Working Document No. ____ ICES NWWG April 26 - May 5 2005

Fishery and survey data on Greenland halibut in Faroese waters (Div. Vb)

J.Boje[1] & Luis Ridao Cruz [2]

[1]Danish Institute for Fisheries Research
Dept. of Marine Fisheries
Charlottenlund Slot
2920 Charlottenlund, DENMARK

[2]Faroe Fisheries Laboratory
Nóatún 1, P.O. Box 3051
FO-110 Tórshavn
Faroe Islands

Information from logbooks from the Faroese otterboard trawl fleet (>1000 hp) was available for the years 1991-2004 (Table 1). It is a rather new fishery and the location of the bulk of fishery has changed from the northeast side of the islands in 1995-1998, to the southwest side since 2000 (Fig. 3). Therefore, the fishery is assumed to have been in the process of learning. Only hauls where G.halibut consisted of more than 50% of the catches and conducted on depths more than 450 meters were selected for the analyses. Effort distribution is provided in Table 1 and Figures 2 and 3. Unstandardised CPUE's by area all show a decrease since the beginning of the series in 1991. The development is somewhat different from area to area since the mid 1990's but all areas show a decrease from 2003 to 2004. More than 5000 hauls was used in a standardization of log(cpue) by means of a GLM using year, month, area and vessel as class variables and depth as a continuous variable. Outcome of the GLM is provide in Fig. 5; the 2004 estimate is the lowest on record. Appendix 1 gives the detailed ouput from the GLM. Length distribution from the commercial trawler- and gillnet fishery is rather stable in the past 4 years (Fig. 6,7).

Since 1995, a Faroese Greenland halibut survey has been carried out on the southern and eastern slope on the Faroe Plateau at depths of 400-600 m. In 1995, the survey was conducted in the first week of July and since then it has been conducted during the first two weeks in June. Usually the total number of hauls has been around 40, except in 1995 and 2003 when only about 24 stations were taken. The stations are not fixed; the skipper decides where and when the hauls are going to be taken and for how long time. The coverage thus vary over the years, only the southeast part being surveyed consistently (Fig. 8). Occasionally a few tows in shallower depths are taken. The majority of the catch consists of immature females (about 80 %). From that survey are selected hauls deeper than 450 m (all stations in 2003) to cover the areas where the commercial fishery takes place. Catch rates calculated as simple averages have generally been low in the survey, but the tendency since the start of the series is a gradual decline in catch rates (Fig. 10 upper part). If taking account of the unbalanced survey coverage by means of a GLM using area variables (for areas see Fig 1) and depth, the catch rates from the survey has a rather stable development over time (Fig. 10, lower part). Length frequencies from the survey are given in Fig. 11.

Table 1. Effort distribution of the 10 deep-sea trawlers used in CPUE calculations.

Sum of Effort_hr_

	Year														
VESSEL	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
1											195				195
2		427	982	847	637	1,041	282	139	79						4,434
3	40	15	252	415	378	2,109		1,136	197	868	312	266	138	150	6,277
4			132	205	40	522	357	31	32	84	82	65		211	1,760
5	192	361	394	521	226	225	264	127	17	406	83	36	57		2,909
6				186	76	1,060	743	178	40	299	188	35			2,806
7				98	200	927	402	144	36	251	318	65			2,441
8	138	130	289												557
9	86	94	236	174	86	240	288	131	37	3	161	77	6		1,619
10	101	104	427	131	185	661	232	70	67	138	78	7	210	190	2,600
Total	557	1,131	2,712	2,576	1,828	6,785	2,568	1,956	504	2,049	1,417	552	411	551	25,598

Sum of Effort_hr_

	Month											
VESSEL	1	2	3	4	5	6	7	8	9	10	11	12
1						181	14					
2	72	207	259	12	336	1,430	1,067	442	70	223	214	103
3	354	517	354	603	656	1,477	993	143	113	490	339	238
4	31	104	32	102	240	310	538	260	81	8	23	32
5	125	117	297	182	153	783	772	70	82	167	131	31
6	351	488	170	235	79	481	378	108	76	254	102	85
7	263	93	155	28	61	768	576	83	39	23	100	253
8	26	50	22		79	105	238	22		5	10	
9	80	151	67	71	254	216	647	11	6	48	28	42
10	59	110	173	112	336	1,122	483	38	23	21	90	32
Total	1,360	1,836	1,528	1,345	2,195	6,872	5,706	1,176	489	1,238	1,038	816

Sum of Effort_hr_

area/ year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
NE	326	266	1452	1147	780	4389	1108	876	230	425	362	122	215	155	11853
NW	105	153	290	232	48	87	129	23	49	144	183	18	114	70	1,645
SE	127	415	639	596	839	1,812	734	363	21	276	56	11	48	38	5,975
SW		297	330	602	161	497	597	694	205	1,205	816	400	34	287	6,124
Total	557	1,131	2,712	2,576	1,828	6,785	2,568	1,956	504	2,049	1,417	552	411	551	25,598

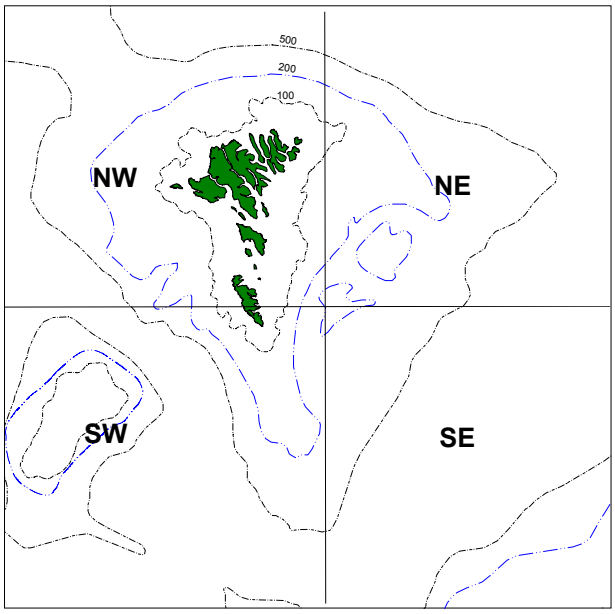


Fig. 1. Map of Faroese fishing areas as used in the GLM analysis.

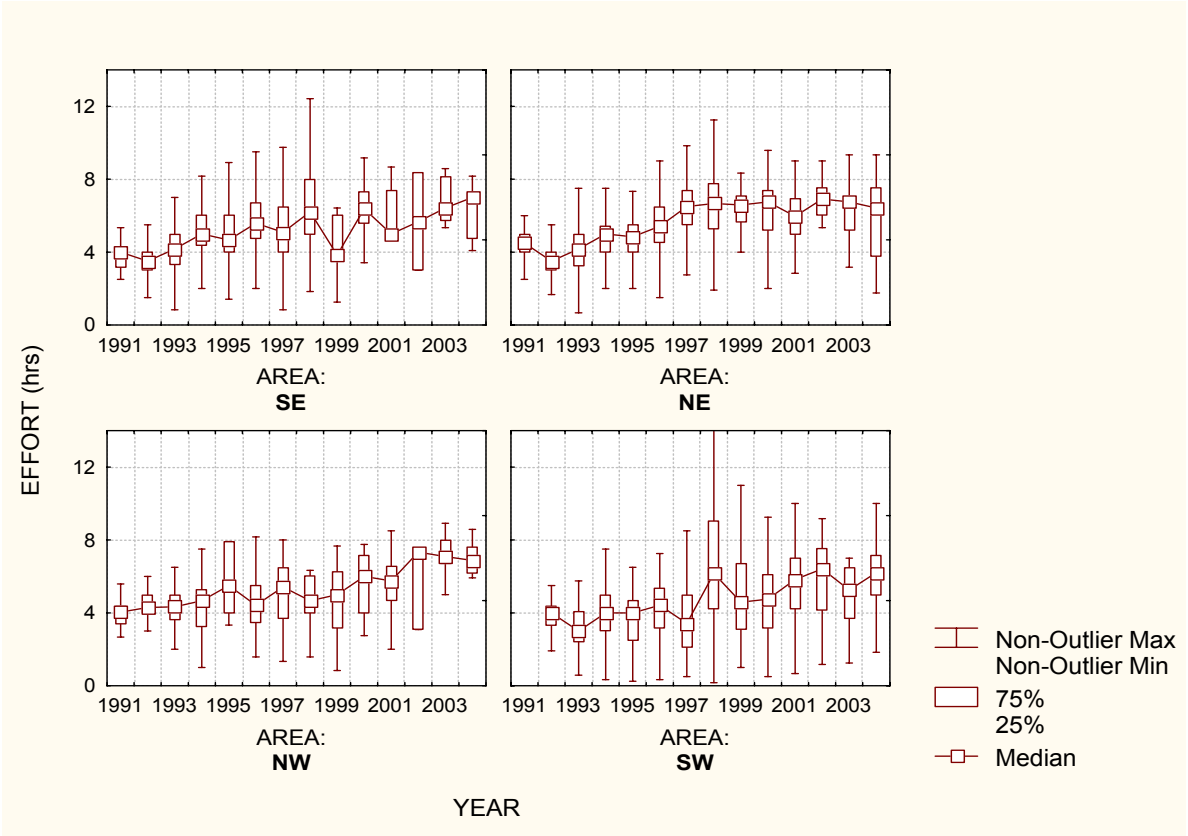


Fig. 2. Development in effort in the trawlfishery in Div Vb by area (see Fig1) and year.

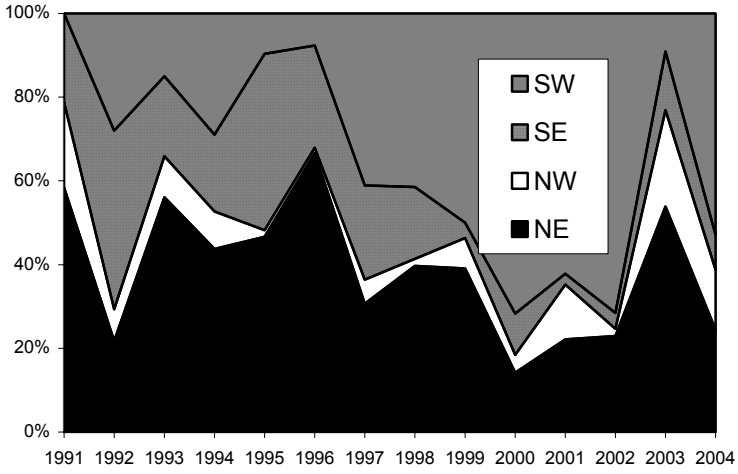


Fig. 3. Effort distribution in the trawlfishery (10 trawlers used in CPUE analysis) by area..

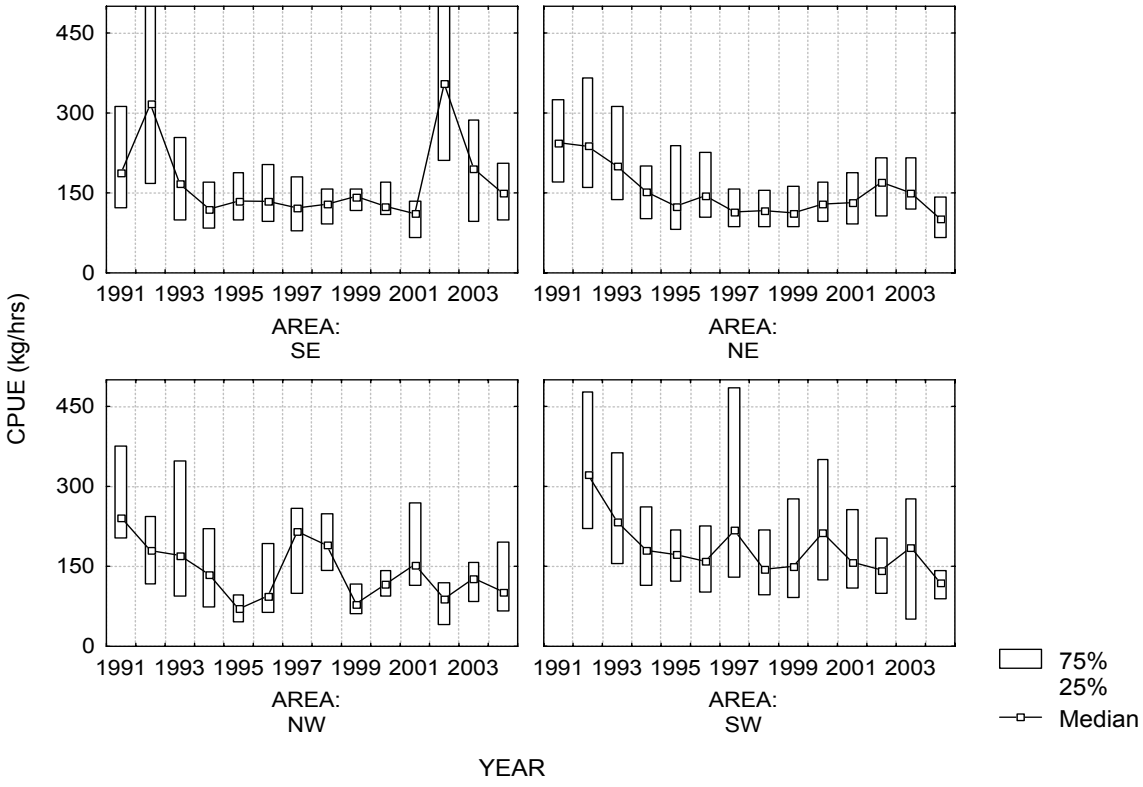


Fig. 4. CPUE (medians) from 10 trawlers by area 1992-2004 (see Fig. 1)

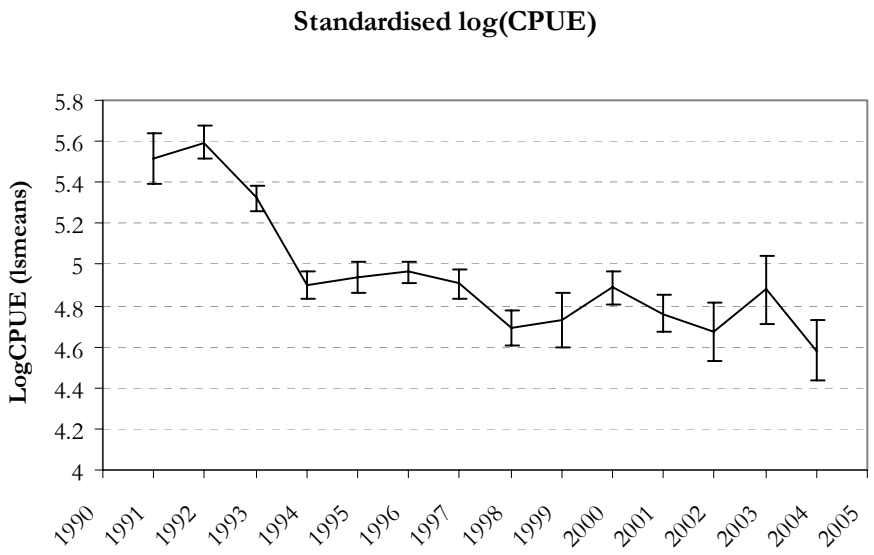


Fig. 5. Standardised log(CPUE) based on logbook information;

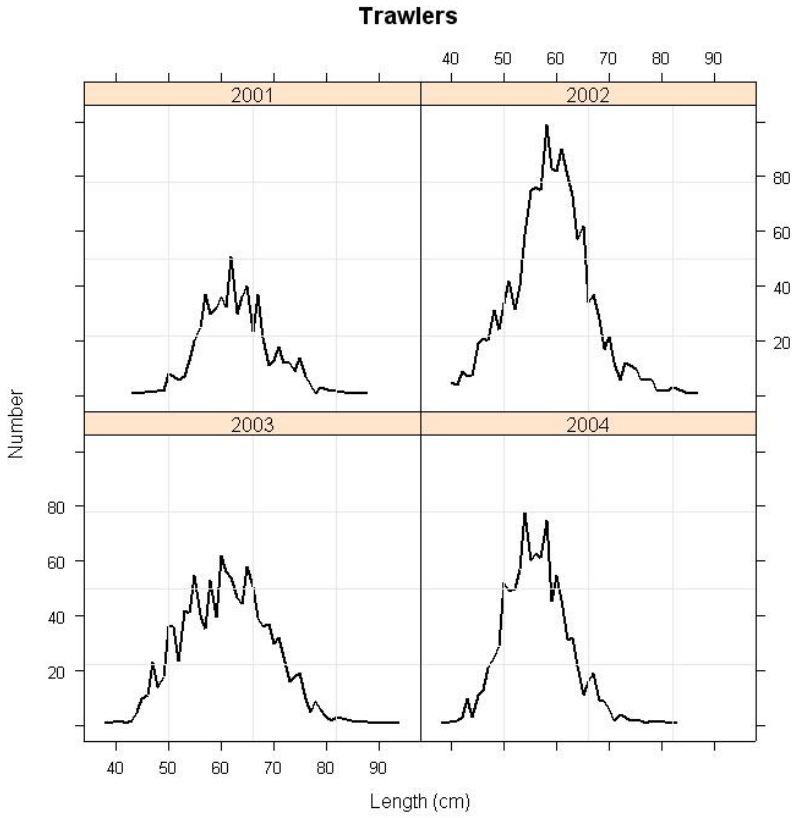


Fig. 6. Length distributions of catches of Greenland halibut from Faroese trawlers.

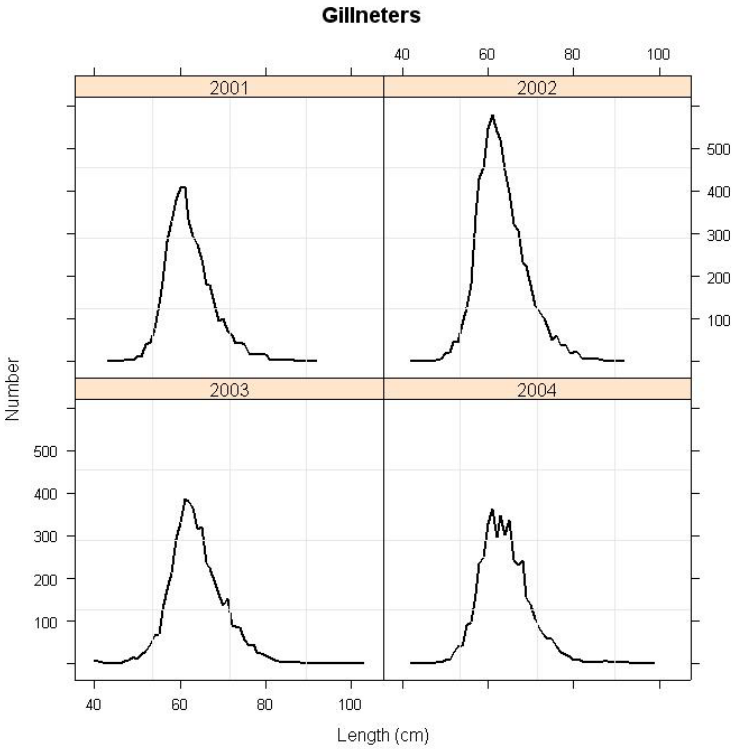


Fig. 7 . Length distributions of catches of Greenland halibut from Faroese gillnetters.

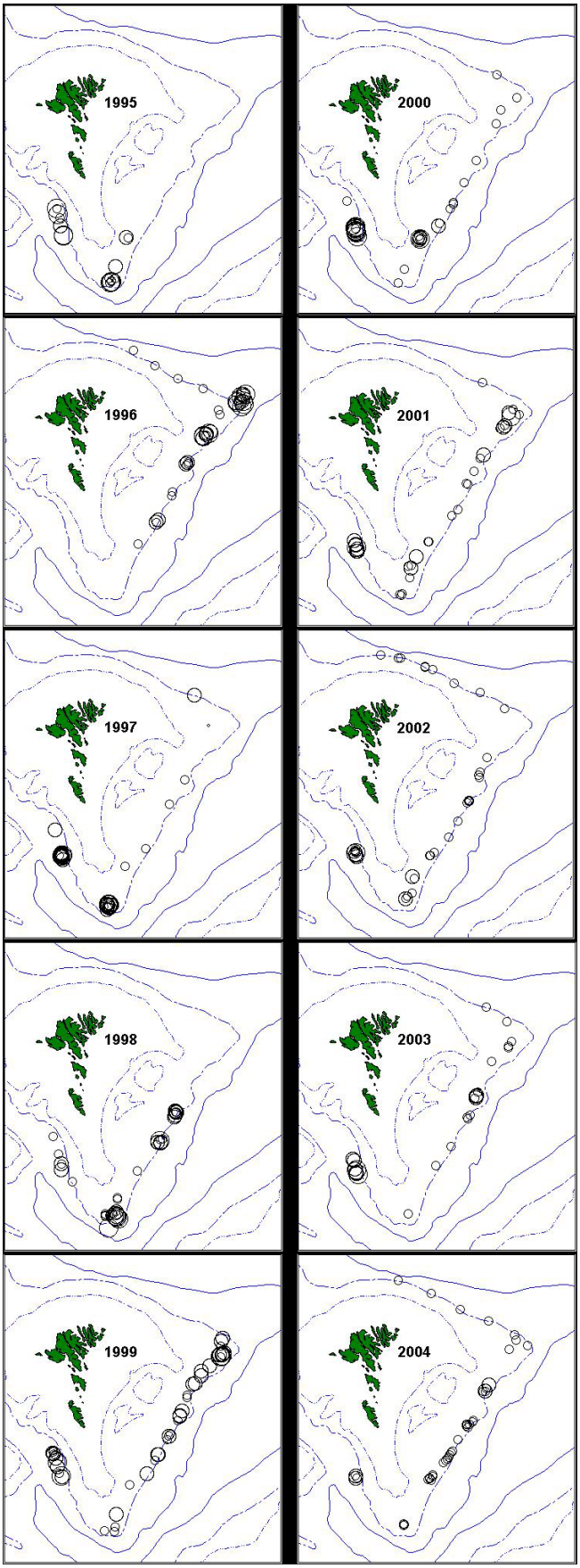


Fig. 8. Catch rates in deepwater survey for Greenland halibut in Vb 1995-2004.

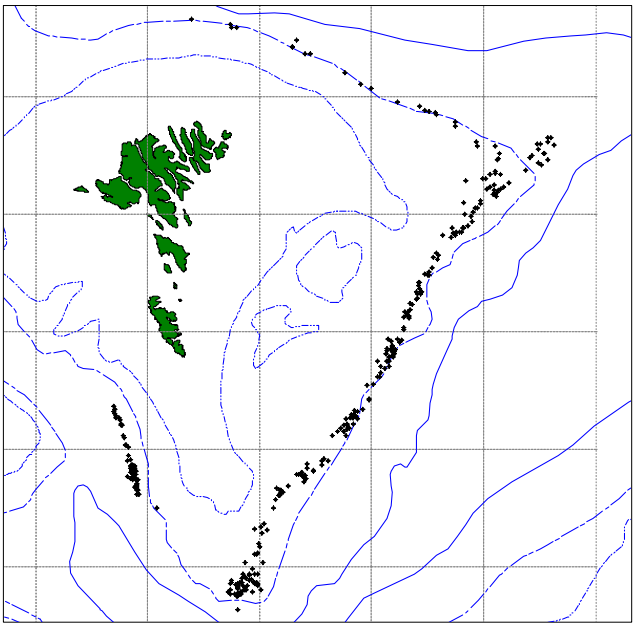
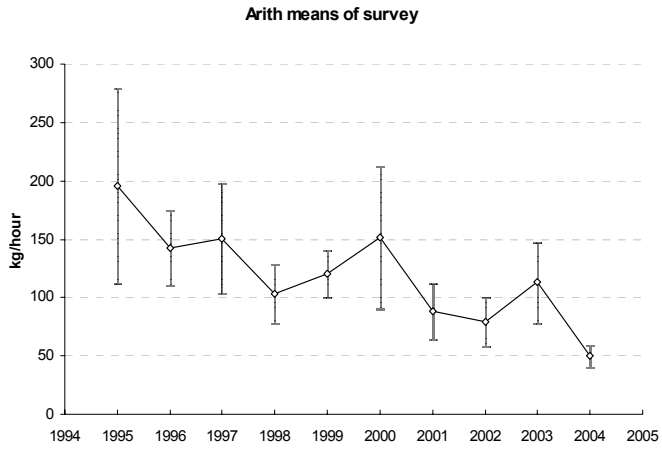


Fig. 9. Total haul distribution in Faroese deepwater survey 1995-2004.



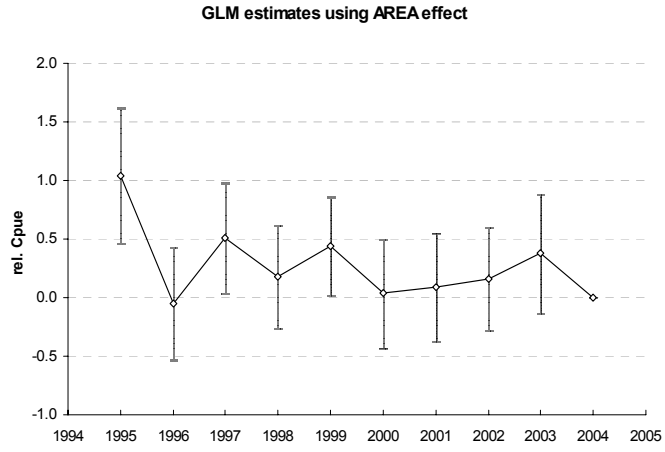


Fig. 10. Faroese deepwater survey catch rates. Upper: arithmetric mean, lower: estimates from GLM (model log(cpue)= year + area + depth).

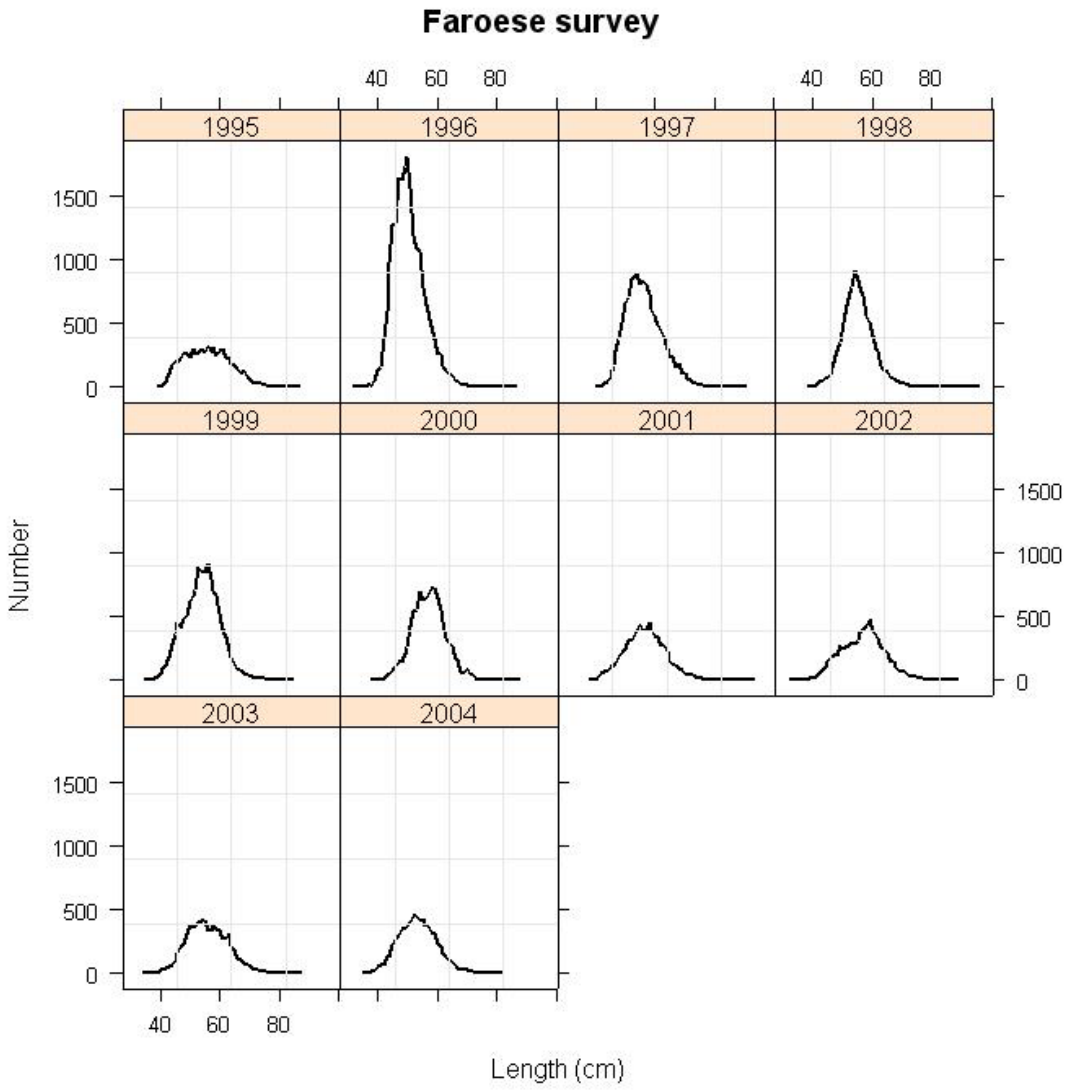


Fig. 11. Length frequencies of Greenland halibut from the Faroese deepwater survey

Appendix: Output from GLM on Faroese logbook data on G.halibut.

The GLM Procedure

Class Level Information

Class	Levels	Values
area	4	NE NW SE SW
YR	14	1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
MD	12	1 2 3 4 5 6 7 8 9 10 11 12
VESSEL	10	TG0002 TG0009 TG0304 TG0405 TG0500 TG0600 TG0700 TN0484 TN0705 VA0320

Number of observations 5090

Dependent Variable: logcpue

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	36	407.964398	11.332344	27.28	<.0001
Error	5053	2099.231140	0.415443		
Corrected Total	5089	2507.195538			

R-Square	Coeff Var	Root MSE	logcpue Mean
0.162717	12.70186	0.644548	5.074440

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	13	194.3369973	14.9489998	35.98	<.0001
area	3	71.0558075	23.6852692	57.01	<.0001
MD	11	94.6093464	8.6008497	20.70	<.0001
VESSEL	9	47.9622463	5.3291385	12.83	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	13	219.4897889	16.8838299	40.64	<.0001
area	3	53.6357448	17.8785816	43.04	<.0001
MD	11	88.0562485	8.0051135	19.27	<.0001
VESSEL	9	47.9622463	5.3291385	12.83	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		4.564666363	B	0.09651773	47.29	<.0001
YR	1991	0.929590364	B	0.09496789	9.79	<.0001
YR	1992	1.013120524	B	0.08235346	12.30	<.0001
YR	1993	0.739659104	B	0.07693550	9.61	<.0001
YR	1994	0.314207029	B	0.07726624	4.07	<.0001
YR	1995	0.359730148	B	0.08101656	4.44	<.0001
YR	1996	0.381832649	B	0.07397182	5.16	<.0001
YR	1997	0.325168095	B	0.07771899	4.18	<.0001
YR	1998	0.110948587	B	0.08064548	1.38	0.1690
YR	1999	0.147638348	B	0.09817489	1.50	0.1327
YR	2000	0.306294268	B	0.07902957	3.88	0.0001
YR	2001	0.177947323	B	0.08459404	2.10	0.0355
YR	2002	0.090441462	B	0.09875250	0.92	0.3598
YR	2003	0.294291070	B	0.10817138	2.72	0.0065

YR	2004	0.000000000	B	.	.	.
area	NE	-0.249407698	B	0.02660210	-9.38	<.0001
area	NW	-0.340777359	B	0.04196567	-8.12	<.0001
area	SE	-0.291276356	B	0.02985637	-9.76	<.0001
area	SW	0.000000000	B	.	.	.
MD	1	0.285148247	B	0.06886762	4.14	<.0001
MD	2	0.234728738	B	0.06652460	3.53	0.0004
MD	3	0.292434597	B	0.06634358	4.41	<.0001
MD	4	0.134117273	B	0.06980840	1.92	0.0548
MD	5	0.024132403	B	0.06572590	0.37	0.7135
MD	6	0.306091180	B	0.05890442	5.20	<.0001
MD	7	0.079939560	B	0.05836773	1.37	0.1709
MD	8	-0.023279628	B	0.07001239	-0.33	0.7395
MD	9	-0.091830515	B	0.08708877	-1.05	0.2917
MD	10	-0.064369243	B	0.07066886	-0.91	0.3624
MD	11	-0.127197958	B	0.07241420	-1.76	0.0791
MD	12	0.000000000	B	.	.	.
VESSEL	TG0002	0.418149019	B	0.12123669	3.45	0.0006
VESSEL	TG0009	0.109380076	B	0.03677823	2.97	0.0030
VESSEL	TG0304	0.225319622	B	0.03685873	6.11	<.0001
VESSEL	TG0405	0.036230903	B	0.04939068	0.73	0.4633
VESSEL	TG0500	0.038770546	B	0.04084819	0.95	0.3426
VESSEL	TG0600	0.089608954	B	0.04420853	2.03	0.0427
VESSEL	TG0700	0.341368222	B	0.04315925	7.91	<.0001
VESSEL	TN0484	0.018891757	B	0.06787400	0.28	0.7808
VESSEL	TN0705	0.227464816	B	0.04641781	4.90	<.0001
VESSEL	VA0320	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.

The GLM Procedure
Least Squares Means

YR	logcpue LSMEAN	Standard Error	Pr > |t|
1991	5.51190265	0.06263281	<.0001
1992	5.59543281	0.04214676	<.0001
1993	5.32197139	0.03143989	<.0001
1994	4.89651932	0.03444710	<.0001
1995	4.94204244	0.03896841	<.0001
1996	4.96414494	0.02642917	<.0001
1997	4.90748038	0.03551524	<.0001
1998	4.69326088	0.04289286	<.0001
1999	4.72995064	0.06945975	<.0001
2000	4.88860656	0.04012499	<.0001
2001	4.76025961	0.04565715	<.0001
2002	4.67275375	0.07214936	<.0001
2003	4.87660336	0.08420925	<.0001
2004	4.58231229	0.07299538	<.0001

area	logcpue LSMEAN	Standard Error	Pr > |t|
NE	4.92404630	0.02283356	<.0001
NW	4.83267664	0.03827463	<.0001
SE	4.88217764	0.02737242	<.0001
SW	5.17345400	0.02833475	<.0001