

## **The fishery for Greenland halibut in ICES Div. XIVb in 2001**

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### **1. Description of the 2001 fishery.**

The fishery for Greenland halibut in ICES Division XIVb is a directed fishery, nearly almost exclusively carried out by use of trawl besides an insignificant longline fishery. The total catch in 2001 amounted a record high of 10636 t, a 51% increase in catches from 2000 which is about 40% above the 1996 – 2000 level. (Fig.4). TAC in 2001 was 14 500 t including by-catch. Since 1995 the contribution from longlines has decreased steadily from 40% to only 3 % of total catches in 2001.

Foreign fleets historically took the bulk of the catches; in 2001, however, preliminary information suggest that Greenland (incl. fishery on Greenland quotas) caught about 50% of the total catches, while Germany and Norway took the other half. Russia and Faroe Islands only took an insignificant part of the total catches (Table 2). In Table 1 is given catches by nation and subdivisions in Div. XIVb based on information from about 50% of the fishery. The remaining part is not allocated to subdivision. A map of the subdivisions is shown in Fig. 1. Only Norway had a small longline fishery on 294 t. In the trawl fishery Greenland, EU and Faroe Islands did not utilise their quotas fully (40-80%), while Norway exceeded their quota by 145 %.

Since 1996, a southern fishing ground at approximately 62°N has gained increasing importance (Fig. 2). The longline fishery is mainly carried out in the southern areas of East Greenland (south of 64°45' N latitude), while the trawl fishery extends somewhat more northerly to about 65°30' N latitude (Table 3.). However, in 2001 the main part of trawl catches were also taken in the southernmost fishing grounds (Subdiv. XIVb-6).

The fishery is conducted during all seasons with a peak in July-August (Table 4). The seasonal distribution of the fishery is somewhat different between subdivisions in XIVb; catches in the northern subdivisions peak in summertime, while catches in most southerly areas peak in spring and autumn. The longline fishery is limited to June-August due to smaller vessels that are more sensitive to weather conditions. Trawl fishery is conducted during the entire year. These patterns have been stable for many years.

In 2001, preliminary information suggest that the total fleet consists of 16 vessels, 3 longliners and 13 trawlers (Table 5). The fleet has been reduced since 1996, where 44 vessels operated (9 longliners, 33 trawlers and 2 unknown).

### **2. Input data to assessment.**

#### **2.1 Sampling from the commercial fishery.**

Length frequencies of catches are available from 4 Norwegian trawlers and 3 Norwegian longliners. About 4000 Greenland halibut were length measured from the two fisheries. The distributions allocated to subdivisions are shown in Fig. 6. Trawl catches peaks at lengths of about 50-70 cm, while longline catches peaks at 70 cm for the southern area (XIVb6) and at 80-85 cm in the more northerly subdivision XIVb5.

## 2.2 Logbook information from the commercial fishery and spatial description of historic fisheries.

From logbook information from the 13 vessels given in Table 5 in 2001, comprising 54% of the total catch of 10,636 tons, the distribution of the fishery is shown by CPUE (kg/hr) for each haul in XIVb in Fig. 1. The fishery is mainly limited between the two depth contours 500 m and 1000 m from 62°N, 41°W in southwest to 65°30'N, 30°W in north-east. In recent years, highest cpue's are found in the southernmost fishing grounds.

The distribution of the fishery in the period 1991 to 2001 is shown in Fig. 2. The coverage of total nominal catches is given in Table 6. Only the northwestern area have been fished nearly through the entire period, while the area between 64°N and 65°N seem to be regularly exploited in recent years. The fishery south of 63°N has been conducted since 1996. In 2001 the fishery is allocated rather continuously along the continental shelf at depths of 500-1000 m from 30°W to 41°W.

In order to calculate a standardised CPUE index, a GLM analysis (multiplicative model) was carried out using logbook information including only hauls where *G. halibut* composed more than 75% of the total catches. The model included year, month, fleet and area effects (see appendix 1). ICES Division XIVb was divided into three areas: a southern south of 63°30'N. North of this boundary two areas was defined: an eastern area east of 33°W, and a western area west of 33°W (Fig. 1). The fleets were divided into categories by nation and tonnage. The tonnage classes seem to be rather uniform within each nation: smallest vessels are 'small Japanese trawlers' (j1) less than 1000 GRT, the Greenland vessels is about 1500 GRT, and no exact information is available for UK, FRG and Norwegian vessels, however, a qualified guess may be about 2000 - 2500 GRT for these fleets. The output of the GLM is given in appendix 1 and in Fig. 3 is shown the development of the standardised CPUE during 1991 -2000. From 1991 to 1994 CPUE increases whereafter it has been relatively stable and seem to decrease in 2001. The increase in 1991-93 is an expected development in a new fishery; the catches increased from 1991 to 1993 from 875 tons to 2275 tons as seen in Fig. 4. Calculated effort follows the trend in total catches (Table 6). CPUE for fleets separately show the similar trend with some variation, however, the trend for Norwegian trawlers decrease sharply since 1999.

## 2.3 Research surveys

In June/July the Greenland research vessel 'Pamiut' conducted a random-stratified bottom-trawl survey in East Greenland. Results from the survey are described in a WD by O.A. Jørgensen, this meeting. Age readings are available from the survey.

## **3. Status of fishery/stock.**

The fishery in East Greenland has shown a dramatic increase in catches in 2001, from about 7,000 tons in 2000 to about 11,000 tons in 2001. Overall estimated CPUE's have been stable since 1993, although CPUE trends varies considerably between fleets. Effort (hours) has lowered somewhat in the end of the 90'ies, but increased noticeably since then along with increasing catches. Present TAC was not fully utilised, even though some fleet exceeded their TAC significantly. Concurrent with this new fishery since 1991, fishing has moved down the continental slopes (depth has increased gradually), but tended to stabilise in recent years at depths of 800-1000 m. Even though the stock/fishery thus presently seem stable in the area, the considerable increase in catches in 2001 is expected to affect the stock in the medium term.

Table 1. Nominal catches (tonnes) of Greenland halibut in ICES Division XIVb (Greenland EEZ) in 2001. Provisional data from logbook information and GFLC.

Subdivision	Faroe Isl.	Greenland	Norway	Russia	Germany	Unknown	Total
XIVb-1			28				28
XIVb-2		83	108				191
XIVb-3		3					3
XIVb-4	32	565	568	88	48		1,301
XIVb-5	48	641	148	489	191		1,517
XIVb-6		181	141	41	1729		2,092
XIVb-7		9	39		527		575
<b>Total</b>	<b>80</b>	<b>1,482</b>	<b>1,032</b>	<b>618</b>	<b>2,495</b>	<b>4,929</b>	<b>10,636</b>

Table 2. Nominal catches of Greenland halibut in ICES XIVb by gear in 2001. Provisional data from Greenland Fisheries License Control

Gear	Faroe Isl.	Greenland	Norway	Russia	Germany	Total
longline			294			294
trawl	59	5060	1682	186	3355	10,342
<b>Total</b>	<b>59</b>	<b>5,060</b>	<b>1,976</b>	<b>186</b>	<b>3,355</b>	<b>10,636</b>

Table 3. Nominal catches of Greenland halibut in Subdivisions of Division XIVb by gear in 2001. Provisional data from logbook information and GFLC.

Subdivision	longline	trawl	Unknown	Total
XIVb-1	28			28
XIVb-2	103	88		191
XIVb-3		3		3
XIVb-4	7	1,294		1,301
XIVb-5	111	1,405		1,516
XIVb-6	10	2,083		2,093
XIVb-7	35	541		576
<b>Total</b>	<b>294</b>	<b>5,414</b>	<b>4,928</b>	<b>10,636</b>

Table 4. Nominal catches of Greenland halibut in Subdivisions of XIVb during season and by gear in 2001. Provisional data.

Subdiv.	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
XIVb-1		1	7	9		2		32					51
XIVb-2							1						1
XIVb-3			2				7	11	4		5		28
XIVb-4			63	30	10	152	312	271	47	13	25	2	925
XIVb-5			21	45	145	135	364	389	261	109	38	83	1591
XIVb-6			177	262	321	350	465	236	90	253	235	95	2484
XIVb-7						11	42	92					145
<b>Total</b>		2	269	345	475	651	1192	1031	401	375	303	180	5225
longline						22	103	38					162
trawl		2	269	345	475	629	1089	993	401	375	303	180	5062
<b>Total</b>		2	269	345	475	651	1192	1031	401	375	303	180	5225

Table 5. Number of vessels by nation in the fishery for G.halibut in ICES XIVb in 2001.Provisional data.

Nation						
Gear	Faroe Isl.	Germany	Greenland	Norway	Russia	Total
trawl	1	3	3	4	2	13
longline				3		3
Total	1	3	3	7	2	16

Table 6. CPUE relative to year 1991 derived from logbook information using a multiplicative model (see appendix 1).

Trawlerfleet	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
UK (England, Wales & Scotland) (uk)	1.000	0.606	2.280		2.289	2.297	1.688	2.997			
Fed. Rep. Germany (frg)	1.000	1.281	1.768	2.047	2.071	2.324	2.622	2.521	2.481	2.384	2.241
Greenland (gr)	1.000	0.650				1.654	1.698	1.322	0.760	1.361	1.440
Japan <1000GRT (j2)	1.000		0.379								
Norway (no)	1.000	0.275	3.034	2.405		1.854	2.037	2.154	2.186	1.391	0.542
Russia (rus)	1.000	1.276					1.335	1.385			3.014
<b>All</b>	<b>1.000</b>	<b>1.054</b>	<b>1.806</b>	<b>2.011</b>	<b>1.955</b>	<b>2.075</b>	<b>2.276</b>	<b>2.235</b>	<b>2.118</b>	<b>2.161</b>	<b>1.878</b>
Nos. of hauls	245	229	589	171	395	2006	2114	1425	791	1473	2233
Logbook catches as % of total catch	22	12	29	7	12	46	77	53	26	48	54
Total catches XIVb (t)	875	1,240	2,275	3,180	4,783	6,892	6,320	5,564	4,970	7,058	10,636
Total effort (hrs)	<b>875</b>	<b>1,176</b>	<b>1,259</b>	<b>1,581</b>	<b>2,447</b>	<b>3,321</b>	<b>2,776</b>	<b>2,489</b>	<b>2,347</b>	<b>3,265</b>	<b>5.665</b>

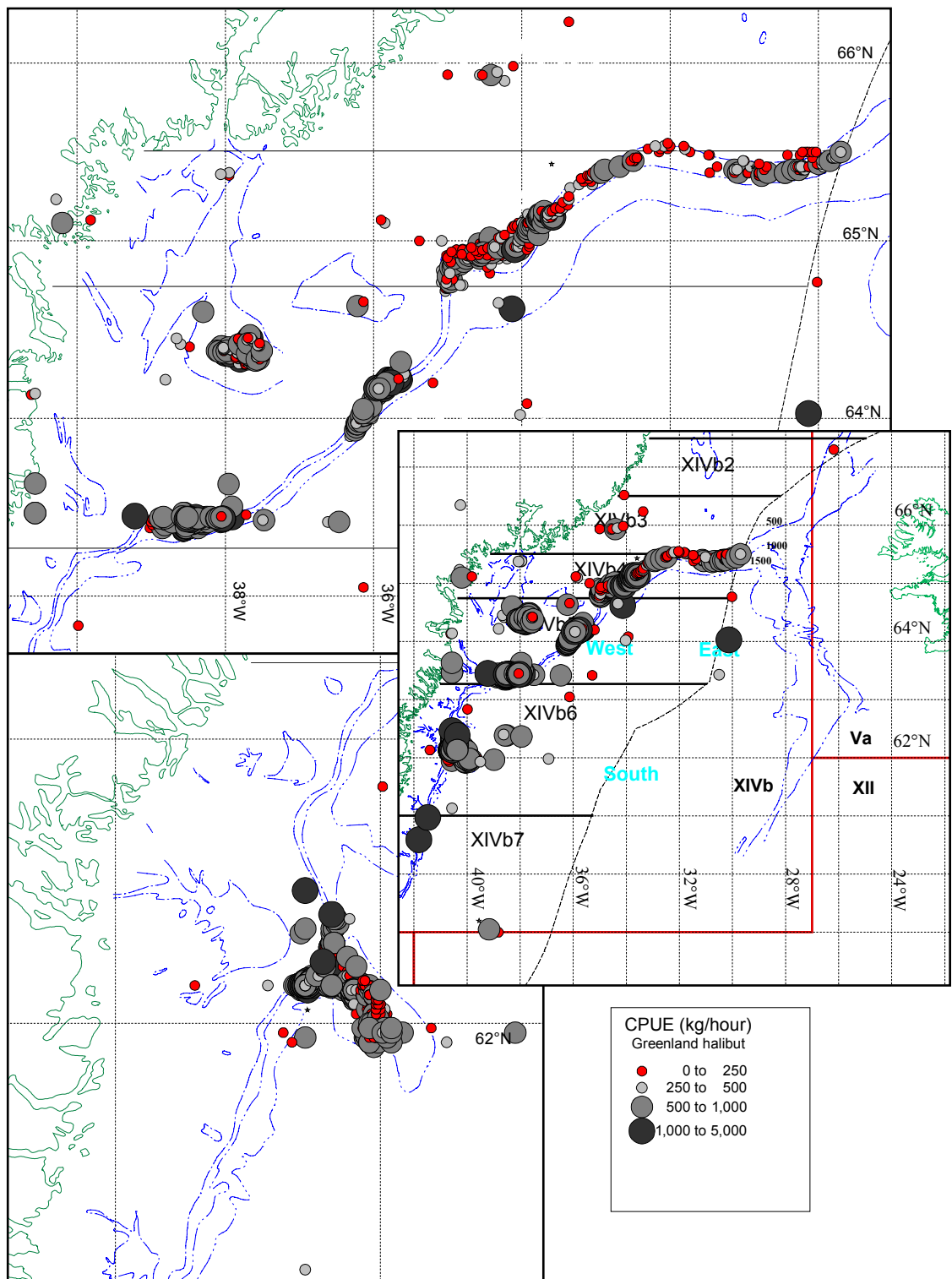


Fig. 1. Distribution of 2001 fishery (CPUE) for Greenland halibut in Div. XIVb.

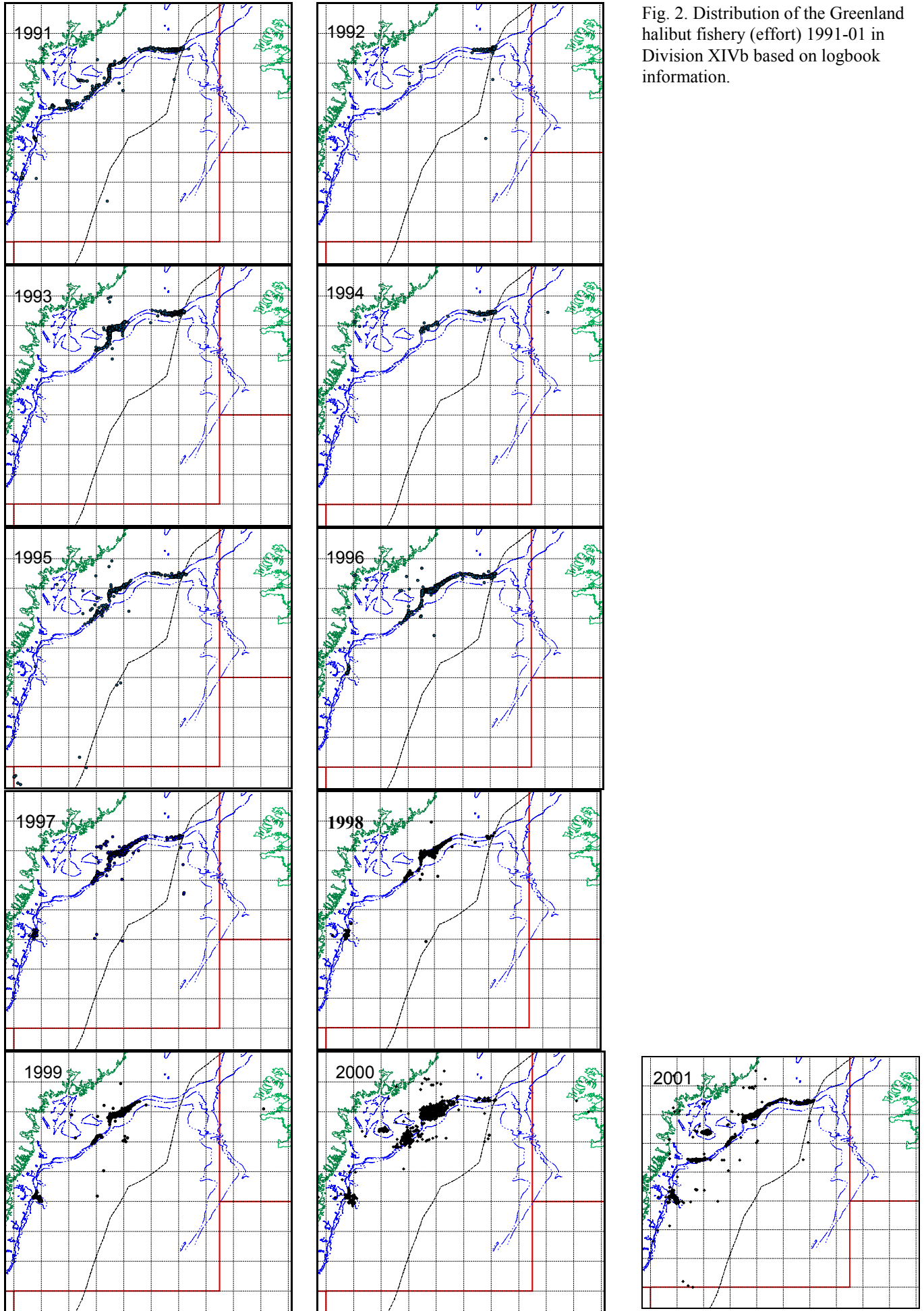


Fig. 2. Distribution of the Greenland halibut fishery (effort) 1991-01 in Division XIVb based on logbook information.

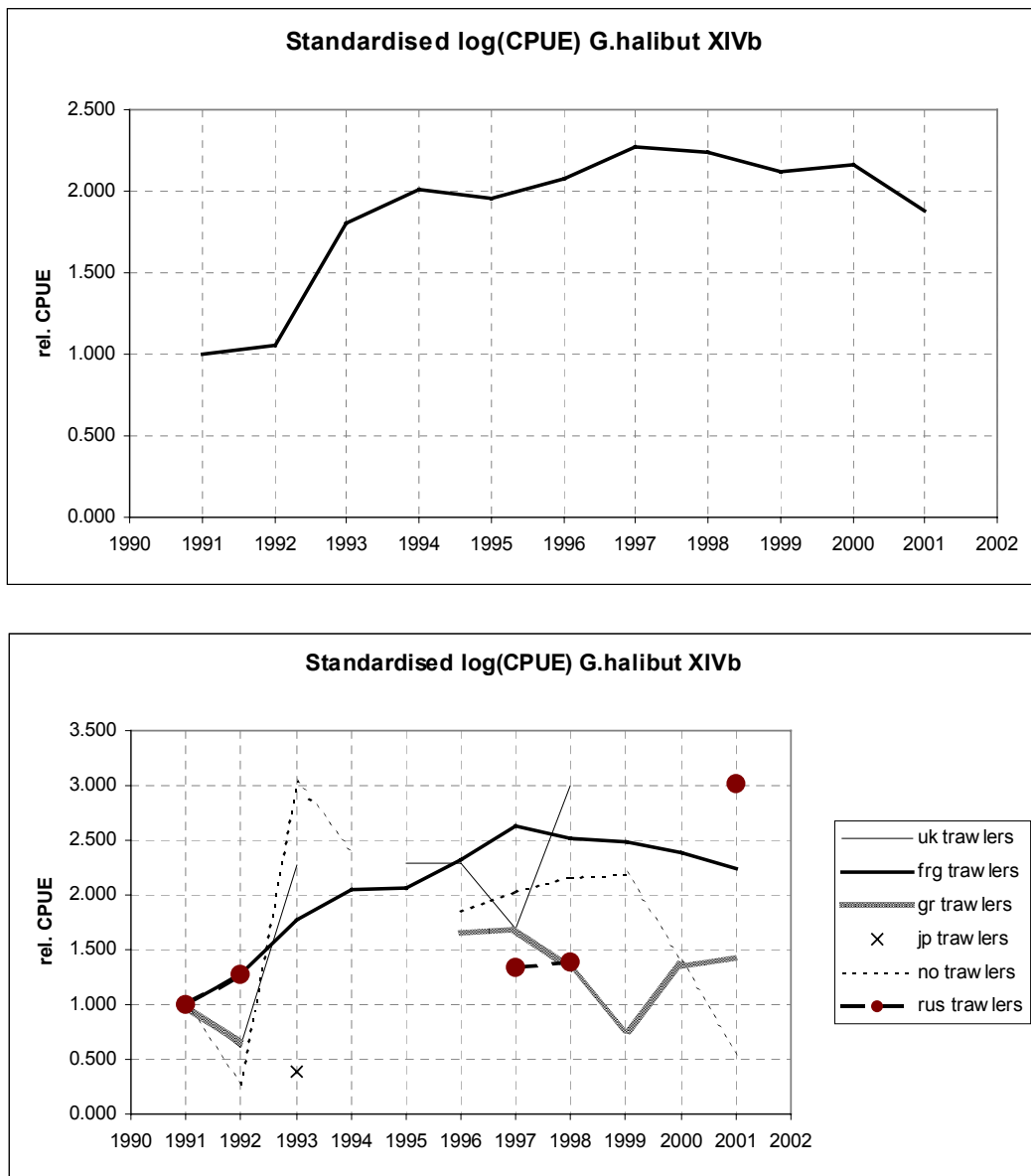


Fig. 3. Plots of standardised cpue based on logbook information; only hauls where *G.halibut* composed more than 75% of total catch are included in analysis. **Upper:** relative log(CPUE) all fleets, **Lower:** relative log(CPUE) per fleet.

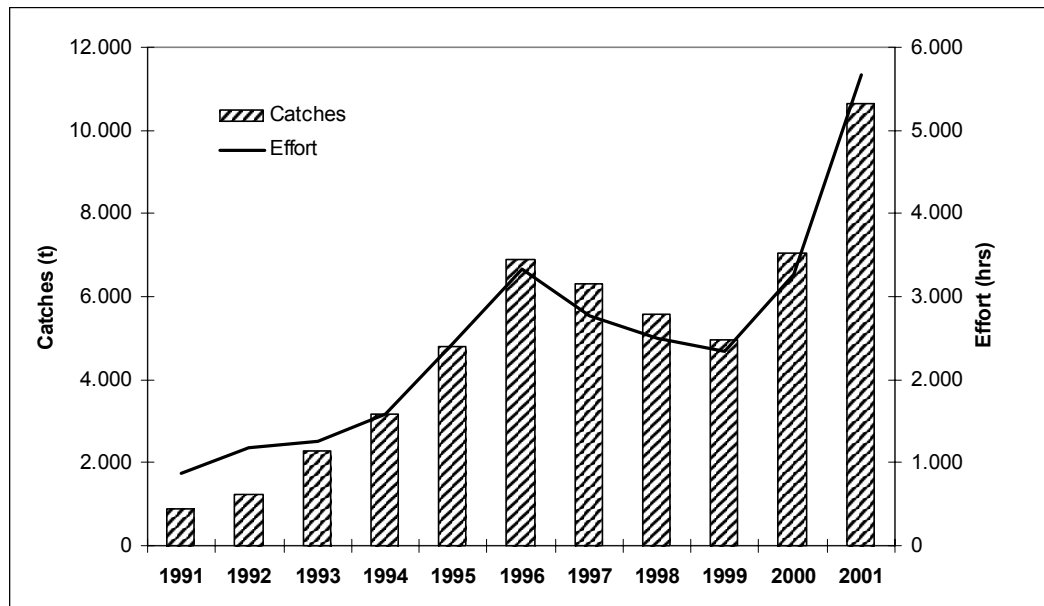


Fig. 4. Estimated total effort and total catches in the fishery for Greenland halibut in East Greenland ICES XIVb. Preliminary 2001 data from logbooks.

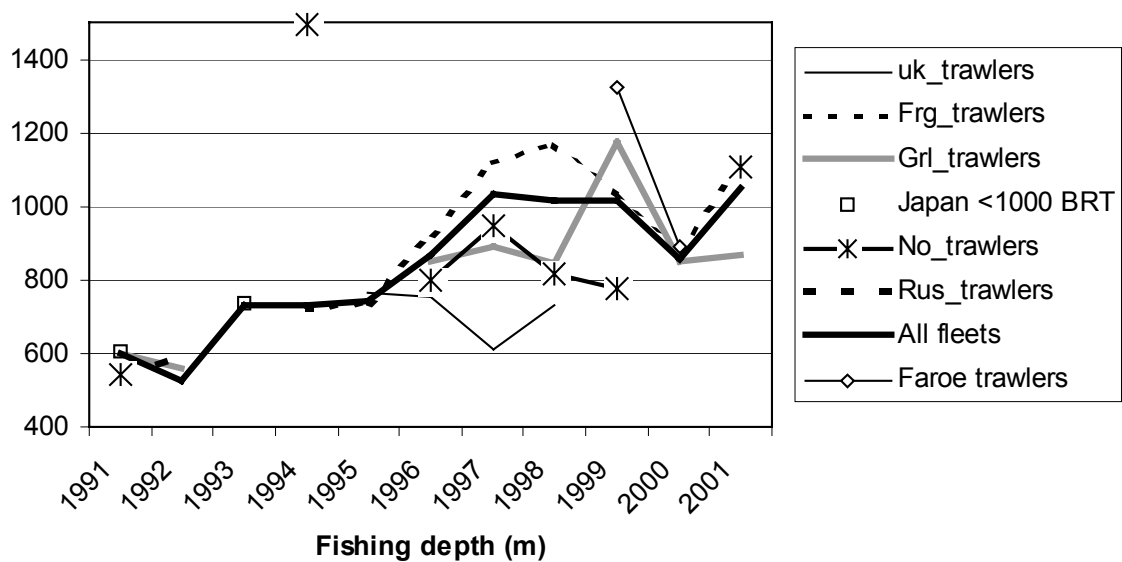


Fig. 5. Mean fishing depth per year by fleet in the period 1991-01 based on logbook information from the Greenland halibut fishery in Div. XIVb.



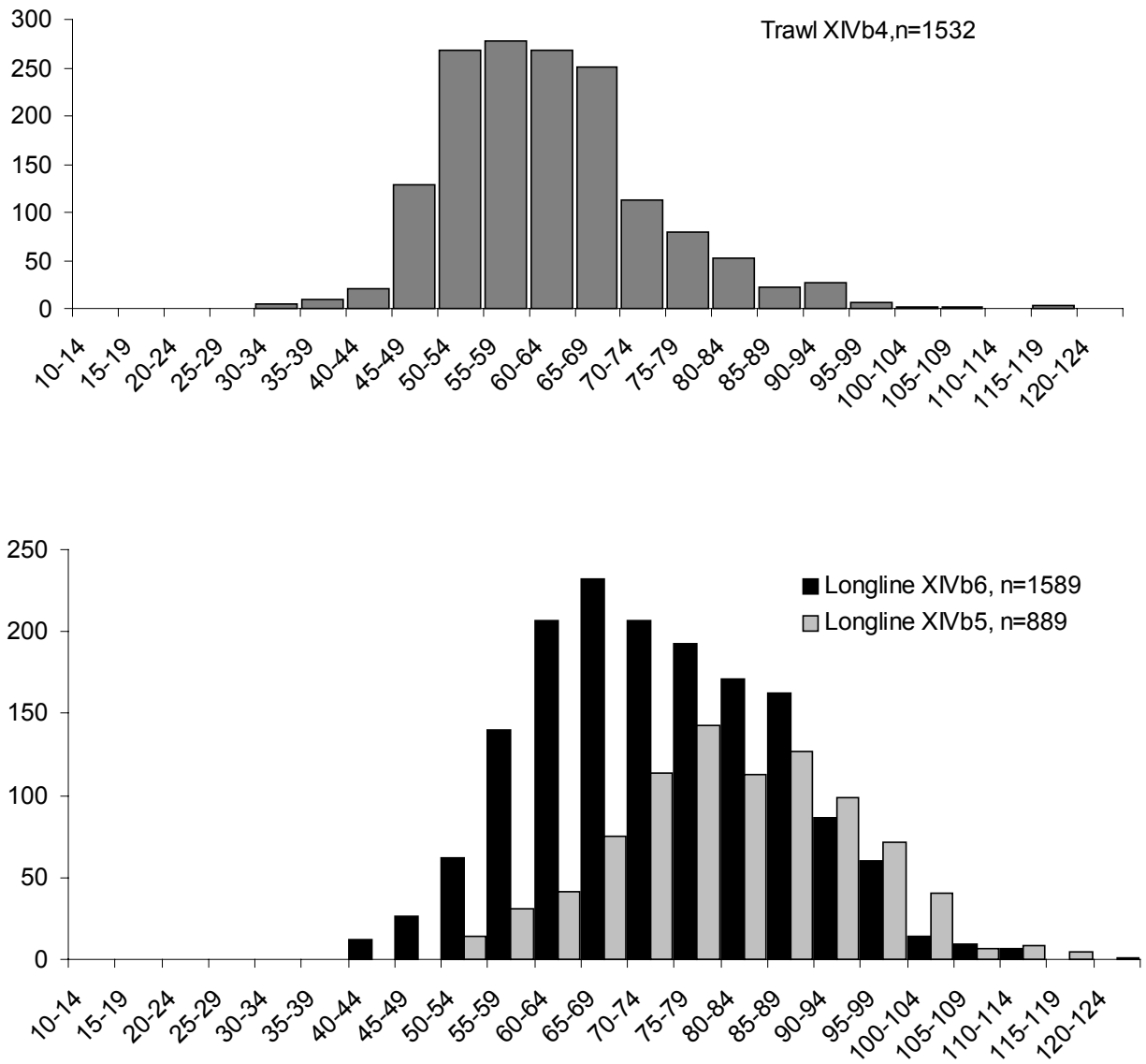


Fig 6. Length distributions from the Norwegian fishery for Greenland halibut Div.. XIVb in 2001.

## Appendix 1.

Greenland halibut ICES XIVb

The GLM Procedure

Class Level Information

Class	Levels	Values
AREA	3	east south west
YR	11	1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
FLEET	8	uk_trawlers fa_trawlers frg_trawlers gr_trawlers j1_trawlers j2_trawlers no_trawlers rus_trawlers

Number of observations 310

NOTE: Due to missing values, only 302 observations can be used in this analysis.

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The GLM Procedure

Dependent Variable: logcpue

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	30	92.1049053	3.0701635	8.54	<.0001
Error	271	97.4150633	0.3594652		
Corrected Total	301	189.5199686			

R-Square	Coeff Var	Root MSE	logcpue Mean
0.485991	10.53382	0.599554	5.691705

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	10	65.02331239	6.50233124	18.09	<.0001
AREA	2	5.50085061	2.75042530	7.65	0.0006
MD	11	13.31626030	1.21056912	3.37	0.0002
FLEET	7	8.26448200	1.18064029	3.28	0.0023

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	10	47.13426981	4.71342698	13.11	<.0001
AREA	2	4.95564820	2.47782410	6.89	0.0012
MD	11	12.81971583	1.16542871	3.24	0.0004
FLEET	7	8.26448200	1.18064029	3.28	0.0023

Parameter	Estimate	Standard Error	t Value	Pr >  t
Intercept	5.043474758 B	0.25063627	20.12	<.0001
YR 1991	-0.877625688 B	0.18407897	-4.77	<.0001
YR 1992	-0.823572749 B	0.18252394	-4.51	<.0001
YR 1993	-0.071132796 B	0.22682557	-0.31	0.7541
YR 1994	0.133716538 B	0.25437942	0.53	0.5996
YR 1995	0.077027791 B	0.24047995	0.32	0.7490
YR 1996	0.197533343 B	0.16908221	1.17	0.2437
YR 1997	0.398670185 B	0.15817837	2.52	0.0123
YR 1998	0.357838998 B	0.16649135	2.15	0.0325
YR 1999	0.239915624 B	0.18246700	1.31	0.1897
YR 2000	0.283812791 B	0.17551759	1.62	0.1070
YR 2001	0.000000000 B	.	.	.
AREA east	0.158941858 B	0.09099219	1.75	0.0818

AREA south 0.384841397 B 0.10403107 3.70 0.0003  
 AREA west 0.000000000 B . .  
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## The GLM Procedure

Dependent Variable: logcpue

Parameter		Estimate	Standard Error	t Value	Pr >  t
MD	1	-0.335759641 B	0.27113747	-1.24	0.2167
MD	2	-0.680815233 B	0.25667544	-2.65	0.0085
MD	3	-0.055478603 B	0.22823886	-0.24	0.8081
MD	4	-0.016316734 B	0.21258727	-0.08	0.9389
MD	5	0.124520768 B	0.23255981	0.54	0.5928
MD	6	0.318825648 B	0.20478860	1.56	0.1207
MD	7	0.334023669 B	0.19727820	1.69	0.0916
MD	8	0.205117206 B	0.19644876	1.04	0.2974
MD	9	0.074257565 B	0.19359541	0.38	0.7016
MD	10	-0.086485528 B	0.19983885	-0.43	0.6655
MD	11	0.084161952 B	0.21403959	0.39	0.6945
MD	12	0.000000000 B	.	.	.
FLEET	uk_trawlers	0.290375474 B	0.21032597	1.38	0.1685
FLEET	fa_trawlers	-0.808874983 B	0.39829085	-2.03	0.0432
FLEET	frg_trawlers	0.381493116 B	0.17949859	2.13	0.0345
FLEET	gr_trawlers	0.445954419 B	0.18565349	2.40	0.0170
FLEET	j1_trawlers	-0.102536890 B	0.49545089	-0.21	0.8362
FLEET	j2_trawlers	0.941400163 B	0.33870277	2.78	0.0058
FLEET	no_trawlers	0.327236016 B	0.18624072	1.76	0.0800
FLEET	rus_trawlers	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

Level of YR	N	-----logcpue----- Mean	Std Dev
1991	27	4.82445443	0.76629175
1992	27	4.66663807	0.74418209
1993	19	5.51739657	0.75689135
1994	9	5.71737446	0.46265378
1995	12	5.70386362	0.41671662
1996	42	5.91342417	0.51130745
1997	44	6.04310978	0.67208344
1998	38	6.07190559	0.62020558
1999	24	5.82609031	0.78656557
2000	32	5.92304073	0.56020432
2001	28	5.84091954	0.68213800