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Fisheries and catches of Greenland Halibut Stock Component in NAFO Division 1A Inshore in 2014.

by

Rasmus Nygaard

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

Abstract

This paper presents catch information, results from data collection from commercial landings and CPUE indices based on logbook data.

The inshore fishery for Greenland halibut developed in the beginning of the twentieth century, with the introduction of the longline to Greenland in 1910. The majority of the inshore fishery is concentrated in the Disko Bay and the districts surrounding Uummannaq and Upernavik. The fishing grounds are concentrated near cities and settlements in the area, but also tends to concentrate in areas of iceberg producing glaciers where better fishery is obtained. Access to the ice fjords is limited in some seasons, and varies from year to year. The stocks are believed to recruit from the spawning stock in the Davis Strait, and no significant spawning has so far been documented inshore. Therefore, the stocks are believed to be dependent on recruitment from the offshore spawning areas. There is little migration between inshore and offshore and between the districts and a separate TAC is set for each area. Quota regulations were introduced as a shared total quota in 2008, but in 2012 the TAC was split in two components with ITQ's for vessels and shared quota for open boats. In 2014, "quota free" areas within each subarea were set by the Government of Greenland, and in these areas catches were not drawn from the total quota. The only other significant fishery in the areas is the trawl fishery targeting shrimp in the Disko bay. Length frequencies in the landings has systematically been collected by the Greenland institute of Natural Resources since 1993. Logbooks have been mandatory for vessels larger than 30'ft since 2008.

Introduction

Greenland halibut can be found in all waters around Greenland both offshore and inshore but the highest concentrations has always been found in NAFO division 1A inshore. The Greenland halibut stock component in Div. 1A inshore is considered to be recruited from the stock in the Davis Strait, but the adults appear resident in the fjords and are isolated from the offshore spawning stock (Riget and Boje, 1989). As a result, the inshore component probably does not contribute to the spawning stock in the Davis Strait (Boje, 1994). In samples from Disko Bay <10% of females in the reproductive age, were mature during the assumed peak spawning period in spring (Simonsen and Gundersen 2005). Also in former times only sporadic spawning was observed in the inshore area (Jørgensen and Boje, 1994) and the inshore component is therefore not assumed to be self-sustainable, but dependent on recruits and immigration from the offshore area (Bech, 1995). Evidence that supported this stock structure in 1994 caused NAFO to separate the assessment and advice on the inshore stock components from the offshore component in the Davis Strait and Baffin Bay.

Settlement occurs both inshore and offshore, but large concentrations of 1 year old recruits are mainly found inshore in the Disko bay and on the Banks West of Greenland particularly in NAFO division 1B and 1A. Less is known about recruitment inshore in other areas although high densities of juvenile Greenland halibut is however yearly observed in trawl surveys, West of Uummannaq and Upernavik.

The Disko Bay is of major importance to the shrimp fishing industry and earlier studies of the by-catch of Greenland halibut in the commercial shrimp fishery (Jørgensen and Carlsson, 1998) suggest that the by-catch is considerable and could have a negative effect on recruitment to the inshore stock component. To minimize by-catch of fish in the shrimp fishery, offshore shrimp trawlers have been equipped with grid separators since 2002 and inshore shrimp trawlers (Disko Bay) since 2011. The implementation of sorting grids in the shrimp fishery has led to a protection of juvenile fish species dependant on size and shape. Greenland halibut is in this sense less protected by the sorting grids due to the flat shape than other species with a more round body shape (SCR 07/88). A study of the by-catch in the offshore fishery suggested that grid separators currently used in the shrimp trawl offers high protection for Greenland halibut larger than 25 cm (SCR 07/88). The implementation of grid separators in the inshore component after 2011 may therefore have led to a reduction in fishing mortality in the Disko bay. Besides the Disko bay and a small area inshore in Division 1 B there is no trawl fishery in other inshore areas.

Description of the fishery

The inshore fishery for Greenland halibut started in the beginning of the 1900 century with the introduction of the longline to Greenland. The fishery started in the Disko Bay and gradually spread to the Uummannaq and Upernavik districts. The fishery is traditionally performed with longline from small open boats or from dog sledges through a hole in the sea ice. In recent decades small vessels have entered the fishery. In the mid 1980s gillnets were introduced to the inshore fishery, and were used more frequently in the following years. Longline fishery still constitutes the majority of the total landings. In the late 1990s, the first regulations limiting areas open to gillnet fishery were introduced in order to limit effort to the winter season. Competence to regulate seasons and areas open to gillnet fishery was transferred to local administrations in 2004, and areas open to gillnet fishery has expanded since then. The gillnet fishery is regulated by a minimum mesh-size of 110 mm (half meshes). In general, gillnets have narrow selection curves and only targeting fish at certain size intervals. Estimated selection curves for Greenland halibut suggests that 110 mm gillnets has maximal selectivity of Greenland halibut in the size interval 70-80 cm, but fish poorly in the size interval 50 to 60 cm. Licences requirements were introduced in 1998 and in 2008 TAC and quota regulations were introduced for the inshore fishery. 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 total Individual Transferable Quota and total quota set for each district.

Description of the Catches

Although the fishery started in 1910, catches were less than 1.000 tons until 1960 and during the 1970's catches gradually increased to around 3.000 tons. In the 1980's and 1990's catches increased further to above 20.000 and peaked at the end 1990s at about 25.000 tons. Since then catches have stabilized to a but has for more than two decades supported catches of more than 20.000 tons per year for the districts combined. Some inter district variation in the catches has however been observed (table 1, fig 2).

In the **Disko Bay,** catches increased during the 1980s and peaked in 2004 to 2006 with catches of more than 12.000 tons per year. Catches were thereafter halved in 3 years to just 6.300 tons in 2009 (table 1.). The decrease in the landings of Greenland halibut in the Disko Bay was in this period not quota regulated and no significant reduction in prices or effort was observed. The most likely explanation for the decrease from 2006 to 2009 is therefore the fishery was less favourable during this period. Since 2009 catches has increased and in 2014, 9.177 tons was landed from the area. The fishery in the Disko bay has always been highly concentrated around the bank just south of Ilulissat and typically more than one third of the Disko Bay catches are from small area (fig.3). Other important fishing grounds in the Disko Bay is the deep Kangia ice fjord (>900m) and the northern part of the Disko Day concentrated around the settlements Saqqaq and Qeqertaq and the ice fjord Torssukattak east of the settlements. In 2014, areas west of the important Ilulissat Icefjord bank were set as quota free area for all vessels along with the inner parts of the Kangia Icefjord when transporting the catch with dog sledges.

In **Uummannaq**, catches increased during the 1980s and peaked in 1999 at more than 8.000 tons (tab.1 and fig.1 and 2). Since then, catches have stabilized around 6000 tons but in 2014 more than 8199tons was landed from the fjord which is the highest observed. The fishery in Uummannaq is scattered all over the fjord near settlements (fig.3) Particular in the deep South-eastern part of the fjord from Uummannaq and towards East where depths of more than 1500 meters are common and large iceberg producing glaciers are located holds the more important fishing areas.

In **Upernavik**, catches increased from the mid 1980's and peaked in 1998 at a level of 7.000 tons (tab.1, fig.1 and 2). This was followed by a period of decreasing catches that could be due to a reduced effort. In 2014, 7381 tons were caught in the Upernavik area. The area consists of several large ice fjords, but the main fishing grounds are the deep Ikeq fjord (Upernavik Icefjord) and Gulteqarffik (Giesecke Icefjord) and the shallower fjords surrounding Upernavik and the settlements in the area (fig 3). Use of gillnets have been prohibited in Upernavik, but derogations have been given for a fishery outside the Icefjords since 2002.

Commercial data

Catch data

Data on the all inshore landings are reported to the Greenland Fishery Licence Authority (GFLK). Factories receiving the catch gather information on the fishery, including effort and location on individual fishing events and send the raw data to GFLK on a weekly basis. The high resolution of the landings therefore currently allows for a breakdown of catches by area (fig 3) gear season and likewise.

Mean length in landings

Individual samples of length in landings has been collected in the areas for decades by Grønlands fiskeri-undersøgelser (GF) and later by the Greenland Institute of Natural Resources (GINR). In general samples are collected several times during the seasons. In **Disko bay** mean length in the longline landings of Greenland halibut caught in summer are generally smaller than fish caught during winter, and winter mean size in general shows higher inter annual variation (fig 4). The winter fishery conducted from the Sea ice is highly dependent on ice coverage allowing access to the inner parts of the Kangia icefjord, where larger fish are accessible at greater depths. In Disko Bay mean length in landings, have decreased since 2001 and the 2013 summer fishery landings and the 2014 winter fishery landings has a mean length among the smallest observed (fig.4). The decreasing mean length can also be observed in the plotted length distributions from longline landings as a general decrease of all sizes particularly after 2002 (fig 5).

Mean length in the gillnet landings gradually increased until 2004 but suddenly changes to a lower values in 2009 (fig 6). The sudden decrease in the gillnet landings is likely caused by a failing fishing success of the 110mm Greenland halibut gillnets and an increased use small meshed gillnets used to target Greenland halibut.

In **Uummannaq** there is not the same difference between summer and winter fishing grounds as in the Disko bay and only small differences in the summer and winter mean lengths from longline landings are observed. The mean length in longline landings gradually decreased at a slow rate during the past two decades, but stabilized in the most recent years (fig 4). The minimum size in the longline landings from Uummannaq has decreased during the past two decades, but the size range has increased and the landings still contain significant numbers of large fish (fig. 5). Mean lengths in the gillnet landings gradually increased until 2004 but has stabilized since then (fig 6).

In **Upernavik** the summer and winter fishery also to a large degree takes place in the same areas and only minor differences are seen in the length frequencies from summer and winter fishery (fig 4). The mean length in the landings has been stable since 1999, except for a decrease in the 2010 and 2011 summer fishery. However, the mean length in the summer longline fishery increased in 2012 and 2013 to the stable level observed since 1999. The decrease observed in the winter fishery longline mean in 2014 was likely related to poor ice conditions during the sampling period forcing the fishery to take place near settlements and at shallower waters. The size range in the longline landings were very wide in the beginning of the 1990s, but gradually turned to a more narrow distribution by 2010 (fig 5). Since then the range has increased and both smaller and larger fish are observed in the longline landings in 2013. The decreasing mean lengths in the gillnet landings seen since 2013 and 2014 could indicate an increased use of smaller meshed gillnets normally used when targeting cod (fig 6).

Logbook CPUE

Logbooks have been mandatory for vessels greater than 30'ft (9,4m) since 2008. A GLM model was applied to longline fishery logbook data since 2008 (fig 7-9, appendix I). Raw logbook CPUE observations were log-transformed prior to the GLM analysis and outlier values were excluded from the analysis (5<logCPUE<8). Vessels with less than 200 logbook observations were also excluded. In general the longline Logbook GLM model explained less than 25 % the variability in the data and only covers 5-30% percent of the total landings. The CPUE series does not account for fishing grounds within the area and shifts in the distribution could also cause changes in the trends.

The **Disko bay logbook CPUE** index reveals little year to year variation and slow but gradual decrease in yield per effort after 2009, and the 2014 CPUE is the lowest observed (fig 7). However the GLM explained little of the variance observed in the data.

The **Uummannaq logbook CPUE** index was based on far fewer observations, since the Uummannaq >30^{ft} vessels are fewer and a higher proportion of the catch is taken by small open boats. The index however indicates an increasing CPUE in 2014 (fig 8).

The **Upernavik logbook CPUE** index shows greater inter annual variation and higher recalculated mean CPUE's than observed in Uummannaq and Disko Bay districts (fig 9). The apparent fluctuation is likely related to the year to year variation in access to the very good fishing grounds in the narrow but deep Gieskes ice fjord (Gulteqarffik is the Inuit word for "where the gold is collected") and Upernavik ice fjord. Both areas are highly productive and always provide a good fishery, but just as at Kangia in the Disko Bay, glacier ice and massive icebergs periodically limits the access to the areas.

References

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Table 1. Landings and Greenland halibut (‘000t) in Div. 1A inshore distributed on the main fishing areas: Disko Bay, Uummannaq and Upernavik.

	Disko Bay	Uumman naq	Upernavik	Unknown /other	Total in Div. 1A inshore:
1987	2,3	2,9	1,6	0,4	7,2
1988	2,7	2,9	0,8	0,6	7,0
1989	2,8	2,9	1,3	0,6	7,5
1990	3,8	2,8	1,2	0,5	8,4
1991	5,4	3,0	1,5	0,0	9,9
1992	6,6	3,1	2,2	0,1	11,9
1993	5,4	3,9	3,8	0,0	13,1
1994	5,2	4,0	4,8	0,0	14,0
1995	7,4	7,2	3,3	0,0	17,9
1996	7,8	4,6	4,8	0,0	17,3
1997	8,6	6,3	4,9	0,0	19,8
1998	10,7	6,9	7,0	0,0	24,6
1999	10,6	8,4	5,3	0,1	24,3
2000	7,6	7,6	3,8	2,2	21,1
2001	7,1	6,6	3,2	0,0	16,9
2002	11,7	5,3	3,0	0,0	20,1
2003	11,6	5,0	3,9	0,0	20,5
2004	12,9	5,2	4,6	0,0	22,7
2005	12,5	4,9	4,8	0,8	22,9
2006	12,1	6,0	5,1	0,0	23,2
2007	10,0	5,3	4,9	0,0	20,6
2008	7,7	5,4	5,5	0,3	18,9
2009	6,3	5,5	6,5	0,0	18,3
2010	8,5	6,2	5,9	0,0	20,6
2011	8,0	6,4	6,5	0,0	20,9
2012	7.8	6,2	6,8	0,1	20,7
2013	9,1	7,0	6,0	0,0	22,1
2014	9,177	8,199	7,381	0,128	24,886

Notes
2013: Quota enhanced
2014: Quotafree area layed down by Government of Greenland. All catches included in catch statistics.

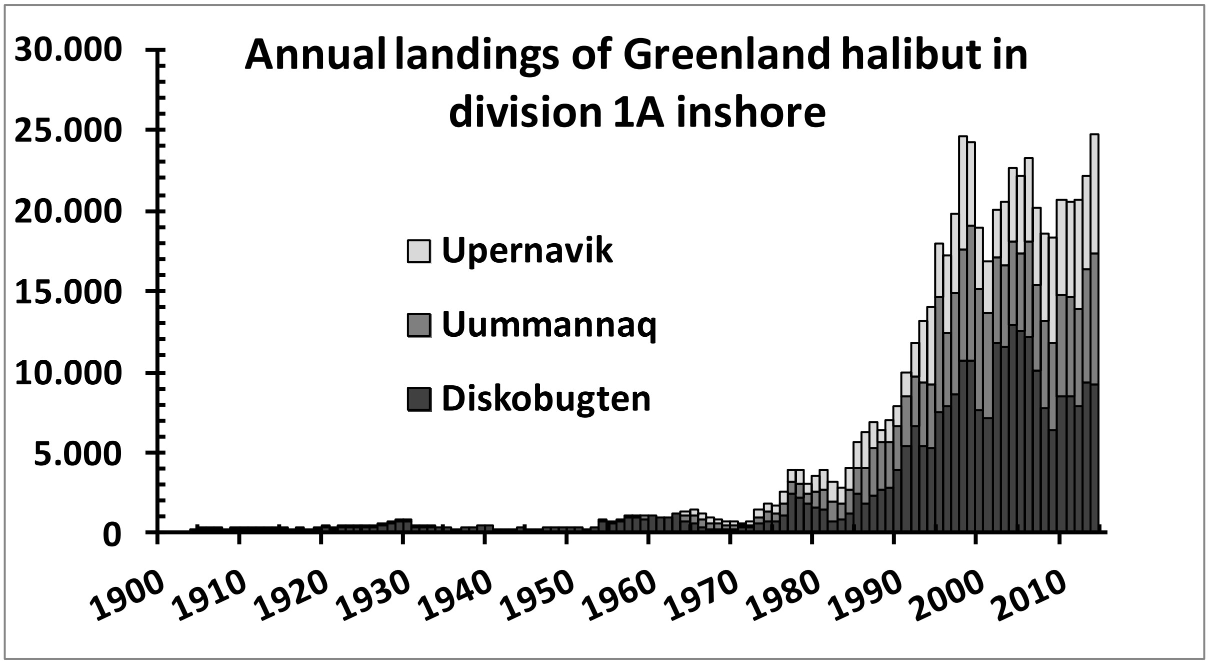

Fig. 1. Catches of Greenland halibut in NAFO Subarea 1 Division 1Ainshore since 1904 for NAFO division 1A inshore in North West Greenland.

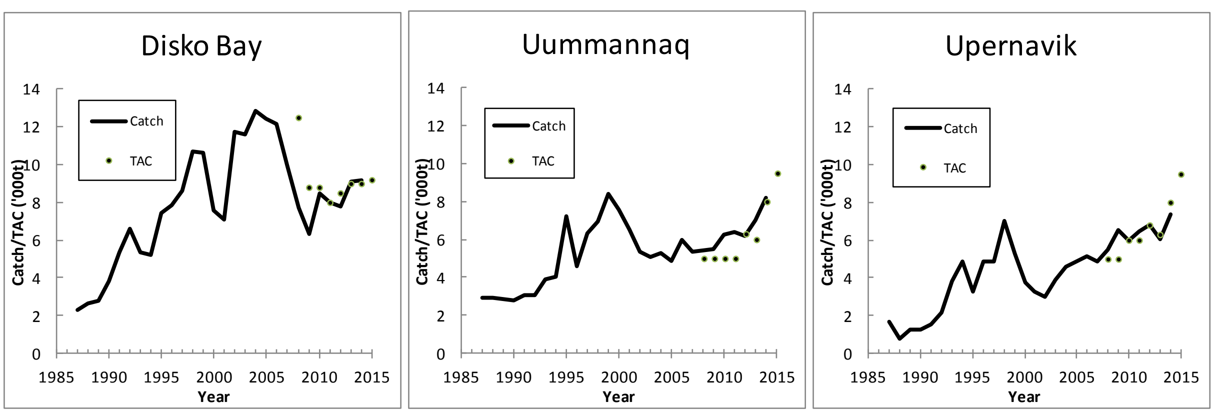

Fig. 2. Greenland halibut in NAFO division 1A inshore: Catches since 1987 by district. Disko bay (left), Uummannaq (center) and Upernavik (right).

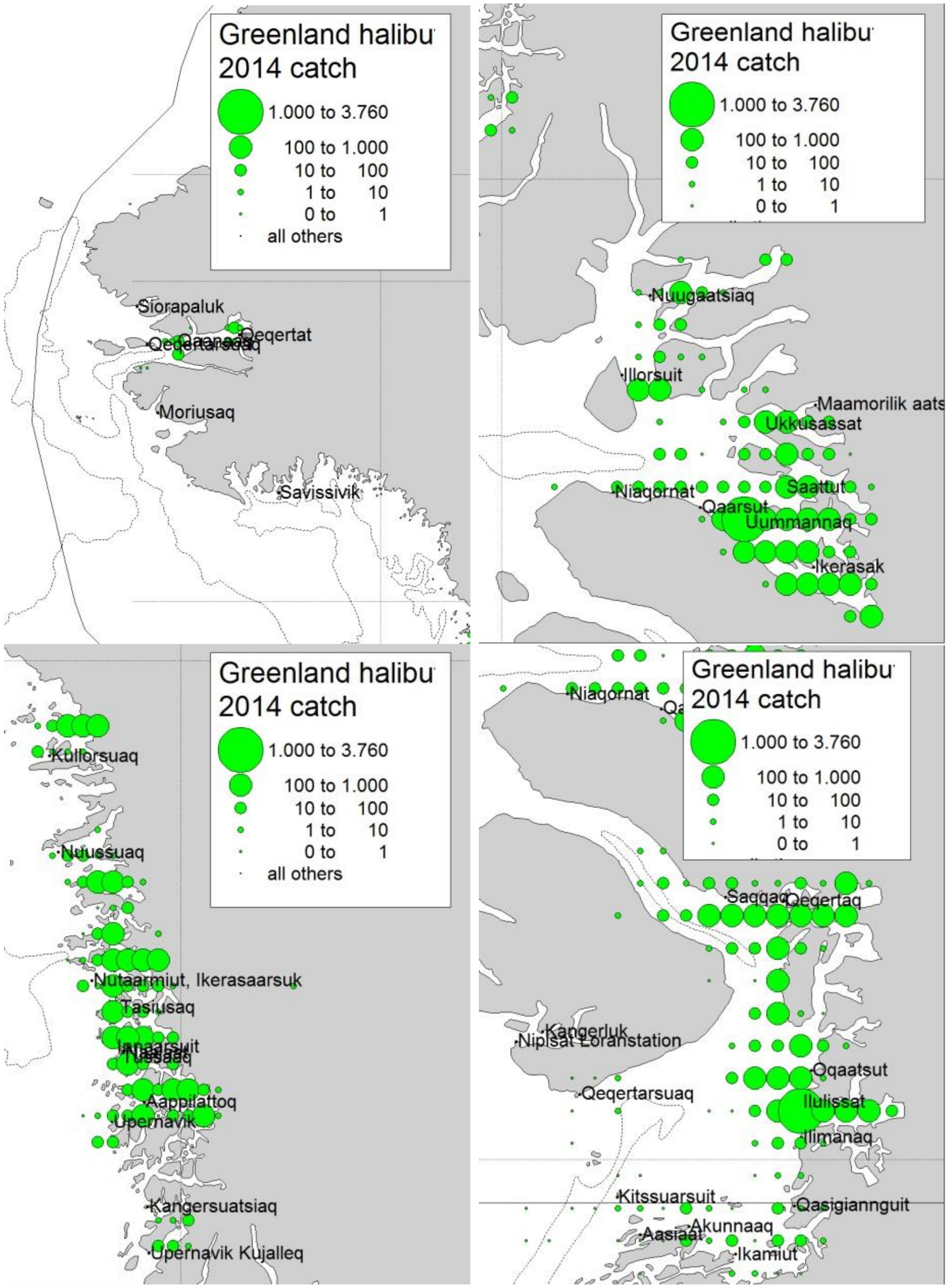

Figure 3 Greenland halibut catch by statistical square in NAFO division 1A inshore in 2014: The Qaanaq area (top left), Upernavik (bottom left), Uummannaq (top right) and the Disko bay (bottom right).

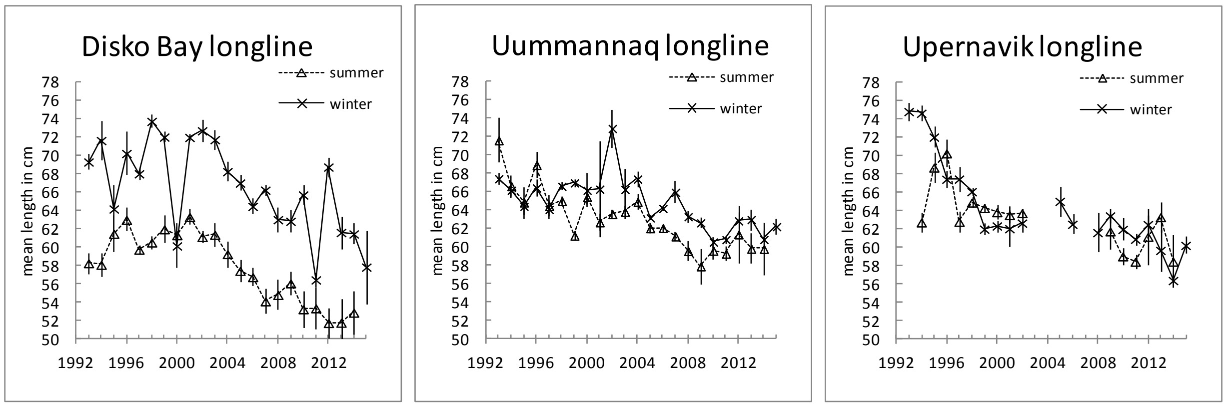

Fig. 4. Longline mean length in landings from in the Disko bay (left), Uummannaq (center) and Upernavik (right) +CL.

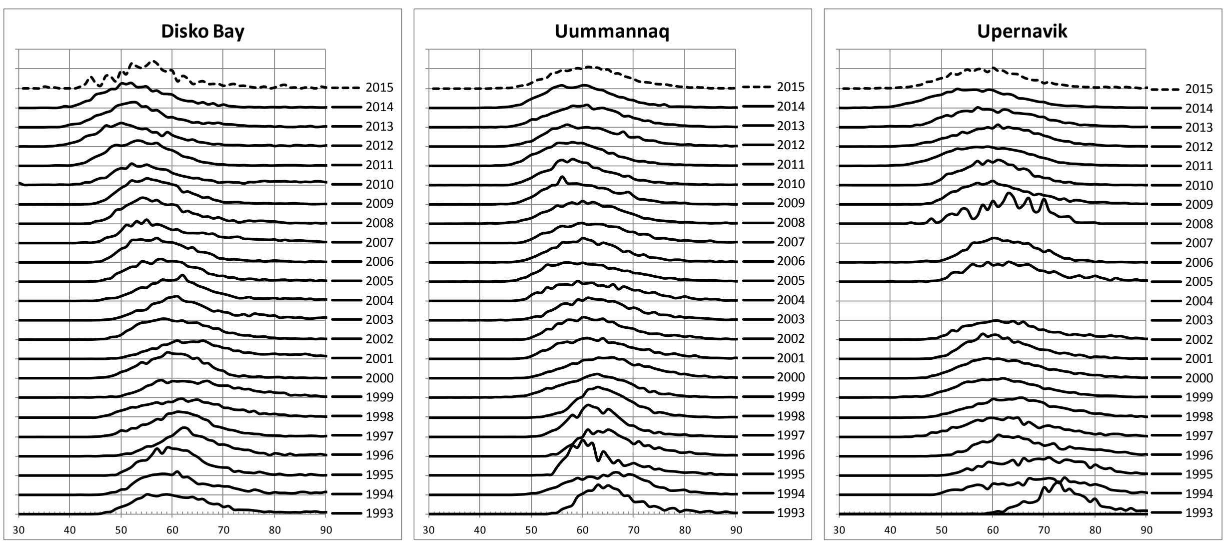

Fig 5 Disko bay length frequencies in longline landings in % of number measured all months combined.

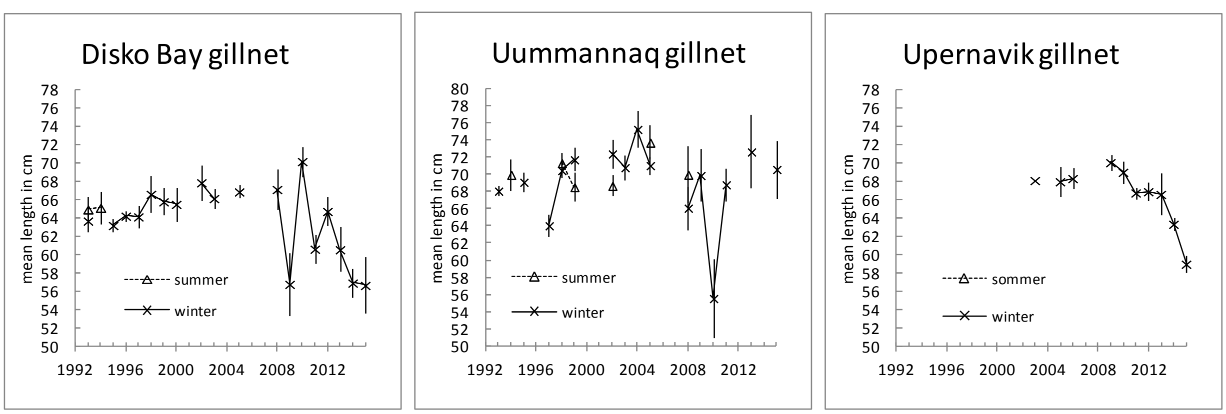

Fig. 6. Gillnet mean length in landings from in the Disko bay (left), Uummannaq (center) and Upernavik (right) +CL.

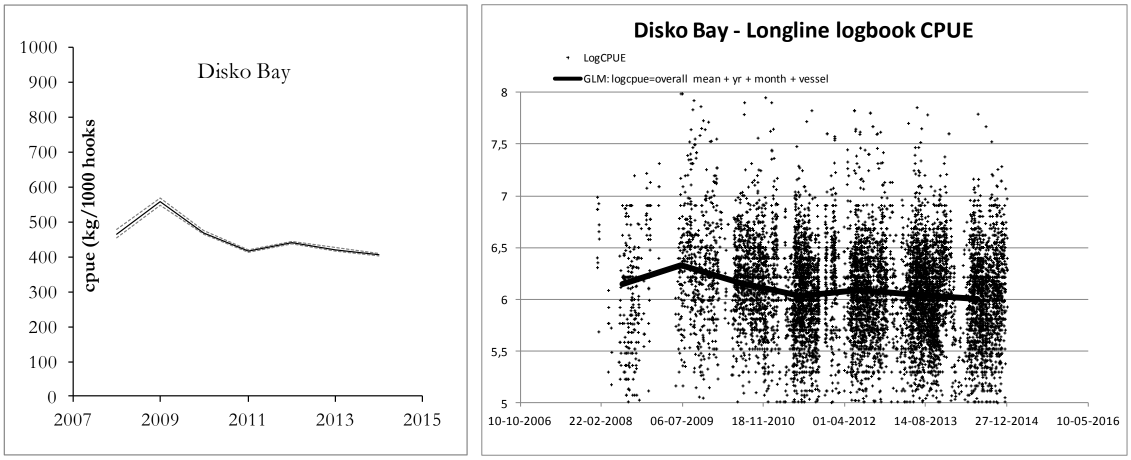

Fig 7. Standardized CPUE series for for commercial LongLine catches.

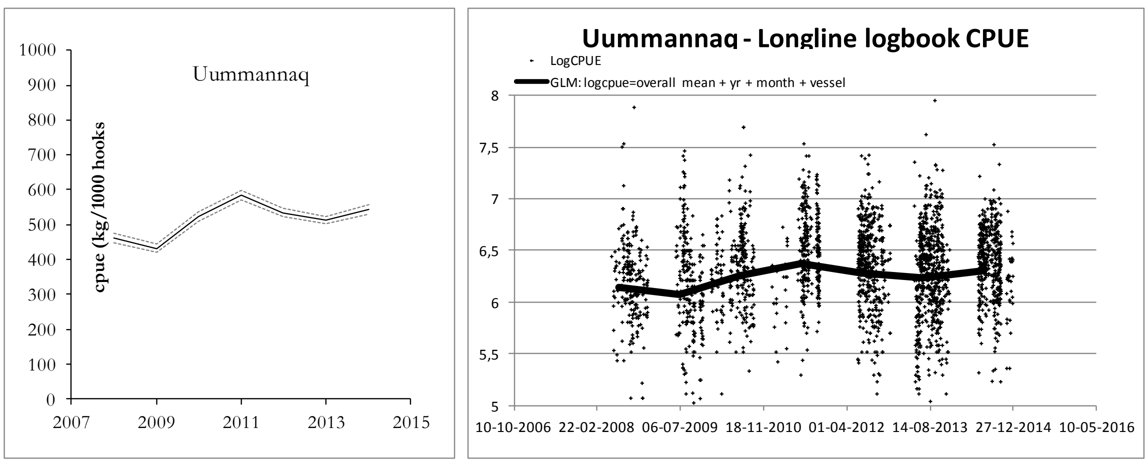

Fig 8. Standardized CPUE series for for commercial longLine (thick line) . + indicate logCPUE(kg/1000hooks) by date.

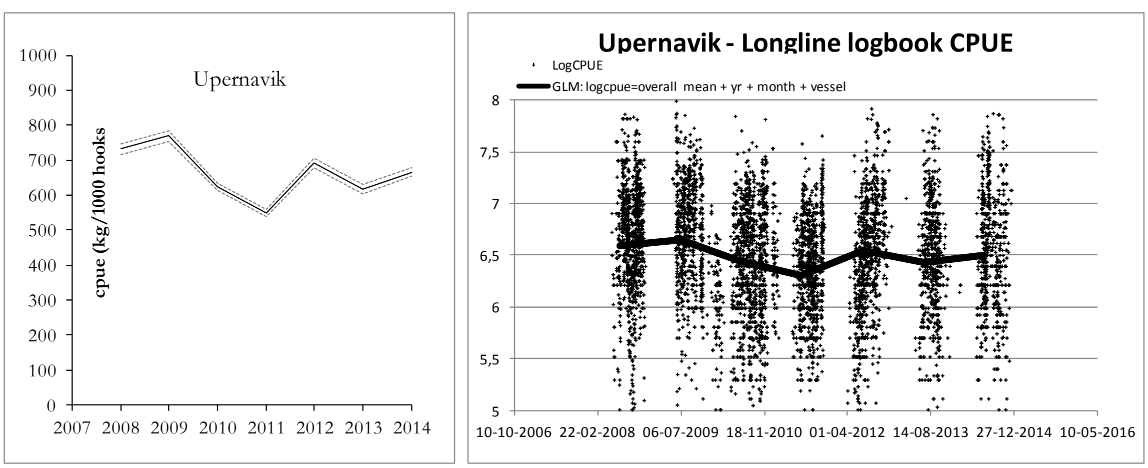

Fig 9. Standardized CPUE series for for commercial longLine (thick line) . + indicate logCPUE(kg/1000hooks) by date.

Appendix

INSH 1AX
The GLM Procedure

Class Level Information		
Class	Levels	Values
YEAR	7	2008 2009 2010 2011 2012 2013 2014
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
FTJ_ID		Vessel numbers deleted

Number of Observations Read 10558
Number of Observations Used 10558

INSH 1AX

The GLM Procedure
Dependent Variable: LogCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	45	437.590449	9.724232	62.83	<.0001
Error	10512	1626.883988	0.154764		
Corrected Total	10557	2064.474438			

R-Square	Coeff Var	Root MSE	LogCPUE Mean
0.211962	6.472527	0.393401	6.078014

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	6	60.2160635	10.0360106	64.85	<.0001
MD	11	58.9831844	5.3621077	34.65	<.0001
FTJ_ID	28	318.3912013	11.3711143	73.47	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	6	50.1274506	8.3545751	53.98	<.0001
MD	11	52.0853546	4.7350322	30.60	<.0001
FTJ_ID	28	318.3912013	11.3711143	73.47	<.0001

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	6.060603138	B	0.02787843	217.39	<.0001
YEAR 2008	0.136110675	B	0.02850967	4.77	<.0001
YEAR 2009	0.318345184	B	0.02059360	15.46	<.0001
YEAR 2010	0.145232847	B	0.01487894	9.76	<.0001
YEAR 2011	0.026332413	B	0.01338902	1.97	0.0492
YEAR 2012	0.081789883	B	0.01317125	6.21	<.0001
YEAR 2013	0.036455022	B	0.01258843	2.90	0.0038
YEAR 2014	0.000000000	B	.	.	.
MD 1	0.087361437	B	0.02419445	3.61	0.0003
MD 2	-0.074959872	B	0.03058003	-2.45	0.0143
MD 3	-0.165474246	B	0.04068105	-4.07	<.0001
MD 4	-0.192769255	B	0.03092440	-6.23	<.0001
MD 5	-0.182012236	B	0.02080365	-8.75	<.0001
MD 6	-0.036513256	B	0.01927332	-1.89	0.0582
MD 7	-0.101758484	B	0.01899609	-5.36	<.0001
MD 8	-0.093175104	B	0.01944979	-4.79	<.0001
MD 9	-0.194056360	B	0.01989988	-9.75	<.0001
MD 10	-0.158105250	B	0.01968182	-8.03	<.0001
MD 11	-0.079577665	B	0.02095284	-3.80	0.0001
MD 12	0.000000000	B	.	.	.
FTJ 1	0.543382157	B	0.02956895	18.38	<.0001
FTJ 2	-0.009921967	B	0.02804303	-0.35	0.7235
FTJ 3	-0.030305557	B	0.03307726	-0.92	0.3596
FTJ 4	0.238653815	B	0.02801990	8.52	<.0001
FTJ 5	0.018666080	B	0.02783585	0.67	0.5025
FTJ 6	-0.140845195	B	0.03167656	-4.45	<.0001
FTJ 7	-0.130780082	B	0.03147589	-4.15	<.0001
FTJ 8	0.210251048	B	0.03241213	6.49	<.0001
FTJ 9	0.087883888	B	0.02955597	2.97	0.0030
FTJ10	-0.171734597	B	0.02693348	-6.38	<.0001
FTJ 11	0.055495969	B	0.02650808	2.09	0.0363
FTJ 12	-0.084072878	B	0.02805471	-3.00	0.0027
FTJ 13	-0.060427327	B	0.03029239	-1.99	0.0461
FTJ 14	-0.079045430	B	0.02820866	-2.80	0.0051
FTJ 15	0.209699892	B	0.02824298	7.42	<.0001
FTJ 16	-0.111798214	B	0.03343209	-3.34	0.0008
FTJ 17	-0.018131648	B	0.03429347	-0.53	0.5970
FTJ 18	0.009782100	B	0.03263353	0.30	0.7644
FTJ 19	0.100153894	B	0.02707050	3.70	0.0002
FTJ 20	0.099814310	B	0.03066416	3.26	0.0011
FTJ 21	-0.177847110	B	0.03097544	-5.74	<.0001
FTJ 22	0.318576229	B	0.02875122	11.08	<.0001
FTJ 23	0.290735603	B	0.03283607	8.85	<.0001
FTJ 24	-0.201471437	B	0.03435419	-5.86	<.0001
FTJ 25	0.196487460	B	0.02859756	6.87	<.0001
FTJ 26	0.301270627	B	0.02936368	10.26	<.0001
FTJ 27	-0.133030058	B	0.03061758	-4.34	<.0001
FTJ 28	0.008823204	B	0.03397909	0.26	0.7951
FTJ 29	0.000000000	B	.	.	.

Note: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

INSH 1AX

The GLM Procedure
Least Squares Means

YEAR	LogCPUE LSMEAN	Standard Error	Pr > |t|
2008	6.14367648	0.02676307	<.0001
2009	6.32591099	0.01877774	<.0001
2010	6.15279865	0.01195983	<.0001
2011	6.03389822	0.00996232	<.0001
2012	6.08935569	0.00975037	<.0001
2013	6.04402083	0.00890483	<.0001
2014	6.00756581	0.01028975	<.0001

Uummannaq Longline Logbook CPUE

INSH 1AUM
The GLM Procedure

Class Level Information		
Class	Levels	Values
YEAR	7	2008 2009 2010 2011 2012 2013 2014
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
FTJ_ID		vessel numbers deleted

Number of Observations Read 2784
Number of Observations Used 2784

INSH 1AUM
The GLM Procedure
Dependent Variable: LogCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	26	81.8603295	3.1484742	23.34	<.0001
Error	2757	371.9358569	0.1349060		
Corrected Total	2783	453.7961863			

R-Square	Coeff Var	Root MSE	LogCPUE Mean
0.180390	5.797093	0.367296	6.335858

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	6	21.10215056	3.51702509	26.07	<.0001
MD	11	33.14833318	3.01348483	22.34	<.0001
FTJ_ID	9	27.60984573	3.06776064	22.74	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	6	15.63897112	2.60649519	19.32	<.0001
MD	11	32.96917501	2.99719773	22.22	<.0001
FTJ_ID	9	27.60984573	3.06776064	22.74	<.0001

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	6.407528852	B	0.05729047	111.84	<.0001
YEAR 2008	-0.161475603	B	0.03040144	-5.31	<.0001
YEAR 2009	-0.229780157	B	0.02976331	-7.72	<.0001
EAR 2010	-0.039514596	B	0.03085542	-1.28	0.2004
YEAR 2011	0.072952733	B	0.02716916	2.69	0.0073
YEAR 2012	-0.017271704	B	0.02402048	-0.72	0.4722
YEAR 2013	-0.060456746	B	0.02192915	-2.76	0.0059
YEAR 2014	0.000000000	B	.	.	.
MD 1	-0.218279998	B	0.10314658	-2.12	0.0344
MD 2	0.012020984	B	0.08800146	0.14	0.8914
MD 3	-0.120802264	B	0.08741559	-1.38	0.1671
MD 4	0.065190521	B	0.10336982	0.63	0.5283
MD 5	-0.232699549	B	0.06365392	-3.66	0.0003
MD 6	0.075300282	B	0.05512245	1.37	0.1720
MD 7	0.221967063	B	0.05505627	4.03	<.0001
MD 8	0.100966714	B	0.05519115	1.83	0.0674
MD 9	0.016854371	B	0.05536978	0.30	0.7608
MD 10	0.003937793	B	0.05630114	0.07	0.9442
MD 11	-0.133878486	B	0.06243817	-2.14	0.0321
MD 12	0.000000000	B	.	.	.
FTJ 1	-0.235413381	B	0.02904300	-8.11	<.0001
FTJ 2	-0.199069730	B	0.03260293	-6.11	<.0001
FTJ 3	-0.225706269	B	0.02803757	-8.05	<.0001
FTJ 4	-0.085692213	B	0.02946819	-2.91	0.0037
FTJ 5	0.035649158	B	0.02911759	1.22	0.2209
FTJ 6	-0.032795355	B	0.03123737	-1.05	0.2939
FTJ 7	-0.150297242	B	0.03282508	-4.58	<.0001
FTJ 8	0.032503094	B	0.03148962	1.03	0.3021
FTJ 9	-0.053834002	B	0.02958285	-1.82	0.0689
FTJ 10	0.000000000	B	.	.	.

Note: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

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The GLM Procedure
Least Squares Means

YEAR	LogCPUE LSMEAN	Standard Error	Pr > |t|
2008	6.13713577	0.02891990	<.0001
2009	6.06883122	0.02853917	<.0001
2010	6.25909678	0.02433034	<.0001
2011	6.37156411	0.02408128	<.0001
2012	6.28133967	0.02312989	<.0001
2013	6.23815463	0.02079478	<.0001
2014	6.29861138	0.02238736	<.0001

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The GLM Procedure

Class Level Information		
Class	Levels	Values
YEAR	7	2008 2009 2010 2011 2012 2013 2014
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
FTJ_ID		Vessel numbers deleted

Number of Observations Read 10661
Number of Observations Used 10661

The GLM Procedure
Dependent Variable: LogCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	39	776.730850	19.916176	101.27	<.0001
Error	10621	2088.666778	0.196654		
Corrected Total	10660	2865.397628			

R-Square	Coeff Var	Root MSE	LogCPUE Mean		
0.271073	6.796074	0.443457	6.525199		

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	6	154.6107718	25.7684620	131.03	<.0001
MD	11	133.6347618	12.1486147	61.78	<.0001
FTJ_ID	22	488.4853163	22.2038780	112.91	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	6	104.7154222	17.4525704	88.75	<.0001
MD	11	124.3018722	11.3001702	57.46	<.0001
FTJ_ID	22	488.4853163	22.2038780	112.91	<.0001

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	6.566169011	B	0.04341151	151.25	<.0001
YEAR 2008	0.093208941	B	0.01788717	5.21	<.0001
YEAR 2009	0.143704422	B	0.01863230	7.71	<.0001
YEAR 2010	-0.066711463	B	0.01626356	-4.10	<.0001
YEAR 2011	-0.194456517	B	0.01636901	-11.88	<.0001
YEAR 2012	0.037068205	B	0.01593221	2.33	0.0200
YEAR 2013	-0.076825909	B	0.01747258	-4.40	<.0001
YEAR 2014	0.000000000	B	.	.	.
MD 1	0.063289564	B	0.05403342	1.17	0.2415
MD 2	-0.274579572	B	0.05788401	-4.74	<.0001
MD 3	-0.646474749	B	0.09381019	-6.89	<.0001
MD 4	-0.747061648	B	0.15395298	-4.85	<.0001
MD 5	-0.397462930	B	0.04407527	-9.02	<.0001
MD 6	-0.394364878	B	0.04021380	-9.81	<.0001
MD 7	-0.164506020	B	0.03972930	-4.14	<.0001
MD 8	-0.117250976	B	0.03967188	-2.96	0.0031
MD 9	-0.272001258	B	0.03977950	-6.84	<.0001
MD 10	-0.155610598	B	0.04028220	-3.86	0.0001
MD 11	-0.105180086	B	0.04037716	-2.60	0.0092
MD 12	0.000000000	B	.	.	.
FTJ 1	0.195241592	B	0.03092382	6.31	<.0001
FTJ 2	-0.116909473	B	0.02574811	-4.54	<.0001
FTJ 3	0.426173857	B	0.03629208	11.74	<.0001
FTJ 4	-0.066520856	B	0.02502052	-2.66	0.0079
FTJ 5	0.310756624	B	0.03192644	9.73	<.0001
FTJ 6	0.247657642	B	0.02560769	9.67	<.0001
FTJ 7	0.520804634	B	0.02593798	20.08	<.0001
FTJ 8	0.588402496	B	0.03435806	17.13	<.0001
FTJ 9	0.375460984	B	0.02764763	13.58	<.0001
FTJ 10	0.176034922	B	0.02790015	6.31	<.0001
FTJ 11	0.239211667	B	0.02486402	9.62	<.0001
FTJ 12	-0.117785560	B	0.02976805	-3.96	<.0001
FTJ 13	-0.150163812	B	0.02707337	-5.55	<.0001
FTJ 14	0.501995227	B	0.02557939	19.62	<.0001
FTJ 15	0.172801630	B	0.02747267	6.29	<.0001
FTJ 16	0.427972368	B	0.03068113	13.95	<.0001
FTJ 17	0.261267539	B	0.03201397	8.16	<.0001
FTJ 18	0.059817314	B	0.03471508	1.72	0.0849
FTJ 19	0.179564607	B	0.03594388	5.00	<.0001
FTJ 20	0.096033665	B	0.03090522	3.11	0.0019
FTJ 21	-0.022535529	B	0.02379181	-0.95	0.3436
FTJ 22	0.372504446	B	0.02482818	15.00	<.0001
FTJ 23	0.000000000	B	.	.	.

Note: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

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The GLM Procedure
Least Squares Means

YEAR	LogCPUE LSMEAN	Standard Error	Pr > |t|
2008	6.59515969	0.02021259	<.0001
2009	6.64565517	0.02111414	<.0001
2010	6.43523929	0.01786838	<.0001
2011	6.30749423	0.01902907	<.0001
2012	6.53901895	0.01866754	<.0001
2013	6.42512484	0.02065674	<.0001
2014	6.50195075	0.02007972	<.0001