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Methods and results of the total trawl survey
of bottom fish in Subarea 3 in 1971-1980

by

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The total trawl survey in Subarea 3 has been conducted by PINRO scientists for 10 years running. Annually over 300 trawlings are performed with a bottom otter trawl with a fine-meshed netting inserted into the codend. Each trawling lasts 1 hour, vessel speed being 3.5 knots. Positions of trawling stations are fixed and constant, every year all trawlings are performed along the same routes, the vessel course and depth of trawling remain the same.

Position of most stations was chosen long ago. The assessment of young commercial bottom fish, cod and haddock chiefly, has been conducted by PINRO since 1962. A table of mean catches of yearlings, two-year-olds and three-year-olds of cod is annually given in the USSR National Report on investigations in the ICNAF (later NAFO) area. From 1971 not only young fish, but the whole catch from each trawling at the same stations is examined. All bottom fish - mass and rare, large and small, eatable and non-eatable - are measured. Fish of many species are also dissected (25-50 specimens from a catch) to determine sex, maturity stage, stomach fullness and food composition. Usually those fish are also dissected, which size composition is analysed separately for males and females. But in many cases, when measuring redfish, for instance, sex is determined without dissection.

If a catch of some fish species - redfish, for instance, - is great, it is rather difficult to measure and even to count quickly

all fish caught. That's why the catch is distributed into 40-50 kg wooden barrels. Then all fish from 5 or 10 barrels are measured. With the amount of fish in these barrels and the number of barrels, in which the whole catch has been distributed, known, the total abundance and biomass of fish caught are then determined. In other words, not a total number of specimens but a sample is dealt with in such cases.

A characteristic of such a sample (size or sex composition, for instance) applies then to the whole catch.

Size-weight keys for all bottom fishes were obtained during a long-term period of investigations. Therefore, when analysing a catch not all fish are usually weighed: the weight may be determined later using length frequency distribution and size-weight key.

Age samples are taken from catches at random - 250-400 specimens, as a rule, including 100 specimens of Gadidae and Macruridae, liver of which is weighed. Fish are aged by otoliths or scale in laboratories on shore, sometimes on board a vessel.

In 1971-1978 depths up to 500 m were trawled. In 1979-1980 to assess deep-sea fishes more thoroughly, trawlings at the depths up to 800 m were also included in the total trawl survey programme. The surveyed area was also changed a little. Thus, the total trawl survey in Div.3P was conducted from 1971 to 1976, later after the introduction of a 200-mile fishery zone around the Miquelon Island (France) it became impossible to carry it out. In 1978-1980 trawlings were also performed in Div.2J. As for Divs.3K, 3L, 3M, 3N and 3O trawlings were done annually during the whole decade, what permits to compare the results obtained from the depths up to 500 m.

In 1979 and 1980 due to the development of investigations in accordance with the Flemish Cape Project, the total trawl survey at the bank was conducted twice: in spring (March/April) and in summer (June/July). A comparison of the data obtained permitted to arrive at important conclusions concerning fish seasonal migrations and time of the most representative assessment.

In recent years the total trawl survey was conducted in two steps also in those divisions, which are crossed by the boundary of a 200-mile zone of Canada. However, in such cases no station was performed twice: only part of a division was surveyed during each entrance. One and the same division was entered twice (Div. 3N in 1980, for instance), what resulted from a desire to cross the 200-mile zone boundary as rarely as possible, because there is usually a loss of time when waiting for a permission to enter or to leave the zone. Therefore, first only that part of a division was surveyed, which was situated outside the zone, later the part within the zone and in-between investigations were conducted in a near-by division.

The total trawl survey was sometimes interrupted for a short period by other works planned for a cruise (mass tagging, studying of the selectivity of fishing gears, trawlings with conventional trawl to obtain length-age data).

Table 1 shows dates of the total trawl survey in 1971-1980. Unfortunately, they were not the same in different years, in some cases the difference amounted to several months, what resulted from purely organization problems, a protracted repair of vessels, for instance.

In 1971-1978 the total trawl survey was conducted by the R/V "Perseus-III", in 1979 - by the trawler "Suloy" and in 1980 - by the trawler "Nikolai Kononov". The trawlers are practically of the same type, but differ from the R/V "Perseus-III" in displacement, main engine and trawl winch power, navigational and detection instruments.

A preliminary estimate of the abundance of each fish species is obtained after determining the mean number of specimens per one fish-counting trawling (or, what is the same per hour trawling, as each trawling lasts one hour). A comparison of these indices for different years permits to arrive at a preliminary conclusion whether the abundance of a given species in one or another division increases, decreases or remains stable (for instance, the abundance

of cod at the Flemish Cap or that of deepwater redfish at southern slopes of the Grand Newfoundland Bank). Similarly the mean biomass of fish per hour trawling is estimated.

Such tables are annually included in the USSR National Report on investigations. More detailed data are presented in Research Documents (indices of fish abundance at different depths - 101-200 m, 201-300 m etc.; mean length of fish of each species by depth ranges).

The abundance and biomass of main commercial fishes may be estimated more precisely using the so-called area method. A position of each trawling and catch of one or another fish species (cod, for instance) obtained are plotted on a large-scale chart. Then, near-by trawling stations, where catches have been approximately the same, are connected by a closed line, and the outlined area is determined. Thus, all the area under survey is divided into many parts with different density of fish concentration. For further calculations we use: a) area of each part, b) area fished off during one trawling, c) area of the whole surveyed area, d) trawl catchability coefficient, i.e. the ratio between the number of fish caught and the total number of fish which were in the trawl way. The ratio is usually given in per cents. For each fish species it was determined with the help of underwater photographing, visual observations at hydrostat on board the R/V "Perseus-III". Using the above said values and the amount of fish caught with a fish-counting trawl in the surveyed area, an absolute abundance (and biomass) of the stock under consideration can be easily calculated.

The absolute biomass of some populations (cod at the Flemish Cap, for instance) is calculated annually, and this estimate conforms well with those obtained through other methods - virtual population analysis method, for instance.

In accordance with the agreement with Canadian scientists the results of each total trawl survey (abundance and biomass of demersal fish per trawling) are sent to St. John's. Based on these data stock size may be determined through different methods, for instance,

distribution of catches by "strata" (as accepted by Canadian scientists).

The estimate of the abundance and biomass will be reliable only in those cases, when the total trawl survey covers the whole distribution area of a stock. The area and depths covered now by our trawlings permit to assess the abundance and biomass of such comparatively shallow-water fish as cod, haddock, long rough dab, yellow-tail flounder, golden redfish, Atlantic and spotted wolffish, eel-pout, spiny skate. The depths inhabited by deep-water redfish, witch, northern wolffish are not fully covered by our trawlings. A considerable part of the distribution area of Greenland halibut, rock grenadier, white hake is outside the surveyed area.

Each fish-counting trawling is always accompanied by measurements of temperature at standard depths and in most cases by hydrochemical analysis of water samples. These data permit to determine the influence of oceanological conditions on vertical and horizontal distribution of different demersal fishes.

Utilization of the total trawl survey results with the aim of estimating the abundance and biomass of demersal fish is described in some papers by PINRO scientists to the ICNAF and NAFO Sessions, for instance, in:

- Chekhova V.A., A.K.Chumakov, A.I.Postolaky, 1978. Preliminary assessment of abundance and biomass of cod on Flemish Cap based on data from trawl surveys in 1972-1977. ICNAF Res.Doc. 78/VI/27, Ser.No.5188.
- Chumakov A.K., L.I.Serebrov, 1978. The determination of the catchability coefficient of bottom trawl for cod and Greenland halibut. ICNAF Res.Doc. 78/VI/24, Ser.No.5185.
- Chekhova V.A., A.K.Chumakov, A.I.Postolaky, 1980. Cod abundance and biomass in Divs.3NO and 3M according to data from groundfish trawl survey during 1977-1979. NAFO SCR Doc. 80/II/41, Ser.No.NO73.
- Chekhova V.A., A.I.Postolaky, 1981. Abundance and biomass of cod on the Grand Bank (Divs.3NO) and Flemish Cap (Div.3M). NAFO SCR Doc. 81/II/9, Ser.No. N273.

Table 1. Dates of the total trawl survey in 1971-1980.

Year	2J	3K	3L	3M	3N	3O	3P
1971	-	26.07-15.08 24.06- 5.07	5-25.07 3-15.06	11-13.05 4- 7.04	16.06- 2.07 11-22.04	31.05-15.06 27.04-12.05 29.05- 2.06	25-31.05 12-20.05
1973	-	31.07-26.08	20-30.07	15-18.07	30.06-10.07	8-24.06	1- 7.07
1974	-	11-19.08	21-29.07 1- 7.08	22-26.08	15-27.06	3-13.07	13-19.07
1975	-	24-30.08	30.08-14.09	21-24.06	27-31.07 14-23.09	1- 3.07 15-17.07 20-27.07	3- 9.07
1976	-	1-14.06	9-25.05	10-16.03	24-25.03	13-22.04	8-13.04
1977	-	9-23.07	27.04-1.05 19-23.05 28-29.05 2-11.06	20-25.04	1- 6.05 24-27.05	19.06- 3.07	-
1978	15-24.06	2- 7.07 9-14.07	30.05-10.06	26.07- 1.08	10-19.06	14-15.06 20-25.06	-
1979	26-31.05	13-26.06	30.04-13.05	20-26.04 5- 6.04 5-18.06	8-11.04 17-22.04	22-29.04	-
1980	11-20.07	14-15.06 18-27.06	5-8.05 3-13.06	23-27.04 30.04- 3.05 24.07- 1.08	8-14.05 29.05- 1.06	21-29.05	-