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Russian Research Report for 1991

by

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PINRO Research in the NAFO Area in 1991

by

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Subareas 0 and 1

A. Fisheries status

During August 1991 one sealing ship was operated in the Greenland halibut fisheries in Div. 10. Rock grenadier occurred as a by-catch (to 37%). In late August-early September one more ship of the PST-type continued the fishing (fishing depth 650-1100 m). Daily catch of the sealing ship averaged 5.2 t, of PST - 1.2 t.

In Div. OB trawl fishing for halibut covered the period from July to November. In July daily catch by 4 ships like PST amounted to about 7 t. Beginning from August 1-2 ships of the STM-type were fishing in the depth from 800 to 1180 m, in November one more ship of ZRS-type (sealing ship) entered the fishery and fished to as deep as 1400 m. Daily catch by STM averaged 4.1-5.3 t, by ZRS - 3 t. 1-2 ships of the PST-type continued fishing for halibut in October-November in the depth from 700 to 1050 m. Daily catch varied from 2.5 to 7.5 t. By-catch of grenadier did not exceed 10%.

Total catch is given in Table 1 (preliminary).

B. Special research

1. Environmental studies

a. Oceanographic observations

Oceanographic observations were conducted in the Davis Strait within fishing zone of Canada south of 66°N on RV "Kapitan Shaitanov" in November. The observations involved temperature and salinity measurements in 53 random and 7 standard casts along transect 34-A at the latitude of the Resolution Island (Table 2).

A comparative analysis of water temperature distribu-

tion for 1991 and 1990 showed a reduction of negative water temperature fields over the Baffin Land, and a growth, particularly in the Hudson Strait trough, of fields of warmer temperatures above 3°C. Greatest rise of temperature in the bottom layer occurred at the Canada-Greenland threshold, where the temperature was 1°C and more higher, than in 1990.

2. Biological studies

Greenland halibut (OB)

A trawl survey in Div. OB was carried out from 3 to 17 November. A total of 59 research tows were made between 200 and 1500 m depth over the area of 36.6 thou.sq.miles. Survey technique was the same as in previous years (Rikhter et al., NAFO SCS Doc. 91/5).

Greenland halibut occurred in catches over all surveyed area, except stratum 8. Fish were scattered, no commercially-important concentrations were found. Largest catch of 175 kg per hour tow occurred in stratum 5, depth 900-1100 m.

The size of male halibut varied from 12 to 70 cm (mean length 43.99 cm) and of females from 12 to 93 cm (mean length 44.21 cm). Mean length and weight increased with depth. Only 3 juvenile halibut (mean size about 8 cm) were caught during the survey time.

In all strata the number of males in catch was bigger, than females. In catches from above 750 m immature males prevailed. The proportion of mature fish in catch increased with depth and was a peak one (47.3%) in 1000-1250 m. There were no mature females in catch from above 750 m, their percentage was a peak one (10.7%) in 1250-1500 m.

Number of Greenland halibut in Div. OB was estimated at 50.8 mill.fish, and biomass at 43.2 thou.t (Table 3), this is much lower than in previous years, except 1987, when these indices were of the same magnitude.

No trawl survey was conducted in SA I.

Rock grenadier

A trawl survey in Div. OB was carried out from 3 to 17 November in the depth range from 201 to 1500 m. Grenadier occurred in catch from 640-1350 m, catches were very small and did not exceed 25 kg per hour tow. No grenadier occurred in catch from north of 64°24'N. The length of male grenadier in catch varied from 18 to 72 cm, mean length 50.6 cm, that of females - from 27 to 73 cm, mean length - 53.4 cm. Sex ratio was 1.2:1.

All males and females were immature. Intensity of feeding was on the average level. Shrimp, euphausiids, squid were principal prey.

No trawl survey was conducted in SA I.

Subareas 2 and 3

A. Fisheries status

Greenland halibut. Div. 2H was a major bottom trawl fishing area off Labrador. 10 fishing ships of different type worked simultaneously in the area from August till mid-November. Tows were made in 230-1900 m. Daily catch by PST was 3-5 t, STM - 3-4.5 t, BMRT - 3-5.5 t. Fishing efficiency declined towards October and grew in November. Rock grenadier and catfish occurred in small numbers as by-catch.

Rock grenadier. No directed fishing for grenadier was carried out. It occurred in small numbers as by-catch in the Greenland halibut fishery.

Redfish. In 1991 Russian fishing ships fished for redfish mostly over the Flemish Cap and beyond the Canada economic zone off southern and south-western Newfoundland, besides, in the Canada zone off southern Newfoundland and the Notre Dame Bay.

From January to November a group of ships from SEVRYBA and ZAPRYBA were fishing mostly with a mid-water trawl on all slopes of the bank in the depth between 300 and 850 m. Only in the end of the fishing season bottom and combined fishing were used. Catches by pelagic trawl varied from 4 to 9 t per hr tow.

Fishing for redfish in the southern and south-western areas over the Grand bank ^{was carried out} mainly in the depth from 200 to 700 m in June-October. Fishing efficiency was at the 1990 level and varied from 4 to 8 t per hr tow.

In the area of the Notre Dame Bay the fishing was only occasional.

Capelin. In 1991 the national quota of the USSR in Divs. 3NO was 15 thou.t. However, since there were no commercially-important concentrations of capelin in these areas the quota was not realized.

In May RV "Vilnius" worked in Div. 3O in scouting for capelin. A group of ships (5-6 BMRT) was doing scouting works in Div. 3N beyond the 200-mile economic zone of Canada. Occasional catches of pre-spawning capelin were as big as 0.5 t per tow.

In August-September a group of ships (3-4 ships) was

scouting for capelin over a vast area of Divs. 2J and 3K. No commercially-important concentrations were found. From 25 November to 5 December 2 ships were fishing for capelin in Div. 3K. Mean daily efficiency was about 20 t and total catch - 300 t. It was the lowest at record catch in the whole history of the USSR capelin fishery in this area.

Other species. No directed fishery for other species was carried out, small by-catches occurred in Greenland halibut and redfish fisheries.

B. Special studies

1. Environmental studies

a. Hydrographic observations in SA 2

Oceanographic works in SA 2 were performed on the shelf and continental slope of the Labrador by research ships, "Kapitan Shaitanov" and "Vilnius" in September-November. During this time 105 random and 17 standard casts were made along transects 8-A and 38-A.

In 1991 the mean water temperature in the cold component of the Labrador current in 0-200 m and Irminger component of the same current in 200-500 m was at the normal level estimated for 1964-1986. In 0-200 m and 500-1000 m in the Irminger component the mean water temperature was at the 1990 level and 0.3-0.4°C below normal. Water temperature and salinity were unusually high in the bottom layer in the main branch of the Labrador current over the Hamilton bank. Along the outer edge of the shelf they did not exceed the long-term means by more than 1°C and 0.5 psu.

b. Hydrographic observations in SA 3

Oceanographic observations in SA 3 were performed by RVs "Vilnius" in November-December and "Kapitan Shaitanov" in September.

In spring and summer seasons 183 random casts were done by RV "Vilnius" in Divs. 3LNO and 3M, besides, 28 standard casts along standard transects 1-A, 2-A, 4-A, and 6-A. No oceanographic works were performed in Div. 3K, because of heavy ice.

From survey materials water temperatures in the bottom layer over the Newfoundland bank at points of a regular half-degree grid were estimated as well as their deviations from long-term means for 1971-1990. Estimations showed, that in April-June 1991 water temperatures near the bottom over the greater part of the

Grand bank (about 66% of its area) were below normal, however, higher, than in 1990. In Divs. 3N and 3O mean bottom temperature was 0.7-1.0°C higher, than in 1990 and 0.4° and 0.8°C below normal. In Div. 3L the mean temperature remained at the level of abnormally cold 1990 and was 0.7°C below normal.

In September 15 oceanographic casts were performed by RV "Kapitan Shaitanov" on the eastern slope of the Funk Island bank. The temperature in the whole water column was higher, than in 1990. Strongest warming was recorded for the 50-150 m depth interval (0.8°C on the average). In the surface 30 m interval and in 200-500 m water temperature was, on the average, 0.3-0.4°C higher, than in similar period of 1990.

In November 51 random casts were done by RV "Vilnius" over the Grand Newfoundland bank. Observations showed, that the mean bottom temperature was much lower, than in 1990 and the lowest at record since 1986.

2. Biological studies

In 1991, like in previous years, priority was given to evaluation of the status of commercial stocks through trawl and acoustic surveys. Table 4 shows survey details, time and amounts of materials collected.

Rock grenadier (2+3K). Trawl survey by RV "Kapitan Shaitanov" in Div. 2G consisted of two parts: from 26 September to 15 October south of 60°N and from 17 to 21 November north of 60°N in 200-1500 m depth. Catches varied from several kilos to 1.1 t. Largest catches were taken in the vicinity of the continental slope at 59°50'N in 1100-1360 m.

The length of males was 17-88 cm, mean length 49.4 cm, of females - 17-89 cm, mean length 52.0 cm. Sex ratio was 2:1. All fish were immature. Copepods, shrimp, euphausiids, squid and fish were major prey.

In Div. 2H the survey was carried out from 21 November to 4 December. Grenadier occurred in catches from 380-1310 m depth. Largest catch, to 150 kg, was taken from 960-1300 m.

The length of males was 19-88 cm, mean length 45.1 cm, that of females - 17-90 cm, mean length 46.4 cm. Like in Div. 2G mean length of fish increased with fishing depth. Sex ratio was 1.6:1. In this division grenadier were feeding most intensely, the diet was the same as in Div. 2G.

From 18 to 25 September 31-hour tow by 100 m depth interval was done starting from 500 m depth and down to

1500 m in Div. 3K to study the vertical distribution of commercial species. Redfish were found to be distributed

in all covered depth range, largest catch (to 290 kg) was taken from 800-1000 m. Rock grenadier occurred in catch from 700-1500 m, its percentage in catch and mean length increased with fishing depth. Catches of grenadier were small, about 2 times lower, than in 1990, and did not exceed 370 kg. Males had the length of 20-90 cm, mean length 50.8 cm, females - 20-100 cm, mean length 54.4 cm. Sex ratio was 1.9:1.

Greenland halibut (2GH). A survey for Greenland halibut in Div. 2G consisted of two parts. From 26 October to 1 November it covered the area south of 60°N, and from 17 to 21 November the area between 60° and 61°N. A total of 139 valid tows were done in depth range from 200 to 1500 m, covered area was 168 thou.sq.miles.

A survey in Div. 2H was carried out from 21 November to 4 December and covered the depth range from 300 to 1500 m and the area of 3.1 thou.sq.miles. A total of 51 valid tows were done.

In either division the largest catch of Greenland halibut was taken from 1000-1250 m. A peak catch by research bottom trawl in Div. 2G contained 300 kg and it was 370 kg in Div. 2H.

Male length varied from 12 to 67 cm (mean length 42.0 cm). Halibut of smaller size were found in Div. 2H, where the mean length was 38.54 cm. Females were larger than males. Size frequency distribution covered fish from 12 to 99 cm, the mean length in Div. 2H was 38.14cm, and 43.31 cm in Div. 2G. A total of only 7 juveniles with the length from 8 to 11 cm were caught in the two divisions. Fish length grew with fishing depth.

The majority of fish taken from above 1000 m were immature. The percentage of mature fish increased with depth and was a peak one in the depth range from 1250 to 1500 m. As for the sex ratio, males slightly predominated, their percentage in catch from deeper than 500 m was about 60%.

Numbers of Greenland halibut in Divs. 2GH were estimated at 23.1 mill.fish and biomass at 15.5 thou.t. These indices were bigger, than in 1990, and survey area in 1991 was 7 times bigger than in 1990.

Redfish (3M). As shown by the trawl survey carried out in May-June, the commercial stock over the Flemish Cap was composed mainly of fish with the length from

25 to 29 cm at age 10-12 from strong 1979-1981 year-classes. In 1991 a new rich 1989 year class was noted to appear.

The research survey indicated, that numbers and biomass of fish within access to the bottom trawl increased against 1990 and were 2006,1 mill.fish and 45.4 thou.t (Tables 5,6). Acoustic estimates were 1850,0 mill.fish and 62.4 thou.t. Of this amount 1450.0 mill.fish or 38.1 thou.t were distributed in the 4 m bottom layer. Total stock was estimated at 3856.1 mill.fish, in numbers and 107.7 thou.t by biomass (SCR Doc. /92, Vaskov et al.). Growth of numbers was associated with a rich 1989 year class, however, total biomass estimate was the lowest at record for 1988-1991.

Redfish (3LNO). In 1991 catches from Div. 3NO over the Grand Newfoundland bank were dominated by fish 20-27 cm in length. In contrast to southern slopes of the Grand bank, larger fish are found in Div. 3L. Redfish of 24-30 cm prevailed in this division.

As shown by the trawl survey the redfish stock in Div. 3N in 1991 was at the level of the previous year. (SCR Doc. /92, Vaskov et al.). Numbers and biomass of redfish in Div. 3L in 1991 were higher than corresponding indices for 1990. At the same time, a sharp decline of the stock in Div. 3O was noted.

Total number of redfish in Divs. 3LNO, as indicated by the trawl-acoustic survey, declined in 1991 to 543.2 mill.fish against 1680.0 mill.fish in 1990, and the biomass to 214.5 thou.t from 337.4 thou.t.

Cod (Div. 3M). A trawl survey over the Flemish Cap in April-May 1991 showed, that the cod stock continued to be at a low level, although estimates of numbers and biomass were higher in 1991, than in 1990 and were 10.5×10^6 fish and 6.7×10^3 t (Tables 5,6).

Low numbers were caused by weak recruitment from 1989 and 1990 year classes as well as heavy fishing on strong 1986 year class. During the survey time catches were dominated by immature cod from the 1988 year class, 33-42 cm in length. The percentage of mature fish did not exceed 19%. Thus, it can be suggested, that in 1992 and 1993 the biomass of cod will be close to the low 1991 level.

Cod (Divs. 3NO). Numbers and biomass of cod in Divs. 3NO in 1991 were bigger than in 1989 and 1990 and were estimated at 35.8×10^6 fish and 142.1×10^3 t. Trawl-

acoustic survey provided estimates of 39.2×10^6 fish for numbers and 151.0×10^3 t for biomass of cod, which were higher than in 1989 and 1990. The survey also showed a recruitment to the Newfoundland cod stock from 1989 year class, which will enter the commercial stock in 1992-1993. Growth of numbers and biomass of cod in Divs. 3N0 could be expected in 1992 and 1993.

Cod (Divs. 3KL). No research was done in Div. 3K in 1991, because of tough ice conditions in the survey time.

In 1991 numbers of cod in Div. 3L were estimated to be the highest for 1987-1991 and constituted 170.2×10^6 fish. Biomass estimate was higher in 1991, than in 1990. The trawl-acoustic survey also provided a higher estimate of numbers, compared to 1989 and 1990, which were estimated at 198.0×10^6 fish, and biomass at 189.4×10^3 t. Catches were dominated by fish 36-47 cm in length at age 3-5 years.

Bearing in mind estimates from previous years, it can be supposed that in 1992-1993 the cod stock in Divs. 3KL will remain at the same level.

American plaice (3M, 3LNO). A trawl survey on the Flemish Cap in 1991 (Div. 3M) showed, that after a sharp decline of numbers and biomass of American plaice, observed since 1986, they have now grown considerably. If in 1990 numbers and biomass of American plaice were estimated to be the lowest at record for all years, when a random-stratified trawl-acoustic survey was carried out (since 1983), and constituted 2.6×10^6 fish or 1.2 thou.t, in 1991 the estimates were 12.7×10^6 fish and 14.4 thou.t (Tables 5,6). However, in view of the fact, that trawl surveys conducted by Spain in 1988-1990 showed a relatively steady status of the stock with only a slight decline in 1990 (biomass estimates were 11.8, 10.5, 9.1 thou.t, respectively), it can be guessed, that our 1990 trawl survey underestimated the stock. Besides, a recruitment from rich 1986 year class contributed to the growth of numbers and biomass.

In 1991 catches from Flemish Cap were dominated by fish 36-52 cm in length (mean length 44.68 cm) at age 7-9 years.

The stock of American plaice over the Grand Newfoundland bank (3LNO) continued to decline. The 1991 trawl survey estimated the numbers of American plaice in this area at 320.9×10^6 fish and biomass at 110.2 thou.t.

which are the lowest estimates for 1983-1991. However, since catches taken over the Grand bank in 1991 contained considerable amounts of 4- and 5-yr-olds, it can be expected, that the biomass may slightly grow in coming years. Catches were dominated by fish of 18-36 cm in length.

Yellowtail flounder (3NO). A trawl survey in Divs. 3NO in 1991 showed, that numbers and biomass of yellowtail flounder remained at the level of the previous year and was close to the level of 1987-1988, they were estimated at 64.5×10^6 fish or 27.3 thou.t (Tables 5,6). Large fish of 33-40 cm in length prevailed.

Witch flounder (3LN). Numbers and biomass of witch flounder in Div. 30 were estimated by the trawl survey in 1991 at 15.3×10^6 fish or 8.1 thou.t, that was higher, than in 1983-1990. In Divs. 3LN numbers and biomass continued to be at a low level, 2.8×10^6 fish or 2.1 thou.t. Like in 1990 fish of 34-49 cm in length prevailed.

Capelin (3LNO, 2J + 3K). In 1991 Russian acoustic surveys in the NAFO area with the purpose to estimate stock size of capelin and trawl surveys to evaluate the year class strength at age 0 were continued.

The acoustic survey in Divs. 3LNO was carried out by RV "Vilnius" from 6 June to 6 July, almost one month later than usual. Total biomass over the survey area was estimated at 118.0 thou.t, 30 times below the 1990 survey estimate. It should be mentioned, that the northernmost survey track ran along the ice edge, where most dense concentrations of capelin were recorded, and therefore, some part of fish might not be covered by the survey.

The autumn acoustic survey in capelin foraging areas (2J3K) was carried out by RV "Vilnius" from 28 October to 15 November. Total biomass of capelin in the area was estimated at 19.2 thou. t.

Along with acoustic survey a trawl survey of 0-group capelin in Div. 3L was carried out by RV "Vilnius" from 15 November to 30 November 1991. The 1991 year class was estimated by the survey as an average one.

Thus, as indicated by the surveys capelin stock declined almost 30 times against the 1990 level. The reason behind such a drastic stock drop within only one year, instead of expected growth, is not clear. Probably, abnormally low water temperatures in the capelin habitat are not of least importance.

Table 1. USSR catch in SA 0, 2, 3, 4 in
1989-1991

Species	Div.	1989	1990*	1991*
Cod	2GH	-	-	-
	2J+3KL	25	135	4
	3NO	5	18	67
	3M	-	22	1
Haddock	4VWX	182	163	191
	4VWX	470	273	195
Sebastes mentella	3NO	-	-	2
	2+3K	483	135	-
	3LN	10879	7362	3545
	3O	4517	3811	4278
	3M	13892	34581	8878
Rock grenadier	4VWX	195	262	263
	0+1	1	101	74
	2+3	2552	543	67
American plaice	2+3K	1	29	-
	3M	105	-	3
	3LNO	-	17	30
	4VWX	-	46	65
Witch flounder	2J+3KL	-	1	2
	3NO	3	9	-
	4W	-	-	9
Greenland halibut	0+1	32	6515	1576
	2+3KL	915	2377	2833
Capelin	2J+3K	22512	68223	429
	3NO	3384	14076	-
Silver hake	4VWX	72696	55981	49376
	3NO	-	-	-
Saithe	4VWX	1782	1052	1204
Yellowtail flounder	3LNO	-	-	-
Herring	4VW	1212	2512	932
Mackrel	3+4	311	3638	1182
Argentine	4VWX	105	199	43
Squid Illex	3+4	1656	2080	560
Others		37	12677	2374
Total		137952	216838	78203

* Preliminary data

Table 2.

Inventory of Oceanographic Stations in the Northwest Atlantic

COUNTRY: RussiaYEAR: 1991

SHIP NAME	NAFO SUB-AREA	NAFO STANDARD SECTION				OTHER STATIONS						TYPE	
		Date Span	Name	Parameters (T,S,O ₂ ,etc.)	Tot. Stns.	Seasons			Parameters (T,S,O ₂ ,etc.)	Tot. Stns.			
						JFM	AMJ	JAS			OND		
"Vilnius"	3	13.04	I-A	T,S	7		I7I	I2			T,S	183	Bottle
35 cruise		21-22.04	2-A	T,S	6								Bottle
		26.04	4-A	T,S	8								Bottle
		27-28.04	6-A	T,S	7								Bottle
"Kapiten Shaibnev"	0	2-3.II	34-A	T,S	7								Bottle
25 cruise	2	27-28.09	38-A	T,S	6								Bottle
	0	23.I0	8-A	T,S	11								Bottle
	2								53		T,S	53	SND
	2							6	38		T,S	44	Bottle
	2								43		T,S	43	SND
	3							19			T,S	19	Bottle
"Vilnius"	2												
37 cruise	3								18		T,S	18	Bottle
									89		T,S	89	Bottle
												449	

Table 3. Numbers and biomass of Greenland halibut in Div. OB as indicated by the trawl survey.

Stratum	Depth	Number of tows	Mean		Mean catch per 1 hr tow		Numbers x 10 ³	Bio-mass, t
			Length cm	Weight g	No.	kg		
I	20I-300	3	8,5	6	I,0	0,0I	87,3	0,5
8	"-	3	-	-	-	-	-	-
22	"-	3	32,5	32I	0,3	0,I	27,4	8,8
2	30I-400	3	35,9	43I	8,0	3,4	546,4	235,3
9	"-	3	35,4	443	4,3	I,9	644,8	286,0
23	"-	3	28,4	206	27,3	5,6	946,5	I95,I
3	40I-500	3	4I,6	726	23,3	I6,9	2260,7	I64I,I
I0	"-	4	33,3	406	32,3	I3,I	I870,5	760,3
24	"-	3	29,I	270	42,0	I,I4	2254,0	609,5
4	50I-750	4	45,6	925	64,8	59,9	I120I,8	I036I,I
I1	"-	4	40,6	690	56,5	39,0	4836,0	3336,8
25	"-	4	32,9	388	4I,3	I6,0	3254,2	I262,7
5	75I-1000	5	46,3	926	I03,4	95,8	7927,3	7343,8
I2	"-	3	44,9	832	42,7	35,5	I490,2	I239,5
6	I00I-1250	5	50,0	I162	I15,6	I34,3	8455,9	9825,7
I3	"-	3	48,5	I038	93,3	96,8	I185,7	I230,3
7	I25I-1500	3	50,9	I279	62,7	80,2	3808,8	487I,0
Total		59					50797,5	4320,5

Table 4. Inventory of biological surveys

SA	Div.	Month ¹	Survey type ²	Objectives	No. of tows
3	3LNO	4-6	S	Groundfish, temperature salinity	261
	3LNO	5	O	Capelin, temperature salinity	60
	3M	4-5	S	Groundfish, temperature salinity	107
0	OB	II	S	Greenland halibut, grenadier, temperature salinity	59
2	2G	10-II	S	Greenland halibut, grenadier, temperature salinity	139
	2H	II-12	S	Greenland halibut, grenadier, temperature, salinity	51
	2J3K	II	O	Capelin, temperature, salinity	11
3	3K	9	O	Grenadier, Greenland halibut, temperature, salinity	31
	3LNO	II	O	Larval capelin, temperature, salinity	25

- I Use number from 1 to 12 for months
 2 Insert S for stratified-random and O for other surveys.

Table 5. Numbers of bottom fish in SA 3 as indicated by trawl surveys in 1984-1991, mill.fish

Species	Div.	1984	1985	1986	1987	1988	1989	1990	1991
Cod	3K	295,9	286,0	270,4	132,9	306,2	229,9	276,3	-
	3L	311,9	180,7	297,0	73,4	89,4	123,2	99,6	170,2
	3NO	259,3	520,7	269,8	54,2	55,4	13,4	5,2	35,8
	3M	60,7	37,1	37,2	36,8	26,7	70,4	4,3	10,5
Redfish	3K	749,1	810,3	816,1	154,6	44,1	68,5	44,6	-
	3LN	720,3	245,1	133,4	182,1	167,3	44,7	23,1	41,8
	3O	763,8	1232,4	750,7	99,4	348,8	170,4	537,8	92,7
	3M	376,7	177,3	1200,2	463,2	183,1	283,8	74,7	2006,1
American plaice	3K	93,3	48,8	48,3	44,4	56,9	17,6	21,8	-
	3LNO	1295,6	693,8	826,8	604,3	458,6	708,5	350,8	320,9
	3M	26,5	15,8	33,4	16,5	10,0	8,3	2,6	12,7
Yellowtail flounder	3NO	261,0	194,0	89,6	64,8	45,4	128,2	60,1	64,5
	3K	16,2	28,4	22,1	8,3	5,5	4,9	3,5	-
	3LN	12,6	15,3	7,5	6,3	3,0	4,6	1,9	2,8
	3O	4,3	6,6	11,8	6,0	10,3	5,1	4,3	15,3

Table 6. Biomass of bottom fish in SA 3 as indicated by trawl surveys in 1984-1991, thou. t

Species	Div.	1984	1985	1986	1987	1988	1989	1990	1991
Cod	3K	355,3	243,6	271,3	130,5	331,2	352,2	335,7	-
	3L	383,3	177,1	437,2	132,9	159,4	195,5	123,7	166,7
	3NO	266,8	457,7	425,4	289,8	110,2	81,5	57,5	142,1
	3M	31,2	28,1	26,1	10,2	7,7	36,5	3,9	6,7
Redfish	3K	319,8	356,9	372,8	69,5	13,8	34,5	21,7	-
	3LN	199,4	85,9	46,8	60,8	40,0	10,9	7,1	14,5
	3O	108,7	129,0	109,4	19,2	34,5	27,9	98,6	13,5
	3M	132,3	51,9	309,5	106,4	47,0	83,3	17,7	45,4
American plaice	3K	52,7	17,9	18,9	18,4	13,9	5,9	6,9	-
	3LNO	642,1	325,6	348,6	225,8	160,4	244,6	129,4	110,2
	3M	7,5	7,8	20,2	9,3	6,5	5,0	1,2	14,4
Yellowtail flounder	3NO	96,9	84,5	39,5	26,5	20,8	43,8	27,5	27,3
	3K	13,0	19,8	14,5	5,0	3,1	3,2	2,1	-
	3LN	9,3	12,2	6,2	4,7	1,9	3,1	1,2	2,1
	3O	2,5	3,4	5,9	3,9	6,8	2,9	2,7	8,1

AtlantNIRO Research Report in NAFO Subarea 4 in 1991

by

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A. STATE OF FISHERY

According to the provisional data, Soviet silver hake catch in 1991 amounted to 53.200 t that means 5% reduction as compared to the catch estimate of the previous year when 56.000 t was caught. As a whole fishery in 1991 was similar to that of observed in 1990. Possibly, it can be explained by the similarity of the oceanographic conditions, determining silver hake behaviour and distribution in April-July. Catch-per-unit-effort data (current information) by month and year are presented in Table 1. From the data obtained we can see that in April 1991 catch-per-fishing-day differed insignificantly from the mean longterm value. As to the May and June values are concerned they decreased noticeably. Data for July are not representative ones, as silver hake left the fishery area and migrated to the north of SMGL. Hake constituted from 85% to 90% of the total catches. Other species by-catch didn't exceed the allowable level (provisional data).

The 1992 silver hake fishery stock size judging by the TAC values recommended by Scientific Council is the same as it was in 1991. The fishery will be based on the fish aged 2-4 belonging to the strong 1988 and 1990 year-classes and comparatively weak 1989 year-class. Fishery situation is expected to be the similar as it was in 1991. In May-June some improvement is possible. Mass spawning is supposed to start a little bit earlier as compared to that of the previous year.

B. SPECIAL RESEARCH

Environmental studies

Environmental studies on the Scotian Shelf were conducted in two directions. The first one included hydrometeorological studies performed in 1991. They were based on the analysis of the sea surface temperature (SST), indices of surface water boundary location, wind conditions parameters and water column temperature in autumn period. The last data were collected by R/V Maltsevo during annual juvenile hake survey.

The second direction included studies of the environmental conditions influencing formation of the silver hake concentrations in the shelf area. Ecological surveys made by R/V Evrika in 1990 within the framework of the Joint Soviet-Canada programme were the major part of these studies. Monthly means of SST in the junctions of 2-degree grid were used for the first type of studies. Temperature was measured in datum points of the Scotian Shelf, Grand Banks off Newfoundland and Labrador Sea. Using these data new long-term means for each month from 1977 and 1991 and SST anomalies basing these means were calculated in 1991. Temporal series of indices for location of cold shelf waters, slope waters and northern edge of the Gulf Stream boundaries were continued. Data on wind conditions were collected by the vessels and then averaged by week and month. Information on water column temperature collected in 1991 was limited by bathythermographic series of the autumn survey.

The 1991 data analysis showed temperature decrease in the upper layers of the Scotian Shelf, Grand Banks off Newfoundland and Labrador Sea. The same picture could be observed in 1990 as well. Number of months with SST negative anomaly ranged from 6 to 10. As far as water boundary location is concerned, spring-summer negative anomalies were found both in 1990 and 1991, i.e. displacement of these boundaries to the south occurred. Autumn temperature analysis between 0 and 200 m showed that on the Scotian Shelf negative and positive anomalies occurred in the upper and intermediate and bottom layers, respectively. Comparing all the indices with 1990 conditions we can trace a

tendency to the slight-temperature increase in 1990. This tendency resulted in decrease of SST negative anomaly absolute values as compared to those observed in 1990. In some cases a change of negative anomalies for positive ones occurred. As for the wind conditions winds of the western quarter prevailed in 1991 with strengthening of north component in January-April and south component in May-December. Thus, on the whole, 1991 can be determined as the second after 1989 cold year with clearly pronounced tendency to water temperature increase against the background of the interannual changes in 1986-1991.

Within the framework of the second type of studies complex data analysis was continued. Data were collected during conducting ecological surveys on the Scotian Shelf continental slope according to the Soviet-Canada programme on the silver hake research. The objective of the programme was to study conditions for hake concentrations formation during feeding and prespawning periods. Distribution fields for bottom temperature, salinity, phosphates and geostrophic circulation were constructed and three-dimensional circulation fields were calculated. Distribution fields for major groups of feeding plankton and silver hake catches were presented as well. As a preliminary hydrological front can be considered to be the main factor stimulating formation of the fishery hake concentrations and providing relevant temperature and food conditions. Some results of the environmental studies will be presented in details in a series of the special reports.

Biological studies

In November regular joint Soviet-Canada trawling survey on juvenile silver hake (0-group) was conducted. Totally 80 trawling stations were made, i.e. 30 trawling stations less than in previous years. We refused to make stations in some layers of the Eastern Scotian Shelf where juvenile hake was not practically available during many years of observation. Preliminary index of abundance for 0-group (mean weighted catch per set) was 76.2 specimens, i.e. the third least value of year-class for the period of observation.

In 1991 samples were collected only in May and June as the

observers couldn't manage to get to the fishing areas in time.

On the whole sampling intensity decreased. In all about 43.000 specimens were measured and 460 pairs of otoliths for silver hake age determination were taken. According to data obtained specimens of 26-33 cm long constituted the bulk of the catches (Table 2). Mean length increased noticeably as compared to that of the previous year. Usually fish aged 2-4 prevailed in the catches (Table 3). However, this year share of fish aged 3 and 4 (1988 and 1987 year-classes) increased greatly as compared to that of the previous year. So did mean age estimates. Analysis of hake biological state and catch-per-unit-effort by 5-day period was made using data collected by the observers in 1991 (Table 4). If to compare with the situation observed in 1990 larger individuals constituted the catches taken in May and June. Maturation rate (mean maturity stages) was at 1990 level. In May 1991 mean value of stomach fullness exceeded the level of the previous year. Influence of silver hake abundance on weight growth rate was studied. Taking into account some uncertainties concerning state estimation of silver hake stocks we can't draw a reliable conclusion on relationship between weight growth and population abundance, though some facts support this supposition. Detailed analysis is given in a special scientific paper.

Analysis of data for mackerel collected by R/V Evrika in summer 1990 has been completed. Fish length in the catches ranged between 20 and 43 cm; age composition ranged from 1 to 10 years. Individuals aged 2-3 of 27-33 cm long prevailed in the catches. Means for length and weight by age group are presented in Table 5.

Table 1

Soviet silver hake catches per vessel-day by year
and month (current data)

Year	Month				:Mean Catch :per Fishery :Season (t)
	: April	: May	: June	: July	
1977	32,7	25,0	39,5	35,4	31,3
1978	20,3	16,8	17,1	26,9	23,5
1979	21,8	25,9	25,8	36,5	27,4
1980	22,8	20,6	21,0	23,6	20,9
1981	14,1	27,9	22,9	30,6	26,6
1982	49,7	37,9	37,4	31,9	37,2
1983	37,8	33,9	21,3	14,3	30,5
1984	44,8	34,3	35,8	43,1	38,4
1985	41,9	42,2	33,2	40,5	38,9
1986	-	50,2	42,0	42,4	44,3
1987	49,2	37,0	34,5	12,3	32,6
1988	43,8	40,4	33,5	15,3	36,8
1989	44,0	44,0	34,7	31,0	40,7
1990	35,1	24,1	24,5	33,0	24,5
1991	31,8	25,7	23,8	23,7	25,4
Mean catch for 1977- 1991 (t)	32,7	32,4	29,8	29,4	32,0

Table 2

Length composition of silver hake in the Soviet commercial catches (%)

Length (cm)	Year				
	1987	1988	1989	1990	1991
15	+	-	0,2	+	+
16	0,1	-	0,4	0,1	+
17	0,3	+	0,5	0,2	+
18	0,3	+	0,5	0,4	0,4
19	0,2	+	0,4	0,3	0,2
20	0,1	+	0,5	0,4	0,2
21	0,2	+	1,3	0,2	0,1
22	0,2	+	1,7	0,3	+
23	0,2	0,1	1,7	1,4	0,1
24	0,5	0,5	1,6	4,7	0,0
25	12,2	1,8	3,0	10,8	9,9
26	15,2	4,9	4,8	14,8	0,0
27	13,0	10,9	5,2	15,0	12,3
28	9,7	17,5	7,3	12,6	16,2
29	7,2	19,8	11,6	11,4	16,7
30	7,3	16,2	15,2	9,8	15,4
31	6,9	11,8	15,0	7,6	12,2
32	6,7	7,0	12,2	4,4	9,8
33	4,9	4,4	7,5	2,5	3,3
34	3,4	2,7	4,0	1,2	0,0
35	2,2	1,3	2,2	0,6	0,0
36	1,3	0,7	1,2	0,4	0,4
37	0,8	0,3	0,8	0,2	0,2
38	0,3	0,1	0,4	0,1	0,1
39	0,3	0,1	0,3	0,1	0,1
40	0,2	+	0,2	+	+
41	0,1	+	0,1	+	+
42	0,1	+	0,1	+	+
43	+	+	0,1	+	+
44	+	+	+	+	+
45	+	-	+	+	-
46	+	-	+	+	-
47	-	-	+	+	-
48	-	-	+	+	-
49	-	-	+	-	-
50	-	-	+	-	-
51	-	-	+	-	-
Mean length (cm)	28,4	29,4	29,6	27,7	29,1
Mean weight (kg)	0,151	0,190	0,188	0,141	0,187

Table 3

Age composition of silver hake in the Soviet commercial catches (%)

Age (yr)	Year				
	1987	1988	1989	1990	1991
1	1,6	+	5,0	2,3	1,0
2	59,3	42,4	31,7	51,4	23,1
3	21,0	41,3	38,1	32,4	43,6
4	14,5	13,8	20,2	11,6	26,6
5	2,8	2,4	4,1	1,8	5,1
6	0,6	0,1	0,8	0,5	0,5
7	0,2	+	0,1	+	0,1
8	-	+	+	+	+
9	-	-	+	-	-
Mean age	2,6	2,8	2,9	2,6	3,1

Table 4

Catch-per-unit-effort values and some biological characteristics for silver hake in 1991 by month and 5-day period

Month and 5-day period	Mean catch per fishing day (t)	Mean length (cm)		Mean stage of maturity		Mean stomach index	
		Male	Female	Male	Female	Male	Female
May							
1.	27,2	-	-	-	-	-	-
2.	34,0	28,2	30,5	3,1	3,1	2,0	2,1
3.	27,0	27,8	30,0	3,3	3,2	1,6	1,8
4.	32,3	28,4	30,7	3,8	3,5	1,7	1,7
5.	29,5	27,7	29,5	3,7	3,3	1,9	2,0
6.	27,9	27,9	30,2	3,8	3,4	1,2	1,3
June							
1.	16,4	27,8	29,5	4,2	3,5	2,6	1,7
2	19,4	28,2	30,8	4,1	3,9	0,3	0,4
3	22,3	28,2	30,7	4,0	3,7	1,7	1,3
4	19,0	28,0	30,7	4,1	3,7	1,4	1,6
5	25,4	27,2	29,4	4,2	3,9	1,0	1,1

Table 5

Mackerel Length and weight by age group

Age group	1	2	3	4	5	6	7
Mean length (cm)	22,1	27,8	31,4	33,4	36,7	37,0	42,5
Mean weight (kg)	0,086	0,210	0,325	0,401	0,564	0,545	0,845