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USSR Trawl Surveys in NAFO Subareas 0, 2, 3

by

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ABSTRACT

Methods of the USSR trawl surveys in NAFO Subareas 0,2,3 are reviewed in the present paper. Principle objectives and sampling techniques applied during surveying of the NAFO Subarea 3 allowed to discern three periods of investigations: 1961-1970, 1971-1982 and 1983-1985.

Information from trawl surveys for Greenland halibut in Subareas 0 and 2 in 1980-1985 is presented.

It is concluded that coordinated efforts of NAFO member states are needed for joint surveying.

INTRODUCTION

NAFO Subareas 2 and 3 have been surveyed by PINRO since 1954. From 1954 to 1961 primarily scouting works were conducted, distribution of fish was studied, data on the size-age composition, feeding, sex composition and maturity, migrations of major commercial species were collected.

From December 1961 onwards the Polar Institute conducted annual trawl surveys which for principle objectives and sampling techniques may be divided into three periods: 1961-1970, 1971-1982 and 1983-1985.

The principle objective of the 1961-1970 surveys was to estimate the yearly recruitment to cod, haddock and redfish populations using a quantitative assessment of the young. The yearclass strength was estimated from the average number of fish in a catch per hour haul.

In 1971-1982 the total trawl surveys were conducted - a quantitative assessment of demersal fish of all species and size groups. Estimates of the relative abundance and biomass expressed as the average number and weight of fish in a catch per hour haul were derived for major commercial species (cod, haddock, redfish, American plaice, Greenland halibut, dab)(Konstantinov, 1981).

Since 1983 the surveys were conducted using the stratified-random method for fishing station selection (NAFO method). Estimates of the relative abundance and biomass of commercial fishes were derived for individual strata and for the whole area.

Trawl survey methodology

1961-1970 surveys - Table 1 presents information from trawl surveys in 1961-1970, which were made by side-trawlers. A typical side-trawler (BRT - large trawler) was 73.6 m in length, with the gross tonnage 1492 t, net tonnage 829 t, main engine power 1080 hp.

A bottom trawl, 24.9 m long (without bag), was used with a distance between wings 10-12 m and vertical opening 1.6-1.8 m. The bottom line was equipped with 500 mm diameter bobbins, the cable length was 90 m. Oval 5.5 sq.m three-slot boards were used. Cod-end mesh size was 110 mm. A fine-meshed 9 m long netting with 16-20 mm mesh bar was inserted in the codend. The trawl was towed at 3.2 knots for 1 hour. Observations were carried out on a 24-hour basis.

The number of fishing stations depended on the overall duration of the cruise and the time of work in the area under survey. In the beginning of investigations fishing stations covered a vast area, therefore, their number in each subarea was small. Positions of fishing stations were randomly chosen but so that to envelope different depths and the areas which seemed important for fisheries. Most successful fishing stations were occupied every year.

In 1967 to make the coverage of the survey area more complete a new grid of stations was devised using rectangles similarly to oceanographic sections intersecting the shelf latitudinally. In subsequent surveys positions of fishing stations were relatively fixed, within accuracy of the vessel position-finding. The grid

of stations was corrected - additional fishing stations located on the shelf and slopes were included, zones with irregular bottom topography were rejected. The survey was restricted to Divs. 3KLMNOP. By the end of the period (1969-1970) about 300 fishing stations were planned for the mentioned areas and completed (Table 1).

Sampling techniques and catch analysis in 1961-1970.

In this period the principle objective was to assess quantitatively young cod, haddock and redfish. Prior to 1967 when the surveys were conducted during the winter period cod and haddock up to 35 cm and redfish to 15 cm in length were believed to pertain to the young. Since 1968 observations have been carried out in the spring-summer period. Bearing in mind seasonality in the fish growth, cod and haddock to 40 cm and redfish to 20 cm long inclusive were assigned to the young.

Catches were processed following the procedure described below. For small catches all young fish were selected and their lengths were taken. In catches to 1 t only a portion of young fish was measured, all the rest were counted. In catches above 1 t (redfish predominantly) containers were used to count the fish: the average number of fish in one container was multiplied by the number of containers, which comprised the whole catch. The cod and haddock above 35 cm and redfish above 20 cm in length were measured, but the total number in the catch was not determined.

Prior to 1968 all young fish from small catches and only 100 individuals from large were taken for age determination. Later on only 300-500 young fish were taken from each area to determine age. The fish were taken from different tows so that they represented all size groups.

Samples containing larger-sized fish, 300 individuals from each area, were taken from one large catch. For this a part of the catch was separated with the fish not specifically selected by size.

The average number of the young aged 1, 2 and 3 years in the catch per hour haul was accepted as an index of the relative abundance of new yearclasses. The yearclass strength was estimated using the long term average norm. The long term average norm was

derived from the sum of mean indices of fish abundance for each age group and area divided by the number of years of observations (Konstantinov, 1983, Table 5).

1971-1982 surveys. From 1971 onwards the trawl surveys were carried out by stern-trawlers. In order to preserve the long term time series of data and to derive comparable data 141 comparative tows were made in 1971 by BRT "Rossiya" and BMRT-1202 "Persey-III" which sampled the same cod concentrations running at parallel courses. The comparison of catches made by vessels of different types using different gears indicated that the catches by the RV "Persey-III" were on the average 1.4 times larger than those by BRT "Rossiya". Owing to this, estimates of the young fish abundance derived in the previous years were multiplied by 1.4.

Table 2 presents data from summer trawl surveys in Divs. 2J, 3 KLMNOP in 1971-1982. The 31/27.2 m trawl with 4 m vertical opening, distance between wings at 14.3 m (Figs. 1, 2), 90 m long cables, 400 mm diameter bobbins, 5.0 sq.m trawl boards, 130 mm mesh in the codend was used. A 19 m long small-mesh netting with a mesh bar of 20-24 mm was inserted in the codend.

The trawl was towed at 3.5 knots for 1 hour. Observations were carried out on a 24-hour basis.

Fishing stations were made at fixed positions. In the course of surveying positions of fishing stations slightly varied depending on the accuracy of the vessel position-finding, availability of the depth to be sampled, bottom topography, ground, and other reasons. The number of fishing stations completed in each survey depended on the duration of the cruise, but commonly 300 fishing stations were planned for Divs. 3 KLMNO. In 1979-1980 surveying of the Flemish Cap was made twice - in spring and summer.

Sampling techniques and catch analysis in 1971-1982.

A quantitative assessment of bottom fishes both exploited and unexploited of all size groups was carried out since 1971.

Each catch was sorted by species and the fish were measured and counted. In the case of large catches of fish of some species 300-600 individuals were selected from any part of the catch and measured.

The fish were measured from the tip of the snout to the end of the caudal fin to the nearest 1 cm. For example, at 35.5 cm we put 36 cm, at 35.4 cm - 35 cm. For all fish sex was determined except cod and haddock.

The quantitative assessment was made following the procedure used in the previous surveys: counting of individual fish or counting with the use of containers.

The weight of fish of major commercial species was determined. For this purpose based on age data collected in the previous years the size-^{weight} keys were derived, which were revised in subsequent surveys. If the weight data for some species were not available every fish was weighed individually. The total weight of fish of each species in the catch was determined through multiplication of the average weight (estimated from the size frequency) by the number of fish caught.

To determine the age composition of fish 300 individuals of the following species were taken from each area: cod, haddock, redfish, American plaice, dab, witch, halibut, grenadier. Samples were taken from large catches, a portion of the catch was separated so that the size composition of fish in the sample corresponded to their size composition in the catch. Concurrent with sampling of adult fish (cod, sometimes redfish) samples of the young (100-300 individuals) were taken from each area.

The average number and weight of fish in the catch per hour haul were accepted as relative abundance and biomass indices, which were derived separately for each species and area by dividing the total number and weight of fish by the number of tows including those without catch (Konstantinov, 1983, Tables 3, 4).

Stratified-random trawl surveys in 1983-1985.

Since 1983 the trawl surveys are carried out following the NAFO method.

As in previous years surveys were conducted by BMRTs, however, in 1985 the survey was made by PST, a vessel of smaller tonnage (Table 3), which might to some extent affect the survey results. As previously the 31/27.2 m trawl with a small-mesh netting was used, which was towed at 3.5 knots. In 1983 the towing was made for 1 hour.

In 1984 to increase the number of fishing stations 30-min
tows were used. Observations were made on a 24-hour basis.

The number of fishing stations depended on the duration of the cruise, usually 450 to 550 stations, out of which 120-130 were completed on the Flemish Cap, where the number of stations in each stratum depended on its area. In other parts commonly 3 fishing stations were occupied in each stratum. If the time permitted larger strata were covered with greater number of fishing stations.

Positions of fishing stations had been initially determined on the chart with strata divided into small rectangles (0°10' of latitude and 0°20' of longitude). The rectangles were enumerated and positions of fishing stations were determined from the random number table. The distribution of fishing stations over narrower strata with irregular configuration was relatively even. During surveying positions of fishing stations were corrected with regard for the availability of the given depth, bottom topography, ground, telephone cables location as well as with respect to fishing and buffer zone boundaries, different obstacles (long-lines, traps, vessels, rigs, floating stations, icebergs, ice fields).

The accident rate for fishing gears is higher when fishing at random stations. Tows with considerable damages of the trawl netting, especially those of the bag, and other defects were not counted, but if it was possible they were repeated in the same stratum at the site with more suitable conditions. Tows shorter 30 min. and longer 1 hour 10 min. for one hour hauls (in 1983) and below 20 min and above 40 min. for 30-min. hauls (1984-1985) were not counted. The catch made during the time period shorter or longer than the above range was used to calculate the catch which could have been taken per a haul time unit.

Sampling techniques and catch analysis in 1983-1985.

Methods of catch analysis, quantitative assessment and weighing were the same as in the previous years. Before 1985 sampling methods associated with age determination also did not change.

In 1985 samples to determine age were collected following the Canadian techniques. For age determination fish were selected from different catches, 15-20 individuals from each size group.

If the sex was determined, 20 males and 20 females from each size group were taken to determine age. Thus, cod, haddock, beaked redfish and halibut (Div.3K) were sampled. American plaice and ~~haddock~~ were not sampled for age determination in 1985, however, 20 males and 20 females were selected from each size group for individual weighing.

As indicated by calculations, at an absolute error in the mean age equal to ± 0.5 year, 15 cod, 38 redfish, 37 grenadier and 13 halibut should be taken from each size group for age determination. Then a relative error in the mean age will constitute $\pm 9-13.5\%$ for different species.

Methods of abundance and biomass estimation in 1983-1985.

Estimates of the relative abundance and biomass were derived using the NAFO methods. In each stratum the mean number and weight of fish in the catch captured in the area towed per a time unit (1 hour or 30 min.) were determined from a series of tows.

Further calculations were made using the formula:

$$n = \frac{S}{S_1} \cdot n_1$$

where n - abundance or biomass of fish in the given stratum

S - area of the stratum

S₁ - area towed

n₁ - mean number (or weight) of fish in the catch per a time unit.

The size of the towed area was determined through multiplication of the distance covered by the vessel towing trawl per 1 hour (or 30 min.) by the distance between wings. At the speed of 3.5 knots the vessel covered 3.5 miles per 1 hour, and 1.75 miles per 30 min. At such a speed the distance between wings constituted 14.3 m. The area towed during 1 hour was 0.027 sq.mile and 0.0135 sq.mile per 30-min haul. The trawl fishing efficiency was conventionally accepted equal to 1.

Estimates of the relative abundance and biomass for each stratum were then summed to derive the estimate for the whole area.

Estimates of the abundance and biomass presented in the USSR National Reports for 1983-1985 may be checked using initial survey data mailed to Canada every year in formats No.1 and 2.

Trawl surveys for Greenland halibut in Subareas 0 and 2 and Div 3K in 1980-1985.

Trawl surveys for Greenland halibut in the Baffin Island and Labrador areas were initiated in late 1980. Table 4 presents information regarding vessels, survey area and number of fishing stations.

Similarly to southern areas a 31/27.2 m trawl which was towed at 3.5 knots per 1 hour was used. Observations were carried out on a 24-hour basis.

In all years positions of fishing stations in northern areas were randomly chosen. Major criteria for fishing station position were ground conditions and suitability of a site. Tows were made within 300-1300 m of depth in each 100 m interval.

Abundance and biomass estimates were derived separately for each 100 m depth interval. The mean number and catch of fish in a catch per hour haul (per 0.027 sq.mile) were determined from a series of tows at the given depth, then the density of aggregation over 1 sq.mile and that over the area of each of the given depth intervals throughout the whole survey area were found. The total for the survey area was determined by summing up estimates for individual depth intervals.

It should be noted that the number of fishing stations, size of the survey area and depth of towing varied markedly by years due to changing ice conditions in northern area, which undoubtedly affected stock estimates which should be considered approximate (Chumakov, Poletaev, 1985).

Methods of oceanographic observations in the period of trawl surveys.

Oceanographic observations were made to characterize environmental conditions and to evaluate their effect on fish distribution. They comprised: standard meteorological observations over air temperature and humidity, wind direction and velocity, wave, atmospheric pressure, clouds, ice; water temperature and salinity measurements at fishing sites and standard hydrographic sections at depths: 0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1500 and 2000 m.

Hydrographic observations were performed using standard in-

struments. Water temperature was measured with deepwater reversing thermometers (TT), bathometers (BM-48) were used for water sampling. Salinity was measured with electric salinometer 601-MK ("Auto-lab", Austria). Water temperature in 0-200 m was measured with mechanical bathythermograph at 00 and 12 hours GMT.

Oceanographic measurements were made before or after towing. In some cruises to save the time they were made only at some stations selected with respect to the distance between stations, towing depth and expected state of water.

Observations at standard hydrographic sections were made if they had been included in the cruise programme.

Conclusions

At present enhancement of the reliability of estimates of demersal fish stock size is most complicated and urgent problem. A cooperation of NAFO member states in recent years indicated the need for both information exchange and calibration of fishing gears, development of standard techniques and instruments. Joint surveys within a relatively short period of time would allow to complete a required number of fishing stations and to attain an adequate coverage of the distribution area of major commercial fishes. Such cooperation is certainly feasible with research programmes well organized and coordinated and initial data exchanged on a broad scale.

References

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Table 1. Information regarding trawl surveys conducted in 1961-1970

Year	Period	Area	Vessel	Cruise No.	Number of valid hauls	Principle objective
1961-1962	Dec - Mar	2J, 3KLMNOP, 4VWX, 5Z	BRT-95 "Pobeda"	I	181	Quantitative assessment of young cod and haddock (to 35 cm) and redfish (to 15 cm)
1962-1963	Dec - Jan	2GHJ, 3KLMNOP	BRT-95 "Pobeda"	4	180	" "
1964	Jan - Mar	2J, 3KLMNOP	BRT-95 "Pobeda"	I	148	" "
1964-1965	Dec - Feb	3KLMNOP	BRT-97 "Sevastopol"	22	153	" "
1965-1966	Dec - Feb	2GHJ, 3KLMNOP	BRT-97 "Sevastopol"	24	118	" "
1967	Jan - May	2J, 3KLMNOP	BRT-99 "Novorossiysk" BRT-97 "Sevastopol"	2I 26	182	" "
1968	Apr - June	3KLMNOP	BRT-96 "Rossiya"	10	222	Quantitative assessment of young cod and haddock (to 40 cm) and redfish (to 20 cm)
1969	Apr - Jul	2J, 3KLMNOP	BRT-96 "Rossiya"	11	276	" "
1970	Mar, May - Aug	3K 3LMNOP	BMRT-1202 "Persey-III" BRT - 96 "Rossiya"	4 13	299	" "

Table 2. Data from 1971-1982 trawl surveys

Year	Period	Area	Vessel	Cruise No.	Vessel length m	Gross tonnage/net tonnage, t	Main engine power h.p.	Number of tows	Principle objective
1971	May-Aug	3 KLMNOP	BMRT-1202 "Persey-III"	6	83,6	3030/I09I	1x2000	240	Quantitative assessment of bottom exploited and unexploited fishes
1972	Apr-Jul	3 KLMNOP	" "	8	83,6	3030/I09I	1x2000	241	
1973	June-Aug	3 KLMNOP	" "	11	83,6	3030/I09I	1x2000	291	
1974	Jun-Aug	3 KLMNOP	" "	12	83,6	3030/I09I	1x2000	266	
1975	June-Sept	3KLMNOP	" "	14	83,6	3030/I09I	1x2000	295	
1976	Mar-Jun	3 KLMNOP	" "	15	83,6	3030/I09I	1x2000	294	
1977	Apr-Jul	3 KLMNO	" "	18	83,6	3030/I09I	1x2000	227	Estimation of abundance and biomass of major commercial fishes (cod, haddock, redfish, American plaice, dab, halibut)
1978	May-Jul	2J, 3KLMNO	" "	20	83,6	3030/I09I	1x2000	262	
1979	Mar-Jun	3 KLMNO	BMRT-2645 "Suloy"	2	78,0	2947/I330	1x2400	309	
1980	Apr-Jul	2J, 3KLMNO	BMRT-0422 "Kononov"	2	83,1	2889/I345	1x2400	334	
1981	Jun-Jul	2J, 3KLMNO	" "	4	83,1	2889/I345	1x2400	232	
1982	Apr-Jul	2J, 3KLMNO	BMRT-2645 "Suloy"	2	78,0	2947/I330	1x2400	324	

Table 3. Information regarding 1983-1985 trawl surveys conducted following stratified-random scheme

Year	Period	Area	Vessel	Cruise No.	Vessel length, m	Gross tonnage/net tonnage, t	Main engine power, h.p.	Haul duration	Number of hauls
1983	May-Jul	3KLMNO	BMRT-2645 "Suloy"	27	78,0	2947/1330	1x2400	1 hour	464
1984	Mar-Jul	3KLMNO	- " -	30	78,0	2947/1330	"	30 min	514
1985	Mar-Jun	3KLMNO	FST MG-1363 "Genicheski"	2	59,1	1140/348	1x2200	30 min	447

Table 4. Information regarding the trawl surveys for Greenland halibut in Divs. OB, 2H and 3K in 1980-1985.

Year	Period	Area	Vessel	Cruise No.	Vessel length, m	Gross/net tonnage t	Main engine power h.p.	Haul number	Haul duration
1980-1981	Dec-Jan	OB, 3K	BMRT-0422 "Kononov"	3/80	83,1	2889/1345	1x2400	69	1 hour
1981	Dec	OB	BMRT-1202 "Persey-III"	26	83,6	3030/1091	1x2000	11	1 hour
1981	Jul	3K	BMRT-0422 "Kononov"	4/81	83,1	2889/1345	1x2400	48	1 hour
1982	Jul	3K	BMRT-2645 "Suloy"	2	78,0	2947/1330	1x2400	53	1 hour
1982-1983	Nov-Jan	OB, 3K	BMRT-2645 "Suloy"	26	"	"	"	51 67	1 hour
1983	Jul	3K	- " -	27	"	"	"	94	1 hour
1983	Nov-Dec	OB, 2GH	- " -	29	"	"	"	125	1 hour
1984	Jul	3K	- " -	30	"	"	"	113	30 min
1984	Sept, Nov-Dec	OB 2GH	BMRT-2645 "Suloy" BMRT-0023 "Kuropatkin"	31 6	" 93,7	" 3141/1117	" 1x5200	105	1 hour
1985	Jun	3K	FST-1363 "Genicheski"	2	59,1	1140/348	1x2200	53	30 min
1985	Nov-Dec	OB, 2GH	BMRT-0422 "Kononov"	33	83,1	2889/1345	1x2400	83	1 hour

Rigging of sampling trawl 31/27.2 m
Headline 31 m

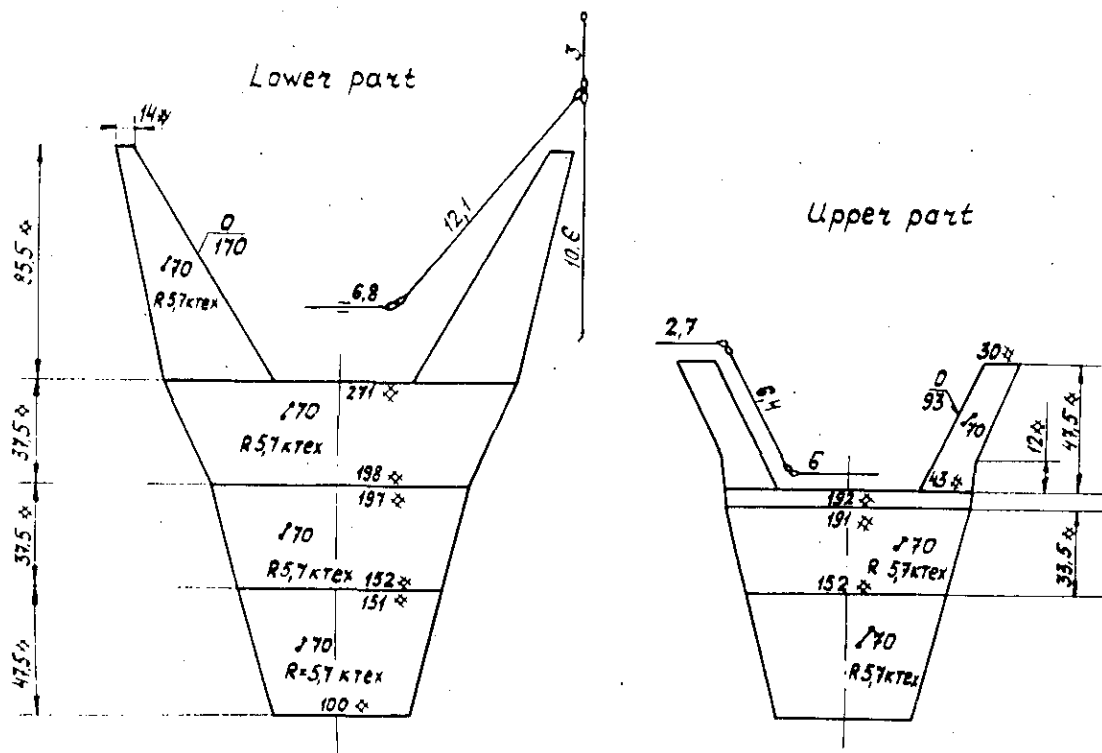


Fig. 1 Parameters of the 31/27.2 m bottom trawl
(1971-1985)

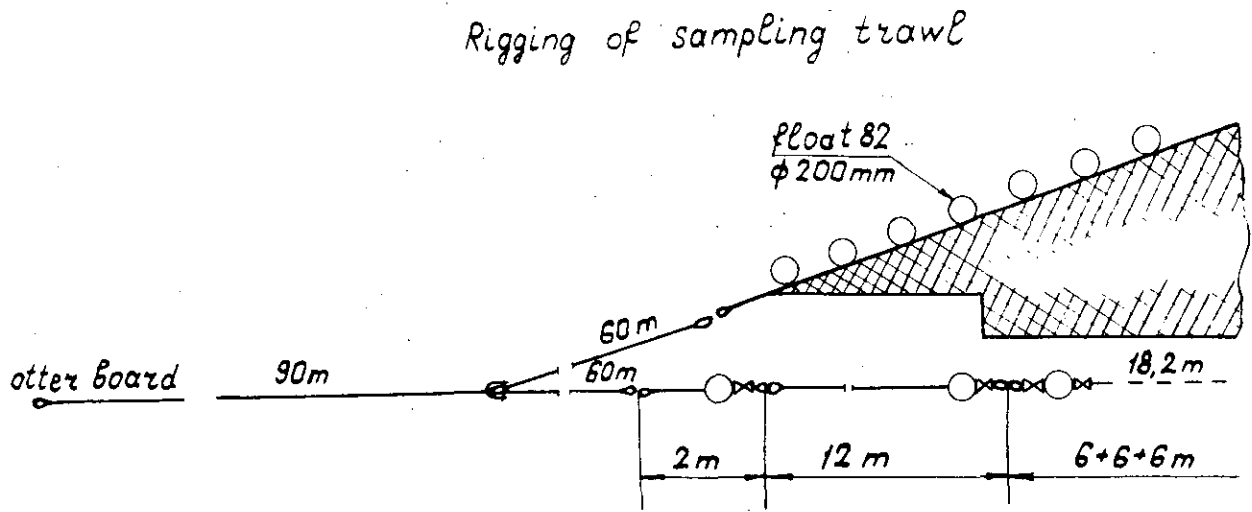


Fig. 2 Rigging of the 31/27.2 m bottom trawl (1971-1985)