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An Assessment of the Inshore Greenland Halibut Stock Component in NAFO Division 1A

by

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1. Description of the Fishery and Nominal Catches.

The Greenland halibut stock component in Division 1A is considered as a separate part of the Davis Strait stock (Boje et al. 1994). The stock do not contribute to the spawning stock in Davis Strait (Boje, 1994) and spawning is only sporadic in the inshore area where all the fishery takes place (Jørgensen & Boje, 1994). Hence the inshore stock is not a self-sustainable stock, but dependent on recruitment from the nursery area South of Disko Island.

There is practically no offshore fishing for Greenland halibut in Division 1A. In 1994 18 tons were taken by a Greenland longliner.

The main inshore fishing grounds for Greenland halibut is located in Division 1A, where total landings amounted to 14,049 tons in 1994, comprising 99 % of the total inshore landings in Greenland. The inshore landings in Division 1A were around 7,000 tons in the late 1980's, but have been steadily increasing to 8,000 tons in 1990 and 14,000 tons in 1994 (table 1). In recent years the inshore landings are rather evenly distributed throughout the year.

The fishery is traditionally performed with longlines from small boats below 20 GRT, or by means of dog sledges, typically in the inner parts of the ice fjords at depths between 500 to 800 m. In the middle of the 1980's gillnets were introduced to the inshore fishery, and were used more commonly in the following years. In 1989 gillnets and longlines accounted equally for the Greenland halibut catches in Division 1A, but since then the annual proportion of catches from each gear has varied considerably. Authorities have in recent years tried to reduce the use of gillnets, because of their high efficiency and 'ghost-fishing' problems with lost gear, as an attempt to keep the inshore stock at a appropriate exploitation level. Longline catches comprised 76 % in 1993 and 73 % in 1994.

The inshore fishery in Division 1A is located in three areas: Ilulissat, Uummannaq and Upernavik (fig. 1).

Ilulissat.

The Greenland halibut fishery is conducted in, and in front of an ice fjord in the immediate vicinity of Ilulissat town, and in an ice fjord north of Ilulissat, Torssukattak. Use of gillnets is prohibited in the innermost part of the ice fjords.

The catches at Ilulissat increased from about 2,000 tons in 1987 to 6,577 tons in 1992. In 1993 the catches decreased to 5,367 tons and further to 5,201 tons in 1994 (table 1). Longline catches comprised 84 % in 1992 and decreased to 67 % in 1994.

Uummannaq.

Uummannaq comprises a large system of ice fjords, where the fishery for Greenland halibut is conducted. The main fishing ground is the southernmost fjord Qarajaq Ice fjord. Use of gillnets is prohibited in the inner parts of the fjords.

The catches at Uummannaq were stable about 3,000 tons in the period 1987 to 1992. In 1993 and 1994 the catches increased to 4,000 tons (table 1). In 1992 longline catches comprised 77 % of the landings at Uummannaq, but has decreased to 57 % in 1994.

Upernavik.

The northernmost area consist of a large number of ice fjords. The main fishing grounds are Upernavik Ice fjord, Tussaqa and Gieseckes Ice fjord, all north of Upernavik town. Use of gillnets is prohibited in the whole area.

The catches in Upernavik area have increased steadily from 450 tons in 1987 to 4,800 tons in 1994 (table 1). The substantial increase from 1993 to 1994 is probably due to initiatives by the authorities, where effort was allocated to Upernavik from southern areas in 1994.

2. Input Data.

2.1 Research longline fishery.

Before 1993 various longline trial fisheries with research vessels from Greenland Institute of Natural Resources were conducted. Due to different survey design and gear, these surveys are not quite comparable. In 1993 a longline survey for Greenland halibut was initiated for the inshore areas of Ilulissat, Uummannaq and Upernavik. The survey is conducted annually covering two of three areas alternately, in order to obtain CPUE index series for Greenland halibut in the inshore areas. In July-August 1994 the research longline vessel 'Adolf Jensen' covered the fjord areas of Upernavik and Ilulissat. A total of 73 longline settings with 58,000 hooks were performed. CPUE values (table 2) and mean length (table 3) from Ilulissat were at the same level as in the 1993-survey, but below values obtained from longline surveys in 1986-1987. The survey was conducted for the first time at Upernavik, but both CPUE and mean length values were higher than for Uummannaq and Ilulissat. The relative length distributions from the 1993-survey, at Ilulissat and Uummannaq, and the 1994-survey are seen in figs. 2 and 3 respectively.

2.2 Commercial fishery data.

Catch-at-age for the three inshore areas were based on sampling from the commercial fishery covering area, gear and season (tables 4, 5, 6). Calculations of catch-at-age data for 1988 to 1990 are described in Boje, 1991. Due to insufficient coverage of seasons in Ilulissat catch at age data were pooled within the year for the years 1991, 1992 and 1994. Similarly in Uummannaq catch at age data were pooled within the year for the years 1993 and 1994, and also in Upernavik catch at age data were pooled within the year for the years 1991 and 1993. The age length key used for gillnet catches in Upernavik derived from Uummannaq.

Mean weight-at-age and age-length keys from 1993 were applied to 1991- and 1992-data. Catch-at-age data for Upernavik 1991 and 1993 were obtained by using an Uummannaq age-length key from 1993. In 1994 age-length keys were obtained for all three areas.

Three different age readers have been engaged in otolith readings in the periods 1988-1990, 1993 and 1994. Results of otolith exchanges showed that age readings within the entire period are not quite comparable, influencing the assessment. Particularly the 1994 age composition appear inconsistent with the rest of the time series.

2.3 Maturity Data.

A preliminary study of inshore Greenland halibut maturity stages was presented (Nielsen & Boje, 1995). No further information of maturity was available.

2.4 Recruitment Data.

Information of the recruitment stage of the stock was presented (Bech, 1995), suggesting that the recruitment is at a stable level. The proportion of recruitment to the inshore areas is unknown.

3. Assessment

3.1 Catch Curve Analysis.

The recent level of fishing mortality was estimated by means of catch-curves using data from the commercial longline fishery. M was set to 0.15. At Ilulissat the F values were within the range 0.41-0.51 giving a mean F_{1994} of 0.46. In Uummannaq the F values were within the range 0.87-0.92 with a mean F_{1994} of 0.89. At Upernavik the F values were within the range 0.36-0.57 with a mean F_{1994} of 0.44.

In order to calculate relative F -at-age, stock composition was estimated by extrapolation of catch-curves. Relative F was weighted, taking into account the catch by season and gear (tables 7.1-7.3). Mean weight-at-age data derived from the summarized 1994 data.

3.2 Yield per Recruit Analysis.

Yield per recruit analysis were performed for each area. At Ilulissat $F_{0.1}$ was estimated to 0.19 and F_{max} to 0.28. As the F_{1994} was estimated to 0.46, the exploitation of the inshore stock in Disko Bay is well beyond F_{max} (fig. 4). At Uummannaq $F_{0.1}$ was estimated to 0.23 and F_{max} to 0.36. The F_{1994} value was 0.89, and also far beyond F_{max} (fig. 5). At Upernavik $F_{0.1}$ was estimated to 0.21, F_{max} was 0.33 and F_{1994} was estimated to 0.44 (fig. 6). The high F_{1994} values suggests that the stock in all the inshore areas in Division 1A is growth overfished. In the long term a higher yield per recruit could be obtained by lowering the fishing mortality.

3.3 Survey Results.

CPUE and mean-length values from the 1993 and 1994 longline surveys at Ilulissat are stable, but below values from surveys in the 1980's. At Uummannaq has the CPUE value and mean-length been steadily decreasing. The stock at Upernavik was considered as a virgin-stock until 1994, where a large scale fishing started. CPUE and mean length values from 1994 are larger than both Ilulissat and Uummannaq.

3.4 Comments on the Assessment.

Data for maturity ogive are not available. The recruitment stage at the nursery area is at a stable level, but the proportion of recruitment to the inshore areas is unknown.

Due to insufficient sampling and different age readers, the use of catch at age data for a VPA-analysis is not likely to give reliable results. The results of the yield per recruit analysis showed the same for each of the three areas: the inshore stock is exposed to growth overfishing, and the exploitation level should be lowered. However, the quality of the input data impede an analytical assessment (VPA) and exact allowable catch figures can therefore not be provided.

Age-determinations are fundamental for assessments, and the problems with discrepancies in age-readings have to be solved. Catch-curve analysis should be performed back in time to obtain historical time series of F. A comparison of commercial length frequencies is advised to evaluate whether or not differences in age determinations reflects real changes in the lengths compositions. Yield per recruit analysis should be performed with standardized age-ranges.

4. References.

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Nielsen, J.G. & J. Boje, 1995. Sexual Maturity of Greenland Halibut at West Greenland Based on Visual and Histological Observations. NAFO SCR Doc. 95/18. Serial No. 2525.

Table 1. Landings (tons) of Greenland halibut in division 1A, separated in main fishing areas (Ilulissat, Uumannaq[Uumma] and Upernavik[Upern]). 'Ship' indicates buying up made by chartered ships. Unkno. indicates catches from unknown areas within 1A.

Area/yr	1987	1988	1989	1990	1991	1992	1993	1994
Ilulissat	2258	2670	2781	3821	5372	6577	5367	5201
Uumma	2897	2920	2859	2779	3045	3067	3916	4004
Upern	445	777	1075	875	1495	1783	2593	4844
Ship	1189	-	178	370	-	373	1212	1006 ¹
Unkno.	407	636	599	507	17	-	-	-
1A	6789	7043	7492	8352	9929	11800	13092	14049

¹ indicates that the landings already are included in Upernavik-landings.

Table 2. CPUE values (kg/100 hooks) from longline surveys conducted in division 1A inshore areas (Disko=Disko Bay[Ilulissat], Uummann=Uumannaq).

Area/year	1962	1985	1986	1987	1993	1994
Disko	-	-	8.3	16.5	3.1	3.1
Uummann	4.6	13.7	-	8.6	2.8	-
Upernavik	-	-	-	-	-	5.2

Table 3. Mean length (cm) from catches taken in inshore longline surveys (Disko=Disko Bay [Ilulissat], Uummann=Uumannaq).

Area/year	1962	1985	1986	1987	1993	1994
Disko	-	62.4	53.5	62.2	55.9	56.5
Uummann	67.8	70.5	-	61.8	57.5	-
Upernavik	-	-	-	-	-	64.6

Table 4. Catch at age of Greenland halibut in 1988-1994 at Ilulissat, in Disko Bay.

Catch in numbers (thou.)							
age/year	1988	1989	1990	1991	1992	1993	1994
4	0	0	0	5	34	7	0
5	0	0	0	5	92	15	1
6	1	0	0	11	122	62	33
7	9	0	1	279	332	280	389
8	59	14	24	806	476	479	771
9	182	106	141	535	390	339	838
10	173	121	185	333	451	280	292
11	132	94	188	238	532	240	66
12	73	49	126	76	309	122	3
13	63	33	80	45	140	91	1
14	65	39	59	67	92	112	2
15	38	31	42	57	18	75	0
16	18	19	23	35	0	57	2
17	11	14	15	7	0	12	0
18	4	8	6	2	0	10	0
19	0	0	0	0	0	7	0
total	827	529	890	2501	2988	2186	2398

Table 5. Catch at age of Greenland halibut in Uummannaq area in 1988-1994. - indicates insufficient sampling.

Catch in numbers (thou.)							
age/year	1988	1989	1990	1991	1992	1993	1994
5	0	0	0	-	-	0	0
6	0	0	0	-	-	0	1
7	1	0	1	-	-	9	20
8	5	2	3	-	-	45	171
9	20	9	15	-	-	200	373
10	52	35	47	-	-	202	375
11	121	98	108	-	-	142	182
12	143	120	121	-	-	138	70
13	121	99	101	-	-	104	41
14	96	76	82	-	-	158	15
15	49	38	42	-	-	93	3
16	23	19	20	-	-	28	0
17	13	14	15	-	-	19	0
18	4	6	6	-	-	0	0
19	0	0	0	-	-	0	0
20	0	0	0	-	-	0	0
21	0	0	0	-	-	1	0
total	648	516	563	-	-	1141	1253

Table 6. Catch at age of Greenland halibut in Upernavik area 1988-1994. - indicates insufficient sampling.

age/year	Catch in numbers (thou.)						
	1988	1989	1990	1991	1992	1993	1994
4	0	0	0	8	-	0	0
5	0	0	0	70	-	0	0
6	0	0	0	125	-	0	2
7	0	0	0	186	-	1	50
8	6	2	2	240	-	3	172
9	33	16	17	105	-	26	399
10	55	34	41	43	-	40	249
11	80	59	62	19	-	32	227
12	74	66	57	18	-	67	184
13	68	69	52	13	-	92	124
14	62	73	48	22	-	157	35
15	31	40	25	17	-	108	0
16	13	18	11	6	-	39	0
17	7	10	5	3	-	20	0
18	2	3	1	0	-	3	0
total	431	389	323	876	-	589	1441

Table 7.1 Input data for the Yield/recruit analysis, 1994. Mean weight at age (kg) and relative F values for Greenland halibut at Ilulissat, from samplings in 1994.

age	mean weight (kg)	relative F
5	0.475	0.0169
6	0.778	0.1461
7	1.162	0.5662
8	1.786	0.8317
9	2.438	0.9860
10	3.306	1.0
11	4.184	0.9694
12	5.402	0.7908
13	6.795	0.7256
14	8.478	0.6800
15	9.909	0.6800
16	11.944	0.6800
17	13.125	0.6800
18	14.175	0.6800

Table 7.2. Input data for the Yield/recruit analysis, 1994. Mean weight at age (kg) and relative F values for Greenland halibut at Uummannaq, from the 1994 sampling.

age	mean weight (kg)	relative F
5	0.646	0
6	1.085	0.0270
7	1.161	0.2400
8	1.629	0.6140
9	2.436	0.8600
10	3.342	1.0
11	4.234	0.9500
12	5.166	0.9200
13	5.960	0.9400
14	7.878	0.8800
15	9.189	0.5800
16	11.708	0.5700
17	13.125	0.5700

Table 7.3. Input data for the Yield/recruit analysis, 1994. Mean weight at age (kg) and relative F values for Greenland halibut at Upernavik, from samplings in 1994.

age	mean weight (kg)	relative F
5	0.646	0.0660
6	0.757	0.1200
7	1.092	0.6780
8	1.583	0.9500
9	2.325	1.0
10	3.106	1.0
11	4.081	1.0
12	5.073	1.0
13	5.684	1.0
14	7.145	1.0

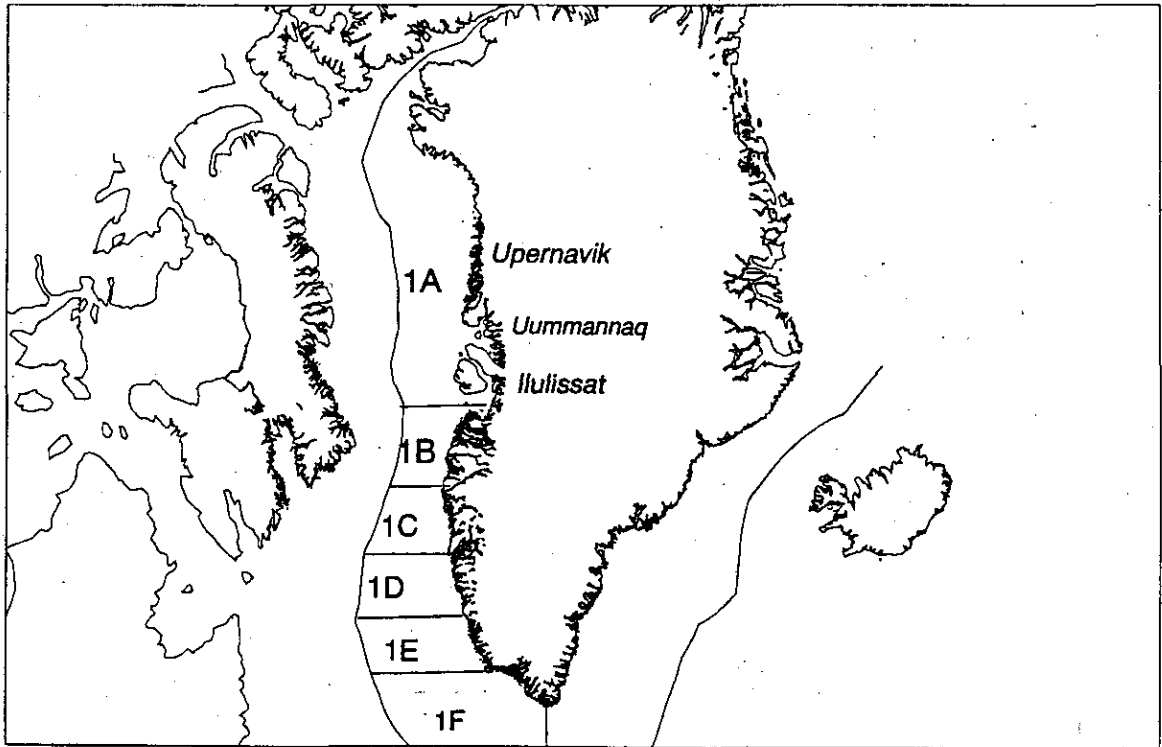


Fig. 1. Location of main inshore fishing grounds for Greenland halibut in Subarea 1A.

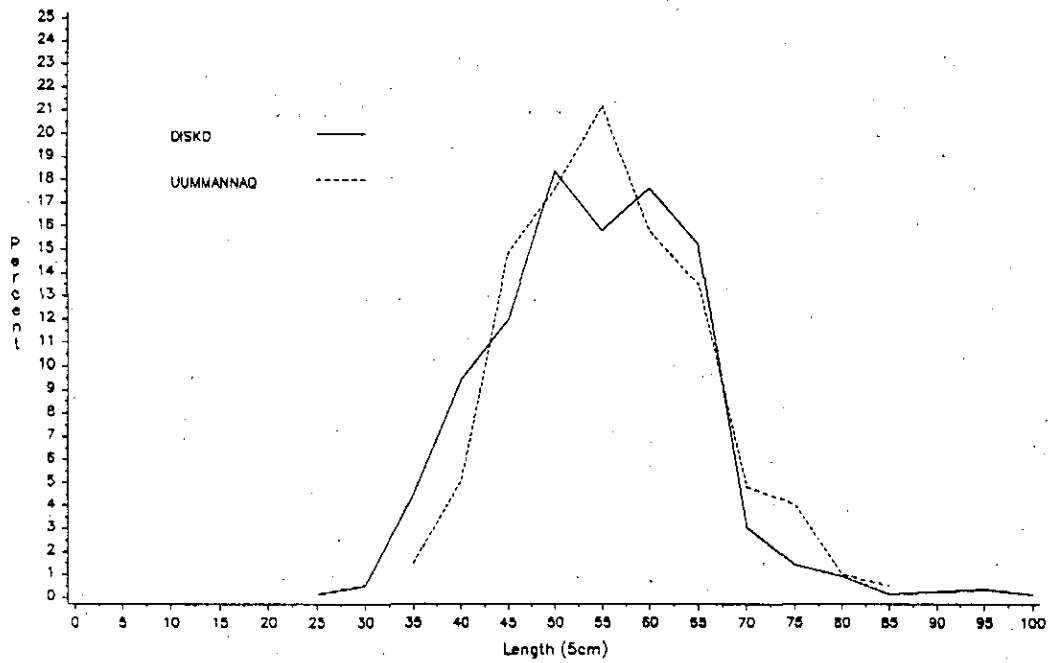


Fig. 2. Relative length distributions (5 cm-groups) from catches taken during longline survey in 1993, in Disko Bay and at Uummannaq.

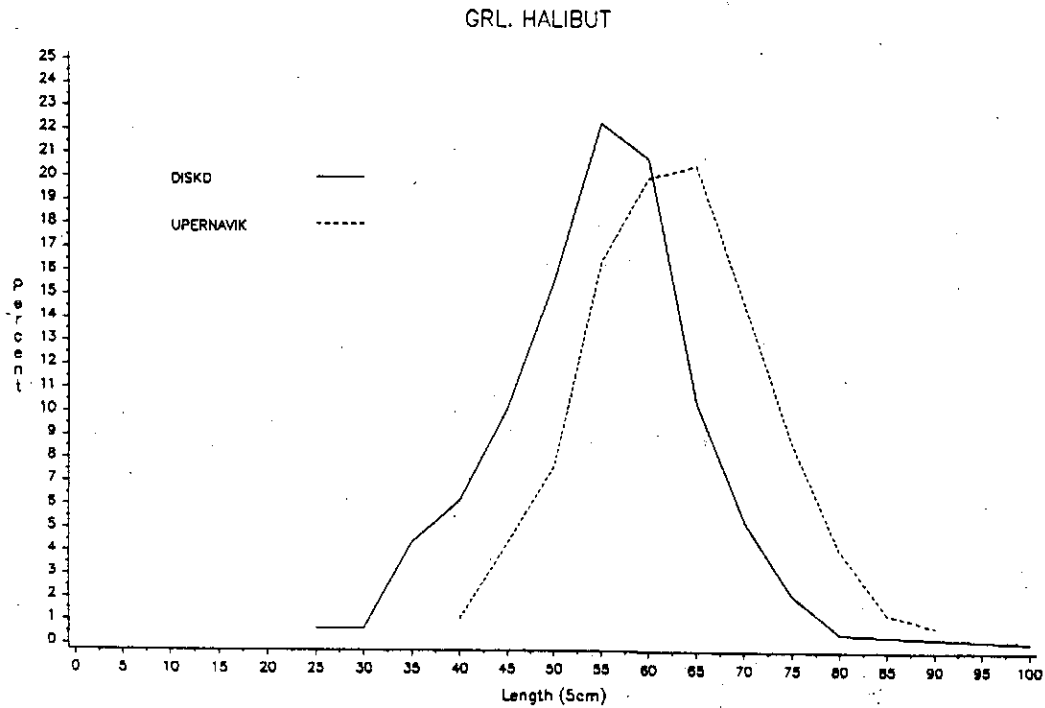


Fig. 3. Relative length distributions (5 cm-groups) from catches taken during the 1994 longline survey, at Upernavik and in Disko Bay.

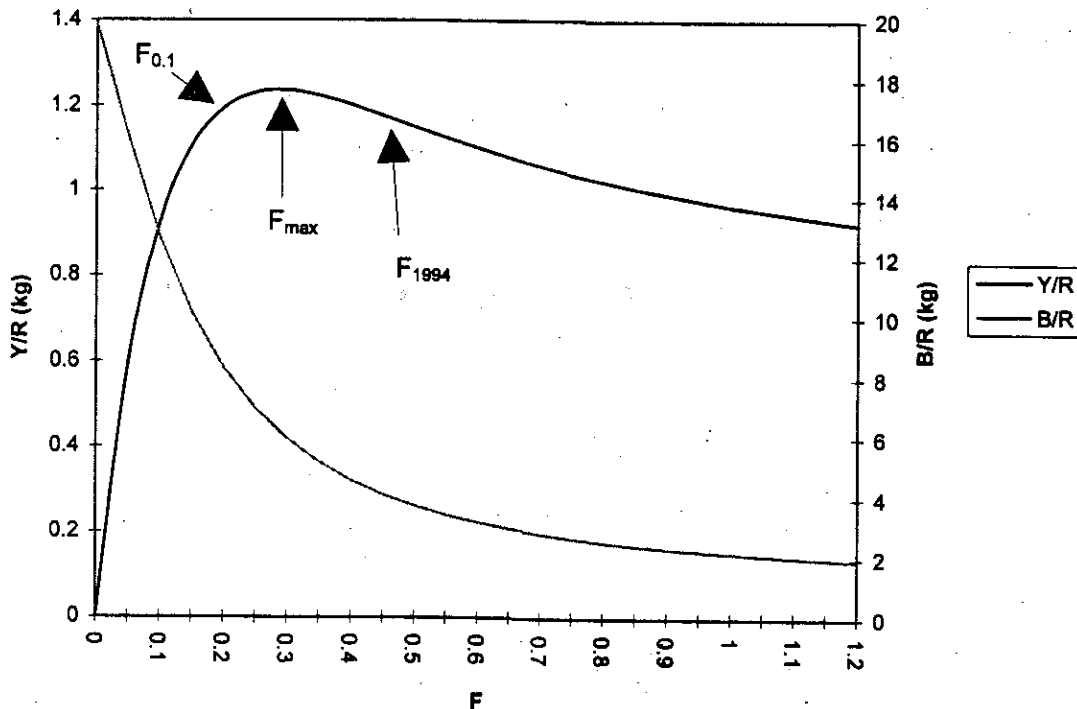


Fig. 4. Yield/recruit (Y/R) and biomass/recruit (B/R) curves from Disko Bay (Ilulissat) in 1994.

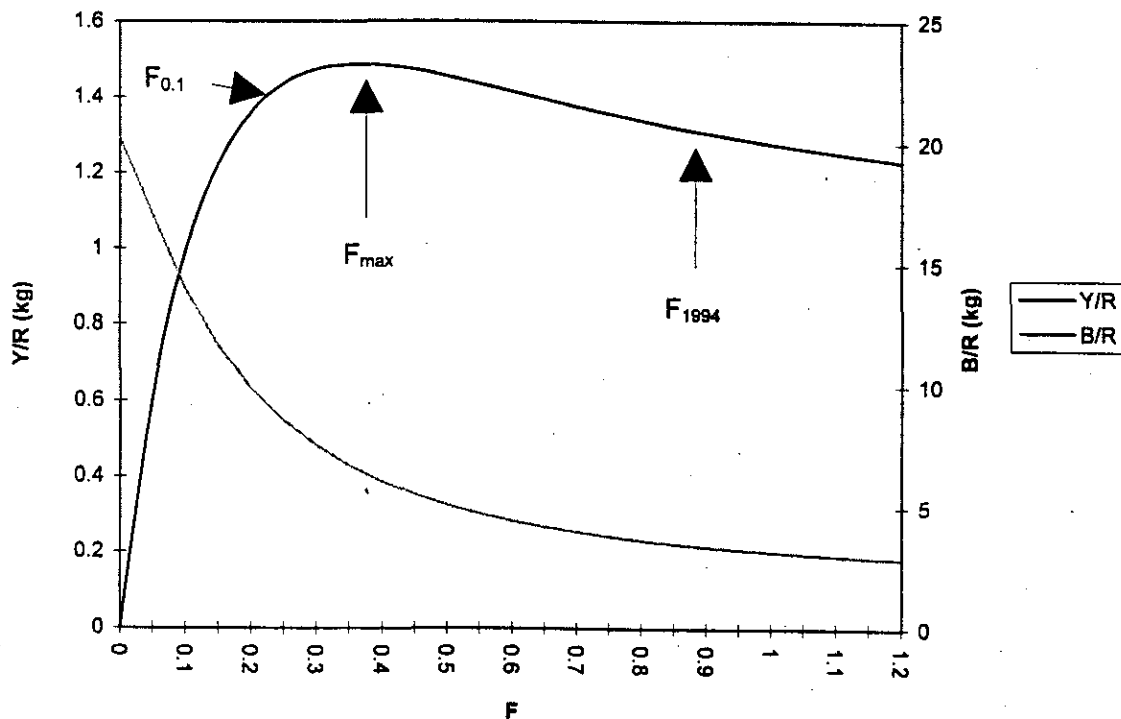


Fig. 5. Yield/recruit (Y/R) and biomass/recruit (B/R) curves from Uummannaq in 1994.

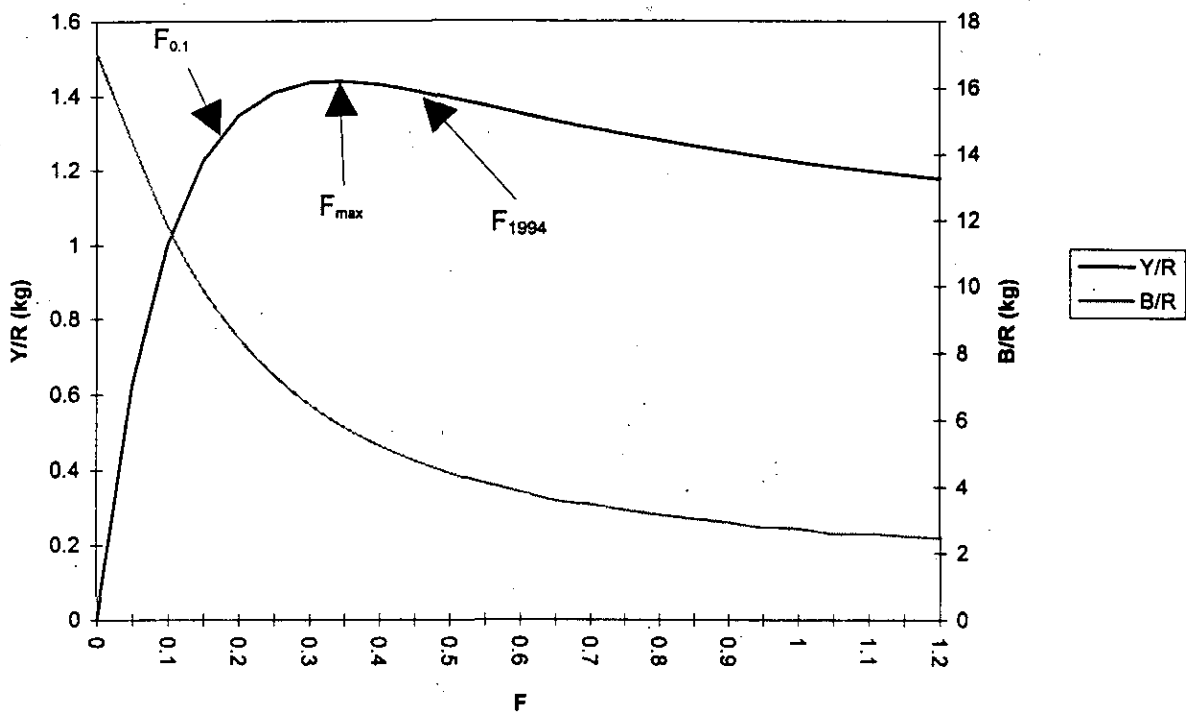


Fig. 6. Yield/recruit (Y/R) and biomass/recruit (B/R) curves from Upernavik 1994.