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Stock Assessment of Cod From NAFO Subarea 3 by the Data From 1991 Trawl-Acoustic Survey

by

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ABSTRACT

Trawl-acoustic survey was conducted in NAFO Divs. 3M, 3NO and 3L in April-July 1991. Cod stock remained at a low level in Div.3M. By the data from trawl-acoustic assessment the fish abundance made up 12.9×10^6 indiv., biomass - 8.2×10^3 t in 1991 against 19.0×10^6 indiv. and 15.2×10^3 t - in 1990.

A growth in cod stock was observed in Divs.3NO and in 1991 the abundance constituted 39.2×10^6 indiv. and biomass - 151.0×10^3 t.

Abundance of cod in Div.3L exceeded those for 1989 and 1990 and made up 198×10^6 indiv. Biomass has been reduced since 1988 and amounted to 189×10^3 t.

INTRODUCTION

Research cruises for observations over stock status of commercial fish species in NAFO Subarea 3 are carried out by PINRO during a number of years.

Traditional trawl-acoustic survey was conducted by RV "Vilnius" in April-July 1991. Obtained results, estimation of abundance and biomass of cod stocks in 1991 compared to the data for 1977-1990 are analyzed in the paper.

MATERIAL AND METHODS

A stratified-random trawl survey was carried out by the methods developed by Doubleday (1981) and adopted in NAFO and was followed by acoustic survey.

Acoustic observations allowed to assess cod stock distributed above a zone of fishing by bottom trawl (Mamylov, 1988).

Results from the 1991 survey were compared to retrospective data from trawl and trawl-acoustic surveys to characterize year-to-year variations in the stock status (Kuzmin, 1991).

Mean catches were taken from 0.5 hr trawling. Strata where no cod were registered in catches have not been included into the calculations.

RESULTS

Div. 3M. In April-May 1991 no essential cod aggregations were registered on the Flemish Cap Bank. Fish were distributed all over the area with catches predominating along the southern and western slopes of the bank (Fig.1).

Catches per a half-hour trawling did not exceed 280 kg. Pelagic cod concentrations were also insignificant (Fig.1).

Cod at 3 and 4 yr from the 1988 and 1987 yearclasses predominated in catches (Fig.2).

The 1986 yearclass, which prevailed in catches taken from research surveys for 1987-1990 and carried out by the USSR and Spain (Vasguer, 1989, 1990, 1991), was the third by abundance in 1991.

As indicated by the data from the 1991 USSR trawl survey the cod stock on the Flemish Cap Bank exceeded the previous year estimate, however, remained at low level against the 1983-1991 period (Table 1). In 1991 number of mature fish in catches remained to be low in 1991 under their growth continuing since 1990 (Table 2).

Divs. 3NO In April 1991 minimum catches reached 460-730 indiv. ^(3-3.5t) in the south of the Grand Newfoundland Bank (Divs. 3NO) and were obtained when trawling the depths from 180 to 350 m with essential fish aggregation in Div. 3O. During survey a considerable shifting of large (90-130 cm) cod from shallows of the bank to the slope of Div. 3O was noted. Mean catches at 55-270 m depths constituted 4-28 indiv. and 10-160 indiv. - deeper.

Emerged trend for restoration of south Newfoundland cod stock should be noted by the results from 1991 survey (Tables 3,4, 5). Abundance and biomass in 1991 were higher than in previous years (1989, 1990) and amounted to 35.8 mill.indiv. and 142.1 thou.t.

According to the estimate obtained by trawl-acoustic method

cod abundance constituted 39.2×10^6 indiv. and biomass - 151.0×10^3 t which is higher than the estimates for 1989-1990 (Table 6).

By the data of Canadian researchers abundance of cod in Divs. 3NO was also higher compared to the estimates for 1989-1990 (Baird et al., 1991).

No cod at age 1 were found in considerable quantity during trawl survey in 1990. Fish of 2-5 yr and 9-10 yr constituted the catches with 2-year olds predominating (Table 7). Thus, a portion of mature fish in the stock has reduced and made up 25% against 28 and 33% in 1989 and 1990, respectively.

Mean length of size frequency of cod caught in Div. 3N in 1991 was the least compared to those for 1990 (Table 8) and 1989 (Kuzmin, 1991). Thus, an increase in commercial catches from Divs. 3NO should be expected due to a recruitment of cod from 1989 to commercial part of the stock in Divs. 3NO.

Divs. 3KL. In Div. 3L main cod aggregations were found at 270-365 m depths in the northeastern slope of the Grand Bank (Fig. 3). The highest catches amounted to 600-960 indiv. (430-850 kg). Fish 36-47 cm long of 3-5 yr predominated in catches (Table 9). By results from the 1991 trawl survey the abundance was the highest from 1987 to 1991 and amounted to 170.2×10^6 indiv. in Divs. 3L (Table 10).

Due to complicated ice conditions in spring-summer period no survey was conducted in Div. 3K in 1991. By the results from surveys conducted in previous years any reduction in cod stock is hardly be expected in Div. 3K (Table 11).

CONCLUSION

The Flemish Cap cod stock remains at a low level though the abundance and biomass in 1991 are higher against 1990. The 1986 year-class cod, due to a commercial withdrawal, prevailed in catches of 1991 no longer, as it was in 1987-1990.

In 1991 a growth in cod abundance was noted in Divs. 3NO. The 1989 yearclass prevailed in age populational structure, which will recruit to a commercial stock in 1992-1993.

In 1991 a lack of survey in Div. 3K complicated the cod stock assessment in Divs. 3KL, however, to judge by results from the investigations carried out in Div. 3L in 1991 and by estimates obtained for preceding years in Divs. 3KL, the cod stock is expected to be maintained at a previous level.

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Table 1. Mean catches per trawling, abundance and biomass of cod in Div. 3M by the data from the 1977-1991 trawl surveys

Year	Area, sq. mile	Number of hauls	Mean catch		Abundance, 10 ⁶ spec.			Biomass, 10 ³ t		
			Number, spec.	Weight, kg	Maximum	Mean	Minimum	Maximum	Mean	Minimum
1977	9081	24	234.30	201.30	282.88	157.61	52.33	262.58	135.40	8.23
1978	7487	30	42.35	39.90	38.24	23.42	8.60	30.79	22.07	13.36
1979	9081	64	80.60	60.95	102.73	54.22	5.70	71.78	40.99	10.21
1980	9081	76	14.60	17.90	12.64	9.82	7.00	16.31	12.02	7.74
1981	7745	29	28.35	43.45	24.58	16.28	7.98	34.83	24.93	15.02
1982	9081	62	15.35	20.55	14.03	10.34	6.66	23.87	13.83	3.79
1983	9081	103	97.40	34.30	100.39	65.53	30.87	31.07	23.07	16.06
1984	9081	103	90.20	46.40	75.40	60.88	45.98	39.29	31.21	23.13
1985	9081	106	55.09	41.70	44.64	37.06	29.48	34.88	28.07	21.48
1986	9081	108	55.30	38.70	53.29	37.20	21.11	36.76	26.06	15.36
1987	8479	104	58.60	16.20	50.96	38.82	22.68	13.28	10.15	7.02
1988	8411	97	42.90	12.40	37.90	28.73	15.50	10.45	7.72	4.99
1989	9081	109	104.72	54.30	107.91	70.44	32.98	53.89	36.52	19.14
1990	7813	85	7.40	8.80	5.86	4.31	2.76	5.42	3.92	2.42
1991	9081	82	15.62	10.02	18.31	10.51	2.71	11.59	6.74	1.88

Table 2. Number of mature and immature fish in catch per trawling by the data from the 1983-1991 trawl surveys on the Flemish Cap Bank

Year	No. of immature fish, spec.	No. of mature fish, spec.	No. of mature fish, %	Total, spec.
1983	83.06	11.30	11.6	97.40
1984	76.50	13.71	15.2	90.20
1985	40.72	14.38	26.1	55.09
1986	44.66	8.64	15.6	55.30
1987	56.28	2.32	4.0	58.60
1988	42.14	0.79	1.8	42.90
1989	100.61	4.12	3.9	104.72
1990	6.20	1.20	16.3	7.40
1991	12.62	3.00	19.2	15.62

Table 3. Mean catches per trawling, abundance and biomass of cod in Div. 3N by the data from the 1977-1991 trawl surveys

Year	Area, sq. mile	Number of hauls	Mean catch		Abundance, 10 ⁶ spec.			Biomass, 10 ³ t		
			Number, spec.	Weight, kg	Maximum	Mean	Minimum	Maximum	Mean	Minimum
1977	16455	43	91.26	80.87	136.00	109.43	82.95	119.39	97.80	76.17
1978	15240	42	87.27	70.56	212.71	98.52	-15.66	151.67	79.86	7.76
1979	16276	45	20.74	13.44	28.03	25.01	21.99	24.48	22.23	19.99
1980	15902	51	23.44	29.43	38.58	27.81	16.65	47.79	34.67	21.56
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	29.98	119.47	84.21	48.98
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	108.73
1986	16300	67	81.42	132.01	156.50	98.30	40.11	229.69	159.39	89.10
1987	16455	72	12.11	23.28	27.25	14.76	2.26	39.49	28.35	17.22
1988	14858	59	34.20	36.30	86.65	37.81	-11.42	62.00	39.95	17.90
1989	15503	94	5.53	47.20	8.57	8.35	4.13	85.05	54.18	23.30
1990	15280	63	2.00	22.00	3.61	2.25	0.89	46.17	24.90	3.63
1991	11574	81	13.11	23.81	19.74	11.24	2.73	33.60	20.41	7.21

Table 4. Mean catches per trawling, abundance and biomass of cod in Div. 3O by the data from the 1977-1991 trawl surveys

Year	Area, sq. mile	Number of hauls	Mean catch		Abundance, 10 ⁶ spec.			Biomass, 10 ³ t		
			Number, spec.	Weight, kg	Maximum	Mean	Minimum	Maximum	Mean	Minimum
1977	16743	42	41.73	42.57	69.98	51.75	33.53	70.84	52.80	34.98
1978	13501	37	21.82	21.78	28.87	21.63	14.38	32.00	21.78	11.57
1979	17259	42	15.13	20.91	29.67	19.35	9.03	48.15	26.74	5.33
1980	16734	43	14.65	29.52	25.24	18.17	11.09	50.78	36.61	22.44
1981	14913	29	12.29	16.07	16.31	13.58	10.86	23.15	17.76	12.37
1982	16775	40	48.17	67.40	102.82	59.86	16.89	130.51	83.74	36.98
1983	17586	45	47.45	46.20	92.11	60.13	29.25	87.45	61.85	36.24
1984	17752	59	112.20	122.20	250.00	160.70	71.37	195.75	147.49	99.24
1985	17648	55	182.48	133.47	503.06	238.54	-25.97	297.95	174.47	51.00
1986	18287	78	128.10	198.70	277.20	171.50	65.80	405.31	268.02	128.73
1987	17875	66	29.77	197.45	71.74	39.42	7.10	575.18	261.47	-52.23
1988	18147	79	13.24	52.30	26.28	17.80	9.32	131.45	70.27	9.09
1989	18240	93	5.24	20.24	10.29	7.08	3.87	37.02	27.35	17.69
1990	13052	52	3.20	33.70	4.40	3.05	1.70	48.34	32.57	16.80
1991	16958	70	19.56	96.90	48.47	24.57	2.87	264.50	121.72	-21.06

Table 5. Mean catches per trawling, abundance and biomass of cod in Div. 3N0 by the from the 1977-1991 trawl surveys

Year	Area, sq. mile	Mean catch		Abundance, 10 ⁶ spec.	Biomass, 10 ³ t
		Number, spec.	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	32536	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	289.8	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
1990	28312	2.5	27.4	5.2	57.5
1991	28532	16.9	67.3	36.8	142.1

Table 6. Estimation of abundance (10⁶ spec.) and biomass (10³t) of cod by the data from trawl and acoustic surveys for 1987-1991

Year	Survey	3K		3L		3N0		3M	
		Abundance	Biomass	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass
1987	Trawl	132.9	130.5	73.4	131.9	54.2	289.8	36.8	10.2
	Acoustic	136.0	134.8	29.4	45.3	6.7	36.9	40.2	9.3
	Total	268.9	265.3	102.8	177.2	60.9	326.7	77.0	21.6
1988	Trawl	306.2	331.2	89.4	159.4	55.4	110.2	26.7	7.7
	Acoustic	228.8	143.3	194.9	223.8	135.2	149.8	123.8	26.5
	Total	535.0	474.5	284.3	383.2	190.6	260.0	150.5	34.2
1989	Trawl	230.0	352.2	123.2	195.5	13.4	81.5	70.4	36.5
	Acoustic	235.6	308.7	62.9	88.3	4.9	25.0	88.7	41.8
	Total	465.6	660.9	186.1	283.8	18.3	107.5	159.1	78.3
1990	Trawl	276.2	335.6	99.6	123.7	5.2	57.5	4.3	3.9
	Acoustic	193.2	213.4	77.8	101.5	2.6	2.8	14.7	11.3
	Total	469.4	549.0	177.4	225.2	7.8	60.3	19.0	15.2
1991	Trawl	No data		170.2	166.7	36.8	142.1	10.5	6.7
	Acoustic	data		27.8	22.7	3.4	8.9	2.4	1.5
	Total			198.0	189.4	39.2	151.0	12.9	8.2

Table 7. Mean number of cod at 1-18 in catch per half-hour trawling in Divs. 3N0 by the data from the 1977-1991 trawl surveys, spes.

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	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	-	+
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	0.2	5.1
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	0.4	1.8
4	13.1	15.8	3.8	2.4	4.2	10.3	9.4	25.1	50.4	41.7	1.0	0.5	1.0	0.6	2.4
5	7.6	10.8	3.4	2.6	1.9	10.2	7.7	12.5	40.3	23.2	1.0	0.2	0.2	0.4	2.7
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	0.2	0.8
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	0.1	0.2
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	0.1	0.4
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	0.1	1.1
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	0.2	1.0
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	0.1	0.5
12	0.1	+	0.1	+	0.1	0.2	0.1	0.1	0.4	0.4	0.4	0.2	0.1	0.1	0.6
13	+	+	+	+	+	0.1	+	+	0.2	0.2	0.1	0.1	0.1	+	0.2
14	+	-	+	+	+	+	+	0.1	-	+	0.1	-	+	+	0.1
15	+	-	+	+	+	+	0.1	-	-	+	-	-	+	+	0.1
16	+	-	+	-	+	+	-	-	+	-	+	-	+	-	-
17	-	-	+	-	-	-	-	-	-	-	-	-	+	+	+
18	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-
Mean number for period surveyed	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	2.5	16.9

Table 8. Length composition of cod in NAFO Subarea 3 by the data from the 1990 and 1991 trawl surveys, X.

Length, cm	3K		I		3L		3N		3O		3M				
	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991			
9-11	-	-	-	-	-	+	-	-	-	-	-	-			
12-14	-	-	+	1	-	1	-	-	-	1	3	-			
15-17	-	n	+	1	-	26	-	12	4	30	-	-			
18-20	1	o	5	3	18	145	9	92	1	17	-	-			
21-23	1	1	17	16	57	188	14	109	12	8	-	-			
24-26	5	d	30	19	84	74	41	43	43	29	-	-			
27-29	12	a	47	38	57	24	27	15	61	23	-	-			
30-32	21	t	75	46	48	42	55	12	36	19	-	-			
33-35	18	a	81	76	97	52	50	23	56	115	-	-			
36-38	32	112	137	106	42	50	41	75	291	-	-	-			
39-41	52	99	115	79	48	55	25	99	178	-	-	-			
42-44	79	113	118	40	65	73	27	136	63	-	-	-			
45-47	62	86	119	84	97	64	21	102	30	-	-	-			
48-50	98	67	83	35	78	59	23	110	37	-	-	-			
51-53	139	54	77	9	63	64	21	99	45	-	-	-			
54-56	136	36	47	13	24	45	25	46	40	-	-	-			
57-59	159	35	31	-	18	27	25	59	32	-	-	-			
60-62	89	38	19	9	3	18	17	28	18	-	-	-			
63-65	47	26	11	13	3	5	23	15	11	-	-	-			
66-68	22	22	10	13	1	14	13	10	8	-	-	-			
69-71	10	17	7	18	-	9	10	1	3	-	-	-			
72-74	7	13	6	9	1	18	12	-	5	-	-	-			
75-77	3	10	6	-	1	5	13	-	1	-	-	-			
78-80	4	6	4	13	-	23	21	-	1	-	-	-			
81-83	1	3	2	-	1	18	27	3	-	-	-	-			
84-86	-	3	3	-	1	5	33	-	-	-	-	-			
87-89	-	2	2	4	+	9	35	1	-	-	-	-			
90-92	-	2	1	-	1	14	30	1	-	-	-	-			
93-95	-	1	1	13	-	5	29	-	-	-	-	-			
96-98	-	+	+	9	+	18	25	1	-	-	-	-			
99-101	-	1	1	9	+	23	25	-	-	-	-	-			
102-104	-	-	-	9	1	23	19	-	-	-	-	-			
105-107	-	+	-	9	1	37	22	-	-	-	-	-			
108-110	-	1	+	26	+	5	26	-	-	-	-	-			
111-113	-	2	+	22	+	23	22	-	-	-	-	-			
114-116	-	1	-	26	2	23	21	-	-	-	-	-			
117-119	-	1	+	18	1	9	19	-	-	-	-	-			
120-122	-	+	+	9	1	9	21	-	-	-	-	-			
123-125	-	+	+	18	1	9	7	-	-	-	-	-			
126-128	-	-	-	22	3	18	7	-	-	-	-	-			
129-131	-	-	-	-	-	5	4	-	-	-	-	-			
132-134	-	+	-	-	-	5	4	-	-	-	-	-			
135-137	-	-	-	-	-	-	1	-	-	-	-	-			
138-140	-	+	-	-	-	9	-	-	-	-	-	-			
No. of fish, %	998	-	998	1000	1000	1001	1000	1000	1000	999	-	-	-	-	-
No. of spec.	13183	-	5248	8876	227	2673	219	2763	675	1800	-	-	-	-	-
Mean length, cm	51.83	-	44.71	43.76	53.30	34.88	61.36	62.48	43.95	39.87	-	-	-	-	-

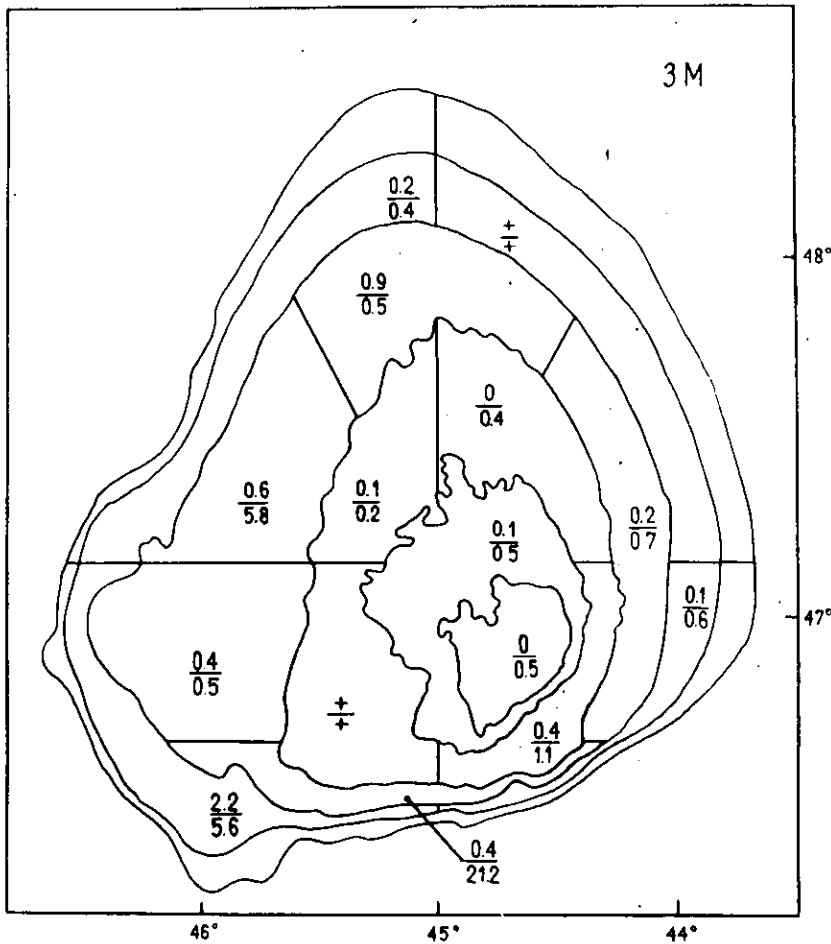


Fig.1. Distribution of cod on the Flemish Cap Bank by the data from acoustic survey in April-May 1991. Figures indicate density of fish aggregations, expressed in mean units of echointensity by strata: in pelagic (over line), in bottom layer (below line)

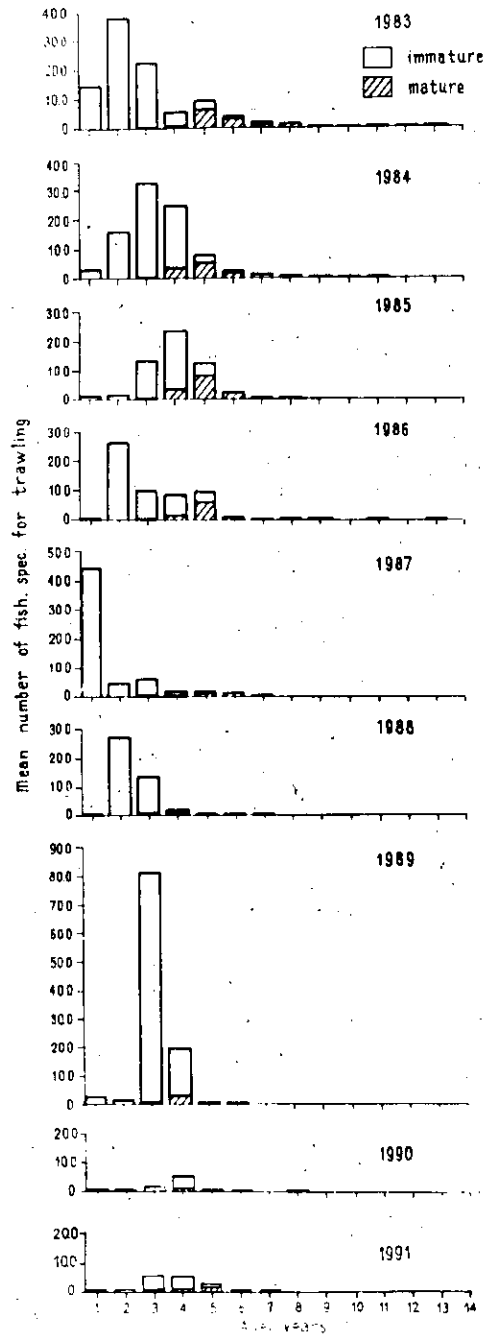


Fig.2. Number (indiv.) of immature and mature cod at different age in mean catch per trawling by the data from trawl surveys on the Flemish Cap Bank

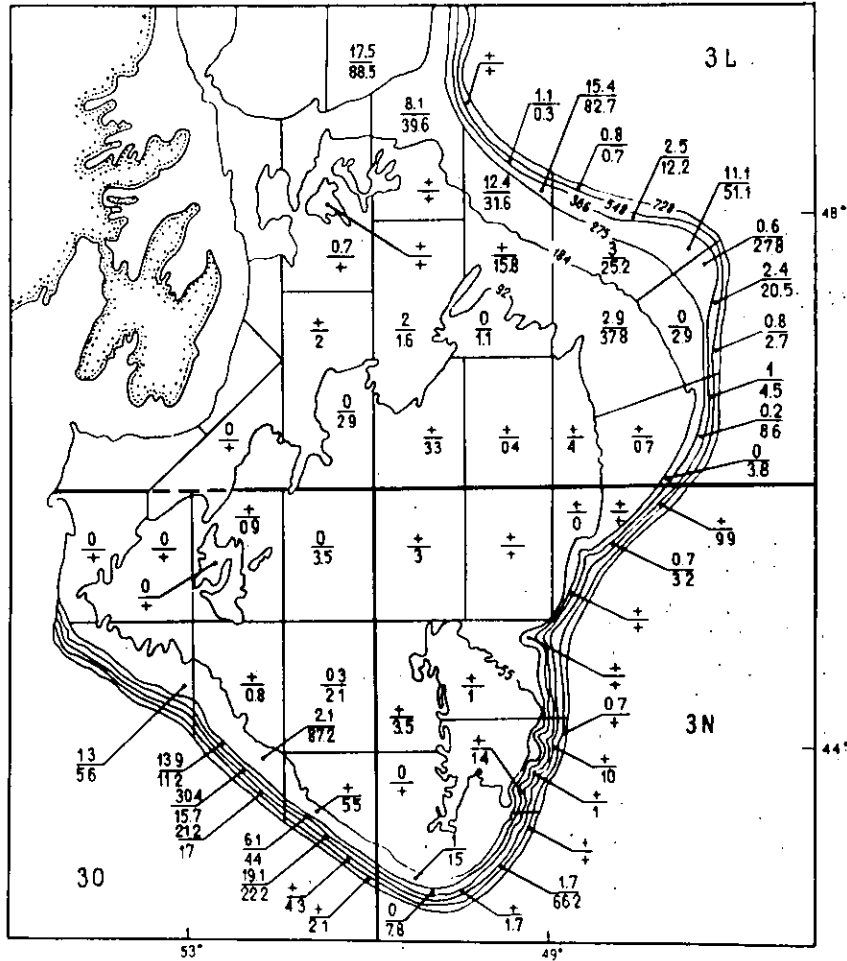


Fig.3. Distribution of cod on the Grand Bank in April-June 1991.
See Fig.1 legend