INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 2955
(D.c. 3)

ICNAF Res.Doc. 73/22

ANNUAL MEETING - JUNE 1973

Distribution and abundance of young cod off Newfoundland in April - June 1972

by

A. Yu. Bulatova
Polar Research Institute of Marine
Research and Oceanography (PINRO),
Murmansk, USSR

Introduction

Each year, since 1961, the Polar Institute estimates an abundance of cod fry on the Newfoundland shelf. From 1961 to 1970 surveys were carried out by the side-trawlers *Sevastopol* and *Rossiya*. *Perseus III* surveyed the North-Newfoundland Bank and the whole Newfoundland shelf in March 1970 and in May 1971 respectively. A converting factor was calculated to compare indices of the abundance of fry obtained by *Perseus III* and *Rossiya* in preceding years.

Material and Methods

Vessels made trawlings on the standard network of stations covering depths of possible distribution of fry (Fig. 1). After each trawl haul water temperatures were taken at depths of 0, 20, 50, 100, 150, 200, 300 and 400 m. The bottom trawl used had a capron small mesh net inserted into the codend (8 mm from knot to knot). All young cod up to 40 cm were measured. Average number of fish per hour trawling was taken as an abundance index. A total of 24,837 specimens were measured from catches in Subarea 3 in April - July 1972 and 3,967 fish were aged.

Distribution

It is known that young cod are found over the whole Newfoundland shelf up to 350-400 m deep but their maximum concentrations are observed in certain parts; for example, in spring and summer in Div. 3L, 3N and 3P great concentrations of young cod remain near the outer edge of the shelf (Fig. 2).

Kotenev and Matishov (1972) state that the bottom relief affects the direction and velocity of currents and temperature conditions, and thus influences the distribution of the sea fauna. According to their data fishing is concentrated in such bottom relief areas as the outer edge of the shelf, deep-water valleys, canyons and troughs. The same regularity in distribution is also typical of young cod.

On the North-Newfoundland Bank (Div. 3K) fry are found over the whole shelf (depths of 150-300 m), but the greatest concentrations are observed along the edges of the longitudinal deep-water trough. They stay along the boundary of cold Labrador and transformed Atlantic waters.

On the gentle north-eastern slope of the Grand Bank (Div. 3L) which is not dissected by troughs, young cod concentrate on the outer edge of the shelf and form some large concentrations in the northern, central and southern parts at depths of 150-350 m. In the northern part of the division (48°30' - 49°00') and in the south (47°00'), young cod concentrations are so stable that we could find them during several years and at different times of the year: in April 1969, June - July 1971 and 1972, and in August 1970. Stability of the northern concentration possibly results from characters of the bottom relief and a vortex of the Labrador Current waters observed sometimes in this area (Buzdalin and Elizarov, 1962). The southern concentration remains in the area where a sharply pronounced and stable frontal zone is found on the boundary of the Labrador waters and those of the North Atlantic Current.

Another feature of the distribution of fry in Div. 3L is interesting. In July 1971, a boundary of waters with negative temperatures ran at the depth of 150 m. Young cod remained deeper than the cold water layer, at depths of 180-290 m where water temperatures were 0.4° to 3.4°C. In June 1972, cold water was found to a depth of 200 m. In spite of this, the young cod occupied the same depths as before and most of the large

catches were taken in at depths with temperatures ranging between -1.5° and +0.6°C.

On the steep (dissected by multiple canyons) south eastern slope of the Grand Bank (Div. 3N) young cod are found in a small range of depths along the slope. Influxes of warm water into canyons, formation of eddies and sharply pronounced frontal zones (Kudle and Burmakin, 1972) favour concentrating the young fish along the edges of canyons (Fig. 3).

One can mark in spring four constant concentrations on the south eastern slope: approximately at 46°00', 45°00', 44°00' and 43°00'N. Depth of their habitat depends on the location of water with 0°C temperature: the number of young cod increases in waters with positive temperatures close to the 0°C isotherm.

In April 1972, waters with negative temperatures were found up to the depth of 250 m and the number of young cod increased in catches taken at depths of 250-370 m, the water temperature being 0° to 2.3°C. In the shallow part of Div. 3N, the area covered with the cold water, trawlings were unsuccessful, and in waters with temperatures over 0°C catches of young cod included not more than 10 individuals per hour trawling. However, in June 1971, considerable concentrations of young cod feeding on spawning capelin were observed on the south eastern part of the shallow water area of the Grand Bank. Evidently, in May - June, when bank waters are warmed up and capelin migration to spawning grounds takes place, many of the young cod leave the slopes of the southern end of the Grand Bank and more to the shallow water area. In April, capelin are not abundant on the shallow south eastern part of the Bank; dense pre-spawning concentrations are found on the south west slope of the Bank in Div. 3O (Kovalyov, 1971).

Distribution of young cod on the south western slope of the Grand Bank (Div. 3O) differed from that on the south eastern slope. In April - May, at depths over 100 m on the slope concentrations of young cod were found only on the south western part which is adjacent to Green Bank and off the southern end of the Grand Bank which was penetrated by cold water of the Labrador Current (Fig. 2 and 4). The fry were very scarce at depths over 100 m occupied by warm waters along the rest of the slope. On the shallow western part of the Bank small schools of young cod were observed in warm water. The northern boundary of the distribution of fish in the shallow water area was conditioned by the location of waters with the temperature of 0°C. Fry did not migrate to the east as they remained near a dense concentration of pre-spawning capelin (Fig. 4). Later, at the end of May and in June, when capelin concentrate on the spawning ground, the young cod following capelin migrate from the south western part of the shallow water area of the Bank.

Repeated trawlings made in June 1972 indicated accumulations of young cod in the shallow south eastern part of Div. 3N. In 44°39'N and 50°48'W, where single specimens were caught in April, the total number of fish taken was 140 individuals and these had the same length composition (specimens of 30-40 cm in length predominated) as those in Div. 3O in April. The importance of capelin as a food object and the fact that the migrations of capelin concentrations can influence the distribution of young cod are indicated by data on the frequency of occurrence of capelin in young cod stomachs. [Frequency of occurrence in a ratio (expressed in %) of a number of stomachs containing a certain food object to the whole number of stomachs analysed.] In April 1972, the frequency of occurrence of capelin in young cod stomachs in Div. 3N was 6% and in June - July 1971 was 44.2%. In Div. 3O, in contrast, the frequency of occurrence of capelin in young cod stomachs was 45.8% in April 1972 and 27.8% in July 1971.

On St. Pierre Bank large stable concentrations of young cod are observed along the outer edge of the shelf at depths of 80-150 m in zones of temperature gradients. In warm water deeper than 250 m they are almost absent, and catches taken on the plateaux of the Bank at a depth of 50 m included not more than 25-50 individuals per hour trawling. In May - June, in the shallow water area, young cod are larger than on the slope. In May 1972, maximum catches (357 and 1,249 specimens) were taken in water with temperatures of 0.1° to 1.4°C.

On the Flemish Cape Bank young cod are found at depths of 150-350 m on the central part of the Bank and on its southern and eastern slopes. The greatest catches were taken at depths of 150-250 m in water with temperatures of 3° to 4°C.

No essential difference was found in the distribution of young cod from April to August. Evidently, both on the Bank and in the northern divisions of the Newfoundland shelf (Div. 3K, 3L) where seasonal changes in temperatures of near-bottom waters are insignificant (Elizarov, 1963), young cod keep to the same parts of the shelf regardless of season. In the south of the Newfoundland shelf their distribution changes considerable from spring to summer, and this is due to sharp variations in temperature conditions and migrations of capelin concentrations.

Estimation of Relative Abundance

Fig. 5 depicts the length composition of young cod in catches taken in April - June 1972. Table 1 includes indices of relative abundance of cod of different year-classes.

For Div. 3N-O, indices of the abundance of cod of ages 1, 2, and 3 years (for Div. 3K ages 3 and 4 years) are summed and their average value is given in the right vertical column. The last row of the table gives the averages by age in the divisions of Subarea 3 calculated on the basis of abundance indices of cod of different year-classes during 11 years of investigations.

As it is evident from the figure and table, the number of yearlings of the 1971 year-class in all divisions apart from the Flemish Cape Bank (Div. 3M) was lower than the long-term mean. Low indices of the cod abundance of the 1970 year-class both in the first and second years of life indicate that all the cod stocks inhabiting the Newfoundland shelf are poor. A number of two-year olds of the 1970 year-class was larger in Div. 3N than in the other divisions and their average catch consisted of 24 specimens while the long-term mean was 31 fish. During the first three years the number of cod of the 1969 year-class was higher than the average only in Div. 3P and 3L. On the St. Pierre Bank the average index was 30 specimens per hour trawling during the first three years while the long-term mean was 21 specimens.

It was reported previously (Bulatova, 1968, 1970) that by-catches of young cod of age 3 years on the North-Newfoundland Bank was about the same abundance of the Labrador cod. Many researchers think that on the north eastern slope of the Grand Bank where cod of different stocks mix, and they are dominated by Labrador cod (Fleming, 1958; Postolaky, 1962; Templeman, 1962; Pinhorn and Wells, 1972). The average number of 3-year olds of the 1969 year-class amounted to 56 specimens in these two divisions and the long-term mean was 57 fish. Consequently, the abundance of the 1969 year-class in the Labrador cod stock is average: it is approximately two times smaller than the 1968 year-class (average catch for Div. 3K-L is 124 specimens).

In the southern Grand Bank (Div. 3N-O) and on the Flemish Cape Bank (Div. 3M) cod of the 1969 year-class were not abundant. Thus, the abundance of cod of the 1968 year-class proved to be higher than that of cod of subsequent year-classes. Similar data on the abundance of cod of the 1968 year-class were obtained by the Canadian ichthyologists (Pinhorn, 1971; Templeman and Fleming, 1972).

Conclusions

1. In spring and summer young cod form stable concentrations along the outer edge of the shelf and the edges of deep-water troughs and canyons in zones of temperature gradients.

2. In May - June, young cod following capelin perform feeding migrations from the south western to the shallow south eastern part of the Grand Bank.

3. To judge by a number of yearlings, the 1971 year-class of cod was poor in all divisions apart from the Flemish Cape Bank.

4. The abundance of cod of the 1970 year-class is lower than the long-term mean for all the stocks of cod on the Newfoundland shelf.

5. The 1969 year-class of cod is poor on the Grand and Flemish Cape Banks, its abundance is average in the Labrador area and somewhat higher than the long-term mean value on the St. Pierre Bank.

6. The 1968 year-class of cod is the most abundant during the last years.

References

Buzdalin, Yu. I. and A.A. Elizarov. 1962. Hydrological conditions in Newfoundland and Labrador areas in 1960. Sovetskie rybokhozyaistvennye issledovaniya v severo-zapadnoi chasti Atlant. okeana, VNIRO-PINRO, M.

Bulatova, A.Yu. 1968. The determining of young cod in the Labrador and Newfoundland areas in 1961/1967. Trudy PINRO, vyp. 23.

Bulatova, A.Yu. 1970. Abundance of young cod in the waters off Newfoundland, ICNAF, Redbook, Part III.

Elizarov, A.A. 1963. On the oceanologic conditions which determine yielding capacity of generations in the most prominent commercial fishes in the north-western part of Northern Atlantic. Okeanologiya, t. 3, vyp. 6.

Fleming, A.M. 1958. Differentiation of cod groups in the Newfoundland and Labrador region. Spec. Publ., ICNAF, No. 1.

Kotenev, B.N. and G.G. Matishov. 1972. Regularities of distribution of canyons of the continental slope and rise of the Northern fishery basin (Labrador Sea, Norwegian - Greenland basin). Trudy PINRO, vyp. 28.

Kovalyov, S.M. 1971. Soviet investigations on capelin on the Grand Bank of Newfoundland in spring - summer. ICNAF, Res.Doc. 72/102.

Kudlo, B.P. and V.V. Burmakin. 1972. Water circulation in the South Labrador and Newfoundland areas in 1970-1971. ICNAF, Redbook, Part III.

Pinhorn, A.T. 1971. Accuracy of abundance indices for cod from St. Pierre Bank (ICNAF Div. 3Ps) based on Canada (Newfoundland) research vessel surveys in terms of comparisons with commercial abundance indices. ICNAF, Redbook, Part III.

Pinhorn, A.T. and R. Wells. 1972. Combined virtual population assessment for ICNAF Divisions 2J, 3K and 3L. ICNAF, Res. Doc. 72/109.

Postolaky, A.I. 1962. Some data on biology of cod from Labrador and Newfoundland areas. Sovetskie rybokhozyaistvennye issledovaniya v severo-zapadnoi chasti Atlanti-cheskogo okeana, Trudy VNIRO-PINRO, M.

Templeman, W. 1962. Divisions of cod stocks in Northwest Atlantic. ICNAF, Redbook, Part III.

Templeman, W. and A.M. Fleming. 1972. Canadian research report, 1971. ICNAF, Res.Doc. 72/36.

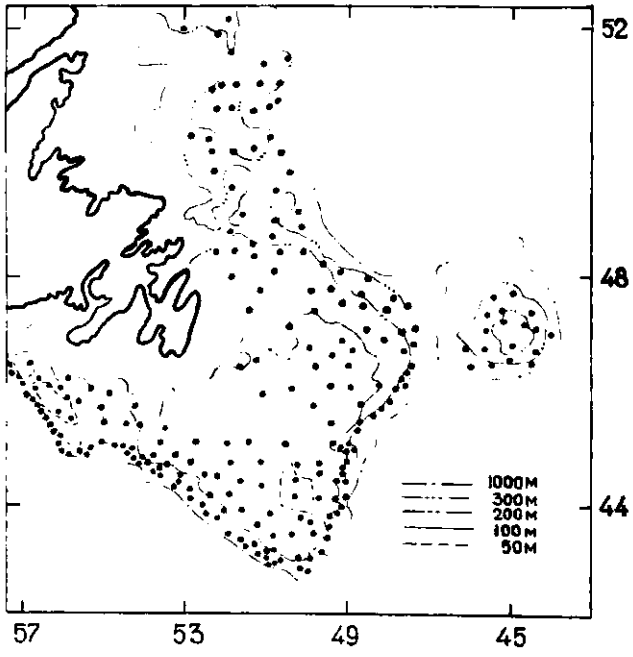

Fig. 1. Location of trawl stations at which the abundance of cod was determined.

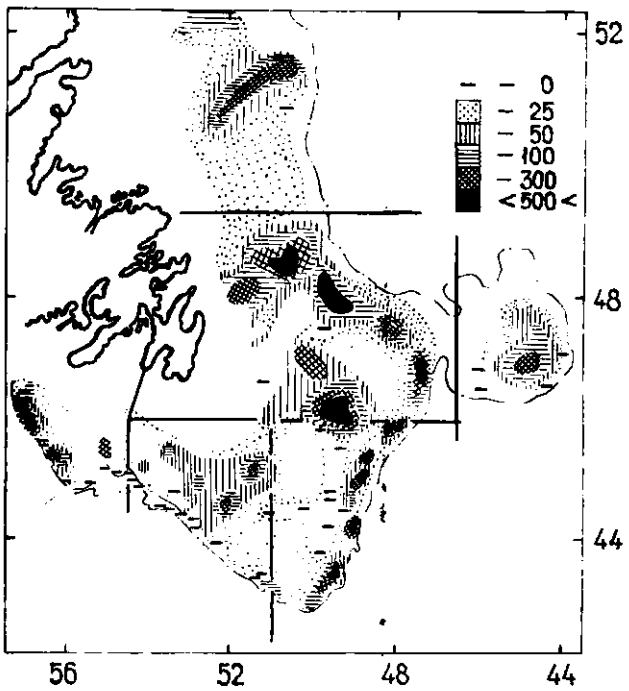

Fig. 2. Distribution of young cod in Subarea 3 in April - July 1972.

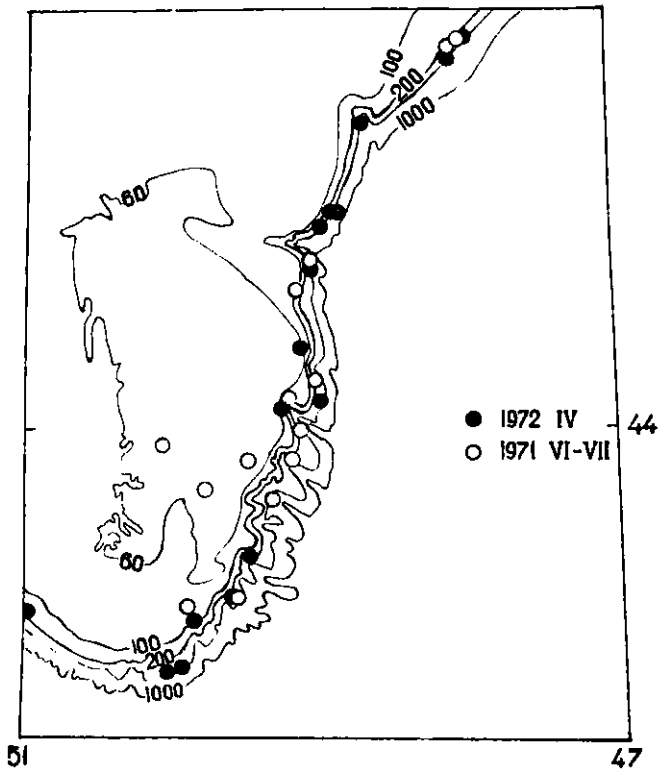

Fig. 3. Location of canyons and catches of young cod (more than 100 specimens per hour trawling) on the south eastern slope of the Grand Bank in 1972 and 1971.

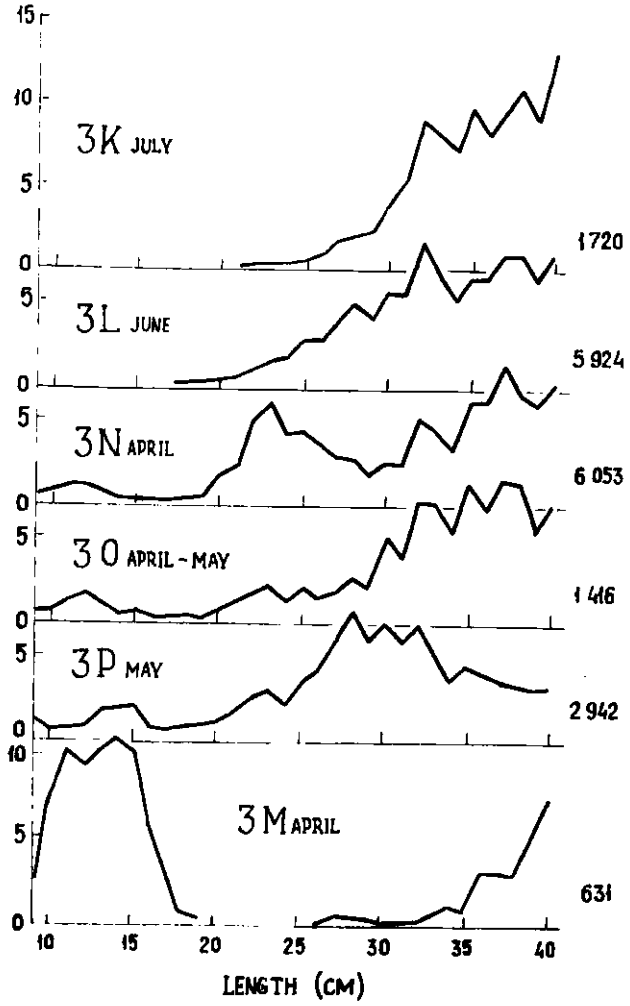

Fig. 5. Length composition of young cod in catches taken off Newfoundland in 1972.

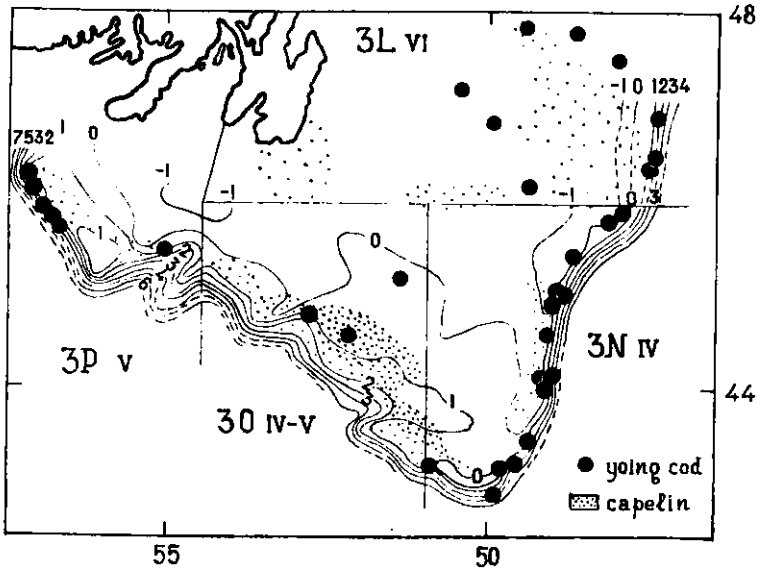

Fig. 4. Temperature of near-bottom waters, distribution of capelin and catches of young cod (more than 100 specimens per hour trawling) in 1972.

Table 1. Average catches of young cod of different year-classes per hour trawling by divisions (in numbers).

Year-class	Age 1						Age 2						Age 3						Age 4						Mean for the year-class at the age 1,2,3 3N-O	Mean for the year-class at the age 3,4 3K
	3K	3L	3N	3O	3P	3M	3K	3L	3N	3O	3P	3M	3K	3L	3N	3O	3P	3M	3K	3L	3N	3O	3P	3M		
1958	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	1	0	2	-	-	10
1959	-	-	-	-	-	-	-	-	-	-	-	-	21	21	8	1	4	-	15	10	1	1	1	-	-	18
1960	-	-	-	-	-	-	5	2	3	0	3	-	11	8	1	2	5	-	11	8	1	0	1	0.4	3	11
1961	1	1	1	1	6	-	3	4	4	3	6	-	20	28	5	1	6	6	27	11	4	1	1	1.4	5	23
1962	1	1	1	7	42	-	2	5	8	2	7	8	15	40	18	2	12	26	24	13	6	1	2	1	13	20
1963	1	2	1	1	3	0.2	1	8	5	1	13	5	36	31	30	1	17	10	17	33	7	3	4	-	13	26
1964	1	1	41	24	31	0.1	3	15	137	13	22	1	8	48	73	42	58	-	28	28	16	7	10	8	110	18
1965	1	1	1	1	5	2	1	1	14	12	21	-	15	12	23	20	25	6	22	37	60	9	9	13	24	19
1966	0	0.1	2	15	7	-	3	8	27	17	32	0.2	27	43	37	34	28	10	40	20	10	4	4	2	44	33
1967	0.2	0.5	0.2	2	0.3	-	8	11	3	4	20	5	34	26	32	14	10	14	12	6	2	2	6	1	18	23
1968	0.5	1	6	18	40	11	7	48	109	28	66	76	40	84	91	23	64	41	26	32	28	5	13	5	91	33
1969	0.5	3	2	4	15	0.3	4	22	11	6	50	1	13	43	26	12	25	1	-	-	-	-	-	-	20	-
1970	0.1	1	6	1	6	0.1	0.5	5	24	3	9	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1971	0	0	4	2	5	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	0.6	1	6	7	15	3.3	3.4	12	31	8	23	12	22	35	31	14	23	14	21	19	12	3	5	4	34	21