  
 BoatPIPALUK -0.6740101 0.0710997 -9.480 < 2e-16 \*\*\*  
 BoatQAJAQ 0.1644972 0.4760556 0.346 0.729692  
 BoatQASIGIAQ -0.2772661 0.0579230 -4.787 1.71e-06 \*\*\*  
 BoatQILANNGAQ -0.1149920 0.0590834 -1.946 0.051644.  
 BoatQAASIINA -0.6032655 0.1429423 -4.220 2.46e-05 \*\*\*  
 BoatRENA G. -0.2046229 0.0824149 -2.483 0.013046 \*  
 BoatRIKKE -0.4623860 0.1015815 -4.552 5.36e-06 \*\*\*  
 BoatSAGDLEQ -0.2772382 0.1169107 -2.371 0.017736 \*  
 BoatSARFARFIK -0.3163449 0.0636829 -4.968 6.87e-07 \*\*\*  
 BoatSAVIK -0.1610679 0.0786815 -2.047 0.040669 \*  
 BoatSOFIE -0.4555905 0.0686614 -6.635 3.36e-11 \*\*\*  
 BoatSUSSI LAILA -0.7717915 0.3391026 -2.276 0.022863 \*

BoatTUPPI	-0.2074201	0.4759357	-0.436	0.662978
BoatTUPPIA	-0.1750695	0.4769267	-0.367	0.713566
BoatUILOQ	0.0558753	0.0783303	0.713	0.475655
BoatULU	-0.0687325	0.0593046	-1.159	0.246487
BoatAAJU S.	-0.0529196	0.0584835	-0.905	0.365554
BoatAAJUUA	-0.2135356	0.0617277	-3.459	0.000543 ***
BoatAALIPAARAQ	-0.4808598	0.0701852	-6.851	7.64e-12 ***
BoatAANAA RUTH	-0.5536362	0.0883815	-6.264	3.86e-10 ***
BoatAAPIKANNA	-0.3037299	0.1022659	-2.970	0.002983 **
BoatAAQA AQQALU	-0.0891635	0.0640493	-1.392	0.163913
BoatAAQA JULIE	-0.9389969	0.1038883	-9.039	< 2e-16 ***
BoatAARSU	-0.4802304	0.0727945	-6.597	4.35e-11 ***
BoatAAVU	0.0004213	0.0666432	0.006	0.994956

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4724 on 13477 degrees of freedom

Multiple R-squared: 0.228, Adjusted R-squared: 0.2201

F-statistic: 28.84 on 138 and 13477 DF, p-value: < 2.2e-16

\*\*\*\*\*

UUMMANNAQ GILLNET LOGBOOK CPUE  
ALL MONTHS MAX CATCH 1001 KG/Gillnet

\*\*\*\*\*

lm(formula = lcpue ~ Year + Month + Boat)

Residuals:

Min 1Q Median 3Q Max  
-4.1929 -0.2735 0.0294 0.3035 2.4793

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	3.537734	0.251801	14.050	< 2e-16 ***
Year2009	0.815221	0.246641	3.305	0.000956 ***
Year2010	0.903036	0.245933	3.672	0.000244 ***
Year2011	1.018867	0.245746	4.146	3.44e-05 ***
Year2012	0.935438	0.252995	3.697	0.000220 ***
Year2013	1.283491	0.251776	5.098	3.58e-07 ***
Year2014	1.196641	0.251345	4.761	1.99e-06 ***
Year2015	1.103722	0.255095	4.327	1.55e-05 ***
Year2016	1.127999	0.254406	4.434	9.48e-06 ***
Year2017	1.185324	0.253364	4.678	2.98e-06 ***
Year2018	1.228226	0.252199	4.870	1.15e-06 ***
Year2019	1.139409	0.252671	4.509	6.66e-06 ***
Year2020	0.926770	0.252104	3.676	0.000240 ***
Year2021	1.043480	0.252128	4.139	3.56e-05 ***
Month2	-0.006126	0.039071	-0.157	0.875409
Month3	-0.198011	0.075026	-2.639	0.008338 **
Month4	-0.282271	0.040510	-6.968	3.68e-12 ***
Month5	-0.247908	0.044598	-5.559	2.87e-08 ***
Month6	-0.130108	0.041147	-3.162	0.001577 **
Month7	0.046702	0.089900	0.519	0.603444
Month8	0.386106	0.241387	1.600	0.109772
Month9	-0.295628	0.520890	-0.568	0.570372
Month11	-0.255023	0.031238	-8.164	4.17e-16 ***
Month12	-0.075526	0.030181	-2.502	0.012371 *
BoatANE-ANNA	-0.187109	0.071192	-2.628	0.008612 **
BoatANGAJE-NUKA	-0.345776	0.077580	-4.457	8.51e-06 ***
BoatANGAJOORA	-0.375990	0.301699	-1.246	0.212741
BoatANGAJOORAQ	-0.371895	0.105408	-3.528	0.000423 ***
BoatANGUTEERAQ	0.191126	0.518796	0.368	0.712590
BoatANGAANNGU	-0.113253	0.044921	-2.521	0.011731 *
BoatANITSI	-0.407379	0.056799	-7.172	8.57e-13 ***
BoatAPUTSIAQ	0.146272	0.151225	0.967	0.333473
BoatARNARISSOQ	0.080362	0.366596	0.219	0.826496
BoatASSA MARIE	-0.512260	0.186429	-2.748	0.006024 **

BoatAVALERAQ -0.053547 0.060363 -0.887 0.375083  
 BoatBJ. NUKARLEQ -0.492663 0.097267 -5.065 4.24e-07 \*\*\*  
 BoatDORTINNGUAQ -0.201050 0.048461 -4.149 3.40e-05 \*\*\*  
 BoatENOKSEN II 0.329527 0.186574 1.766 0.077429 .  
 BoatFALIK L -0.229443 0.052653 -4.358 1.34e-05 \*\*\*  
 BoatIINANNGUAQ -0.071014 0.105966 -0.670 0.502790  
 BoatINUNNGUA -0.256193 0.072787 -3.520 0.000436 \*\*\*  
 BoatITATTAAQ -0.238224 0.081345 -2.929 0.003422 \*\*  
 BoatJENS HENRIK 1.747427 0.202193 8.642 < 2e-16 \*\*\*  
 BoatJULIA NADUK -0.123968 0.050792 -2.441 0.014697 \*  
 BoatJULIANE 0.037665 0.139784 0.269 0.787598  
 BoatJUUKA -0.311945 0.041168 -7.577 4.25e-14 \*\*\*  
 BoatJAAKU-MALIK -0.023697 0.072037 -0.329 0.742200  
 BoatKABENA -0.625138 0.216538 -2.887 0.003908 \*\*  
 BoatKAMMA -0.306855 0.064250 -4.776 1.84e-06 \*\*\*  
 BoatKATRI -2.620932 0.518481 -5.055 4.47e-07 \*\*\*  
 BoatKRISTINA -0.578932 0.071522 -8.094 7.32e-16 \*\*\*  
 BoatKAAKA-AQQALU -0.531343 0.148312 -3.583 0.000344 \*\*\*  
 BoatKAALEERAQ -0.583089 0.200520 -2.908 0.003656 \*\*  
 BoatL. CHRISTINA -1.072313 0.366543 -2.925 0.003456 \*\*  
 BoatLAILA S. -0.002172 0.086468 -0.025 0.979962  
 BoatLENE BOHM -1.337591 0.189449 -7.060 1.91e-12 \*\*\*  
 BoatM.A.FRENA -0.748759 0.093865 -7.977 1.88e-15 \*\*\*  
 BoatMALAMUK 0.387430 0.301758 1.284 0.199239  
 BoatMALIGIAQ S -0.608653 0.100832 -6.036 1.70e-09 \*\*\*  
 BoatMASIK -0.195091 0.056412 -3.458 0.000549 \*\*\*  
 BoatNAJA-NUKA -0.765359 0.366314 -2.089 0.036731 \*  
 BoatNANOQ -0.038429 0.080206 -0.479 0.631872  
 BoatNANUVIK 0.208411 0.132634 1.571 0.116177  
 BoatNEQITAQ -0.022010 0.087266 -0.252 0.800885  
 BoatNIELS -0.881513 0.090544 -9.736 < 2e-16 \*\*\*  
 BoatNIISIKA PAALU -0.284292 0.116976 -2.430 0.015122 \*  
 BoatNORSAQ -0.083656 0.051083 -1.638 0.101567  
 BoatNUKANU S -0.119508 0.129633 -0.922 0.356631  
 BoatNUKARIIT III -0.822083 0.100970 -8.142 4.98e-16 \*\*\*  
 BoatNUKARIIT IV -0.952231 0.236117 -4.033 5.60e-05 \*\*\*  
 BoatNUKARLEQ -0.222180 0.124449 -1.785 0.074279 .  
 BoatNUUNI -0.191034 0.147961 -1.291 0.196730  
 BoatOVE -0.005744 0.203298 -0.028 0.977461  
 BoatPANITUAQ 0.277205 0.138823 1.997 0.045904 \*  
 BoatPAPEROQ 0.323982 0.263209 1.231 0.218427  
 BoatQASIGIAQ -0.017349 0.069139 -0.251 0.801881  
 BoatQILANNGAQ 0.039197 0.043502 0.901 0.367615  
 BoatQAASIINA -0.164207 0.058231 -2.820 0.004824 \*\*  
 BoatRENA G. -0.192733 0.061133 -3.153 0.001628 \*\*  
 BoatRIKKE 0.078520 0.177470 0.442 0.658193

BoatSARFARFIK -0.511106 0.088460 -5.778 8.07e-09 \*\*\*  
 BoatSAVIK -0.454916 0.238173 -1.910 0.056193 .  
 BoatSOFIE -0.082517 0.104750 -0.788 0.430880  
 BoatULU -0.280672 0.063291 -4.435 9.44e-06 \*\*\*  
 BoatAAJU S. -0.339046 0.062844 -5.395 7.20e-08 \*\*\*  
 BoatAAJUUA -0.074494 0.071783 -1.038 0.299433  
 BoatAALIPAARAQ -0.569755 0.222248 -2.564 0.010391 \*  
 BoatAANAA RUTH -0.189863 0.109800 -1.729 0.083847 .  
 BoatAAQA AQQALU -0.788197 0.081507 -9.670 < 2e-16 \*\*\*  
 BoatAAQA JULIE -0.323904 0.096139 -3.369 0.000760 \*\*\*  
 BoatAARSU -0.650179 0.082279 -7.902 3.42e-15 \*\*\*  
 BoatAAVU -0.169451 0.049676 -3.411 0.000653 \*\*\*

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5146 on 4543 degrees of freedom  
 Multiple R-squared: 0.2469, Adjusted R-squared: 0.2318  
 F-statistic: 16.37 on 91 and 4543 DF, p-value: < 2.2e-16