INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

RESTRICTED

Serial No.2603
(D.a.70)

ICNAF Res.Doc.71/53

ANNUAL MEETING - JUNE 1971

USSR Research Report, 1970

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The total USSR catch in the ICNAF Convention Area in 1970 was 709,198 tons (Tables 1 and 1a), i.e. 166,067 tons lower than in 1969.

Subarea 1

A. Status of the Fisheries

In 1970 the total fish catch in this Subarea was 7.8 thousand tons.

B. Special Research Studies

I. Environmental Studies.

In August-October standard hydrographic sections 8-A, 10-A and 11-A were worked by R/V "Persei III" and "Portion". As seen from Table 2 the water temperature in the warm component of the West Greenland Current and especially in the 0-50 m layer was considerably lower than in earlier years for which comparable data are available. Only in 1959 still lower temperatures were recorded along Section 10-A in August but the measurements were then made half a month earlier than in 1970.

II. Biological Studies.

C o d. On Banana Bank in February cod fed on animals actively swimming in mid-water and often stayed high above the bottom. In such periods mid-water trawls brought higher catches than bottom trawls. Unlike these fish the cod on Fyllas Bank in February fed mainly on benthos and formed stable concentrations close to the bottom.

Table 1. Species composition of the USSR catches in the ICNAF area, 1969 and 1970 (tons).

Species	1970						1969
	I	II	III	IV	V	1970 total	total
Herring				72013	39173	111186	166072
Argentine				1615	999	2614	5707
Cod	849	49829	59997	2531	364	113570	190883
Haddock			157	672	103	932	300
Pollock			23	476	51	550	227
Silver hake				168916	28997	197913	113149
Red hake				1165	6515	7680	46409
Grenadier	5980	468	22396			28844	1240.
Flatfish	132	6268	31921	5705	4445	48471	82690
Greenland halibut	444	2497	5195			8136	10323
Redfish	231	4296	58278	13218		76023	77531
Wolffish		536	260	2		798	311
Oceanpout				20	895	915	20085
Scup					93	93	214
Alewife				10	13135	13145	25147
Mackerel			5	3987	56457	60449	51622
Butterfish				3	396	399	9494
Sea robin							1758
Angler fish			839	2123	477	3439	7109
Dogfish, scate			946	3862	6880	11688	19825
Gobies			103		2230	2333	
Atlantic saury					1054	1054	
Menhaden				6		6	
Other fish	175	1529	5591	6486	2872	16653	2762
Squid			4	830	655	1489	1247
Other mollusks				408	410	818	
Total	7811	65423	185715	284048	166201	709198	875265

Table 1a. Species composition of the USSR catches in Northwest Atlantic, 1969 and 1970 (tons).

Species	Total ICNAF area		Baffin Island		Area 6		Total N.W. Atlantic	
	1969	1970	1969	1970	1969	1970	1969	1970
Herring	166072	11186			38210	22406	204282	133592
Argentine	5707	2614			5		5712	2614
Cod	190882	113570		29			190882	113599
Haddock	300	932					300	932
Pollock	227	550					227	550
Silver hake	113149	197913			7138	3044	120287	2000957
Red hake	46409	7680			4099	834	50508	8514
Grenadier	12401	28844	2642	545			15043	29389
Flatfish	82690	48471			898	132	83588	48603
Greenland halibut	10323	8136	813	215			11136	8351
Redfish	77531	76023			90		77621	76023
Wolffish	311	798					311	798
Ocean pout	20085	915			431		20516	915
Scup	214	93			260	72	474	165
Alewife	25147	13145			10380	5954	35527	19099
Mackerel	51622	60449			37563	68026	89185	128475
Butterfish	9494	399			1613	8	11107	407
Sea robin	1758				145	258	1903	258
Angler fish	7109	3439			180		7289	3439
Dogfish, scate	19825	11688			2453	588	22278	12276
Gobies	7465	2333			468	320	7933	2653
Atlantic saury		1054						1054
Menhaden		6						6
Other fish	24256	16653	81	10	3276	666	27613	17329
Squid	1247	1489			158		1405	1489
Other mollusks	1041	818					1041	818
Total	875265	709198	3536	799	107367	102308	986168	812305

Table 2. Average water temperature (°C) in the warm component of the West Greenland Current.

Date	Section	Depth (m)			
		0-50	0-200	50-200	200-500
August 3, 1959	10-A	2.40	1.52	1.11	3.40
August 19, 1963	10-A	3.82	2.62	2.20	3.32
August 8-9, 1964	10-A	3.31	2.01	1.48	3.51
August 10-12, 1967	10-A	3.08	1.36	0.56	4.14
August 14-16, 1970	10-A	2.57	1.62	1.30	4.03
August 3, 1964	11-A	4.09	4.24	4.25	4.90
August 16-18, 1969	11-A	2.20	2.00	1.90	4.36
August 4-5, 1970	11-A	1.95	1.48	1.29	4.06
Sept. 13, 1961	8-A	7.52	6.85	6.66	5.52
Sept. 23-24, 1963	8-A	4.26	5.63	6.14	5.59
Sept. 1-2. 1970	8-A	3.86	4.24	4.37	4.73
Oct. 19-21, 1962	8-A	6.32	6.12	6.06	5.04
Oct. 30-31, 1963	8-A	4.96	5.45	5.62	5.26
Oct. 27-29, 1964	8-A	6.61	6.53	6.52	5.39
Oct. 16-19, 1965	8-A	6.59	6.27	6.17	5.60
Oct. 25-26, 1970	8-A	2.82	4.07	4.49	5.13

In April the cod on the western slopes of Frederikshaab and Danas Banks stayed at the depth of 350 to 400 m but sometimes formed concentrations in mid-layers.

Very dense cod concentrations were located on Nanortalik Bank in August. These might have been cod of the East Greenland stock which moved west of Cape Farewell to feed. In their growth rate the cod caught on Nanortalik Bank were considerably inferior to those of other West Greenland banks. In August the mean length of six-year-olds was 55.6 cm on Nanortalik Bank and 60.5 cm on Danas Bank; the mean length of seven-year-olds was 61.5 cm on Nanortalik Bank and 69.7 cm on Danas Bank.

The size - and age composition of cod in trawl catches is shown in Fig.1. It is evident that the cod of two year-classes were numerically predominant: those of 1965 (particularly in the north) and those of the 1963 year-class (mainly in the south). The cod older than 7 years formed only an insignifican part of the catches.

Subarea 2

A. Status of the Fisheries

The annual catch is given in Table 3.

Table 3. Annual catch in Subarea 2 (metric tons).

Division	Total catch by all type vessels					
	Cod	Redfish	Flat-fish	Green-land halibut	Other	Total
2G	9	-	-	4	-	13
2H	924	98	93	80	40	1235
2I	48896	4198	6175	2413	2493	64175
Subarea 2	49829	4296	6268	2497	2533	65423

B. Special Research Studies

I. Environmental Studies.

In late October hydrographic Section 8-A was made by R/V "Portion". Along the AB portion of the section over the Labrador shelf (between 53°40'N, 55°44'W and 54°50'N, 53°32'W) the water temperature was slightly lower than the average long-term normal (Table 4). In the winter of 1971/72 the negative anomalies along the AB portion of Section 8-A are expected to increase still further.

II. Biological Studies.

1. Cod.

a. Length compisition. As seen from Table 5 the main part of the trawl catches was made up by the cod ranging from 48 to 62 cm; age analysis showed that they belonged to the 1961, 1962

and 1962 year-classes. All these year-classes (particularly the latter) were slightly above the average level as shown by the young Labrador cod surveys in the preceding years (Table 8).

Table 4. Average water temperature (°C) along the AB portion of Section 8-A across Hamilton Inlet Bank (1 November).

Depth,m	1962	1964	1965	1966	1967	1968	1969	1970
0-50	1.58	0.98	1.30	2.41	2.00	2.29	0.82	1.34
50-200	1.34	-0.18	1.06	1.44	0.89	-0.18	0.36	0.31
0-200	1.49	0.17	1.13	1.72	1.19	0.50	0.50	0.60
200-500	1.70	0.98	-	2.47	0.95	0.31	1.64	-

The length compositions given in Table 5 show, apart from the major peak, a minor peak caused by the high abundance of small cod of the 1965, 1966 and 1967 year-classes. Young fish survey data show the latter two year-classes to be highly abundant.

The changes in the length compisition from January to April are related to seasonal migrations of the Labrador cod. In January both immature and pre-spawning cod concentrate on the continental slope of South Labrador. In late February and March almost all mature cod move northward to the main spawning grounds, which accounts for a decrease in the mean length of the cod remaining in South Labrador. Usually at this time there is also a decrease in the catch per hour trawling. In April the big spent cod move back southward and the mean length of cod in trawl catches (as well as the productivity of trawl fisheries) increases again.

b. Marking. 2,907 cod were marked with hydrostatic tags and released in Div.2J.

c. Total fishing and natural mortality. Total mortality rates (Z) for each year from 1961 to 1968 were calculated from the numbers (%) of fish of different ages in the mean catch per hour trawling by Soviet BMRT-type vessels in the first six months of the year in Div.2J.

Table 5. Length composition of cod in trawl catches (‰) at South Labrador (Div.2J), 1970

Length (cm)	January	February	March	April
18-20	-	-	-	1
21-23	1	1	5	14
24-26	4	5	35	34
27-29	5	10	60	18
30-32	16	25	77	17
33-35	35	51	82	21
36-38	58	74	93	33
39-41	106	93	93	45
42-44	100	87	75	50
45-47	95	89	60	56
48-50	113	108	71	92
51-53	106	111	75	112
54-56	111	118	78	135
57-59	98	87	68	120
60-62	64	63	46	94
63-65	38	37	33	61
66-68	23	20	19	42
69-71	16	10	13	25
72-74	6	6	6	12
75-77	3	2	4	8
78-80	2	2	3	6
81-83	-	-	1	1
84-86	-	1	1	1
87-89	-	-	1	1
90-92	-	-	1	1
Total (‰)	1000	1000	1000	1000
Number of fish	7487	10022	9977	3905
Mean length (cm)	49.72	48.92	45.00	51.9

The total mortality rates were calculated only for the fish fully retained by the trawl (i.e. those at the age of over 5-6 years). The total mortality rate varied from 0.473 to 0.777 with the mean of 0.670, which corresponds to the total annual removal of 48.82%.

The natural mortality rate (M) was calculated by the method of successive approximations (Beverton and Holt). The total fishing effort was transformed to the Spanish and Portuguese standard. The natural mortality rate was found to lie between 0.080 and 0.343 with the mid-point at 0.22.

d. Cod fishery forcast. In 1972 the winter cod concentrations on the continental slope of Labrador are expected to be very dense and the trawling fleet is likely to work much more effectively than in 1970 and 1971. The catch per hour trawling is likely to be close to the 1968 level. This forecast is based on the following:

1) the cod of the strong 1966 and 1967 year-classes will reach the commercial size and make a considerable contribution to the stock;

2) increasing negative anomalies of the water temperature over the shelf and the continental slope of Labrador will force cod to pass to deeper water layers, which will result in denser commercial concentrations (for details see the USSR Research Report to the 20th ICNAF meeting, Res.Doc.69/20);

3) in the earlier half of 1972, especially in February and March, the ice conditions in the Labrador area were very severe, which restricted the removal of cod by fisheries.

Subarea 3.

A. Status of the Fisheries.

The annual catch is given in Table 6.

Table 6. Annual catch in Subarea 3 (metric tons)

Division	Total catch by vessels of all types						
	Cod	Grenadier	Redfish	Flatfish	Greenland halibut	Other	Total
3K	28278	22267	6083	11768	4704	2648	75748
3L	194	72	185	395	183	23	1052
3N	20238	57	12926	17749	105	1738	52813
3O	8100	-	12795	1611	194	2306	25006
3P	2693	-	24153	336	9	1195	28386
3M	494	-	2136	62	-	14	2706
Subarea 3	59997	22396	58278	31921	5195	7924	185715

B. Special Research Studies.

I. Environmental Studies.

Water temperature observations were made from R/Vs "Persei III", "Rossiya" and "Portion" along standard sections 7-A, 6-A, 4-A, 3-A, 1-A and 44-A.

Table 7 shows water temperatures in May at the stations of Section 3-A which were occupied in the cold component of the Labrador Current and at the stations of Section 4-A occupied at the junction of bank waters of the Labrador and the North Atlantic Currents. It is evident from Table 7 that there was an intensification of the cold component of the Labrador Current in 1970.

Table 7. Average water temperature (^{o}C) in the 0-200 m layer along Sections 3-A and 4-A (May 15).

Year	Section 3-A		Section 4-A	
	Temperature	Anomaly	Temperature	Anomaly
1968	1.85	+ 1.36	2.25	+ 0.54
1969	0.80	+ 0.31	3.46	+ 1.75
1970	0.44	- 0.05	2.05	+ 0.34

II. Biological Studies.

Cod

a. Young fish survey. As in previous years a young cod survey was made in Subarea 3 (by R/Vs "Persei" and "Rossiya"). Div.3K contains young fish of the Labrador stock brought at the larval stage by the Labrador Current from the north. The abundance of 3-year-old fish in Div. 3K provides the best estimation of the strength of a Labrador cod year-class (Table 8). The comparison of this year's results of the young fish survey with those of previous years confirms that in the Labrador cod fluctuations are much less pronounced than, for example, in the Grand Bank cod. It is also evident from Table 8 that in Div. 3K three-year-old (and four-year-old) fish of the 1966 and 1967 year-classes were fairly numerous.

Table 8. Average catch (numbers) of young cod at the age of 1 to 4 years per hour trawling with a survey trawl.

Year-class	1 year			2 years			3 years			4 years		
	3K	3N	3O	3K	3N	3O	3K	3N	3O	3K	3N	3O
1958										10	1	0
1959							21	8	1	15	1	1
1960				5	3	0	11	1	2	11	1	0
1961	1	1	1	3	4	3	20	5	1	24	4	1
1962	1	1	7	2	8	2	15	18	2	6	1	
1963	1	1	1	1	5	1	36	30	1	17	7	3
1964	1	41	24	3	137	13	8	73	42	28	16	7
1965	1	1	1	1	14	12	15	23	20	22	60	9
1966	1	2	15	3	27	17	27	37	34	36	10	4
1967	1	1	2	8	3	4	32	32	14			
1968	1	6	18	6	109	28						
1969	1	2	4									

On the southern slopes of Grand Bank (Div. 3NO) the 1968 year-class was very prominent (its high abundance was suggested in the USSR Research Report to the 20-th ICNAF meeting).

b. Cod fishery forecast. In 1972 the commercial stock of cod on the southern Grand Bank (and on St.Pierre Bank) is expected to be considerably replenished due to the high abundance of the 1968 year-class. The efficiency of cod fisheries is likely to increase.

c. The removal by fishing and the abundance of cod on Flemish Cap Bank. A paper submitted to the 20-th ICNAF meeting (Res.Doc.70/46) described the relationship between the removal by fishing and the subsequent efficiency of the Flemish Cap cod fisheries. Fig.2 shows that the higher the total cod catch in the four-year period the lower, as a rule, is the catch per hour trawling in the subsequent (fifth) year. However it is also evident from Fig.2 that in recent years the total cod catch on Flemish Cap followed a downward trend. Thus the efficiency of trawl fisheries may be expected to tend to increase. In fact, in February-March 1971 trawlers of some countries reported very good cod catches on Flemish Cap Bank (final efficiency data are not available yet).

Haddock.

The vertebrae number analysis shows that throughout almost the whole of the past decade the haddock found on Grand Bank were predominantly those born on St.Pierre Bank. At the age of 2-3 years these fish migrate from St.Pierre Bank to Grand Bank crossing the coastal branch of the Labrador Current. Only in 1969 and 1970 it was not unusual to find young haddock of local origin, which seems to be an indication of the restoration of the Grand Bank haddock stock. However the St.Pierre haddock are still predominant on Grand Bank. As seen from Table 9, the 1966 and 1967 year-classes were relatively good and in 1970 the numbers of adult haddock in the trawl catches on the southern Grand Bank appeared to be somewhat higher.

Table 9. Average catch (numbers) of young haddock at the age of 1 to 3 years per hour trawling with a survey trawl.

Year-class	1 year		2 years		3 years	
	3NO	3P	3NO	3P	3NO	3P
1963					2	17
1964			4	55	6	153
1965	1	13	1	41	1	4
1966	3	110	8	191	1	20
1967	1	183	1	16	1	2
1968	4	25	8	10		
1969	4	35				

Redfish.

A study of size, age and sexual maturity of deep-water redfish (Sebastes mentella Travin) on the southern Grand Bank confirmed that: 1) the major part of the redfish catches is always made up by mature fish, the females being bigger and older than males; 2) the mean length and age of redfish do not change even with a decline in the abundance of the intensively fished stock; 3) length composition curves always appear to have two peaks, which suggests that redfish of medium size may not stay close to the bottom and are less available for bottom

trawls than small and big fish. Some data on the size-age composition of the mentella-type redfish are presented in Tables 10 and 11.

Table 10. Length composition of mentella-type redfish (‰) in Div. 3N in June 1970.

Length (cm)	Males	Females
19	-	1
20	17	1
21	17	3
22	62	14
23	92	34
24	116	27
25	134	31
26	65	27
27	86	43
28	103	38
29	72	41
30	103	54
31	34	71
32	31	132
33	10	112
34	14	112
35	7	101
36	10	51
37	14	37
38	10	24
39	-	14
40	-	10
41	3	9
42	-	7
43	-	4
48	-	1
Total (‰)	1000	1000
Number of fish	292	764
Mean length (cm)	26.87	31.77

Marking.

2,572 fish were tagged with hydrostatic tags in Subarea 3 (mainly in Div. 3L) including 1,056 yellowtail flounders, 807 American plaices, 660 cods, 17 haddocks, 16 witch flounders, 5 Greenland halibuts and 1 spiny dogfish.

Table 11. Age composition of mentella-type redfish (%o) in Div. 3N in June 1970.

Year-class	(age)	Males	Females
1963	(7)	13	-
1962	(8)	67	24
1961	(9)	280	49
1960	(10)	280	78
1959	(11)	133	102
1958	(12)	147	203
1957	(13)	40	213
1956	(14)	27	154
1955	(15)	13	83
1954	(16)		39
1953	(17)		10
1952	(18)		15
1951	(19)		5
1950	(20)		15
1949	(21)		-
1948	(22)		5
1947	(23)		5
Total (%o)		1000	1000
Number of fish		75	206
Mean age (years)		10.27	12.82

Subarea 4

A. Status of the Fisheries

The annual catch is shown in Table 12.

Table 12. Annual catch in Subarea 4 (metric tons).

Division	Total catch by vessels of all types							
	Flat-fish	Cod	Red-hake	Silver hake	Red-fish	Her-ring	Other	Total
4V	318	45	23	5111	4135	12456	543	22631
4W	5286	2476	1120	158902	8699	59103	10543	255129
4X	101	10	22	4903	384	454	414	6288
Subarea 4	5705	2531	1165	168916	13218	72013	20500	284048

Silver hake. As in 1969, there was a considerable increase in the silver hake catches on the Nova Scotian shelf in 1970. The 1970 silver hake catch was 168.9 thousand tons against 46.3 th. tons in 1969 and 3.4 th.tons in 1968 (Table 13). This is the highest silver hake catch on record since 1962. A decline in catches in 1964-1968 was followed by a considerable increase in 1969-1970. Variations in silver hake catches are attributed to considerable fluctuations of abundance and fishing effort. The fishing effort increased in the years when the abundance of silver hake was high and decreased when it was low, the fleet transferring its effort to other species or other areas.

Table 13. Silver hake catches in Div.4W in 1962-1970 (th.tons)

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970
Catch	8.0	123.0	81.0	50.0	10.3	2.5	3.4	46.3	168.9

Silver hake were fished by big over 1800 tons trawlers in Div. 4W on the slopes of Emerald, Middle and Sable Island Banks and in the Novascotian channel mainly from March through October. More often than in earlier years silver hake concentrations were observed on the eastern slopes of Banquereau Bank and the southern slopes of Browns Bank. Hake were represented in catche by 20 to 40 cm long fish, with over 70% of the catch consisting of 26 to 33 cm long fish. For the period from March to December the mean length was 28.2 cm. The bulk of the catch was made up by the three-year-old fish of the good 1967 year-class (35.9%) and the four-year-old fish of an equally good 1966 year-class, with 11.6% of the catch consisting of two-year-olds and 10.1% of five-year-olds.

Table 14. Percentage age composition of silver hake catches in 4W in 1968-1970

Year	Age									Total (%)	Mean age
	1	2	3	4	5	6	7	8	9		
1968	0.3	11.1	31.9	34.9	15.7	5.3	0.7	0.1	-	100.0	3.7
1969	6.1	6.1	34.0	35.7	12.7	3.6	1.2	0.6	-	100.0	3.6
1970	7.0	11.6	35.9	33.1	10.1	1.4	0.5	0.3	0.1	100.0	3.4

In 1971 the bulk of the catch is expected to consist of the abundant 1967 year-class at the age of 4+ and the 1968 year-class at the age of 3+ which, according to the trawl survey in the August of 1970, is also an abundant year-class. The abundance and catches of silver hake in 1971 are likely to remain at a high level. There is evidence indicating that in 1972 silver hake concentrations are also likely to be considerable.

Haddock. There was no specialized haddock fishery in 1970. They were caught in very small quantities in fishing for other species. The catch was 0.6 thousand tons which is 0.22% of the total USSR catch in Subarea 4 in 1970.

Table 15. Haddock catches in Subarea 4 in 1962-1970 (th.tons)

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970
Catch	2.6	3.7	5.5	45.5	20.6	0.7	0.6	0.2	0.6

No changes are expected in 1971. Haddock are likely to be caught incidentally in silver hake and other fisheries.

Argentine. The 1970 argentine catch declined and was 1.6 th.tons against 4.1 th.tons in 1969 (Table 16). The decline in argentine catches is explained by the closure of the Browns Bank area in spring to protect haddock from being caught on spawning grounds. As haddock are known to stay at depths less than 70 m during this period while argentine are to be found at the depth of 150-250 m the establishment of

the boundary of the area closed to fisheries along the 100 m isobath would make it possible to fish dense argentine concentrations on the slopes of Browns Bank without doing any harm to haddock concentrations on spawning grounds.

Table 16. Argentine catches in Subarea 4 in 1963-1970 (th.tons)

Year	1963	1964	1965	1966	1967	1968	1969	1970
Catch	8.1	4.9	5.6	15.0	4.2	1.6	4.1	1.6

The argentine stock is abundant enough to support a specialized fishery and to provide for better catches.

Herring. The 1970 herring catch was 70.2 th.tons, i.e. 6.4 th.tons more than in 1969 (Table 17).

Table 17. Herring catches in Subarea 4 in 1962-1970 (th.tons).

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970
Catch	0.9	2.7	2.7	5.9	2.2	0.6	2.8	65.6	72.0

Herring were mainly fished from late February to mid.May on the eastern slopes of Banquereau Bank and the northern slope of Emerald Bank. In 1970 there was a redistribution of herring fishery. In 1969 the main portion of the catch was obtained on Banquereau Bank where herring were fished successfully with pelagic trawls from vessels of the RTM "Atlantic" type and with purse seines from the SRT- and SRTR-type vessels.

In 1970 herring concentrations on Banquereau Bank were smaller and the major portion of the catch came from the Emerald Bank area where herring were fished by SRT- and SRTR-type vessels using purse seines.

On Banquereau Bank the bulk of the herring catch consisted of 33-38 cm long fish (88%), with the mean length of 35.4 cm. The Emerald Bank catches were dominated by smaller 27 to 35 cm long herring (86%) with the mean length of 30.2 cm.

The major part of the catch on Banquereau Bank consisted of 7+ to 14+ age groups whereas on Emerald Bank most of the fish caught belonged to age groups of 4+ to 9+ (Table 18). Thus, herring in these two areas differ significantly in size- and age- compositions. Herring occurring on Banquereau Bank and on Emerald Bank in winter and in spring are likely to belong to different populations, which is also supported by the results of the otolith structure analysis of herring samples from these areas.

Mackerel. Mackerel were obtained as by - catch in groundfish fisheries. The 1970 catch was 3.9 th.tons, i.e. there was practically no change as compared to 4.4 th.tons caught in 1969. The information available at present on stock abundance and the areas of commercial concentrations of mackerel is inadequate to give any judgement on fishery prospects.

B. Special Research Studies.

I. Environmental Studies.

Four seasonal hydrographic surveys were conducted in Subarea 4 in 1970 covering shelf waters from St.Pierre Bank to Browns Bank inclusive. The surveys were conducted in January, April, August and October. Observations included water temperature and salinity measurements at standard depths. Figs.3 and 4 show the Halifax section and that across Cabot Strait as an example illustrating seasonal patterns of water temperature distribution The results of surveys indicate that in all seasons of 1970 water temperatures in Cabot Strait were higher than in 1969 and those in the Sambro Deep and Emerald Bank area were lower than or close to the 1969 values.

Table 18. Percentage age composition of herring catches in Subarea 4 in 1969-1970.

	Year	Age														Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Banquereau Bank	1969		0.7	2.4	6.7	11.5	19.9	9.6	10.2	14.6	11.4	8.0	4.8	0.2		100.0
	1970					0.2	1.1	6.8	9.7	17.8	17.5	17.2	14.4	9.8	5.5	100.0
Emerald Bank	1969			0.2	2.1	18.8	26.3	18.0	12.7	8.1	2.6	1.6	0.1			100.0
	1970	0.1	0.2	2.5	16.0	27.7	13.6	26.5	6.2	4.9	1.4	0.9				100.0

II. Biological Studies.

Herring. To identify herring stocks a comparison was made of the otoliths of herring caught in March-April 1970 on Banquereau and Emerald Banks. It was found that 45% of the herring sampled in the Emerald Bank area had otoliths with a wide winter growth zone consisting of several laminated rings. On Banquereau Bank the proportion of fish with such otolith structure was 64%. Pronounced differences were also found in the ratio of the otolith's length to its width (l/d). In the Emerald Bank area this ratio in the 26 to 37 cm long herring was 2.1-2.2 and in the Banquereau Bank area the ratio in the 24 to 38 cm long fish was 2.3-2.5 (Table 19). These data suggest that different stocks are fished on Banquereau Bank and on Emerald Bank in winter and spring.

Subarea 5

Annual catches are presented in Table 20.

A. Status of the Fisheries.

Silver hake. The 1970 silver hake catch on Georges Bank and on the Nantucket shoal was 29.0 th.tons, which is the lowest USSR catch on record since the beginning of this fishery.

Table 21. Silver hake catches in Subarea 5 in 1962-1970
(thousand tons)

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970
Catch	41.9	107.4	167.3	281.4	121.4	70.6	43.9	66.8	29.0

The decline in catches is explained by a further decrease in stock abundance and by some reduction in fishing effort.

The decrease in stock abundance may be attributed to the recruitment in recent years of a number of poor year-classes. The major part of the 1970 catch was taken from April to September on the shelf slopes between

Table 19. Otolith's length to width ratio (l/d) and the body length of herring on Banquereau and Emerald Banks.

Area		Length of herring														
		24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Emerald Bank	l/d			2.1	2.1	2.1	2.2	2.2	2.1	2.1	2.2	2.2	2.1	2.1	2.2	
	number of fish			2	8	16	27	14	3	20	24	17	20	3	1	
Banquereau Bank	l/d	2.4	2.4	2.5	2.4	2.5	2.4	2.4	2.4	2.4	2.3	2.4	2.4	2.4	2.5	2.5
	number of fish	4	11	6	7	5	7	5	9	8	9	15	17	16	4	1

Table 20. Annual catch in Subarea 5 (metric tons).

Div.	Total catch by vessels of all types								
	flat-fish	cod	red hake	silver hake	herring	ale-wife	macke-rel	other	to-tal
5Ze	1432	224	1815	20548	31651	4126	25237	8488	93521
5 Zw	3013	140	4700	8449	7522	9009	31220	8627	72680
Subarea 5	4445	364	6515	28997	39173	13135	56357	17115	166201

Black and Bur Canyons and from the Nantucket Shoal. There was practically no speciealized fishery for silver hake and they were caught along with red hake, mackerel, herring, alewife and other species. The main portion of the catch consisted of 25 to 35 cm long fish with the mean length during the entire period of fishery of 28.6 cm. The predominant age groups were one- to six-year_olds. On the average the proportion of age group 1+ was 16.5%, that of age group 2+ was 13.3%, age group 3+ contributed 18.2%, age 4+ made up 27.6% and age 5+ 15.8%.

Table 22. Percentage age composition of silver hake catches in Subarea 5 in 1968-1970.

Year	Age											Mean age
	1	2	3	4	5	6	7	8	9	10	Total	
1968	1.8	3.4	37.6	34.6	15.5	4.4	1.4	0.9	0.4	-	100.0	3.8
1969	1.3	14.6	33.2	25.5	14.5	5.2	4.0	1.2	0.5	-	100.0	3.8
1970	16.5	13.3	18.2	27.6	15.8	3.8	2.9	1.4	0.3	0.2	100.	3.5

Unlike in previous years there was a considerable increase in the proportion of one-year-olds belonging to the 1969 year-class. The results of abundance survey in the autumn of 1970 indicated that the 1969 year-class was slightly better than other year-classes but on the whole the stock remains at a low level.

Restrictions of the silver hake fishery in the winter and spring of 1970 and a considerable reduction of catches in 1967-1970 do not seem to have resulted in any increase in the stock abundance because the stock has declined due to natural causes rather than under the effect of fishery. Restrictions of silver hake fisheries do not seem to give any positive results. The stock may improve if good year-classes should recruit to the fishery as has been recently observed at Nova Scotia.

Haddock. The catch of haddock on Georges Bank was only 0.1 th.tons. Haddock were caught incidentally in fisheries for other species (Table 23). At present the stock of haddock

consists of poor year-classes and there are no indications of the improvment of the stock in the nearest two years.

Table 23. Haddock catches in Subarea 5 in 1962-1970 (thousand tons)

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970
Catch	1.1	2.4	5.5	81.9	48.9	2.3	1.4	+	0.1

Red hake. In 1970 the red hake catch decreased sharply and was only 6.5 th.tons against 45.0 th.tons in 1969 (Table 24).

Table 24. Red hake catches in Subarea 5 in 1963-1970 (thousand tons).

Year	1963	1964	1965	1966	1967	1968	1969	1970
Catch	3.5	3.6	58.5	82.9	37.6	4.3	45.0	6.5

The main reason for the decrease in catches is the same as in the silver hake fishery, i.e. a decline in stock abundance due to the recruitment of poor year-classes. Another reason is a limitation of the fishery in the earlier part of the year. In 1970 red hake were largely fished on the Nantucket shoal and on the shelf slopes. The catches consisted largely of 30 to 39cm long fish (76%). They were aged 2 to 6 years, with three-year-olds (63.8%) and four-year-olds (29.2%) predominating.

Table 25. Percentage age composition of red hake caught in Subarea 5 in 1968-1970.

Year	Age									Total
	1	2	3	4	5	6	7	8	9	
1968	-	11.0	22.3	29.4	17.9	10.3	4.2	1.4	3.5	100.0
1969	3.4	17.5	25.8	35.4	7.6	0.3	-	-	-	100.0
1970	-	2.5	63.8	29.2	4.2	0.3	-	-	-	100.0

The results of the autumn trawl survey in 1970 indicated that the abundance of the red hake stock was at a low level.

Herring. In 1970 herring catches on Georges Bank and on the Nantucket shoal decreased to 39.2 th.tons as compared to 100.5 th.tons in 1969 and 127.0 th.tons in 1968.

Table 26. Herring catches in Subarea 5 in 1962-1970 (th.tons).

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970
Catch	151.1	97.3	130.7	36.3	117.3	123.6	127.0	100.5	39.2

The main reason for the decline in catches is the decrease in commercial concentrations due to lower stock abundance. The lower catch was also the result of the vessels transferring their effort to mackerel which provided better catches. Herring were largely fished by bottom trawls from April through October. The bulk of the catch was taken in the western part of Subarea 5 in April-May and on Georges Bank in July-October. The major part of the catch consisted of herring at ages 4+ to 8+. 20.2% of the catch consisted of the 1966 year-class at age 4+. 26.5% of the 1965 year-class aged 5+, 17.7% of the 1964 year-class and 15.4% of the 1963 year-class.

Table 27. Percentage age composition of herring caught in Subarea 5 in 1968-1970.

Year	Age											Total
	2	3	4	5	6	7	8	9	10	11	12	
1968	0.2	4.1	9.0	20.3	19.5	39.1	7.6	0.2				100.0
1969	+	5.1	14.3	33.6	21.1	15.1	9.3	1.4	0.1	+	+	100.0
1970	2.0	4.8	20.2	26.5	14.7	15.4	10.9	4.8	0.6	0.1		100.0

All year-classes making up the basis of the commercial stock are weak with the exception of the 1966 year-class which seems to be of moderate strength. Judging by the catches of juvenile herring in the western Gulf of Maine in 1969 the 1967 and 1968 year-classes at the age of 2+ and 1+ were poor and therefore no substantial improvement in stock abundance and catches on Georges Bank can be expected until 1972.

Mackerel. Since 1968 the mackerel catch in Subarea 5 has followed an upward trend and the 1970 catch of 56.4 th.tons is the highest figure on record (Table 28).

Table 28. Mackerel catches in Subarea 5 in 1963-1970 (th.tons)

Year	1963	1964	1965	1966	1967	1968	1969	1970
Catch	0.9	0.5	2.5	5.4	11.9	34.0	47.5	56.4

An increase in the mackerel catch can be attributed partly to a sharp increase in the stock abundance in the past three years and partly to the intensification of fishing for mackerel following a decline in herring stocks. Mackerel were mainly fished with bottom trawls on the Nantucket shoal and Georges Banl from April through December.

The length of the mackerel in catches ranged from 20 to 42 cm, with the bulk of the catch made up by the 28 to 34 cm long fish (76%). The mean length was 30.8 cm. The rich 1966 and 1967 year-classes contributed about 81.7 percent of the catch (Table 29).

Table 29. Percentage age composition of mackerel caught in Subarea 5 in 1969-1970.

Year	Age 1	2	3	4	5	6	7	8	9	10	11	Total
1969		79.9	15.7	4.4								100.0
1970	2.8	1.5	61.6	20.1	5.9	1.0	1.1	1.5	2.9	1.5	0.1	100.0

As mackerel may live to reach the age of 9-11 years the 1966 and 1967 year-classes are likely to be abundant in catchds in 1971.

B. Special Research Studies.

I. Environmental Studies.

In 1970 four seasonal hydrographic surveys were made on Georges Bank and in the southern Gulf of Maine. The surveys were conducted in January, April, August and November.

Figs.5 and 6 show the water temperature distribution in two typical sections in the Grorges Bank area (across the East Passage and along 70°W). In all seasons the subsurface temperatures in the Gulf of Maine, the East Passage and in the Georges Bank area were lower than in 1969. On the southern slopes of Georges Bank the summer and autumn temperatures were higher than in 1969.

II. Biological Studies.

Geogrges Bank herring spawning studies. In September and October 1970 studies of the spawning of herring were continued on northern Georges Bank. Investigators from USA and Canada participated in the studies on board R/V "Albatross IV". The R/V "Albatross IV" had the submergible "Pisces" on board.

Spawning ground surveys included:

1. Observations on the distribution of spawning concentrations.

2. Location of spawning grounds.

3. Estimation of spawning ground areas, the amount of eggs laid, survival of eggs and loss through predation.

4. Observations over the distribution and drift of larvae after hatching.

It was found that in 1970 spawning extended over a longer period than in previous years, starting early in September and continuing to late October. The spawning grounds located over northern Georges Bank were almost the same as in previous years. The total area under eggs was estimated to be 1.9 square kilometers, the amount of eggs laid was 6.9 th.tons and the spawning population was 12.0 th.tons. As compared to previous years there was a considerable reduction in the area under eggs and in the amount of eggs laid. The spawning population was estimated to be 1.180 th.tons in 1964, 530 th.tons in 1965, 150 th. tons in 1966, 130 th.tons in 1968, 60 th.tons in 1969 and only 12.0 th.tons in 1970. Unfortunately there is no information on the amount of herring spawning on other spawning grounds.

Egg survival appeared to be high. The proportion of dead eggs in all samples was not found to be over 1.0%. Considerable cod concentrations were observed on the spawning grounds. The analysis of stomack contents indicated that cod were heavily feeding on herring eggs. Somewhat smaller numbers of flounder, skate, haddock, starfish, sea urchin, Polychaeta and hermit crabs were also observed on herring spawning grounds.

To study larval drift and environmental conditions ichthyoplankton and zooplankton samples were taken and temperature and salinity were measured after the hatching of larvae from mid-October. In late October larvae were found to drift eastward from spawning grounds.

Yellowtail flounder. On the basis of the material collected during the Joint USSR-US Groundfish Survey a comparison was made of the abundance and distribution of the yellowtail flounder populations in southern New England and on Georges Bank. In southern New England yellowtail flounder occurred over the area of 14.0 th.sq.miles in 1968, 15.0th.sq.miles in 1969 and 12.0 th.sq.miles in 1970.

In southern New England the absolute abundance estimated with the use of the catchability coefficient of 0.39 applied by R.Edwards (1968) was 167.6 mln fish in 1968, 160 mln in 1969 and only 100.0 mln in 1970. On Georges Bank the area of occurrence did not change significantly and in 1968 to 1970 varied between 10.4 th.sq.miles and 11.4 th.sq.miles. The 1968 population of 66.8 mln fish dropped to 40.2 mln in 1970. The comparison of the populations in these two areas showed that in southern New England yellowtail flounder was 2.5 times more abundant than on Georges Bank.

Joint groundfish survey. From Augugst to October 1970 a groundfish survey and trawl comparison experiments were conducted by the USSR and US investigators. The total number of hauls made by the Soviet R/V "Kvant" was 330 including 70 experimental hauls. The trawl survey covered the area from Banquereau Bank to Cape Hatteras.

Statistical Area 6

A. Status of the Fisheries

There was practically no change in the total USSR catch in Statistical Area 6 in 1970 (102.3 th.tons) as compared to the 1969 catch of 107.3 th.tons (Table 30). However there were significant changes in the catches by species.

Table 30. USSR catches in Statistical Area 6 in 1963-1970 (th.tons)

Species	Year							
	1963	1964	1965	1966	1967	1968	1969	1970
Silver hake	4.2	16.9	17.3	92.9	18.6	15.0	7.2	3.0
Red hake	0.8	8.4	11.7	25.7	14.9	1.9	4.1	0.8
Herring	0.5	0.2	1.9	2.8	3.2	16.1	38.2	22.4
Mackerel	0.3	0.1	0.1	1.2	6.1	7.3	37.5	68.1
Other	2.1	2.6	2.4	8.4	4.3	12.4	20.3	8.0
Total	7.9	28.2	33.4	131.0	47.1	52.7	107.3	102.3

Silver hake. In 1970 the silver hake catch followed a downward trend and was only 3.0 th.tons against 7.2 th.tons in 1969, 15.0 th.tons in 1968, 18.6 th.tons in 1967 and 92.9 th.tons in 1966. The declining catch is attributed to a decrease in abundance due to the poor 1966 and 1967 year-classes which formed the basis of the commercial stock.

Another reason for the decline in the USSR silver hake catch is the introduction of the closed season from January 1 to April 15 because prior to the introduction of this measure Soviet vessels used to fish for silver hake in the first quarter of the year. The data of the trawl survey conducted in the autumn of 1970 indicate that in 1971 the abundance of silver hake will remain at a low level.

Red hake. The 1970 red hake catch dropped to 0.8 th.tons for the same reasons as the silver hake catch, i.e. the depression of the stock abundance and the closure of the area.

The autumn survey data indicate that in 1971 the abundance of red hake will remain at a low level.

Herring. The 1970 herring catch dropped to 22.4 th.tons against 38.1 th.tons in 1969. The drop in the catch is largely attributed to a decline in stock abundance. Herring caught in Statistical Area 6 belong to the same stock as those fished on Georges Bank. No increase in abundance and catches may be expected in the nearest future. Herring were fished at depths of 40 to 70 m from Long Island to Norfolk. The herring caught were predominantly at ages 5+ to 9+ (Table 31).

Table 31. Percentage age composition of herring catches in Statistical Area 6 in 1968-1970.

Year	Age								Total
	2	3	4	5	6	7	8	9	
1968	0.8	1.2	4.4	26.9	37.4	27.7	1.6	-	100.0
1969	0.2	6.2	10.3	30.2	18.8	16.6	16.1	1.6	100.0
1970	-	2.9	7.8	29.7	15.3	14.9	14.5	14.9	100.0

Mackerel. In recent years commercial concentrations in winter and spring have increased substantialy which contributed to an increase in catches. The 1970 catch of 68.0 th.tons was the highest on record as compared to 37.5 th.tons in 1969 and 7.3 th.tons in 1968 (Table 30).

Mackerel were fished from February to early May. The major part of the catch was taken at Norfolk in February and May, over the shelf from Norfolk to Hudson Canyon in April and at Hudson in May.

The mackerel occurring in Statistical Area 6 in the earlier part of the year belong to the same stock as those fished in Subarea 5.

The catches were dominated by the good year-classes of 1966 and 1967 (Table 32).

Table 32. Percentage age composition of mackerel catches in Statistical Area 6 in 1970.

Age	1	2	3	4	5	6	7	8	9	10	Total
%	7.9	3.1	63.3	19.2	2.5	0.8	0.6	1.2	1.1	0.3	100.0

The average proportion of the 1967 year-class at age 3+ was 63.3% and that of 1966 at age 4+ was 19.2%. In 1971 the abundance of these year-classes is expected to remain at a high level.

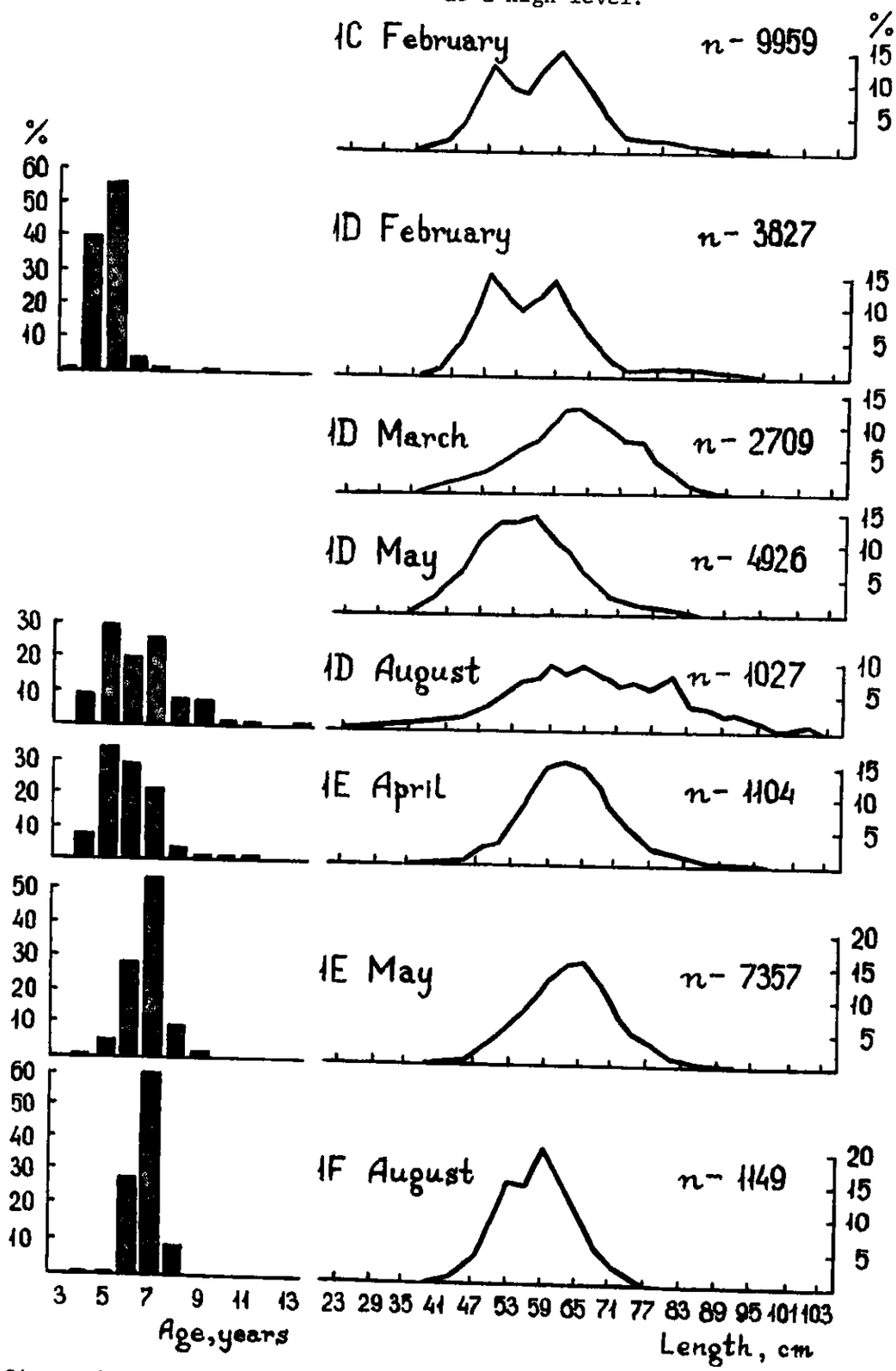

Fig. 1. Size and age composition of cod in West Greenland divisions in 1970.

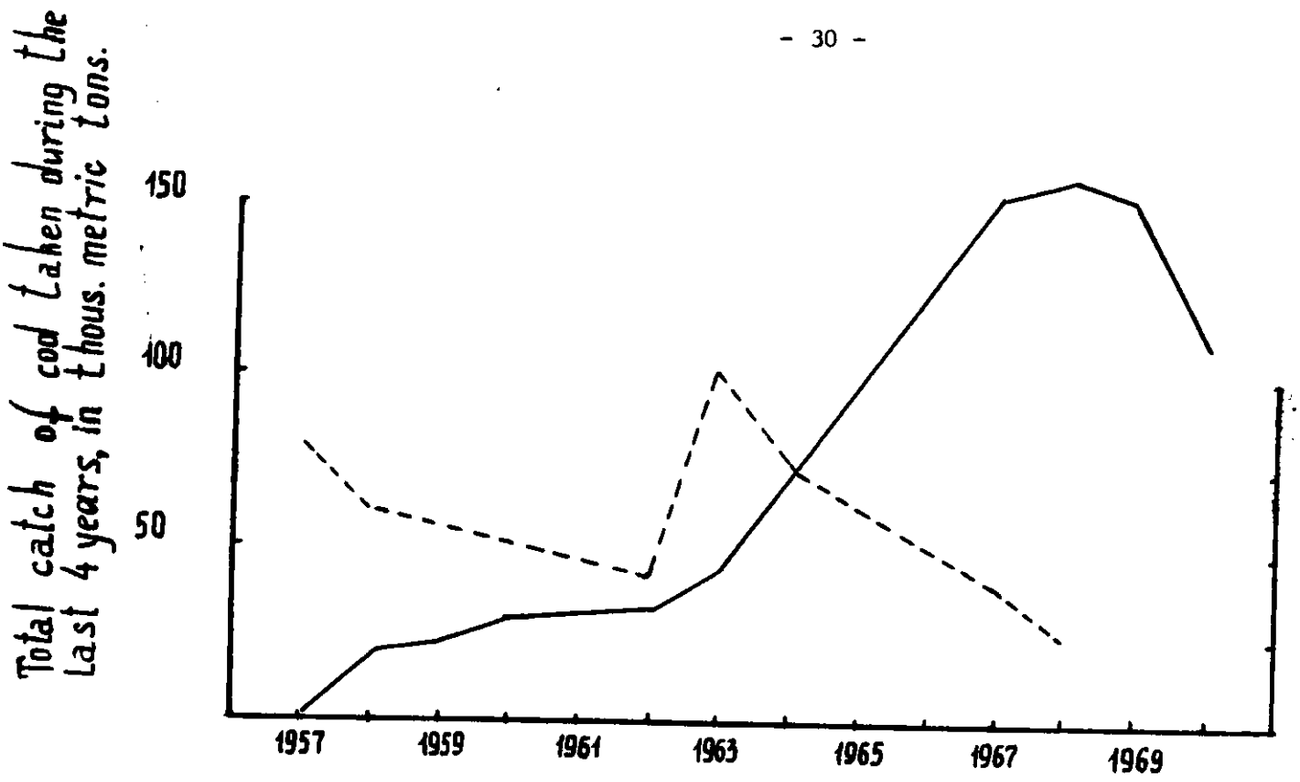

Fig. 2. Catch-per-hour trawling by USSR BMRT-type trawlers over southwestern Flemish Cap Bank in February-April (dotted line) and the total international cod catch on Flemish Cap Bank in the four preceding years (solid line).

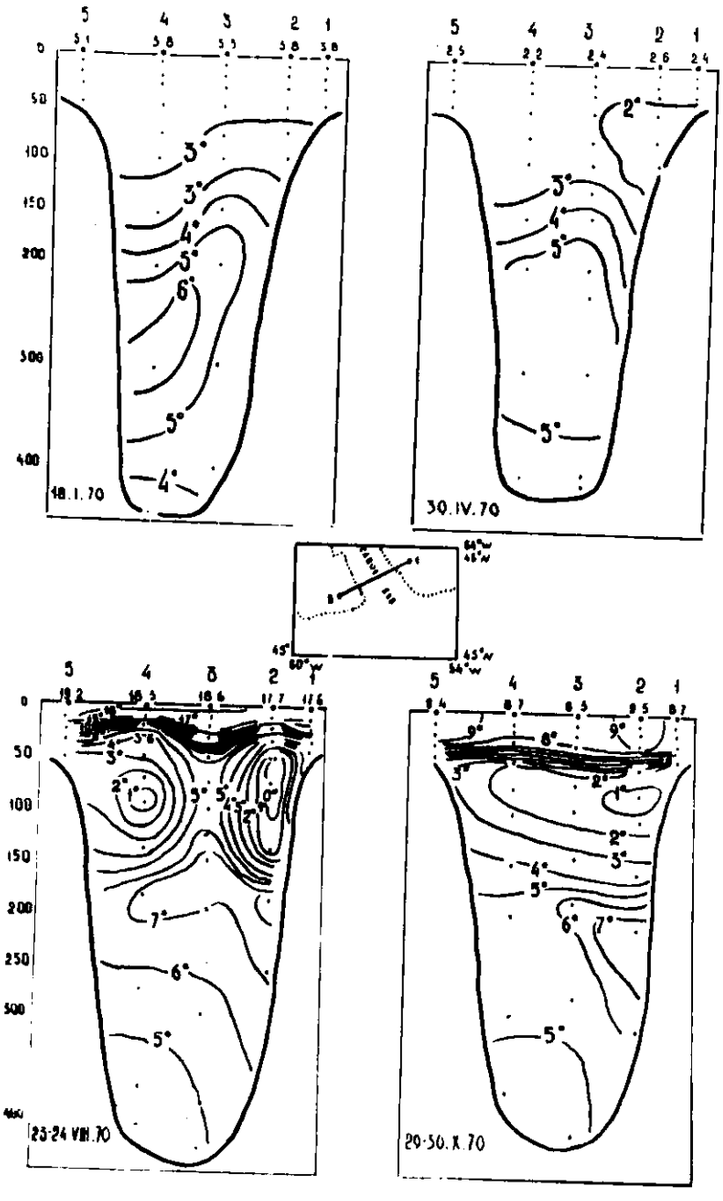

Fig. 3. Water temperatures in the Cabot Strait section in 1970.

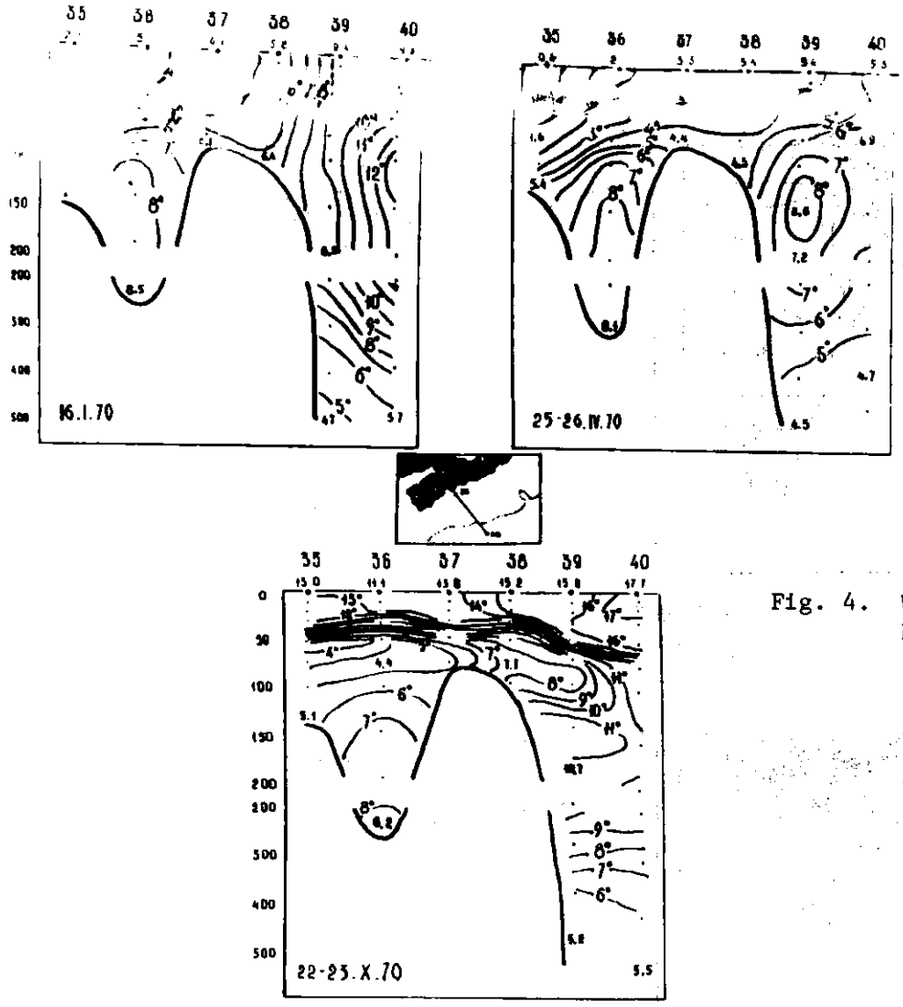

Fig. 4. Water temperatures in the Halifax section in 1970.

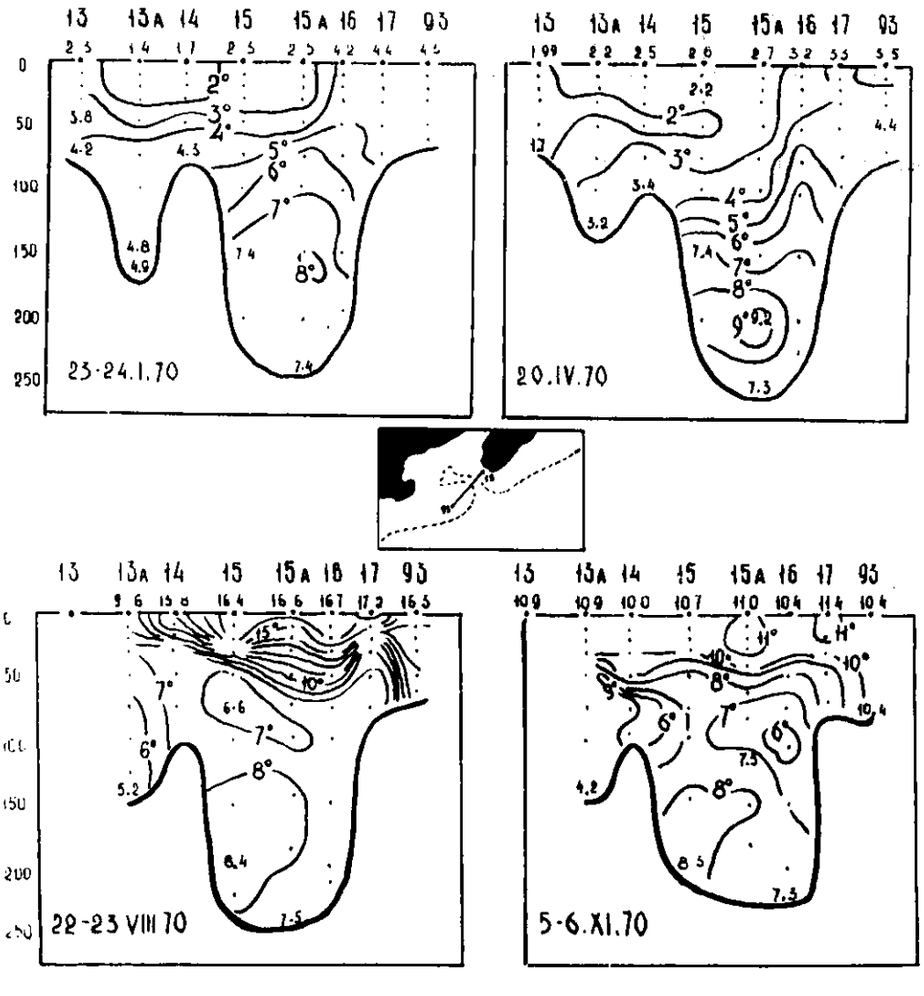

Fig. 5. Water temperatures in the East Passage section in 1970.

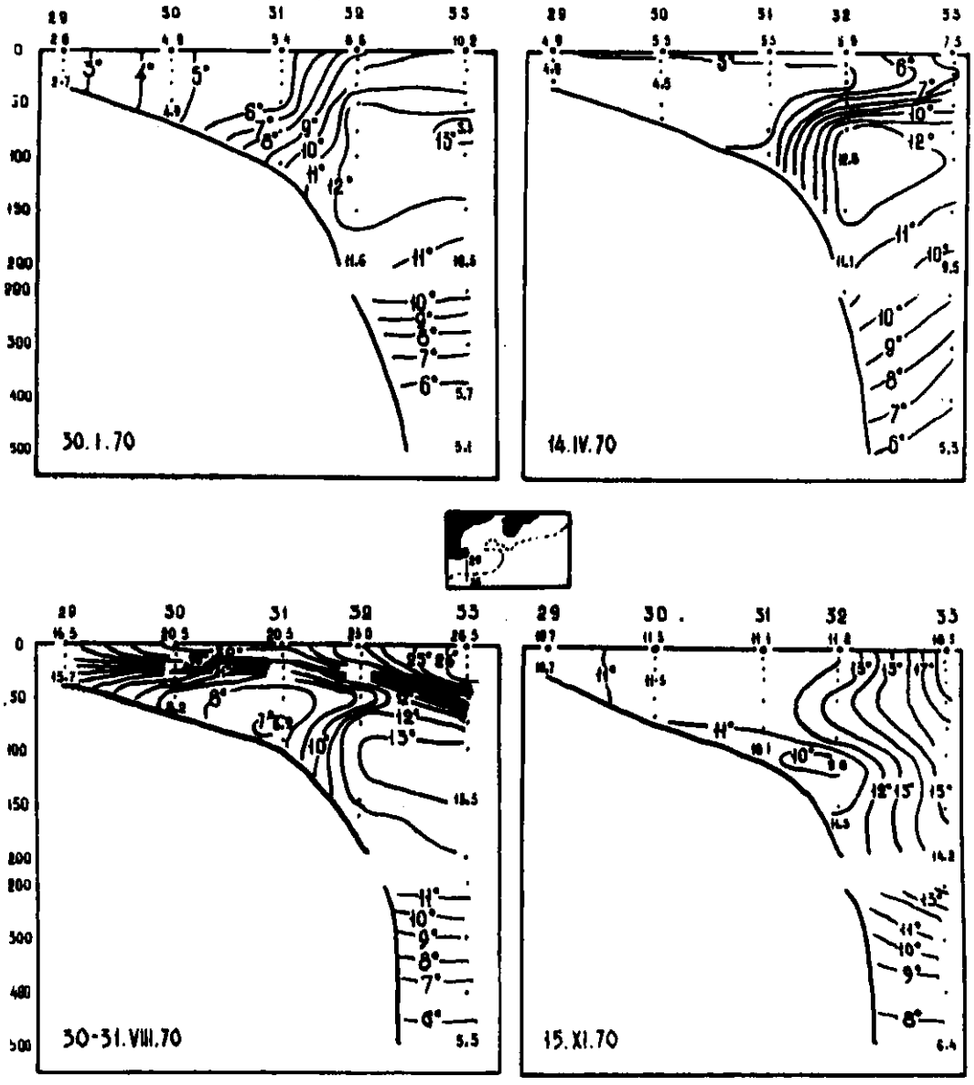

Fig. 6. Water temperatures in the Cape Cod section in 1970.