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Assessment of the Cod Stock in Div. 3NO and Div. 3KL  
from the 1989 Trawl-Acoustic Survey

by

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ABSTRACT

The paper contains the estimates of the cod stocks in Divs. 3NO and 3KL from the trawl-acoustic survey made in March-May 1989.

In Divs. 3NO the cod stock gradually goes down due to poor recruitment from the 1983-1988 yearclasses. The trawl-acoustic survey estimated the abundance at  $18.3 \times 10^6$  fish and the biomass at  $107.5 \times 10^3$  t.

The Labrador cod stock (Divs. 3KL) was close to the 1988 level and higher than the 1977-1989 average. The estimated abundance was  $651.7 \times 10^6$  fish, the biomass -  $944.7 \times 10^3$  t.

INTRODUCTION

For a number of years PINRO has been conducting surveys in NAFO Subarea 3 to monitor the status of commercial fish stocks.

A regular trawl-acoustic survey was made in March-May 1989 by RV "Persey-III". The objective of the paper is to analyse the results obtained, evaluate the abundance and biomass of cod in Divs. 3NO & 3KL in 1989 as compared to the same data for 1977-1988.

MATERIALS & METHODS

The random-stratified trawl survey used the methodology developed by Doubleday (1981) and was made together with an acoustic survey. The acoustic observations allowed estimation of the cod stock part distributed above 1 m from the bottom and out of reach for bottom trawl. Pelagic part of the stock was estimated according to the methodology described by Mamylov V.S. (1988).

The abundance and biomass indices estimated from the trawl-acoustic survey were brought together to derive total values by strata and Division. The strata with no cod in catches were not included into the calculations.

## RESULTS

Divisions 3NO. In March-April 1989 environmental and feeding conditions in the southern Grand Bank were not favourable for formation of cod concentrations. During this period the near-bottom temperatures over the greater part of the area were 0.5-1.5°C below normal and 0.3-1.0°C colder than in 1988. The most considerable anomalies occurred on the eastern slope in the Main Branch of the Labrador Current. The frontal zones were ill-pronounced. No spawning capelin concentrations which make for concentration of cod were observed.

Under such conditions the cod were sparse (Fig. 1). At depths 55-270 m the average catches ranged from 3 to 10 fish in different strata, and at depths greater than 270 m the average catches were up to 16-28 fish per 30 min. tow. Larger fish, the catches of which averaged 40 to 120 kg by strata, occurred in large shallow strata in Div. 3N; on the slopes deeper than 100 m the average catches dropped to 1-16 kg. This seems to account for a relatively high estimate of the biomass at extremely low fish abundance in Div. 3N.

In 1989 the cod abundance as estimated from the trawl survey decreased by a factor of 4, and the biomass by a factor of 1.5 compared to 1988 (Tables 1,2,3). Both estimates were below the 1977-1989 average level (Table 1).

The cod abundance and biomass from the trawl-acoustic survey were  $18.3 \times 10^6$  fish and  $107.5 \times 10^3$  t, respectively, which was also below the values from the 1987-1988 surveys (Table 4).

The southern Newfoundland cod stock values could probably have been somewhat higher if estimated later in the year. Some fish tagged in April near Virgin Rocks migrated to the southern Grand Bank in May-July: of 44 recaptured fish 27% were taken in Divs. 3NO in May-July and 38% - from May to December.

Canadian trawl survey data (Baird and Bishop 1989) also indicated a decrease in abundance (by a factor of 1.5) and in biomass (by a factor of 1.3) of cod in Divs. 3NO though it is not so large as by the USSR data.

Poor recruitment to the stock from the 1983-1988 yearclasses (Table 5) seems to be the major reason of the decrease in the southern Newfoundland cod stock. In 1989 there occurred an increase in the average length and age of fish taken in research

tows (Tables 6,7). Fish of 27 to 38 cm and 63 to 77 cm in length at age 3 to 4 and 7 to 8 from the 1986,1985,1982,and 1981 year-classes made the bulk of the catches. The mature fish in the stock were 28%.

Divisions 3KL. In May the main cod concentrations in Div. 3L were northwest of Virgin Rocks (the peak catch - 800 kg) and in the northern part of the slope at depths 200-240 m (the peak catch - 300 kg). In Div. 3K a higher density of concentrations was observed at depths 320-360 m on the western and eastern slopes of a deepwater trench (Fig.2). A clearly pronounced frontal zone on the western slope of the trench prevented the cod from migrating towards the coast. The average catch within the 300-400 m depth range was 420 kg (peak catches were 1 to 3 t) at smaller and greater depths the catches dropped to 17-25 kg on the average by strata.

Judging by the age and length composition of fish, the Labrador cod stock status is relatively stable (Tables 6,7). Fish of 36 to 44 cm and 54 to 65 cm in length at age 3 to 8 were predominant in the catches taken in Div. 3L. The catches in Div. 3K mainly consisted of 48 to 62 cm fish at age 5 to 7 from the 1984-1982 yearclasses.

Comparison of the 1988 and 1989 trawl survey data shows a decrease in abundance in Divs. 3KL by 1989 (from  $395.6 \times 10^6$  down to  $353.2 \times 10^6$  fish) and an increase in biomass (from  $490.6 \times 10^3$  up to  $547.7 \times 10^3$  t) (Tables 8,9). In general, the stock was close to the 1988 level and above the 1977-1989 average. The trawl-acoustically estimated abundance and biomass were  $651.7 \times 10^6$  fish and  $944.7 \times 10^3$  t, respectively (Table 4).

#### CONCLUSION

The decrease in the southern Newfoundland cod stock (Divs. 3NO) seems to be associated with the poor recruitment to the stock from the 1983-1988 yearclasses. With slightly smaller, than in 1988, abundance but higher biomass the Labrador cod stock in 1989 remained at an above-average level.

#### REFERENCES

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- DOUBLEDAY, W.G., Editor. 1981. Manual on Groundfish Surveys in the Northwest Atlantic. NAFO Scientific Council Studies. Number 2. Dartmouth, Canada, 55 p.
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Table 1. Average catches per tow, abundance and biomass of cod in Divs. 3NO from the 1977-1989 trawl surveys.

Year	Area, nm <sup>2</sup>	Average catch		Abundance (10 <sup>6</sup> fish)	Biomass (10 <sup>3</sup> t)
		Numbers; fish	Weight, kg		
1977	33198	65.6	61.2	161.2	150.6
1978	28741	56.4	47.6	120.2	101.4
1979	33535	17.9	19.7	44.4	49.0
1980	32636	18.9	29.4	45.8	71.3
1981	30121	17.0	25.6	37.8	57.2
1982	33203	55.5	68.3	136.4	168.0
1983	34583	53.6	71.4	137.3	182.8
1984	33894	103.3	106.3	259.3	266.8
1985	34748	202.3	177.8	520.7	457.7
1986	34371	106.0	167.1	269.8	425.4
1987	34330	21.3	113.9	54.2	289.8
1988	33003	22.6	45.1	55.4	110.2
1989	33743	5.4	32.6	13.4	81.5

Table 2. Average catches per tow, abundance and biomass of cod in Div.3N  
from the 1977-1989 trawl surveys

Year	Area, nm <sup>2</sup>	Number of tows	Average catch		Abundance (10 <sup>6</sup> fish)			Biomass (10 <sup>3</sup> t)		
			Numbers, fish	Weight, kg	Maximum	Average	Minimum	Maximum	Average	Minimum
1977	16455	43	91.26	80.87	136.00	109.48	82.95	119.39	97.80	76.17
1978	15240	42	87.27	70.56	212.71	98.52	-15.66	151.67	79.66	7.76
1979	16276	45	20.74	18.44	28.03	25.01	21.99	24.48	22.23	19.99
1980	15902	51	23.44	29.43	38.58	27.61	16.65	47.79	34.67	21.55
1981	15203	42	21.53	34.97	33.35	24.25	15.15	55.74	39.39	23.03
1982	16428	52	62.89	69.21	123.09	76.52	29.96	119.47	84.21	48.96
1983	16997	69	61.30	96.10	106.31	77.16	48.00	179.11	121.00	62.90
1984	16142	71	82.40	99.80	131.58	98.57	65.55	178.30	119.28	60.26
1985	17102	76	223.80	224.50	445.14	282.17	119.20	459.73	283.23	106.73
1986	16300	67	81.42	132.01	156.50	98.30	40.11	229.69	159.39	89.10
1987	16455	72	12.11	23.26	27.26	14.76	2.26	39.49	28.35	17.22
1988	14856	59	34.20	36.30	86.65	37.61	-11.42	62.00	39.95	17.90
1989	15503	94	5.53	47.20	8.57	6.35	4.13	85.05	54.18	23.30

Table 3. Average catches per tow, abundance and biomass of cod in Div. 30  
from the 1977-1989 trawl surveys.

Year	Area, nm <sup>2</sup>	Number of tows	Average catch			Abundance (10 <sup>6</sup> fish)			Biomass (10 <sup>3</sup> t)		
			Numbers, fish	Weight, kg	kg	Maximum	Average	Minimum	Maximum	Average	Minimum
1977	I6743	42	41.73	42.57	69.98	51.75	33.53	70.64	52.80	34.96	
1978	I3501	37	21.62	21.78	28.87	21.63	14.38	32.00	21.78	11.57	
1979	I7259	42	15.13	20.91	29.67	19.35	9.03	48.15	26.74	5.33	
1980	I6734	48	14.65	29.52	25.24	18.17	11.09	50.78	36.61	22.44	
1981	I4918	29	12.29	16.07	16.31	13.58	10.86	23.15	17.76	12.37	
1982	I6775	40	48.17	67.40	102.82	59.86	16.89	130.51	83.74	36.98	
1983	I7586	45	47.45	46.20	92.11	60.18	28.25	87.45	61.85	36.24	
1984	I7752	59	112.20	122.20	250.00	160.70	71.37	195.75	147.49	99.24	
1985	I7648	55	182.48	133.47	503.06	238.54	-25.97	297.95	174.47	51.00	
1986	I8287	78	128.10	198.70	277.20	171.50	65.80	405.31	266.02	126.73	
1987	I7875	66	29.77	197.46	71.74	39.42	7.10	575.18	261.47	-52.23	
1988	I8147	79	13.24	52.30	26.28	17.80	9.32	131.45	70.27	9.09	
1989	I8240	93	5.24	20.24	10.29	7.08	3.87	37.02	27.35	17.69	

Table 4. Estimated abundance ( $10^6$  fish) and biomass ( $10^3$  t) of cod from the 1987-1989 trawl and acoustic surveys

Year	Survey	3 K		3 L		3 NO	
		Abun- :dance	Bio- :mass	Abun- :dance	Bio- :mass	Abun- :dance	Bio- :mass
1987	Trawl	132.9	130.5	73.4	131.9	54.2	289.8
	Acoustic	136.0	134.8	29.4	45.3	6.7	36.9
	Total	268.9	265.3	102.8	177.2	60.9	326.7
1988	Trawl	306.2	331.2	89.4	159.4	55.4	110.2
	Acoustic	228.8	143.3	194.9	223.8	135.2	149.8
	Total	535.0	474.5	284.3	383.2	190.6	260.0
1989	Trawl	230.0	352.2	123.2	195.5	13.4	81.5
	Acoustic	235.6	308.7	62.9	88.3	4.9	26.0
	Total	465.6	660.9	186.1	283.8	18.3	107.5

Table 5. Average numbers of cod at age 1-18 in catch per tow in Divs. 3NO from the 1977-1989 trawl surveys, fish.

Age, years	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Average numbers by age group for 1977-1989
I	0.3	0.2	1.5	0.1	0.5	0.8	3.1	1.2	3.4	0.2	0.8	1.9	0.1	1.1
2	14.8	3.7	2.1	5.4	0.9	13.4	4.7	17.6	18.0	4.4	11.2	10.0	0.7	8.2
3	23.0	18.4	3.8	3.6	6.6	10.0	12.4	33.4	64.3	12.4	2.1	7.2	1.7	15.3
4	13.1	16.8	3.8	2.4	4.2	10.3	9.4	25.1	50.4	41.7	1.0	0.5	1.0	13.8
5	7.5	10.8	3.4	2.6	1.9	10.2	7.7	12.5	40.3	23.2	1.0	0.2	0.2	9.3
6	3.7	4.0	1.4	2.2	1.2	3.8	7.6	5.9	12.7	10.2	1.0	0.5	0.2	4.2
7	1.8	1.6	0.8	1.2	0.8	2.5	3.3	3.5	6.7	4.6	0.8	0.4	0.4	2.2
8	0.8	0.6	0.4	0.7	0.4	2.0	2.0	1.8	2.8	4.2	0.8	0.4	0.5	1.3
9	0.3	0.2	0.2	0.3	0.2	1.2	1.9	1.1	1.2	2.5	0.8	0.5	0.2	0.8
10	0.1	0.1	0.2	0.2	0.1	0.7	0.9	0.8	1.2	1.3	0.7	0.5	0.1	0.5
11	0.1	+	0.1	0.1	0.1	0.3	0.4	0.2	0.6	0.6	0.5	0.3	0.1	0.3
12	0.1	+	0.1	+	0.1	0.2	0.1	0.1	0.4	0.4	0.4	0.2	0.1	0.2
13	+	+	+	+	+	0.1	+	+	0.2	0.2	0.1	0.1	0.1	0.1
14	+	-	+	+	+	+	+	0.1	-	+	0.1	-	+	+
15	+	-	+	+	+	+	0.1	-	+	+	+	-	+	+
16	+	-	+	-	+	+	-	-	+	-	+	-	+	+
17	-	-	+	-	-	-	-	-	-	-	-	-	+	+
18	-	-	-	-	-	-	-	-	-	+	-	-	+	+
Total, fish	65.6	56.4	17.9	18.9	17.0	55.5	53.6	103.3	202.3	106.0	21.3	22.7	5.4	57.4



Table 6. Length composition of cod in NAFO Subarea 3  
from the 1988-1989 trawl surveys, %/oo

Fish length: cm	3K		3L		3N		30	
	1988	1989	1988	1989	1988	1989	1988	1989
9-11	-	-	3	+	2	2	2	6
12-14	I	-	3	I	3	3	-	12
15-17	+	+	9	4	10	19	9	2
18-20	4	I	11	9	187	55	24	17
21-23	12	4	14	13	285	77	61	35
24-26	11	5	17	18	141	67	129	22
27-29	8	4	48	32	113	133	155	19
30-32	15	13	70	52	115	127	139	52
33-35	17	24	67	65	56	110	99	83
36-38	26	23	47	79	22	84	33	63
39-41	60	24	32	74	10	58	10	44
42-44	87	42	33	71	8	33	4	26
45-47	170	55	53	49	4	25	7	26
48-50	206	96	82	41	6	17	9	18
51-53	130	147	75	58	1	16	6	12
54-56	109	144	82	63	+	14	11	14
57-59	68	161	90	82	4	5	14	14
60-62	35	106	65	75	2	9	14	28
63-65	19	56	57	63	3	10	16	48
66-68	10	30	41	47	1	5	19	66
69-71	3	20	25	31	+	12	12	73
72-74	I	11	18	24	2	10	9	54
75-77	2	7	12	12	I	6	8	52
78-80	I	7	13	11	I	5	22	37
81-83	+	6	7	4	-	2	9	29
84-86	I	4	5	4	2	I	13	34
87-89	I	5	3	2	I	-	15	29
90-92	+	2	I	I	+	6	16	16
93-95	+	3	2	I	+	5	20	17
96-98	+	I	2	2	I	4	21	5
99-101	-	-	3	2	-	2	14	12
102-104	-	-	2	2	I	6	23	7
105-107	-	-	I	I	2	7	8	5
108-110	-	-	I	2	3	5	11	2
111-113	-	-	I	2	2	4	10	I
114-116	-	-	I	+	3	18	10	6
117-119	+	-	I	I	3	13	7	-
120-122	-	-	I	I	I	7	4	I
123-125	-	-	I	+	I	6	3	5
126-128	-	-	I	-	2	6	I	2
129-131	-	-	-	-	I	6	2	4
132-134	-	-	-	-	-	-	-	-
135-137	-	-	-	-	-	-	2	-
138-140	-	-	-	-	+	-	I	I
Numbers offish 0/88	998	1001	1000	999	1000	999	1002	999
Numbers of fish	12995	17513	5714	5670	2589	999	1152	832
Average length, cm	48.58	54.46	49.88	50.09	27.86	41.74	47.48	58.03

Table 7. Age composition of cod in Divs. 3KLN0 from the 1987-1989 trawl surveys, ‰

Age, years	3 K			3 L			3 NO		
	1987	1988	1989	1987	1988	1989	1987	1988	1989
I	I	I	-	5	I7	2	36	83	I5
2	II	3I	4	2I	50	36	525	444	I30
3	97	45	48	62	I76	I8I	99	3I9	309
4	257	I3I	9I	I30	I05	289	47	2I	I79
5	434	453	300	240	I26	I34	49	7	35
6	I2I	253	32I	20I	242	I48	45	20	35
7	56	62	I78	I99	I76	98	37	I9	83
8	I5	I8	3I	79	68	80	35	I8	92
9	5	3	I5	26	23	I7	38	20	38
I0	2	I	8	I2	88	3	35	2I	I5
II	-	I	3	8	5	3	24	I5	I5
I2	-	-	+	9	4	4	I9	9	I8
I3	+	+	-	4	I	2	7	4	I5
I4	-	-	-	I	I	I	3	-	II
I5	-	-	-	2	-	+	+	-	3
I6	-	-	-	I	+	I	+	-	3
I7	-	-	-	-	-	+	-	-	2
I8	-	-	-	-	-	-	-	-	I
Numbers of fish, ‰	999	999	999	I000	I002	999	999	I000	999
Age sample, fish	434	5II	375	624	639	-	775	579	540
Average age, years	4.82	5.I4	5.70	5.84	5.32	4.98	3.96	3.I6	5.0I

Table 8. Average catches per trawling, abundance and biomass of cod in Div. 3L from the 1977-1989 trawl surveys

Year	Area, nm <sup>2</sup>	Number of tows	Average catch			Abundance (10 <sup>6</sup> fish)			Biomass (10 <sup>3</sup> t)		
			Number of fish	Weight, kg	Maximum	Average	Minimum	Maximum	Average	Minimum	
1977	28008	58	49.60	38.40	141.96	102.89	63.82	110.24	79.66	49.08	
1978	25664	47	19.44	24.58	45.69	36.96	28.22	63.62	46.73	29.85	
1979	28956	55	48.72	72.76	139.42	104.51	69.60	196.02	156.07	116.12	
1980	30327	62	34.25	58.87	95.33	76.95	58.57	166.57	132.26	97.94	
1981	27840	49	31.61	50.09	88.58	65.20	41.63	141.21	103.31	65.40	
1982	29079	52	32.57	56.74	82.13	70.18	58.29	145.60	122.22	98.84	
1983	31599	83	51.93	86.53	152.32	121.54	90.76	254.13	202.54	150.95	
1984	33243	92	126.64	155.66	388.29	311.85	235.42	476.47	383.30	290.13	
1985	31509	85	77.41	75.86	246.50	180.70	114.90	236.56	177.06	117.56	
1986	33333	108	120.30	177.08	384.13	297.03	209.93	544.53	437.23	329.93	
1987	33333	115	29.73	53.83	91.47	73.41	55.34	167.84	132.91	97.97	
1988	33333	114	36.20	64.50	119.62	89.43	59.25	224.25	159.37	94.46	
1989	33243	122	50.03	79.40	156.84	123.20	89.55	246.98	195.51	144.04	

Table 9. Average catches per tow, abundance and biomass of cod in Div. 3K from the 1977-1989 trawl survey

Year	Area, km <sup>2</sup>	Number of tows	Average catch			Abundance (10 <sup>6</sup> fish)			Biomass (10 <sup>3</sup> t)		
			Number: of fish	Weight: kg	Maximum	Maximum	Average	Minimum	Maximum	Average	Minimum
1977	24329	50	16.73	14.80	38.09	30.15	22.22	33.99	26.68	19.37	
1978	24260	51	6.78	7.58	17.01	12.19	7.37	18.11	13.63	9.14	
1979	22963	51	32.53	44.03	88.01	55.34	22.67	109.54	74.89	40.25	
1980	23410	57	26.74	39.19	59.31	46.38	33.45	84.28	67.96	51.64	
1981	20719	46	12.57	20.05	22.49	19.30	16.11	35.32	30.78	26.23	
1982	23614	55	12.56	24.59	25.65	21.96	18.26	50.30	43.01	35.73	
1983	26015	75	18.25	28.98	44.90	35.18	25.46	70.87	55.85	40.83	
1984	26213	88	152.41	182.98	421.84	295.94	170.03	522.67	355.30	187.92	
1985	17497	47	220.65	187.94	420.99	285.99	150.99	348.79	243.59	138.39	
1986	26546	97	139.28	139.72	329.71	270.43	211.15	335.45	271.30	207.15	
1987	25581	93	70.12	68.88	214.76	132.86	50.96	206.27	130.52	54.76	
1988	26546	95	157.70	170.60	530.50	306.15	81.81	563.61	331.21	98.81	
1989	26009	96	119.33	182.80	436.46	229.90	23.34	700.57	352.16	3.75	



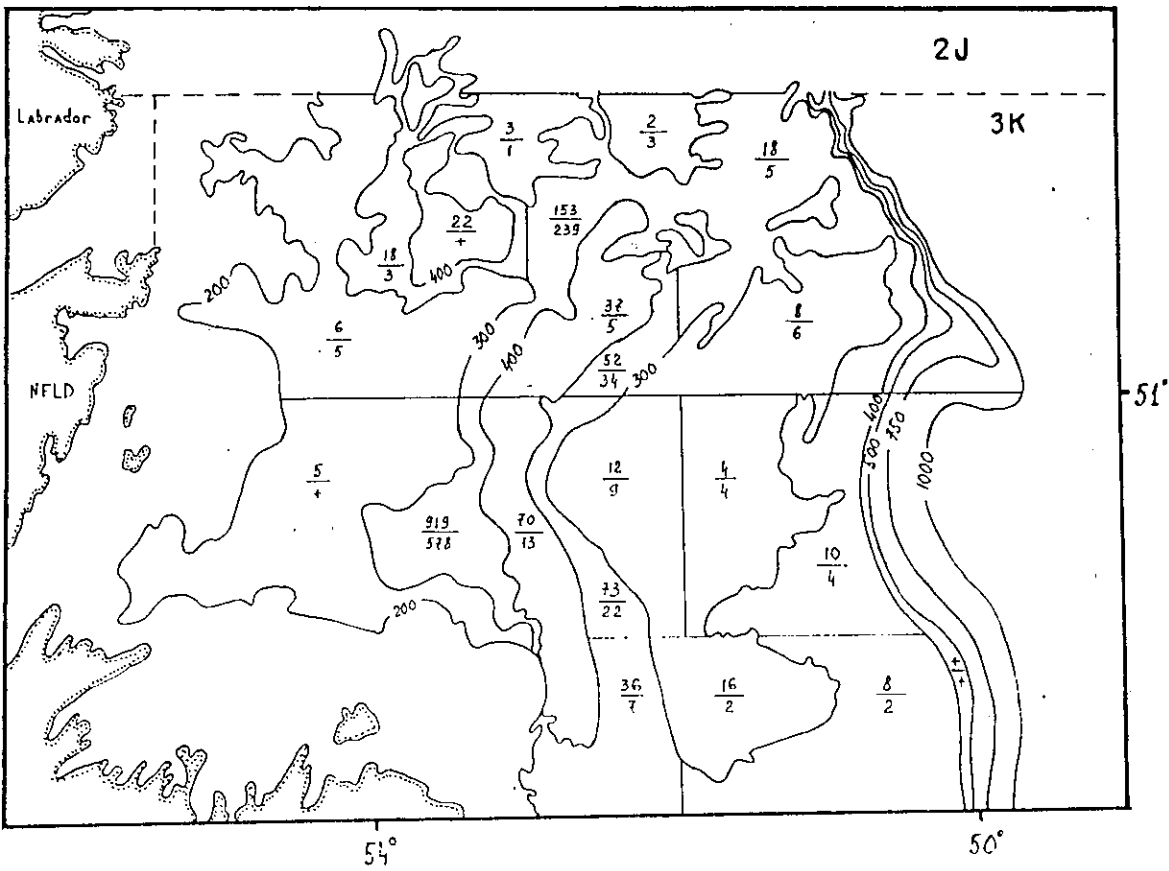


Fig. 2. Distribution of cod in Div 3K in May 1989.  
Legend as in Fig. 1.