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RUSSIAN INVESTIGATIONS ON COD AND HADDOCK
IN THE BARENTS SEA AND ADJACENT WATERS IN
NOVEMBER 1993 - JANUARY 1994

by

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ABSTRACT

Annual traditional trawl-acoustic survey for stock assessment and estimation of young cod and haddock in the Barents Sea and adjacent waters was carried out by three Russian research vessels in November 1993 - January 1994.

The investigations over the area surveyed showed the abundance of cod and haddock from the 1992-1993 yearclasses to be estimated at a level close to the long-term mean value. The 1991 cod yearclass is mean abundant and that of haddock is rich one.

Early in 1994 the total abundance and biomass of cod over the area covered made up 783 mill.indiv. and 1252 thou.t, of which 719 mill.indiv. and 1242 thou.t pertained to commercial stock. Total abundance and biomass of haddock reached 1595 mill.indiv. and 887 thou.t, with 1350 mill.indiv. and 843 thou.t constituting the commercial stock.

For some technical reasons not a whole area was surveyed, therefore, the estimates obtained were somewhat lower. Nevertheless, an increment in haddock stock and stabilization of that of cod were noted.

INTRODUCTION

The trawl-acoustic survey to assess juveniles and bottom fish stocks in the Barents Sea and adjacent waters has been regularly carried out since 1984. It was based on the traditional trawl survey for assessment of young bottom fish at the first three years of life, conducted in autumn-winter since 1948 (Trambachev, 1981). This allowed to use the long-term observations by indices for cod and haddock abundance to assess the yearclasses strength (Melyantsev, Salmov, 1985) and to forecast recruitment of commercial stocks. In the second half of 80's the acoustic methods for estimating abundance of bottom fish distributed in a 10m - layer (Zaferman, Serebrov, 1985; Dorchenkov, 1986, 1991) allowed to overcome, to a certain extent, disadvantages of the

methods previously applied for bottom fish stocks assessment.

MATERIALS AND METHODS

The trawl-acoustic survey for assessment of juveniles and cod and haddock stocks was conducted by the Russian RVs "Professor Marti", "Fridtjof Nansen" and "PINRO" in the Barents Sea and adjacent waters in November 1993 - January 1994 (Fig.1). Compared to 1992 the investigations were done in later time and a lesser area was covered. In total 346 hauls were done with a bottom trawl from 40 to 800 m depths, 294 of them were taken above 500 m depth.

The survey methods remained without changes (Shevelev, Dorchenkov, Mamylov, 1990). The whole area was splitted into 26 strata pooled into ICES areas I, IIA and IIB.

The survey data were IBM processed using SAE (Stock Abundance Estimation) software, developed in PINRO (Ermolchev V.A., Ermolchev M.V.). The latter allows to estimate the bottom fish abundance and biomass to a high accuracy, especially under inhomogeneous distribution of aggregations density; to determine errors in each stratum, area and total error of post-stratification over the whole area on the basis of analysis for integral variations and fish target strength in the area surveyed.

Upon completing the survey a post-stratification was done, i.e. the whole area was divided into 26 strata for cod and 21 - for haddock. Calculations of abundance, biomass and errors for each stratum, areas (I, IIA and IIB) and the whole area were performed with SAE software by two methods, i.e. classic and selective ones (all the echo-intensities are distributed by several numerical levels). As for the first method, the post stratification error for cod varied from stratum to stratum from 9 to 46%, with total error being 9.5%. By the second one the post-stratification error for some strata decreased by more than 10 times, varying from stratum to stratum from 1.3 to 27.2%, with total error constituting 3.5% - for the whole area, 2.0% - for Subarea I, 10.7% - for Div.IIA and 9.3% - for Div.IIB (Tables 3 and 4). For haddock the error varied by strata within 12-53% and total error made up 16% (the 1st method). The error also decreased for some strata by more than 10 times, varying from 2 to 30% (the 2nd method) and total error made up 4.9% - for the whole area, 5.2% - for Subarea I, 8.8% - for Div.IIA and 24.8% - for Div.IIB (Tables 7 and 8).

Total error should also include those caused by other sources, such as species identification of echo-intensities, variation in parameters of environments (temperature, salinity), variation in weather conditions, as well as incomplete assessment of fish distribution and later period of the survey performance. At present it is difficult to determine the error values, however, the cod and haddock stock is suggested to be assessed incompletely during the survey for 1993-1994.

RESULTS AND DISCUSSIONS

In autumn-winter cod and haddock active migration to spawning and wintering grounds led to the fish longer staying in pelagial. 50% of haddock and 53% of cod were distributed in it and fish were easily registered using echosounder.

At the same time the earlier transport of drifting ice and heavy ice coverage did not allow to cover the West Spitsbergen area and resulted in a shortening of the number of stations in the northwest. Besides, unfavourable weather conditions and fuel problems resulted in essential intervals when performing the survey and prevented from investigating the Barents Sea area to the east of 42°E. Compared to 1992 the area surveyed decreased approximately by 20%, mainly due to the areas where an essential amount of young and adult specimens was distributed in 1992 and a duration of the survey was extended by a month. These circumstances reasonably suggest that a considerable underestimation of cod and haddock took place during the survey, particularly in Subarea I. Dense aggregations of cod were found in the frontal zone area in the northwest (Fig.2). Fish migration along the Spitsbergen Current to the spawning and wintering grounds was not yet a mass one; cod with low fatness continued to feed on polar cod. In the second half of November a peak of cod migration in the western direction was registered in the south of the sea. Simultaneously, a considerable amount of large mature specimens migrating for spawning was found in Div.IIa. Aggregations of mean density, represented mainly by fish above 3 yr, have occupied a vast area (from 23°E to the eastern boundary of the area of operations) in the southern Barents Sea (Fig.2). Pattern of fish distribution indicates availability of essential fish aggregations outside the area surveyed in the east.

Main haddock aggregations were traditionally observed in the southern part under the water temperature above 3°C (Fig.3). Unlike cod, the distribution of haddock both the adult and young specimens, had more eastern direction and a large quantity of fish remained outside the area covered. Only single specimens of haddock were found in catches from the northwest.

Young fish assessment

The 1991 cod yearclass abundance, previously estimated as mean, reached the mean yearclass level in 1993 mainly due to an increase in the index for abundance from Div.IIb (Table 1). The 1992 yearclass at age 1+, being characterized as a rich one at a fingerling stage, occurred to be lower than the average by the results from the 1993 assessment, with the mean catch of this yearclass cod taken from the southern Barents Sea reducing by 10 times. The 1993 yearclass is also estimated to be below the average.

The 1991 haddock yearclass, the abundance of which in 1992 was estimated as above the average, joined a group of abundant yearclasses, what confirmed the estimate for this yearclass obtained from 0-group fish assessment (Table 2). The 1992 yearclass from a category of average ones passed to the level below the mean. The abundance of fingerlings from 1993 is lower than the long-term mean.

The values obtained are probably underestimated. Pattern of distribution of young cod and haddock at age 0+ and 1+ shows an essential amount of fish to remain outside the area surveyed in the northwest and, particularly, in the east. Another reasons for the underestimation of juveniles from the 1992-1993 yearclasses are their distribution mainly in pelagial and later settling into the bottom layers.

A possibility of high young fish mortality is also impossible to exclude as a result of cannibalism and predation, which a reduction in the quantity of capelin - the main food object for cod - contributed to. Another reason for such reduction in abundance of fish at age 0+ and 1+ is, probably, a low survival of fish during the first wintering (for 1992 yearclass) and in autumn 1993 (mainly for fish at age 0+) because of deterioration of the nutritive base.

With allowance for the areas not surveyed the 1991-1993 cod yearclasses and those of haddock for 1992-1993 could be considered as mean abundant what is close to the estimates obtained from 0-group fish survey (Anon., 1993).

Stock assessment

Cod. Total abundance and biomass of cod on the Barents Sea shelf made up 783 mill.indiv. and 1252 thou.t respectively, of which 719 mill.indiv. and 1242 thou.t pertain to commercial stock (Tables 5 and 6). Compared to 1992 the commercial stock abundance grew by 1.2 times, what is somewhat lower than it was expected, considering a recruitment of 1988-1990 rich yearclasses to the stock. Specimens from the 1988-1990 yearclasses (above 80% of commercial stock) constitute the bulk of catches. Biomass of commercial stock decreased by 1.2 times relative to the 1992 level. Along with the underestimation of commercial size fish, this results from a retarded growth rate of specimens due to a deterioration of the nutritive base in 1993 which led to a reduction in fish mean weight, as well as to a withdrawal of adult age groups as a result of fishery. About 50% of the total biomass constitute the 1988-1989 yearclasses.

Haddock. Total abundance and biomass of haddock (Tables 9, 10) made up 1595 mill.indiv. and 887 thou.t, respectively, of which 1350 mill.indiv. and 843 thou.t pertain to commercial stock. Compared to 1992 the haddock commercial stock increased by 5 times and biomass - by 3 times mainly due to a recruitment of the 1990 abundant yearclass to the commercial stock (about 70% of total abundance and 60% of total biomass).

CONCLUSIONS

1. The abundance of the 1992-1993 cod and haddock yearclasses is estimated at the level close to the long-term mean. Cod at age 2+ from the 1991 yearclass is set at the level of mean abundant and that of haddock for the same year - as a rich one.
2. Early in 1994 the total abundance and biomass of cod constituted 783 mill.indiv. and 1252 thou.t, respectively, of which 719 mill.indiv. and 1252 thou.t pertain to commercial stock. Specimens from the 1988-1990 yearclasses made up the bulk of cod catches. Total abundance and biomass of haddock, relative to the level in 1992, have grown by 5 and 3 times, respectively, and were 1595 mill.indiv. and 887 thou.t, of which 1350 mill.indiv. and 843 thou.t pertain to commercial stock. Specimens from the 1990 abundant yearclass make up the bulk of haddock stock.

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Table 1. Mean catches of 1-3 years old cod in the southern Barents Sea (I)
and in the Bear Island-Spitsbergen area (IIb) in 1976-1993
(spec. per 1-hour trawling)

Year-classes	Age									Mean catches at the age of 2-3 years old		
	1			2			3			I	IIb	I+IIb
	I	IIb	I+IIb	I	IIb	I+IIb	I	IIb	I+IIb			
1976	1	1	1	1	1	1	4	<1	3	2	1	1
1977	1	1	1	2	1	1	2	1	1	2	1	1
1978	<1	2	<1	<1	<1	<1	1	3	2	<1	1	1
1979	<1	1	<1	<1	<1	<1	<1	8	3	<1	5	2
1980	<1	1	<1	<1	<1	<1	1	8	4	<1	4	2
1981	<1	<1	<1	<1	<1	<1	4	4	4	2	2	2
1982	1	8	4	8	13	10	8	10	9	8	11	9
1983	4	9	6	11	7	9	45	41	43	21	20	20
1984	1	1	<1	2	8	5	7	15	10	5	12	8
1985	3	10	6	2	3	2	4	4	4	3	3	3
1986	<1	2	1	<1	<1	<1	2	5	3	1	2	1
1987	<1	-	<1	<1	<1	<1	<1	1	1	1	<1	<1
1988	<1	<1	<1	<1	<1	<1	7	1	4	3	<1	2
1989	<1	1	<1	4	1	3	7	10	6	5	5	5
1990	6	1	4	4	4	4	36	72	44	15	36	23
1991	3	6	4	3	15	8	8	24	15	5	19	11
1992	10	60	32	1	6	3						
1993*	2	5	3									

* excluding Central and Eastern parts of the southern Barents Sea

Mean catches of young haddock at the first-third years of life in the western, central and coastal Barents Sea in 1970-1993 (spec. per 1-hour trawling)

Year-class	Years of life			Mean at the second-third years of life
	1	2	3	
1970	10	33	31	32
1971	3	3	9	6
1972	2	9	3	6
1973	13	8	6	6
1974	15	35	14	24
1975	163	96	59	77
1976	6	13	4	8
1977	1	1	< 1	< 1
1978	< 1	< 1	1	< 1
1979	< 1	< 1	< 1	< 1
1980	< 1	< 1	< 1	< 1
1981	< 1	< 1	3	4
1982	23	59	63	61
1983	40	79	239	121
1984	9	19	18	19
1985	5	2	3	3
1986	< 1	1	1	1
1987	< 1	< 1	4	2
1988	2	3	21	11
1989	3	25	30	26
1990	81	67	173	118
1991	17	44	69	54
1992	20	8		
1993 *	6			
Mean for 1948-1993	17	22	31	24

* excluding Central parts of the southern Barents Sea

Table 3. Abundance of cod according to data from trawl-acoustic survey carried out in November 1993 - January 1994, mill. of spec.

Area	Layer	Year-class													Total	Error +/- %
		1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981+		
I	Pelagial	1,5	1,0	6,9	60,6	79,8	42,1	14,3	4,1	3,7	1,8	2,7	0,1	+	218,7	1,5
	Near bottom	1,8	1,2	8,4	73,7	97,1	51,3	17,4	5,0	4,5	2,2	3,3	0,1	0,1	266,2	1,2
	Water column	3,3	2,2	15,4	134,3	176,9	93,4	31,7	9,1	8,2	4,0	6,1	0,3	0,1	484,9	2,0
IIa	Pelagial	0,1	+	+	2,2	5,9	7,8	2,6	0,6	0,9	0,5	0,5	+	24,8	7,3	
	Near bottom	0,1	+	+	0,9	2,4	3,2	1,1	0,3	0,4	0,2	0,2	+	9,6	7,8	
	Water column	0,2	0,1	0,1	3,1	8,3	10,9	3,7	0,8	1,3	0,6	0,7	+	34,4	10,7	
IIb	Pelagial	3,8	4,7	18,9	48,9	36,3	20,3	4,6	2,6	2,8	2,0	2,6	0,1	0,2	168,6	6,9
	Near bottom	2,2	2,8	11,0	28,5	21,2	11,8	2,7	1,5	1,6	1,2	1,5	0,1	0,1	95,2	6,2
	Water column	6,0	7,5	30,0	77,4	57,6	32,1	7,3	4,2	4,4	3,1	4,1	0,2	0,2	263,8	9,3
I+IIa+	Pelagial	5,4	5,8	25,9	111,6	122,0	70,2	21,6	7,3	7,4	4,2	5,8	0,2	0,2	412,1	3,0
	Near bottom	4,1	4,0	19,5	103,2	120,7	66,3	21,2	6,8	6,5	3,5	5,0	0,2	0,1	370,9	1,8
	Water column	9,5	9,7	45,4	214,8	242,8	136,5	42,8	14,1	13,9	7,8	10,9	0,4	0,3	783,0	3,5

Table 4. Cod biomass according to data from trawl-acoustic survey carried out in November 1993 - January 1994, thou. t.

Area	Layer	Year-class													Total	Error +/- %
		1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981+		
I	Pelagial	+	0,1	1,3	38,5	85,4	89,4	47,6	19,1	23,9	14,0	20,1	1,7	0,7	341,7	1,5
	Near bottom	+	0,1	1,5	46,8	104,0	108,8	57,9	23,3	29,1	17,0	24,5	2,0	0,8	415,9	1,2
	Water column	+	0,1	2,8	85,3	189,4	198,2	105,5	42,4	52,9	31,0	44,6	3,8	1,5	757,5	2,0
IIa	Pelagial	+	+	+	1,9	8,7	18,9	9,2	2,8	5,7	3,3	3,9	0,1		49,7	7,3
	Near bottom	+	+	+	0,8	3,5	7,7	3,7	1,1	2,3	1,3	1,6	+		21,2	7,8
	Water column	+	+	+	2,7	12,2	26,6	12,9	3,9	8,0	4,6	5,6	0,1		70,8	10,7
IIb	Pelagial	+	0,2	4,1	37,4	56,2	49,5	16,6	13,5	18,5	14,3	23,4	1,1	2,3	270,8	6,9
	Near bottom	+	0,1	2,4	21,9	32,8	28,9	9,7	7,8	10,8	8,4	13,7	0,6	1,3	152,9	6,2
	Water column	0,1	0,3	6,5	59,3	89,1	78,5	26,4	21,3	29,4	22,7	37,1	1,7	3,6	423,7	9,3
+IIa+	Pelagial	0,1	0,3	5,2	75,5	142,9	154,0	72,7	34,9	48,2	32,0	46,3	2,9	3,0	662,1	3,0
	Near bottom	+	0,2	4,0	69,8	141,4	145,4	71,4	32,4	42,4	26,7	40,1	2,7	2,1	589,9	1,8
+IIb	Water column	0,1	0,4	9,2	145,3	284,3	299,4	144,2	67,3	90,6	58,6	86,4	5,7	5,1	1252,0	3,5

Table 5. Abundance of cod in the Barents Sea and adjacent waters
by the end of 1990-1993 (mill. of spec.)

Area	Survey		Year-class											Total		
	year	year	1993:	1992:	1991:	1990:	1989:	1988:	1987:	1986:	1985:	1984:	1983:		1982:	1981+:
I	1990					28	21	49	8	19	23	52	63	26	6	295
	1991				10	15	27	78	34	35	41	44	27	3	+	315
	1992		56		20	192	193	61	32	19	24	14	12	2	+	645
	1993	3	2	15	134	177	93	32	9	8	4	6	+	+	+	485
IIa	1990					+	+	+	+	1	2	4	4	4	1	20
	1991				1	+	+	1	1	3	3	3	3	+	+	15
	1992		+		+	+	1	1	1	1	+	+	+	+	+	4
	1993	+	+	1	3	8	11	4	1	1	1	1	1	+	+	34
IIb	1990						1	2	2	5	8	9	18	12	4	61
	1991				22	13	26	23	8	12	14	22	21	3	1	164
	1992		172		41	141	123	28	12	17	14	15	10	1	+	574
	1993	6	8	30	77	58	32	7	4	4	3	4	4	+	+	264
I+IIa+IIb	1990					28	22	51	10	25	33	65	37	42	11	376
	1991				33	29	53	101	43	50	58	70	51	6	1	494
	1992		228		61	333	317	110	45	37	36	29	22	3	+	1223
	1993	9	10	45	215	243	136	43	14	14	8	11	11	+	+	763

Table 6. Biomass of cod in the Barents Sea and adjacent waters
by the end of 1990-1993 (thou. t)

Area	Survey		Year-class											Total			
	year		1993:	1992:	1991:	1990:	1989:	1988:	1987:	1986:	1985:	1984:	1983:		1982:	1981+:	
I	1990					1	1	11	3	15	32	114	206	126	50	563	
	1991			+		1	6	41	44	75	152	235	193	25	5	777	
	1992		+		+	1	65	217	148	90	82	129	98	96	22	4	952
	1993	+	+			3	85	189	198	105	42	53	31	45	4	1	758
IIa	1990					+	+	+	+	1	3	9	20	21	11	65	
	1991					+	+	+	1	2	6	9	10	19	4	1	57
	1992		+			+	+	1	2	3	3	3	2	2	+	+	16
	1993	+	+			+	3	12	27	13	4	8	5	6	+		71
IIb	1990						+	+	1	5	12	22	69	65	32	206	
	1991					+	2	8	13	10	27	47	101	156	26	8	401
	1992		5			3	56	148	54	33	71	77	101	77	9	4	633
	1993	+	+			6	59	89	78	26	21	29	23	37	2	4	424
I+IIa+IIb	1990					1	1	11	4	21	47	145	297	214	93	834	
	1991					1	3	14	55	56	106	207	370	57	13	1235	
	1992		5			4	121	366	204	126	156	209	201	175	31	8	1606
	1993	+	+			9	145	284	293	144	67	91	59	80	6	5	1252

Table 7. Abundance of haddock according to data from trawl-acoustic survey carried out in November 1993 - January 1994, mill. of spec.

Area	Layer	Year-class												Total	Error
		1993:	1992:	1991:	1990 :	1989:	1988:	1987:	1986:	1985:	1984:	1983:	1982+:		
I	Pelagial	7,7	11,2	95,9	515,1	108,8	14,1	1,9	1,0	1,1	0,9	1,1	0,5	759,4	5,0
	Near bottom	7,9	11,5	99,0	531,6	112,3	14,6	2,0	1,1	1,2	1,0	1,1	0,5	783,7	1,4
	Water column	15,6	22,7	195,0	1046,7	221,0	28,7	4,0	2,1	2,3	1,9	2,3	1,0	1543,1	5,2
IIa	Pelagial	2,7	1,7	2,2	6,5	3,7	1,3	0,4	0,2	0,2	0,1	0,1	+	18,9	5,2
	Near bottom	1,0	0,6	0,8	2,3	1,3	0,5	0,1	0,1	0,1	0,1	+	+	6,8	7,1
	Water column	3,7	2,1	2,9	8,8	5,1	1,8	0,5	0,2	0,3	0,2	0,1	+	25,6	8,8
IIb	Pelagial	0,3	0,4	0,9	12,4	1,3	0,1	+	+	+		+		15,6	16,2
	Near bottom	0,2	0,3	0,6	8,5	0,8	0,1	+	+	+		+		10,7	18,8
	Water column	0,6	0,7	1,5	20,9	2,2	0,2	+	+	+		+		26,2	24,8
I+IIa+ +IIb	Pelagial	10,7	13,2	99,0	534,0	113,8	15,5	2,3	1,2	1,4	1,1	1,2	0,5	793,8	4,7
	Near bottom	9,1	12,4	100,4	542,4	114,5	15,1	2,1	1,1	1,3	1,0	1,2	0,5	801,2	1,4
	Water column	19,8	25,5	199,4	1076,4	228,3	30,6	4,5	2,3	2,6	2,1	2,4	1,0	1595,0	4,9

Table 8. Biomass of haddock according to data from trawl-acoustic survey carried out in November 1993 - January 1994, mill. of spec.

Area	Layer	Year-class											Total	Error	
		1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983			1982+
I	Pelagial	0,2	0,9	19,6	251,1	109,8	20,6	4,1	2,6	2,8	2,6	3,5	1,6	419,6	5,0
	Near bottom	0,2	1,0	20,2	259,2	113,3	21,3	4,3	2,7	2,9	2,5	3,7	1,6	433,1	1,4
	Water column	0,4	1,9	39,8	510,2	223,0	41,9	8,4	5,2	5,6	5,3	7,2	3,2	852,7	5,2
IIa	Pelagial	0,1	0,1	0,4	3,7	4,6	2,2	0,7	0,4	0,4	0,3	0,3	0,1	13,4	5,2
	Near bottom	+	0,1	0,1	1,3	1,7	0,8	0,3	0,1	0,2	0,1	0,1	+	4,8	7,1
	Water column	0,1	0,2	0,6	5,0	6,3	3,0	1,0	0,5	0,6	0,4	0,4	0,1	18,2	8,8
IIb	Pelagial	+	+	0,2	7,3	1,6	0,2	+	+	0,1		+		9,6	16,2
	Near bottom	+	+	0,1	5,0	1,1	0,1	+	+	+		+		6,6	18,8
	Water column	+	0,1	0,3	12,3	2,7	0,4	0,1	0,1	0,1		0,1		16,1	24,8
I+IIa+	Pelagial	0,3	1,1	20,2	261,2	113,8	22,8	4,9	3,0	3,3	2,9	3,9	1,6	442,6	4,7
	Near bottom	0,2	1,0	20,5	265,3	115,8	22,1	4,6	2,8	3,0	2,8	3,8	1,7	444,4	1,4
	Water column	0,5	2,1	40,7	526,5	230,9	44,9	9,5	5,8	6,3	5,8	7,7	3,4	887,0	4,9

Table 9. Abundance of haddock in the Barents Sea and adjacent waters
by the end of 1990-1993 (mill. of spec.)

Area	Survey		Year-class											Total		
	year	year	1993:	1992:	1991:	1990:	1989:	1988:	1987:	1986:	1985:	1984:	1983:		1982:	1981+:
I	1990					536	156	68	27	16	23	42	43	4	1	917
	1991				96	240	120	63	11	4	6	21	17	2	+	580
	1992		105	200	615	200	34	3	4	7	6	+	+	+	+	1174
	1993	16	23	195	1047	221	29	4	2	2	2	2	2	1	+	1543
IIa	1990					27	4	4	+	+	+	1	1	+		40
	1991				11	6	1	+	+	+	+	+	+	+	+	20
	1992		+	+	1	+	+	+	+	+	+	+	+	+		2
	1993	4	2	3	9	5	2	1	+	+	+	+	+	+	+	26
IIb	1990					30	14	2	+	+	+	+	+	+	+	48
	1991				133	120	22	1	+	+	+	+	+			277
	1992		94	45	142	18	1	+	+		+	+				299
	1993	1	1	2	21	2	+	+	+	+		+				26
I+IIa+IIb	1990					594	176	75	28	17	23	43	44	4	1	1004
	1991				240	368	143	65	11	4	7	21	17	2	+	673
	1992		199	245	756	218	35	3	4	7	6	+	+	+	+	1475
	1993	20	26	199	1076	228	31	5	2	3	2	2	2	1	+	1595

Table 10. Biomass of haddock in the Barents Sea and adjacent waters
by the end of 1990-1993 (thou. t)

: Survey :		Year-class												:	
Area :	year :	-----												Total	
:	:	1993:	1992:	1991:	1990:	1989:	1988:	1987:	1986:	1985:	1984:	1983:	1982:	1981+:	:
I	1990				37	22	19	19	21	35	75	96	12	3	339
	1991			3	32	29	39	17	7	13	47	42	6	1	241
	1992		5	22	188	147	48	6	10	19	19	2	1	+	467
	1993	+	2	40	510	223	42	3	5	6	5	7	3	+	853
IIa	1990				2	1	2	+	+	+	1	2	+		8
	1991			1	1	+	+	+	+	+	+	+	+	+	2
	1992		+	+	+	+	1	+	+	+	+	+	+		2
	1993	+	+	1	5	6	3	1	1	1	+	+	+	+	18
IIb	1990				2	3	1	+	+	+	1	1	+	+	8
	1991			12	19	12	1	1	+	+	+	+			46
	1992		3	5	46	17	2	+	+		+	+			75
	1993	+	+	+	12	3	+	+	+	+		+			16
I+IIa+IIb	1990				41	26	23	19	21	35	76	99	12	6	355
	1991			20	52	41	40	18	8	13	48	42	6	1	289
	1992		3	27	236	164	51	7	10	20	20	2	1	+	544
	1993	1	2	41	526	231	45	9	6	6	6	8	3	+	887

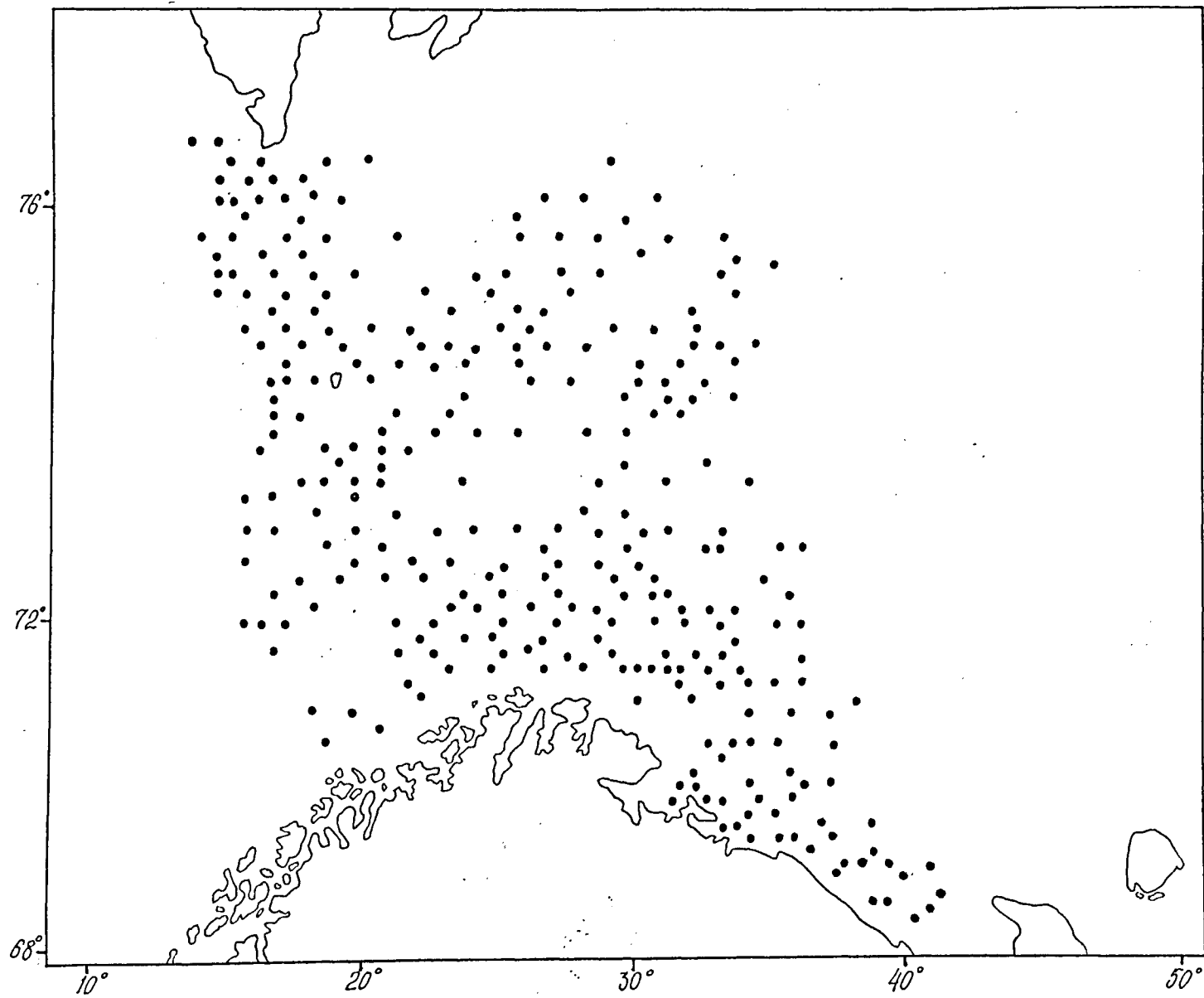


Fig. 1. Trawls stations made in November 1993 - January 1994

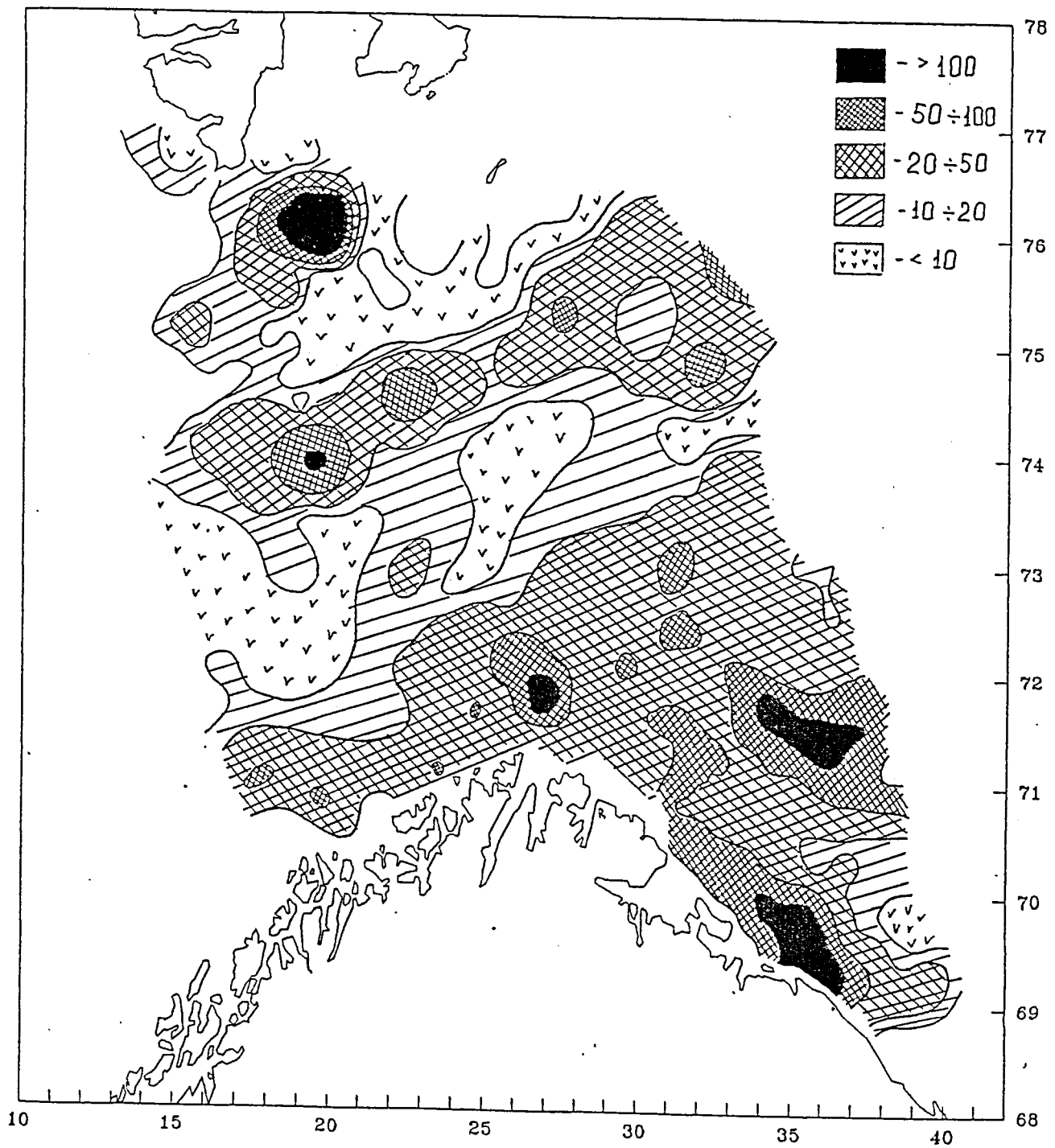


Fig. 2. Distribution of cod echo intensities
in November 1993 - January 1994 ($m^2/mile^2$)

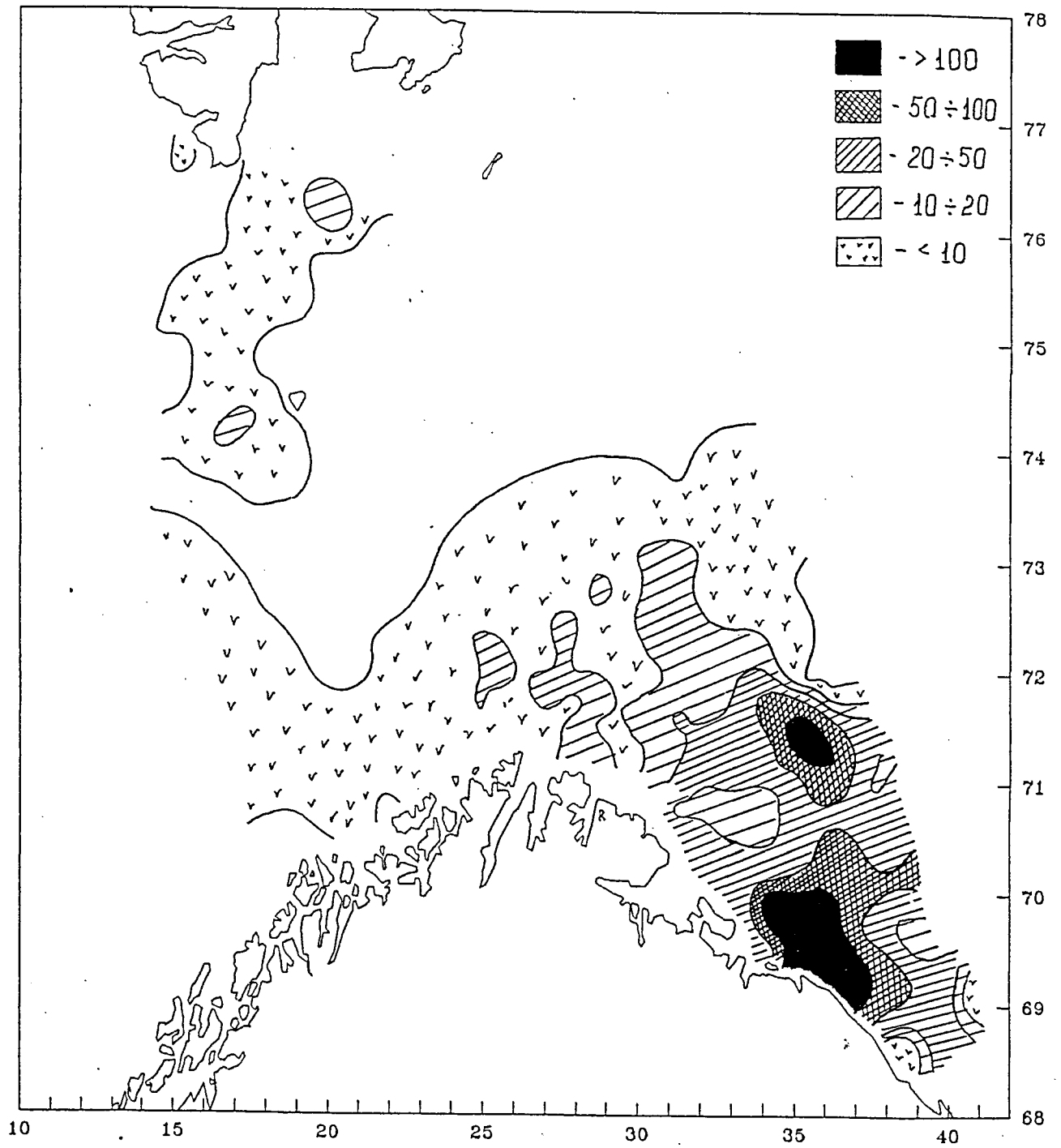


Fig.3. Distribution of haddock echo intensities in November 1993 - January 1994 (m^2/mile^2)