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Russian Research Report for 1994

SECTION I - AtlantNIRO Research
SECTION II - PINRO Research

SECTION I - AtlantNIRO Research in NAFO Subarea 4 in 1994

by

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A. STATE OF FISHERY

In 1994 no Russian fishery existed in the Scotian shelf area, therefore we were unable to collect biological samples required to assess the silver hake stock by means of analytical methods.

In respect to the prospects for 1996 it is possible to suppose on the basis of 0-group trawling surveys and retrospective abundance estimates obtained a year before that the fishing hake biomass will remain at least at the level of 1995. The above assessment seems conservative taking in account that the bulk of catch in 1996 will be represented by 2 relatively strong year-classes of 1992 and 1993.

B. SPECIAL RESEARCHES

Environmental Researches

In 1994 no research expeditions of Russian vessels were carried out in the Scotian Shelf area. Oceanographical researches were performed in two directions.The first is related to the study of international variability of hydrological conditions and assessment of the latter in 1994 to continue fishery monitoring and prediction sea surface temperatures (SST) and surface water boundaries locations were used as a basis. In the first case SST values were obtained from the monthly maps of Moscow Hydrometeocenter at the cross-points of 2.5° x 2.5° geographical grid in the North-West Atlantic areas. In the second case 3-4 days Canadian facsimile maps of ocean conditions analysis were used to define the indices of three water masses boundaries location at each meridian in the area from 55° to 65° W. SST anomalies were estimated from long-term average values in 1977-1991 by months, while the anomalies of water boundaries location were calculated from the long-term average values in 1977-1987.

The analysis of SST shows that in the Labrador and Newfoundland areas the negative anomalies (up to -1.5° C) predominated during spring and summer ,while the positive ones approaching 3.5° C in some months were dominating during fall and winter. In the Scotian shelf area the conditions were defined by dominating positive

SST anomalies during entire year. On the shelf slopes and in the central part the latter values varied from 0° C to 3° C. In the eastern part low negative anomalies were found in winter and spring and the positive ones (up to 3° C) in summer and fall. In the warm slope water zone southward of the Scotian shelf SST anomalies were positive and approached 3.1° C during a year. During the latest 5 years international variability of SST in the Scotian shelf area evidences the continous rising trend (Table 1).

Intra-annual dynamics of the hydrological fronts boundaries at sea surface in the area between 65° and 69°W was characterized by the cold shelf waters northward movement during January-April as compared to the average long-term line, while from May to the end of the year the former was located southward of that line and more southward than in1993.

Such intra-annual wave appears to various extent each year which is likely related to the more intensive advection of warm slope waters to the shelf during fall-winter and to the more strong transport of the cold Labrador waters from the Labrador and Newfoundland areas. In 1994 the slope waters boundary was shifted northwards during January-May and appeared almost at the average long-term location from June to December. Thus, it may be assumed that the warm advection prevailed during the first half of the year which is related to the northward shift of both boundaries. During the second half of the year the cold water boundary moved southward, while the warm slope water boundary was fixed at its long-term average position. The above situation seems to define the conditions favourable to silver hake fishery, since it promotes the gradient zone strengthening within the shelf area allocated to foreign fishery of hake and squid. In general, on the basis of assessment of hydrological conditions in the Scotian shelf area during 1994, it may be concluded that the latter were favourable to fishery of silver hake and squid aggregations of which are associated to the shelf-slope hydrological front and were unfavorable to the hake spawning since the cold water advection during May-September exceeded the standard one and the level of 1993.

The second branch of oceanographical researches is represented by the review of observation data obtained during 6 surveys in the Scotian shelf area from 26 June to 12 July 1990 at the Russian R/V "Evrica" under the terms of Russian-Canadian Agreement. Various environmental factors affecting the silver hake distribution were researched. The near-bottom temperature fields, salinity, nutrients, horizontal circulation and forage zooplankton were compared to the hake catch distribution. Surveys confirmed the formation of feeding and prespawning hake aggregations in the warm side of hydrological shelf-slope front. This front is the necessary environmetal condition for hake, providing both optimal physical terms and forage base, since it is the major mechanism of the latter formation and redistribution. Patches of forage zooplankton represented mainly by large species such as euphausiids are formed at the front under the pressure of mesoscale circulation. The results of the above researches are presented in NAFO Special Report (1995).

Biological Researches

In October-November 1994 the trawling survey of 0-group silver hake was carried out by the Canadian vessel under the joint programme with Canadian

scientists. The estimate of the above-mentioned group abundance allows to assume the year-class of 1994 to be slightly below the average one.

Other Researches

The attempt was undertaken to solve the problem of red-fish (*Sebastes mentella Travin)* population structure in the Irminger Sea in connection to the hypothesis on the likely relation of the latter to the same species in the North-West Atlantic. The results of the researches suppose the existence of 2 red-fish populations in the Irminger Sea. The first one is distributed in pelagic zone including the area outside 200-mile zone ("ocean stock") and the second one inhabits the shelf edge off Iceland and Eastern Greenland. Larvae drifting towards the Western Greenland and maybe even farher seem to originate from the spawning grounds at the shelf edge, while larvae hatched in the central part of the sea are developing within a closed eddy formed by the surface currents. No evidences of the adult red-fish migration into the North-West Atlantic and back are found.

Detailed description of the above-mentioned results is presented in the other scientific document.

Table 1. Average annual SST values in the Scotian shelf area and adjasent waters during 1990-1994

	Years				
	1990	1991	1992	1993	1994
Shelf slope	10.6	11.9	11.8	12.6	13.2
Eastern part	7.6	7.8	7.8	7.8	8.0
Slope waters	17.7	17.8	18.0	19.0	19.2

SECTION II - PINRO Research in the NAFO Area in 1994

by

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I. SUBAREAS 0 AND 1

A. Status of the Fisheries

Greenland halibut. On July, 09, 1995 Russian ships commenced the licensed fishery on Greenland halibut in Div. 0B. Till the end of July, total number of vessels had reached 12: 6 - of the PBT- and 6 - BMRT-type. The fishery period terminated on October, 05. Total catch made up about 3.8 thou. t. The main fishery was carried out along 61°50 - 64°20 N and 61°30 - 57°20 N at 850-1100 m depths. Fishery catch rate per vessel/days of catch for BMRT composed from 3.5 to 5.1 t and for PBT - from 4.0 to 5.3 t. By-catch of grenadier and other fish constituted below 10 % .

B. Special Research Studies

No special surveys for studying fish and their inhabitation were carried out in 1994.

II. SUBAREAS 2 AND 3

A. Status of Fisheries

Greenland halibut. No fishery on halibut was practically carried out off Labrador (2G, 2H and 2J). In SA 3 fishery on halibut was commenced from June, 20, outside the 200-mile zone of Canada in a deepwater area of the Flemish Pass. 6 PBT-type vessels were fishing on halibut along 47°30 - 48°50 N, 46°30 - 46°50 E till July, 06. About 60 t of halibut were caught under daily catch rate 0.8 - 3.2 t. The main reason of low catch rate was a small fishing depth. Halibut samples from commercial catches were collected in the period of R/V "Vaigach" operation in Div. 3N in September and are presented in Table 1.

Redfish. From the second half of July, 1994, some BMRT-type vessels commenced fishery for redfish on the Flemish Cap Bank along 48°13 - 48°17 N, 44°42 - 46°37 E at 300-500 m depths. Catches fluctuated from 3 to 20 t per 1-3 trawling hours (for length composition of redfish catches see Table 2).

In August, 1994, the same group of vessels continued the fishery on the southern slope of the bank at 290-360 m depths. Catches constituted 1-11 t per 1-3 trawling hours. A mean daily catch rate was 14.8 t.

In the end of September - beginning of October, some BMRT-type vessels were fishing for redfish with bottom trawls on the southern slope of the Flemish Cap at 260-390 m depths. A mean daily catch rate was 13.5 t. The fishery was terminated on November, 3. Mean October daily catch rate constituted 17.9 t.

Northern shrimp. Data on Russian fishery for shrimp on the Flemish Cap Bank is extremely limited.

One stern trawler (1 000 h.p.) had fished for shrimp from July to October, 1994. Fishing depths were mainly 300-400 m on the northern and western slopes of the bank during 4 trawling hours, catches constituted from 0.4 to 1.0 t and daily catch - 1.2-2.3t.
Catches per effort slightly increased from July to October. One kilogram of shrimp contained 150-190 specimens. Carapace lengths were from 14 to 38 mm.

Roundnose and roughhead grenadier. No directed fishery for grenadier was carried out. Only small quantities of them were caught during fishery for Greenland halibut and redfish.

Capelin. No fishery was carried out.
Cod. No fishery was carried out.
Other species. No directed fishery for other species was carried out. Small by-catches of wolffish, cod, skates, flounders and grenadiers were in catches of Greenland halibut and redfish. Preliminary catch of commercial fish is presented in Table 3.

B. Special Research Studies (SA 3)

1. Environmental Studies

a) Hydrographic studies

In 1994, R/V "Vilnius" had carried out oceanographic observations in the area of the Grand Bank only: in Div. 3NO - on June, 14-23, and in Div. 3L - from June, 24, to July, 10. In those areas, 47 and 55 trawl oceanographic stations were correspondingly done. Water temperature and salinity were measured at standard horizons with the use of bathometers, reversible thermometers and a laboratory salimeter.

Observational data were processed by methods presented in papers (Borovkov and Tevs, MS 1988, 1992) in order to estimate peculiarities of distribution, deviations from long-term mean values and tendencies of year-to-year changes of pre-bottom temperature and salinity.

Because of the spatial limitation of the survey, characteristics interpolation into a part of knots of a standard calculating net was difficult. Therefore, mean temperature and salinity in Div. 3NO near the bottom for June-July, 1994, were reduced to a standard net area with the use of simple linear regressions between indices, one of which was determined on the base of full sets of interpolated data and the second one - on the base of their parts corresponding to 1994 survey area.

Due to results of analysis, thermohaline conditions in the pre-bottom layer on the Grand Bank in June-July, 1994, were determined by a composition of water masses, typical for this area. Waters of cold intermediate layer (CIL) reached the bottom in the western, northern and north-eastern peripheries of the bank; the southern border of their area (0°C isotherm) had a shape of a horse-shoe (Fig. 1). Location and sizes of the area of CIL waters near bottom were very similar to a long-term mean; however, their minimal temperatures were 0.2-0.4°C lower than usually.

Warmer (upto 3°C) and fresher (32.5 psu) shelf waters, as well as transformed slope waters with temperature higher than 5°C and salinity above 34.0 psu, distributed correspondingly in the central bank and in its south-western edge, i.e. in typical areas.

Fields of abnormal pre-bottom temperature and salinity (Fig. 2) justify on predomination of a small deficiency of heat and salts in the area of CIL waters. Its extremum, expressed in abnormal temperature (-1°C) and salinity (-0.25 psu), was timed to CIL waters intrusion to the south-west of the Grand Bank shallow. The peculiarity of the shelf waters in the central part of the bank was a surplus of warmness and a deficiency of salinity; Extremal abnormities of temperature (1.9°C) and salinity (-0.49 psu) exceeded the corresponding standard deviations 1.7 and 1.3 times.

Characteristics of a thermohaline status of pre-bottom waters in regard to the areas of the Newfoundland shelf are presented in Table 4. It demonstrates a combination of salts deficiency and abnormal temperatures with different signs reflecting a lowered level of heat storage in the northern part of the area (Div. 3L) and a relative surplus of warmness in its south-eastern part (Div. 3N).

Year-to-year changes of characteristics from 1993 to 1994 justify on predomination of a tendency of warming and freshening of pre-bottom waters, rates of which are higher than in its northern part. A combination of these tendencies is probably caused by a decrease of warmness losses and salinity during ice formation from 1992-1993 ice season to 1993-1994 one, that is proved by the decrease of ice coverage of the Labrador Sea peculiar to this period.

In a modern "cold" period on the Newfoundland shelf, which has lasted from the middle of the 80-ies, similar year-to-year changes of a thermohaline status of pre-bottom waters have been already registered two times: in the beginning of a period - from 1985 to 1986 - when changes were small, and immediately after cooling, i.e. between 1990 and 1991 (Fig.3). Repeated same-direction interannual changes in early 90-ies characterise this period as a phase of a slow warming and freshening of pre-bottom waters. Apparently, this phase will be the terminated one in the most prolonged two last 10-year periods of a "cold" cycle.

2. Biological studies by species

A survey of bottom fish stocks was carried out by R/V "Vilnius" from June, 15, to July, 10, in Div. 3L only. About 80 % of the area were observed. The acoustic survey for capelin stocks was conducted by the same vessel from 14 to 24 June, 1994 in Divs. 3LNO (Table 5).

Materials on redfish, cod and capelin are presented in papers.

American plaice (3L). In Div. 3L, catches of American plaice were small (10-25 specimens). Maximal catches were taken in the southern area at 400-500 m depths. Catches contained fish 15-50 cm long; mean length of males was 26.6 cm and females - 29.6 cm. About 70 % of fish were immature. Mean degree of stomach fullness was 0.52. Main food was ophiurans (52.2 % due to occurrence).

Greenland halibut (3L). The largest catches of Greenland halibut in Div. 3L (upto 300 kg per 0.5 trawling hour) were nearby the land slope at 400-650 m depths (in 734, 735 and 736 strata). Length of Greenland halibut was 10-55 cm; mean length of males was 31.9 cm and that of females - 32.1 (Table 9). 90 % of fish were immature. Intensity of halibut feeding was low (mean degree of stomach fullness was 0.6 and main food was capelin and other fish).

Table 1. Length frequency of Greenland halibut on the data of commercial fishery in Div. 3N, September, 1994

Length, cm	Males	Females	Total
18-18	1	-	1
20	3	2	5
22	4	6	10
24	3	5	8
26	9	4	13
28	17	10	27
30	12	7	19
32	9	7	16
34	4	2	6
36	4	-	4
38	3	-	3
40	3	3	6
42	10	3	13
44	4	6	10
46	3	2	5
48	6	1	7
50	2	2	4
52	7	2	9
54	10	1	11
56	3	1	4
58	-	-	-
60	1	-	1
62	2	-	2
64	-	-	-
66	1	-	1
68	1	-	1
No.fish meas.	122	64	186
Mean length,cm	38.4	33.9	36.9
Mesh/hook,mm	120		

Table 2. Length frequency of redfish on the data of commercial fishery in Div. 3M, July, 1994

Length, cm	Males	Females	Total
15	-	1	1
16	1	-	1
17	34	18	52
18	194	136	330
19	678	437	1115
20	609	374	983
21	323	191	514
22	141	109	250
23	53	45	98
24	18	18	36
25	17	24	41
26	74	60	134
27	116	78	194
28	139	78	217
29	156	53	211
30	178	84	262
31	128	100	228
32	155	148	303
33	171	144	315
34	202	114	316
35	184	78	262
36	158	84	242
37	179	129	308
38	133	122	255
39	71	88	159
40	34	78	112
41	11	37	48
42	10	32	42
43	6	17	23
44	-	10	10
45	1	9	10
46	-	2	2
No.fish meas.	4178	2898	7074
Mean length, cm	26.5	27.5	26.9
Mesh/hook, mm		120	

Table 3. Russian catches in Subareas 0, 1, 2, 3 and 4 in 1992-1994. Preliminary data under slash indicate joint venture catches, as received from Canada and Greenland (tonns).

Species	NAFO area	1992	1993	1994
Cod	2	-	-	-
	2+3K	-	-	-
	3O	51/-	-	-
	3M	1/-	-	-
	4X	1/-	-	-
Haddock	4X	1/-	-	-
	3O	-	-	-
S. mentella	2+3K	8/-	-	-
	3L	571/-	-	-
	3O	5845/-	-	-
	3M	2937/-	-	-
	4X	12/-	-	-
Roundnose	0+1	75/75	-	-
grenadier	2+3	30/30	-	-
American	2+3K	4/-	-	-
plaice	3M	-	-	-
	3O	30/-	-	-
	4X	1/-	-	-
Witch	2+3K	-	-	-
	3O	-	-	-
	4	4/-	-	-
Greenland	0+1	7175/7175	-	-
halibut	2+3K	304/-	-	-
Capelin	2+3K	-	-	-
	3O	-	-	-
Silver hake	4X	2016/-	-	-
	3O	-	-	-
Saithe	4X	117/-	-	-
Yellowtail flounder	3O	-	-	-
Herring	4	277/-	-	-
Mackeral	3+4	1937/-	-	-
Argentine	4X	-	-	-
Squid illex	3+4	44/44	-	-
Other		235/-		
Total		21674/7324	-	-

Table 4. Mean near-bottom temperatures and salinities in summer 1994, their anomalies (A) and deviations (D) from the correspondent values of 1993.

Characteristics	NAFO Divisions				
	3L	3N	3O	3NO	3LNO
	Temperature, °C				
1994	0.27	(1.36)	(1.23)	(1.33)	(0.82)
A	-0.16	0.39	-0.06	0.21	-0.01
D	0.39	0.68	-0.20	0.27	0.27
	Salinity, psu				
1994	33.48	(32.99)	(32.92)	(32.99)	(33.27)
A	-0.07	-0.18	-0.17	-0.17	-0.12
D	-0.07	-0.29	-0.14	-0.21	-0.14

Note: data in brackets are obtained by reducing of mean temperature and salinity values to standard net areas.

Table 5. Inventory of biological surveys

SA	Div.	Month	Survey type	Objectives	No. of tows
3	3L	6-7	8	Groundfish, temperature, salinity	97
	3LNO	6	0	Capelin, temperature, salinity	12

1 Use number from 1 to 12 for months
2 Insert 8 for stratified-random and 0 for other surveys.

Table 6. Length frequency of redfish on the data of exploratory fishery in Div. 3L, June-July, 1984

Length, cm	Males	Females	Total
13	-	1	1
14	4	-	4
15	3	-	3
16	11	5	16
17	26	19	45
18	44	43	87
19	31	36	67
20	28	25	53
21	38	33	71
22	50	63	113
23	64	82	146
24	95	106	201
25	160	160	320
26	206	181	387
27	188	177	365
28	163	151	314
29	84	103	187
30	70	118	188
31	58	103	161
32	31	59	90
33	11	17	28
34	16	28	44
35	13	26	39
36	12	18	30
37	8	15	23
38	2	6	8
39	3	3	6
40	5	3	8
41	4	2	6
42	-	1	1
43	-	2	2
44	-	-	-
45	-	1	1
46	-	-	-
47	-	-	-
48	-	1	1
No.fish meas.	1428	1588	3016
Mean length,cm	26.1	26.8	26.5
Mesh/hook,mm	120		

Table. 7 Age-length key of Redfish (males) on the data of exploratory fishery in Div.3L, June-July 1994

Length, cm	Age, years																No.	Weight, g
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
14	2																2	31.5
15		2															2	43.5
16		7															7	49.9
17		11															11	60.6
18		2	10														12	68.8
19			13														13	82.2
20			5	2													7	94.4
21				6	1												7	113.9
22				7	4												11	134.1
23					14												14	158.5
24					13												13	174.2
25					14	2											16	201.4
26					13	8											21	227.1
27					3	10	2										15	264.2
28							19										19	296.0
29							5	8									13	310.7
30								5	3								8	354.3
31								1	6								7	402.0
32										6							6	423.7
33										2							2	504.0
34											2						2	506.5
35											3	1	1				5	552.4
36												6	0				6	653.2
37													2	1			3	671.0
38														0			-	0.0
39														1			1	800.8
40															3		3	864.0
41																3	3	978.3
No.	2	22	28	15	62	20	26	14	9	8	5	7	3	2	3	3	229	
Awerage weight,g	31.5	56.5	79.1	120.3	189.6	243.6	289.8	340.4	387.9	443.8	529.6	640.9	623.7	751.0	864.0	978.3		250.3
Awerage length,cm	14.0	16.6	18.8	21.3	24.4	26.4	28.1	29.5	30.7	32.3	34.6	35.9	36.3	38.0	40.0	41.0		25.4

Table. 8 Age-length key of Redfish (females) on the data of exploratory fishery in Div.3L, June-July 1994.

Length, cm	Age, years																					No.	Weight, g
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
16	1																					1	48.0
17	5																					5	57.6
18	2	8																				10	74.6
19		9																				9	88.3
20		3	2																			5	95.6
21			4																			4	105.0
22			1	5																		6	134.8
23				10																		10	159.9
24				8	2																	10	169.4
25				12	2																	14	201.5
26				4	6																	10	240.3
27				1	11																	12	258.0
28					4	8																12	299.9
29						8	5															13	348.5
30							12	2														14	386.8
31							1	10														11	415.6
32								1	10													11	457.5
33									2													2	486.5
34										10												10	557.2
35										8	1											9	594.2
36											6											6	616.2
37											1	6										7	710.7
38												2	1									3	766.0
39														1								1	805.0
40														1								1	840.0
41															1							1	942.0
42																1						1	950.0
43																	1					1	1055.0
44																		0				-	0.0
45																			1			1	1252.0
46																				0		-	0.0
47																						-	0.0
48																					1	1	1345.0
No.	8	20	7	40	25	16	18	13	12	18	8	8	1	2	1	1	1	0	1	0	1	201	
Average weinht,g	60.6	83.7	108.7	180.7	247.7	324.6	381.3	408.0	468.3	569.4	623.8	726.4	840.0	822.5	942.0	950.0	1055.0	0.0	1252.0	0.0	1345.0		340.3
Average length,cm	17.1	18.8	20.9	24.1	26.5	28.5	29.8	30.9	32.2	34.4	36.0	37.3	38.0	39.5	41.0	42.0	43.0	0.0	45.0	0.0	48.0		27.9

Table 9. Length frequency of Greenland halibut on the data of exploratory fishery in Div. 3L, June-July, 1994

Length, cm	Juveniles	Males	Females	Total
10-11	3	-	-	3
12	10	-	-	10
14	-	1	-	1
16	-	2	-	2
18	-	15	16	31
20	-	42	32	74
22	-	45	52	97
24	-	60	36	96
26	-	165	133	298
28	-	278	233	511
30	-	341	332	673
32	-	279	272	551
34	-	223	186	409
36	-	166	131	297
38	-	97	97	194
40	-	72	51	123
42	-	43	43	86
44	-	20	26	46
46	-	14	13	27
48	-	8	13	21
50	-	7	7	14
52	-	1	-	1
54-55	-	1	2	3
No.fish meas.	13	1879	1674	3566
Mean length, cm	12.0	31.0	32.1	31.0
Mesh/hook, mm	120			

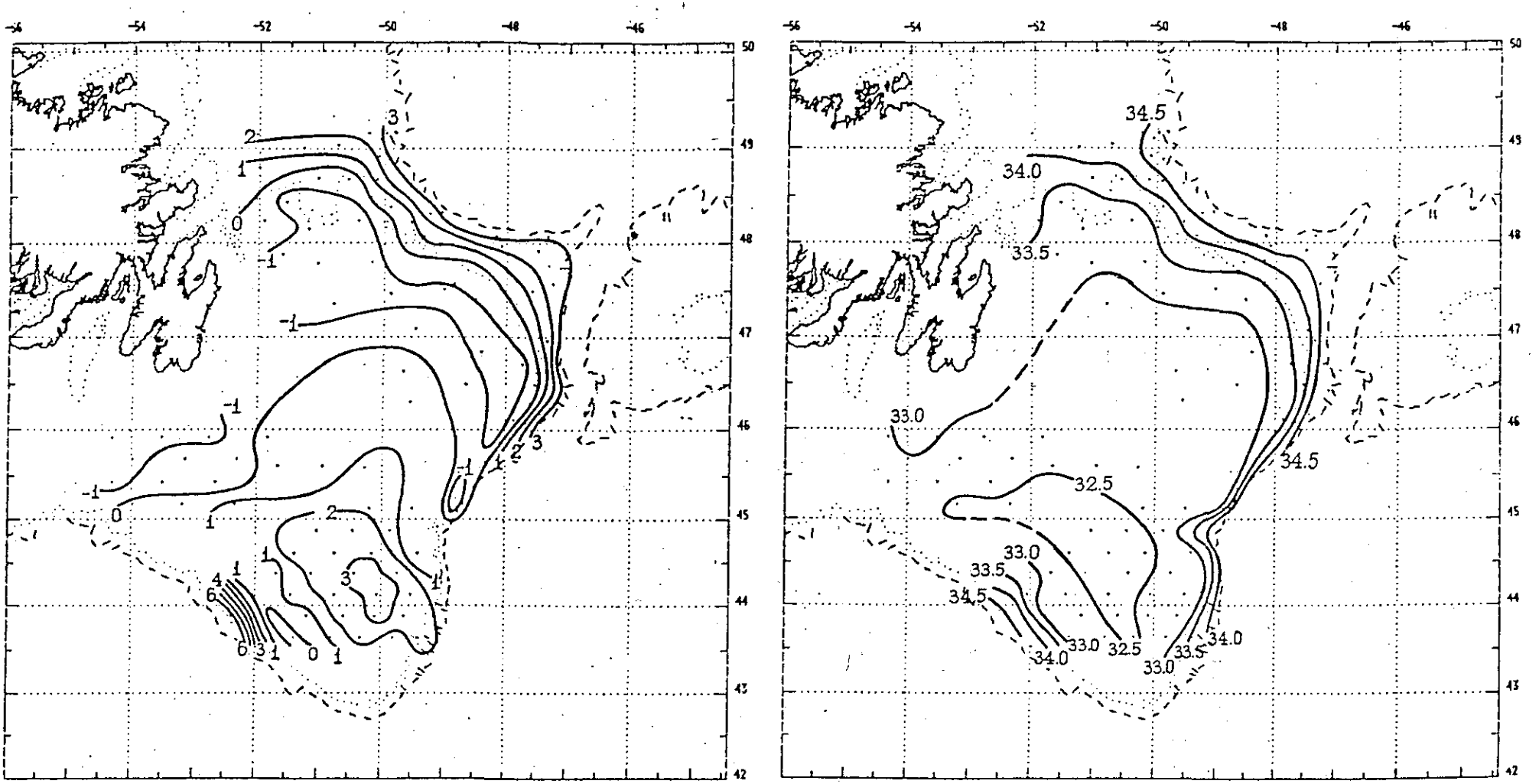

Fig. 1. Near-bottom temperature (°C, left) and salinity (psu, right) on the Newfoundland shelf from RV "Vilnius" survey data for 14 June - 10 July 1994.
200 m isobath - dotted line, 100 m - dashed line

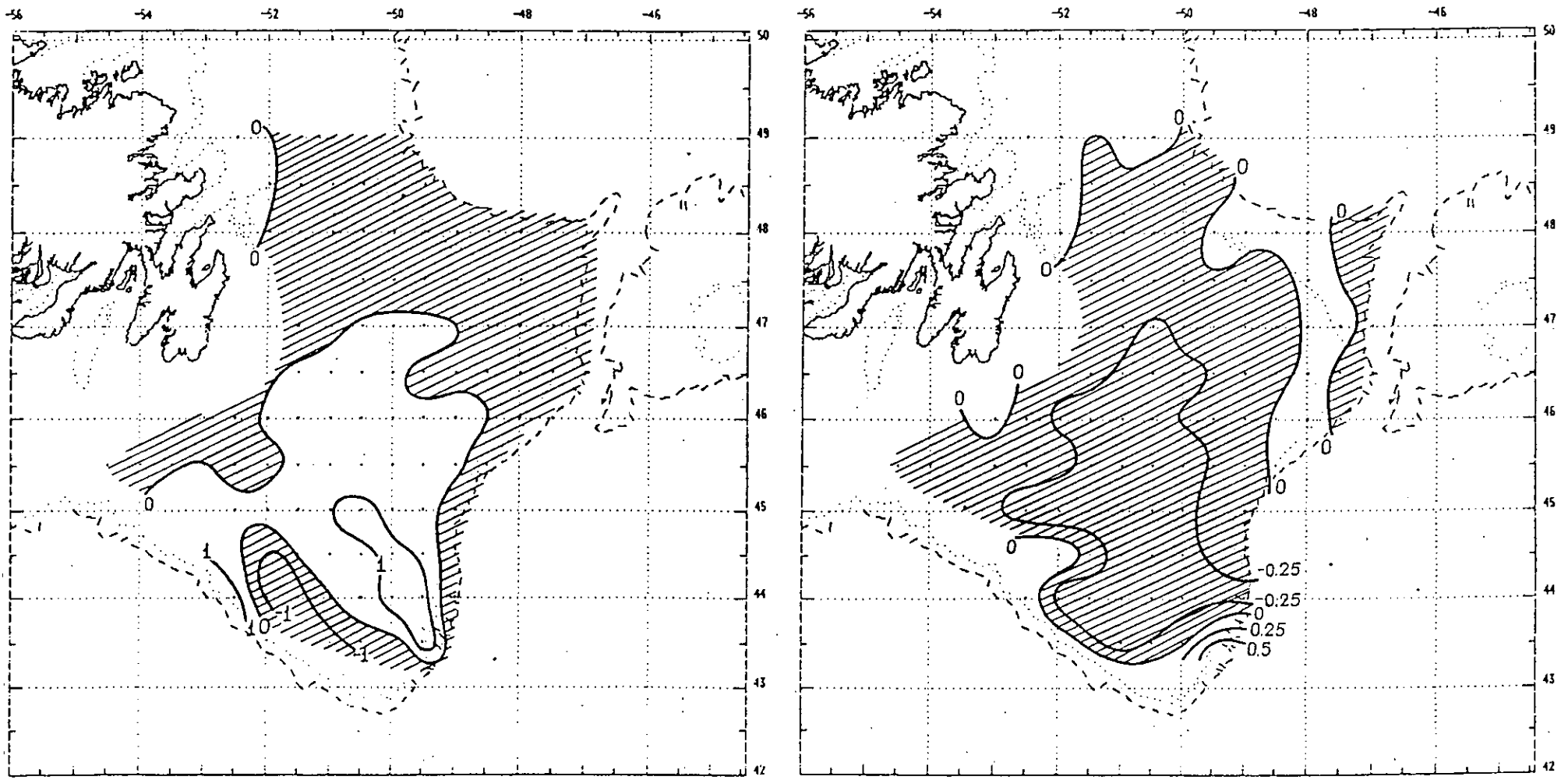

Fig. 2. Anomalies of bottom temperature (left) and salinity (right) on the Newfoundland shelf in summer 1994. Negative anomalies are shaded. For the rest parameters see Fig. 1 legend.

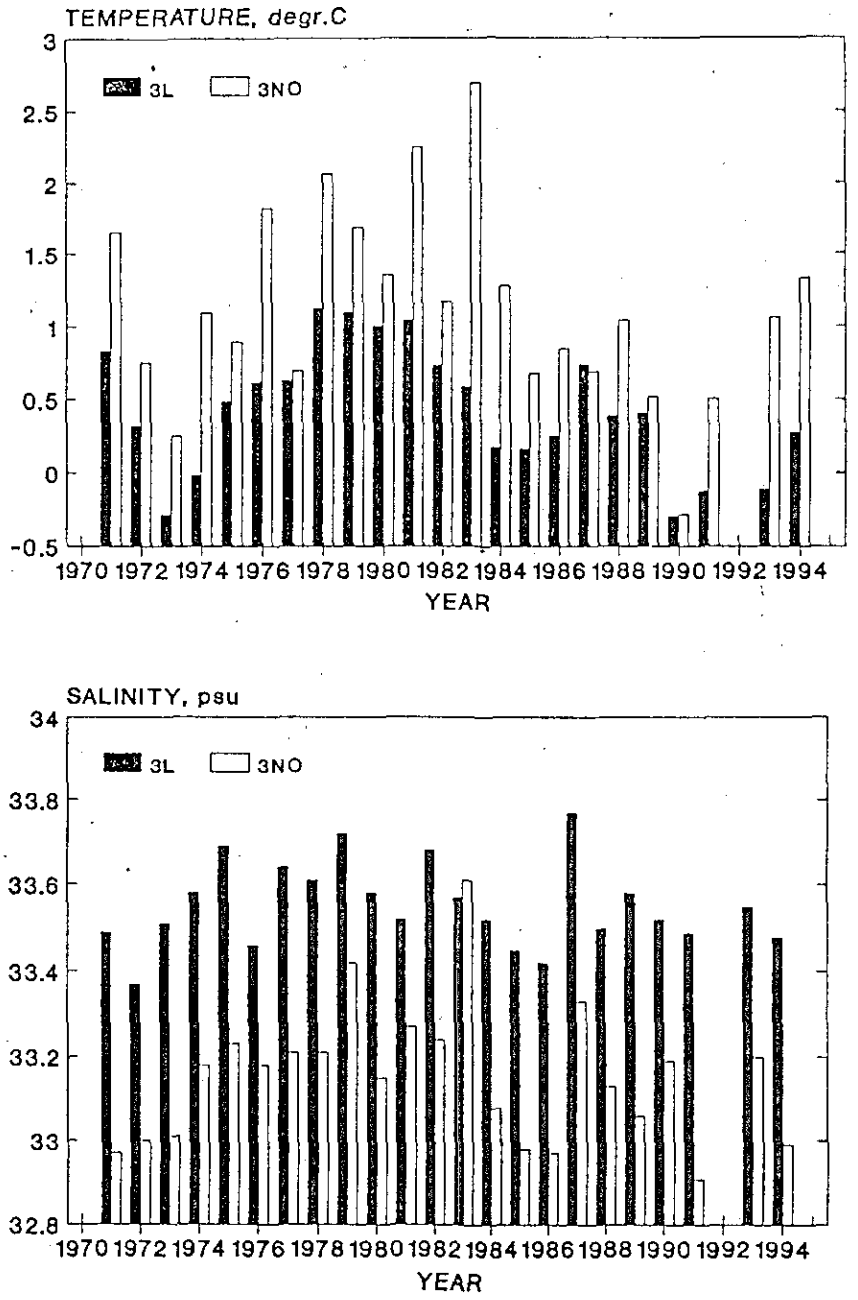

Fig. 3. Long-term variations of spring-summer near-bottom temperature (top) and salinity (bottom) on the Newfoundland shelf in Divs. 3L and 3NO.