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Russian Research Report for 1992

by

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PINRO Research in the NAFO Area in 1992

by

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Subareas 0 and 1

A. Fisheries status

In late June one ship of the PST- and 4 STM-types commenced Greenland halibut fishery in Div.0B. Daily catch averaged 5.1 and 5.7 t, respectively, using a bottom trawl at 850-1000 m depths.

In July 4-8 ships of the PST-type, 2 -STM- and 1 -BMRT-types were fishing in the same division and daily catch amounted to 5.4-6.4 t.

In August the fishing was continued in the depth from 750-1115 m and daily catch by the ships of the PST- and STM-types averaged 6.7 and 7.1 t, respectively, and 7.4 t - by BMRT-type. Daily catch by SRTM-type of long-line fishing was considerably lower , i.e 1.7 t.

In September trawl fishery was carried out by 2 small groups of ships. One of them operated along the boundary of Div.2G at 800-1000 m depths and the second one - to the north of 63°40' - in the depth from 900 to 1050 m. Monthly catch by the ships of PST-type averaged 5.1 t, by STM - 5.0t and BMRT-type - 4.5 t per ship/day fishing. In October daily catches taken by the ships were approximately the same.

In the first half of November a group of ships (1-4 STM-type) operated in close vicinity of Div.1D boundary and hauls were done from 1000 to 1200 m depths. Halibut catches amounted to 2.5-3.0 t, with daily catch being 5.3 t. In the second half of November due to ice coverage the ships shifted to the south-west where a daily catch made up 10 t. Ice fields occasionally blocked the area to 1200-meter isobath and prevented from fishery. By-catch of grenadier did not exceed 8-10%.

Total catch is given in Table 1 (preliminary).

DIV.0B

B.Special research

1. Environmental studies
a)Oceanographic observations

Oceanographic observations were conducted along the continental slope south of 64°15'N between 58 and 62°W on RV "Kapitan Shaitanov" from 25 to 29 November. 26 trawl stations have been occupied, the observations involved salinity and vertical profiles temperature measurements using the STD-system.

The survey was conducted along the polar frontal zone , characterized by subsurface maximum of temperature and salinity contrasts. Water temperature in the upper 50-meter layer varied from -1°C in the area of polar waters in the southwest to 3°C in transformed Atlantic waters over an exterior part of the continental slope with more than 1000 m depths. Thermal structure of waters over the upper mixed layer was determined by a slope of the frontal zone and Atlantic waters with a poorly pronounced maximum of temperatures (>4.5°C) in an intermediate layer (400-600 m).

Biological studies
Greenland halibut (0B)

A trawl survey in Div.0B was carried out in the 500-1300 m depths from 25 to 29 November 1992. Fields of solid ice prevented from conducting the survey. A total of 26 research tows were made by RV "Kapitan Shaitanov". Greenland halibut were scattered and were at low commercial concentrations. Largest catch of 589 kg per hour tow occurred in depth 1160 m. Halibut from 41 to 48 cm long (mean length for males - 43.9 and for females - 46.5 cm) were predominant in catches from the Baffin Land area. Mean length and weight of fish, as well as a relative number of females increased with depth, with a portion of mature specimens amounting to 38.7% maximum below 1250 m. Feeding intensity was not high, mean degree of stomach fullness did not exceed 1. Shrimp and fish were the main feed items. As in previous years, fish at age 5-7 constituted the bulk of catches. According to preliminary estimation halibut biomass made up 31.7 thou.t and abundance - 37.5 mill. spec. These figures correspond to the level of 1987 and approximately by 30% lower compared to 1991. The estimate obtained does not indicate a reduction in stock since the trawl survey in 1992 has covered only 40% of Div.0B.

No trawl survey was conducted in SA I.

~~Rock grenadier~~ (OB) ROUNDNOSE GRENADIER

As in previous years, during the 1992 trawl survey ~~rock~~ Roundnose grenadier occurred in Greenland halibut catches only as small by-catch. Its maximum catch was 15 kg. Mean length of grenadier at mean age 7,8 was 41.1 cm long. A sharp increase was noted in the mean length of males and females and a relative amount of the latter with depth. All males and females were immature. Sex ratio was 1.1:1. Mean degree of stomach fullness was 1.7 and copepods, euphausiids, shrimp and squid were principal prey.

Subareas 2 and 3

A. Fisheries status

Greenland halibut . No fishery on halibut was practically conducted off the Northern (2G) and Central (2H) Labrador, simultaneously the vessels were searching for fish in the main commercial area of the Baffin Land.

ROUNDNOSE
~~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 1992 Russian fishing ships fished for redfish concentrations mostly over the Flemish Cap Bank and beyond the fishing zone of Canada off southern and south-western Newfoundland. In July and August 4 ships operated also in the zone of Canada (Div.3O).

In March-July a small group of Russian ships fished redfish on the western and southwestern slopes of the Flemish Cap Bank at 550-850 m depths. Large catches were registered in the second half of April with subsequent catches being 1-10 t per 2-4 hr of trawling.

In June-August a group of ships were fishing with bottom and mid-water trawls on the southwestern slope of the Grand Newfoundland Bank. Mean catches by bottom trawl made up 23.8 t per day and 19.8 t - by mid-water one.

In July-August catches were essentially higher in the zone of Canada.

Capelin. In 1992 the national quota of Russia 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. Directed scouting for capelin concentrations was not conducted in 200-mile zone. The sites of capelin spawning grounds in the southeastern shallows (3N) outside the zone were periodically controlled. Here some catches were taken (to 2 t per 1-3

trawling hour), with the immature capelin specimens from 10 to 12 cm length predominating.

Small capelin concentrations were found by RV MG-1366 during acoustic survey in the first half of November in Div.3K. Catches did not exceed 1 t per 1 hr trawling, fish of 12-16 cm long at age 2+ and , to a small extent, 3+ prevailed.

Cod (3NO). In 1992 no directed fishery on cod was carried out by Russian fleet in the Northwest Atlantic. Cod were caught only as by-catch when fishing redfish on the Grand Newfoundland Bank southern slopes. In June-August small cod by-catch from 0.3 to 11.6% taken by a bottom trawl, was registered only in small depth (less than 300 m).

Other species. No directed fishery for other species was carried out, small by-catches of wolffish, skate, roughhead grenadier occurred in Greenland halibut fishery and by-catches of flatfishes and skate - in redfish one.

Subarea 2

B.Special studies

a) Oceanographic observations

Oceanographic works were performed along transect 8-A(10-11 November , 11 stations), crossing the Hamilton Inlet Bank, by RV "Kapitan Shaitanov", as well as at random stations on the shelf and continental slope in Divs.2J (7-10 November, 9 stations) and 2GH (30 November-15 December, 34 stations).

Mean water temperature in 50-200 m layer along transect 8-A was lower than the norm by 0.4°C and by 0.3°C below the corresponding value in the similar period 1991. This deficiency of heat resulted from cooling of waters on the shelf and adjacent periphery of the frontal zone over the continental slope; no essential deviations of the norm of thermal state of waters in the Labrador Current Irminger component was found.

All temperature measurements along transect 8-A below 100 m showed its reduction relative to the norm. Typical values for temperature anomalies in the depths from 200 to 1000 m were about -0.2 and nearly -0.5°C in 1200-1500 meter layer, where the Labrador Sea waters are pronounced (LSW), forming a local extremity over a vertical profile of anomalies. Unusual low temperatures of the Labrador Sea waters, are apparently representative of the variations in conditions of this water mass formation, observed in severe recent years.

Subarea 3

1.Environmental studies

a)Hydrographic observations

Oceanographic observations were performed on the Flemish Cap Bank (26 random stations) by RV "Kapitan Shaitanov" from 15 to 20

April and from 17 October to 7 November in Divs.3KLM (55 random stations). In spring deepwater measurements for temperature and salinity were done at the stations by Nansen bottles , as well as by the latter and CTD-system in autumn.

In April water temperature varied in the upper 50-meter layer over the FlemishCap Bank from -0.6°C on the western slopes to 2.7°C on the eastern one and was below the norm by 2-3°C. Deficiency of heat in the upper layer combined with a lower (by 0.2-0.5 psu) salinity. Effects of cooling and freshening fell with depth and near the bottom water temperature anomalies did not exceed -0.5°C (by modulus). Structure of waters in the north of Div.3K in late October - early November was characterized by a wide distribution of cold intermediate layer (CIL) almost all over the shelf area surveyed. Transgression of CIL, registered in autumn seasons early in 90's, is, probably, related to a higher production of these waters in the recent years severe winters.

2.Biological studies

In 1992, like in previous years, priority was given to evaluation of the status of commercial stocks through trawl and acoustic surveys. However, no trawl-acoustic survey for bottom fishes off the Newfoundland , except for the Flemish Cap Bank, was conducted because of financial difficulties. Table 2 shows survey details, time and amounts of materials collected.

ROUNDNOSE
Rock Grenadier (2+3K, 3LM). Trawl survey was conducted by RV "Kapitan Shaitanov" in Divs.2G and 2H at 500-1400 m depths from 30 November to 15 December 1992. Grenadier occurred in catches from 700 m depth and were predominant in those taken from 901 to 1000 m; however, the catches were negligible , i.e. lower compared to 1991. Maximum catches were taken at 1150 m depth (150 kg) and 118 kg - at 1300 m depth. Mean length of fish in catches was 42.8 cm. In all catches males were a little smaller than females. Thus, in Div.2G males from 15 to 80 cm long with mean length being 42.5 cm occurred in catches, as well as females 17-88 cm long with mean length 43.3 cm. Length composition of grenadier was similar in catches from Div.2H.

Sex ratio was 1.6:1 in Div.2G and 1.5:1 - in Div.2H. All fish were immature.

Grenadier were feeding moderately. Mean degree of stomach fullness made up 1.85 and 1.89 in Divs. 2G and 2H. Copepods, Mysidacea, squid, Themisto and shrimp were major prey.

From 22 to 27 October 1992 a set of 1-hour bottom hauls were done every 100 m from 500 to 1400 m depths in Div.3K to study vertical distribution of commercial fishes. Catches at depth to 900 m were from 130 to 200 kg, with S.marinus constituting

to 70% in them. Catches were mainly consisted of Greenland halibut and grenadier with fishing depth and did not exceed 200 kg. Relative amount of grenadier increased with fishing depth and it made up above 80% in catches below 1300 m.

Mean length of both males and females sharply increased with fishing depth (from 35 cm at 501-600 m depth to 60 cm in males and 69 cm in females at 1400-1460 m depths). Mean length of grenadier from Div.3K made up 49.8 cm, mean age - 8.5. Sex ratio was 1.6:1. Both males and females were immature, except for 5 specimens with gonads at maturity stage III. The females were caught in the depth from 1100 to 1460 m. Grenadier were feeding moderately, mean degree of stomach fullness was 1.61. Euphausiids, copepods, shrimp, squid and fish were major prey.

In Divs.3L, 3M (Flemish Pass) hauls were done in the depth 900-1150 m from 17 to 20 October 1992. Catches of grenadier per 1 trawling hour were from 20 to 180 kg. Greenland halibut (40-90%) and rock grenadier (15-20%) constituted the catch, with catfish and roughhead grenadier in it being as by-catch. Males had the length of 16-71 cm, mean length 36.9 cm, females - 17-71 cm, mean length 38.9 cm. All specimens of grenadier were immature. Mean degree of stomach fullness was 1.15. Euphausiids, copepods and shrimp were major prey.

Greenland halibut (2G, 2H, 3K, 3LM). Trawl survey for Greenland halibut in Div.2G was carried out from 30 November 1992 to 6 December 1992. A total of 50 valid hauls were done by strata and covered the depth range from 200 to 1500 m. The largest catch of Greenland halibut was taken from the stratum 906-102 (3 kg). The catches increased when trawling below 1150 m depth.

Male length varied from 13 to 61 (mean length 37.2 cm), females-from 12 to 85 cm (mean length 37.8 cm). Mean length of both males and females increased with fishing depth. Mean length of males was 26.0 cm in the depths 200-500 m, that of females - 26.5 cm, and 43.1 cm in males and 44.7 cm in females in the depths from 1001 to 1500 m.

96.3% of males and 98.6% of females were immature, mature specimens occurred in catches from below 1000 m depth. On the whole, the males constituted 53.9% . Feeding intensity of halibut decreased with fishing depth. Thus, mean degree of stomach fullness of halibut in the depths to 500 m was 1.17, from 501 to 1000 m - 0.47 and 0.26 - in the depths below 1000 m. Squid, Themisto , shrimp and fish were the main food objects.

Trawl survey in Div.2H was conducted from 10 to 15 December 1992. In total 22 one-hour valid hauls were done from 501 to 1500 m depths. Maximum catch of 339 kg was taken from 1280 m depth.

Male length varied from 23 to 61 cm(mean length 39.3 cm), fema-

les - from 20 to 89 cm (mean length 40.8 cm).

All males of Greenland halibut to 750 m depth and females to 1000 m were immature. 9.5% of mature males and 14.1% mature females were taken from 1251 to 1500 m depths. On the whole, the percentage of males from Div.2H was 60.0%.Mean degree of halibut stomach fullness made up 0.32. Squid, shrimp and fish were major prey.

By the data from the trawl survey conducted in Divs.2G and 2H in 1992 numbers of Greenland halibut were estimated at 22.4 mill. spec. and biomass at 14.5 thou.t. These indices are at the level of 1991, however, the survey area was approximately 50% smaller than in 1991.

Trawl survey was performed in Divs. 3L and 3M (Flemish Pass) from 17 to 20 October 1992. In total 9 hauls were done in the depth 900-1150 m. Greenland halibut occurred in all catches, however, they were minor. The largest catch of Greenland halibut (176 kg) per 1-hour trawling was taken from 1150 m depth. In that area Greenland halibut concentrations were,probably, below 1150 m.

Length of Greenland halibut males in catches varied from 36 to 63 cm (mean length 47.8 cm), females - from 33 to 93 cm (mean length 54.1 cm). They were mainly immature fish. Mean degree of halibut stomach fullness was 0.88 and squid, shrimp and fish were major prey.

In Div. 3K in total 30 valid hauls were done in the depth range from 500 to 1460 m each 100 m from 22 to 27 October 1990. Greenland halibut occurred in catches from all depths, with maximum total catches (about 200 kg) being taken from 800 to 1200 m depths, and a portion of halibut made up 25-30%. In the depths below 1300 m a portion of halibut from catches was 3-8% and that of rock grenadier - 85-88%.

Males length in halibut varied from 31 to 70 cm (mean length-43.0 cm) and females - from 25 to 98 cm (mean length 48.6 cm). Mean length of fish grew to 1300 m with fishing depth. Sex ratio was 1.1:1.0. Almost all specimens of halibut were immature. Maximum amount of mature specimens (to 50%) was registered in the depth range from 1201 to 1300 m.

Mean degree of stomach fullness in Greenland halibut varied from 2.36 at 501-600 m depths to 0.00 - at the depths from 1401 to 1460 m (on the average over the area - 1.48). Squid and fish were major prey.

Capelin (2J, 3K).Acoustic survey for capelin was conducted by RV "Kapitan Shaitanov" in Divs.2J and 3K from 30 October

to 15 November 1992. Small aggregations of capelin were found at 250-400 m depths only in the east of Div.3K. Capelin biomass set at 9.6 thou.t proved to be the lowest for recent 10 years. Fish at age 2 from the 1990 yearclass made up the bulk of aggregations (80%). Capelin of 12-16 cm long (mean length 14.1 cm) from check hauls constituted the bulk of catches.

Sebastes marinus (3M). Trawl-acoustic survey to study distribution and biology of S.marinus on the Flemish Cap Bank was carried out by RV "Kapitan Shaitanov" in April 1992. The survey covered the whole bank, excluding for 4 strata on the southern slope (Strata 4, 9, 13, 17).

Redfish at age 4-23 of 8-49 cm long occurred in catches. Specimens from the rich 1990, 1989 and 1985 yearclasses made up the bulk of catches. Major portion of fish was immature. Redfish were distributed over the depths from 200 to 700 m. The densest aggregations and largest catches of redfish were recorded on the western and northwestern slopes. A considerable amount of juveniles at 8-13 cm length contained in the catches.

By results from the trawl survey the abundance of redfish was estimated at 119.5 mill.indiv. and biomass - at 18.2 thou.t and 269.1 mill.indiv. , and 99.5 thou.t - by the data from the trawl and acoustic survey. Thus, the stock of redfish on the Flemish Cap Bank continues to reduce.

Cod (3M). In April 1992 no cod aggregations were found during trawl-acoustic survey. Mean catch per a half-hour valid haul contained 20 specimens. Cod length varied from 12 to 78 cm, with predominant length being 24-30 cm at age 2-3 from the 1990 and 1989 yearclasses. The abundance and biomass of cod on the Flemish Cap Bank (except for 4 strata uncovered in the south of the bank) were estimated at 8.7 mill.indiv. and 2.5 thou.t, respectively. Thus, the reduction in cod stock resulted from a commercial withdrawal of fish from the 1985 and 1986 yearclasses.

American plaice (3M). By results from the trawl-acoustic survey conducted on the Flemish Cap Bank in April 1992 the American plaice abundance and biomass were set at 1.9 mill.indiv. and 1.0 thou.t, respectively. These results are lower than in 1991 and approximately are at the level of 1990 (2.6 mill.indiv. and 1.2 thou.t).

Table 1. Russian catches in Subareas 0, 2, 3 and 4 in 1990-1992 (preliminary data)

Species	NAFO area	1990	1991	1992
Cod	2	-	-	-
	2+3K	135	4	-
	3 O	18	67	51
	3 M	22	1	1
	4 X	163	191	27
Haddock	4 X	273	195	42
	3 O	-	2	-
S.mentella	2+3K	153		6
	3 L	7362	3345	571
	3 O	3811	4278	5845
	3 M	34581	8878	2937
Roughose	4 X	262	263	169
Rock grenadier	0+1	101	74	7/22
	2+3	543	67	7/3
American plaice	2+3K	29	-	
	3 M	-	3	-
	3 O	17	30	-
	4 X	46	65	7/30
Witch	2+3K	1	2	-
	3 O	9	-	-
	4	-	9	-
Greenland halibut	0+1	6515	1576	7/1705
	2+3K	2377	2833	7/21
Capelin	2+3K	68223	429	-
	3 O	14076		-
Silver hake	4 X	55981	49376	7/1920
	3 O	-		-
Saithe	4 X	1052	1204	
Yellowtail flounder	3 O	-	-	-
Herring	4	2512	932	7/123
Mackerel	3+4	3638	1182	7/1201
Argentine	4 X	199	43	7/2
Squid Illex	3+4	2080	560	7/31
Others		12677	2374	126/668
Total		216838	78203	13663/21436

Table 2 Inventory of biological surveys

SA	Div	Month[1]	Survey type[2]	Objectives	No. of tows
3	3M	4	S	Groundfish, temperature, salinity	53
0	0B	11	S	Greenland halibut, grenadier, temperature, salinity	26
2	2G	11-12	S	Greenland halibut, grenadier, temperature, salinity	50
	2H	12	S	Greenland halibut, grenadier, temperature, salinity	22
3	3K	10	S	Greenland halibut, grenadier, temperature, salinity	29
	3LM	10	O	Greenland halibut, grenadier, temperature, salinity	9
	2I3K	11	O	Capelin, temperature, salinity	7

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

AtlantNIRO Research Report in NAFO Subrea 4 in 1992

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A. STATE OF FISHERY

According to the provisional data Russian silver hake catch in 1992 amounted to 13,000 t that means 75% reduction as compared to the catch estimate of the previous year when 49,000 t was caught. The fishery situation in 1992 was extremely unstable and low estimates of catch-per-unit-effort were observed between April and June (Table 1). High by-catch of pollock prevented the fishery to a considerable degree. As a rule it exceeded the allowable 5% level. For this reason the fishing fleet was forced to seek for the areas with a low abundance of pollock. Abnormal hydrometeorological conditions adversely affected the accessibility of silver hake for fishery as well. In the middle of June the fishing fleet left the Scotian Shelf.

By 1993 the size of silver hake stock noticeably decreased as compared to that of the second half the eighties.

As usually the bulk of the stock consisted of fish aged 2-4 belonging to the mean 1989 and weak 1990 and 1991 year-classes. It is worth dwelling on the 1990 year-class that seemed to be comparatively strong basing the juvenile survey data but at the age of 1 was shown to be weak by the results of the July survey. Supposedly it can be explained by the high mortality of the year-class under discussion due to severe winter of 1990-1991.

B. SPECIAL RESEARCH

Environmental studies

Russian vessels conducted no oceanographic observations on the Scotian Shelf in 1992. Therefore, to analyse the 1992 hydrological conditions SST data and information on surface water boundary location were used. As in previous years the SST seasonal variation studied using a group of squares embracing the Scotian Shelf, Grand Banks off Newfoundland and Labrador Sea (Sigaev, 1991; 1992). Monthly mean anomalies of the characteristics mentioned were analysed. As far as the Scotian Shelf was concerned the seasonal variation of the SST anomalies in 1992 (40°-45°N; 60°-65°W) showed a decrease of winter and spring temperature values

as compared to those of the cold 1991. Summer and fall temperature values were close to the values observed in 1991.

On the Grand Banks off Newfoundland (45°-50°N; 45°-50°W) positive temperature anomalies prevailed in winter and early spring as compared to the situation observed in 1991. During the rest part of the year the conditions observed were close to those of 1991. In contrast to 1991 the positive anomalies of SST were recorded in the Labrador Sea (50°-55°N; 50°-55°W) during the first half of the year. Analysis of data on location of the water boundaries showed no considerable difference as compared to the situation observed in 1991. The seasonal variation in location of the cold shelf water boundary in 1992 was similar to that of observed during two previous relatively cold years. The peculiar feature of the above-mentioned variations was that since May the boundary had shifted to the south of its long-term mean position. That fact should be considered as intensification of the cold water advection from the north-east to the Scotian Shelf region. As to the seasonal variations in location of the slope water boundary and norhern Gulf Stream edge no marked difference was found as compared to the sitiation observed in 1991. Thus, the 1992 hydrological conditions in the Scotian Shelf area were indicative of the fact that cold season continued. In the Labrador Sea and on the Grand Banks off Newfoundland as it was observed in 1991 a tendency to the warming-up was found as compared to the conditions recorded in 1989 and 1990. Two periods of the relative temperature decrease (1977-1982 and 1988-1992) and one period of the temperature increase (1983-1985) are characteristic of the SST year-to-year variation in the Scotain Shelf area.

It must be noted that within the periods of the temperature increase and decrease estimates of catch-per-unit-effort for silver hake increased and decreased, respectively. In this connection it may be hypothesized that temperature variations within the upper layer can be considered as one of the factors influening the distribution and accessibility of the silver hake concentrations in the area alloted by Canada for foreign fishery. Relationship between hydrological indices and estimates of catch-per-unit-effort within the Scotian Shelf region were studied using the method of cluster-analysis. A series of equations of multiple regression was obtained which allows to connect monthly means of

catch-per-unit-effort and monthly means of SST and boundary position. Data for 1977-1991 were used. The best results with the highest multiple regression coefficients were obtained for the April catches. In the future the equations are planned to be checked using indepedent data.

In 1992 the environmental factors influencing the distribution pattern and density of the silver hake concentrations were studied as well. Data of the ecological surveys conducted on the Scotian Shelf by the R/V Evrika in May-July 1990 were used. Estimates of the silver hake catches taken during the 30 min hauls were compared with the near-bottom temperature and amount of comparatively small (Calanoida) and large zooplankton (Euphausiidae). Data collected at the 174 stations were used. Basing the results of the statistical analysis it may me supposed that only qualitative relation between the silver hake density and environmental parameters mentioned is available.

Biological studies

In 1992 a continious series of the fall juvenile silver hake surveys conducted during 14 years within the framework of cooperative fisheries research between Canada and Russia was stopped.

Thus, provisional data on 0-group abundance (1992 year-class) are not available and this will have a negative influence on the stock estimates and TAC for 1994.

Samples were taken from the commercial catches between April and June. Volume of the materials collected has decreased greatly. Totally 12,400 specimens were measured and 555 pairs of otoliths for age determination were taken.

As in 1991 specimens of 26-33 cm long constituted the bulk of the catches (Table 2). Abundance of fish aged 1 was insignificant. Usually fish aged 2-4 prevailed in the catches (Table 3). In 1992 reliability of abundance indices for silver hake was studied. Statistically significant correlation was found between fishery and survey indices for fish aged 2 and between survey (fish aged 1) and fishery (fish aged 2) abundance indices of the same silver hake year-classes.

For older age-groups correlation coefficients proved to be unreliable. Probable influence of pollock, cod and haddock by-catch on the estimates of silver hake catch-per-unit-effort were studied as well. The studies have allowed to reveal statistically

significant correlation between the indices under discussion. Thus, the hypothesis that high by-catch of some fish species has an unfavourable influence on the results of silver hake fishery was verified.

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Table 1 Soviet Silver Hake Estimates of Catch per Vessel-Day by Year and Month (t, current data)

Year	Month				Mean catch per fishing season
	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	34.6	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	36.1	24.1	24.6	33.0	24.5
1991	31.8	25.7	23.8	23.7	26.4
1992	24.2	15.1	14.9	-	18.2
Mean catch for 1977-1992	34.3	31.3	28.9	29.4	31.1

Table 2 Length Composition of Silver Hake in the Soviet and Russian Commercial Catches

Length, cm	Year				
	1988	1989	1990	1991	1992*
15	-	0,2	+	+	0,1
16	-	0,4	0,1	+	0,1
17	+	0,5	0,2	+	0,2
18	+	0,5	0,4	0,4	0,3
19	+	0,4	0,4	0,2	0,1
20	+	0,5	0,3	0,2	0,1
21	+	1,3	0,2	0,1	+
22	+	1,7	0,3	+	0,2
23	0,1	1,7	1,4	0,1	0,6
24	0,5	1,6	4,7	0,8	1,4
25	1,8	3,0	10,8	2,9	5,0
26	4,9	4,8	14,8	7,0	8,0
27	10,9	5,2	15,0	12,3	11,3
28	17,5	7,3	12,6	16,2	14,6
29	19,8	11,6	11,4	16,7	12,8
30	16,2	15,2	9,8	15,4	17,2
31	11,8	15,0	7,6	12,2	11,4
32	7,0	12,2	4,9	7,8	8,5
33	4,0	7,5	2,5	3,9	4,2
34	2,7	4,0	1,2	2,0	1,6
35	1,3	2,2	0,6	1,0	1,7
36	0,7	1,2	0,4	0,4	0,4
37	0,3	0,8	0,2	0,2	0,1
38	0,1	0,4	0,1	0,1	0,1
39	0,1	0,3	0,1	0,1	+
40	+	0,2	+	+	-
41	+	0,1	+	+	+
42	+	0,1	+	+	+
43	+	0,1	+	+	+
44	+	+	+	+	+
45	-	+	+	-	-
46	-	+	+	-	-
47	-	+	+	-	-
48	-	+	+	-	-
49	-	+	-	-	-
50	-	+	-	-	-
51	-	+	-	-	-
Mean length (cm)	29,4	29,6	27,7	29,1	29,0
Mean weight (kg)	0,190	0,188	0,141	0,187	0,189

* Russian catches

Table 3 Age Composition of Silver Hake in the Soviet and Russian Catches (%)

Age Year	Year				
	1988	1989	1990	1991	1992*
1	+	5,0	2,3	1,0	1,2
2	42,4	31,7	51,4	23,1	35,1
3	41,3	38,1	32,4	43,6	41,7
4	13,8	20,2	11,6	26,6	17,7
5	2,4	4,1	1,8	5,1	4,1
6	0,1	0,8	0,5	0,5	0,2
7	+	0,1	+	0,1	+
8	+	+	1	+	-
9	-	+	-	-	-
Mean age	2,8	2,9	2,6	3,1	2,9

* Russian catches