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The determination of the catchability coefficient of bottom trawl for cod and Greenland halibut

by

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Abstract

The coefficient of the trawl catchability (Kf) was defined due to the ratio of the fish number (n) in the catch and their abundance (N) in the area fished:

$$Kf = \frac{100 \cdot n}{N} \%$$

It was assumed that the fishing square (S) was equal to horizontal opening of the trawl, i.e. the distance between the otter boards (B board) multiplied by the distance covered with a trawl (L):

$$S = B\ board \cdot L$$

The density of the fish concentrations in the area fished was assessed by means of automatic photocamera towed between the boards on the special false line. The catchability coefficient of the fish-counting trawl (project 1625A) with a small-meshed netting in the codend proved to be equal to 16.6 $\pm$ 2.16% for Greenland halibut and to 6.2 $\pm$ 0.74% for cod.

Introduction

It is assumed to characterize the statistical hit probability of fish into the trawl on its running with the catchability coefficient amounted to the relation between the number of fish in the catch (n) and their quantity in the fishing zone (N)

$$Kf = \frac{100 \cdot n}{N} \%$$

The number of fish in the fishing zone is equal to the square fished (S) multiplied by the absolute density of concentration (ρ):

$$N = S \cdot \rho \quad spec/m^2$$

The catchability coefficient can serve both for the characteristics of the trawl operating efficiency and for the assessment of the density of fish concentrations in the area covered with the total trawl survey. The determination of the catchability coefficient (or absolute trawl calibration) permits to use the data of the total trawl surveys for the assessment of the absolute abundance and biomass of the demersial fishes and invertebrates. Data on the density of fish concentration on the trawl's way and on the square of the area fished are necessary to conduct the calibration. As far as the bottom fishes are concentrated by cables in front of the net mouth (Bagenal,1958,1959; Nikonorov et al,1968),then the square equal to the distance between the boards multiplied by the distance trawled should be considered as the fishing zone of the bottom trawl.

Material and methods

The experimental works conducted aboard the FRV "Perseus III" in the period from December 1976 to February 1977 were assumed as a basis for the present report. The investigations were carried out by the bottom trawl (project 1625A) with a small-meshed netting in the codend (mesh size 20 mm),(Treshchev,1974) on the wintering and prespawning concentrations of cod and Greenland halibut in the areas of the Northwest Atlantic: the Greenland-Canadian Threshold (1C) and South Labrador (2J).

The square of the bottom (S) fished by the trawl was defined through the distance covered (L) multiplied by horizontal opening of the trawl between the boards (B board)

$$S = L \cdot B \text{ board}$$

The distance covered with the trawl was defined through dead and observed reckonings at the beginning and end of trawling. To define the opening of the trawl between the boards first its opening between the ends of net wings (B nets) was measured. Measurement was made

with a net sonde IGEK-y, the vibrator of which was set in the upper part of the wing with radiating surface in the horizontal plane.

The sine of the angle of cables attack and opening between the boards were determined by the ratio of horizontal opening between the nets and length of line with the help of the table of elements of a catenary curve:

$$B_{board} = 2 (\sin \alpha \cdot \ell) + B_{nets}$$

where α = the angle of cables attack, ℓ - their total length including the shackles of the boards (Fig.1).

The density of fish concentrations on the trawl's way was defined by results of the underwater photography by means of an automatical photocamera installed between the boards on a special false line (Fig.1). The central part of it consisted of the combined cable 10 m long with a 20 mm diameter, to which three packs of floats (by 15,10 and 5 pieces in each pack) were bound. Two or three cameras of the "Triton" or "Triton-2C" types were installed on the central part of false line. The ends of the false line were made of steel rope with a 7-8 mm diameter and they were bound with gallows of the boards before their hauling down. The whole false line was 3-5 m longer than the distance between the boards. 16 trawlings were made with the false corkline on the concentrations of Greenland halibut and cod.

Analysis of photographs of cod taken from the headline and false corkline showed that if fish near by the headline is frigtened and swimming on the trawl's way, then near by the false corkline there are no signs of fright and any predominant direction of fish motion (Fig.2). Thus, the density of fish concentration near by the false corkline does not apparently differ from the natural one.

The distance from cameras to the ground and the bottom square in one photo were defined by stereophotos taken with the stereophotocamera "Triton-2C" (Serebrov, 1974). Calibration of stereocamera was made by photographing the objects of test at an operating depth.

Measurements showed that the distances from the false corkline to the ground and from the headline to the ground varied comparatively little. Errors of mean values of the measured magnitudes did not exceed 3.0 - 6.6% (Table 1).

Table 1. Distances from cameras to the ground and mean bottom square in photos when photographing from the false corkline and corkline.

Carrier	Number of measurements	Distance, m		Square, m^2	
		M_{mean}	Error, %	M_{mean}	Error, %
Headline of the trawl 1625A	40	2.30	±1.6	1.45	±3.24
False corkline	37	1.97	±3.0	1.08	±6.6

The rectilinear dependence was observed between the density of cod distribution near the false corkline and the catches. Analogous dependence was observed between the catches and the density of fish concentrations near the headline with the only difference that the density of cod concentration in front of the headline was higher. The linear character of dependence of the catches on density of the concentrations indicates the fact that statistical hit probability of fish into the trawl named the catchability coefficient is close to the constant value and can be defined with a high accuracy provided that sufficient number of measurements was made.

Thus, the use of cameras towed between the trawl boards on the false corkline allows not only to estimate the absolute density of of bottom fish concentrations but to define the catchability coefficient of the bottom trawls too. Combining of the photography with trawling firstly saves the expeditionary time and permits to conduct the investigations at all the depths allowable for trawling, and secondly considerably increases reliability of the materials obtained. It is known that distribution and density of the bottom fish concentration vary depending on depth, relief, nature of ground, availability of food objects and so on. That is why in our mind the definition of the fish concentration density on the whole trawling way is very important.

Results

10 measurements of the trawl catchability coefficient (project 1625A) for cod and Greenland halibut were made on board the FRV "Perseus III" in the areas of the South Labrador and Greenland-Canadian

Threshold in December 1976 and in January 1977. The investigations were undertaken on the commercial concentrations. The mean value of $\bar{K}f$ and statistical error of the mean were calculated on the basis of a series of measurements of the catchability coefficient Kf.

Table 2. The bottom trawl catchability (project 1625A with a 20 mm netting in the codend) on the concentrations of cod and Greenland halibut.

Species of fish	Number of measurements	Catchability coefficient K'f and its mean error	Mean error in % to the catchability coefficient value
Greenland halibut	10	16.6 ± 2.18	17.30
Cod	10	6.2 ± 0.74	11.94

As can be seen from Table 2 the trawl catchability coefficient for Greenland halibut is more than twice higher than that for cod which probably resulted from different selectivity of these species due to the form and length of their body. The catchability coefficient for small cod is considerably lower than that for large ones (Serebrov, 1974).

No doubt that if the size composition sufficiently varies within the investigated area, then the corresponding K'f for fish of the given size composition should be accepted in every case when estimating the absolute abundance of fish. The definition of K'f for each length group of fish of the given species would be the most promising. It will be possible only in the case when the measurement of fish length by photographs is successfully conducted. It can be put into practice with the help of technique if to place on the false corkline the automatic stereocamera with an ample reserve of film and a high frequency of survey. The designing of similar cameras is conducted in PINRO.

In spite of the small number of measurements errors of mean values K'f proved to be comparatively not great. This extremely important fact shows that taking quite enough measurements the mean value of K'F for the fish of the given species and biological condition can be fully used for calculations of the absolute abundance and population biomass on the basis of data of the total trawl survey.

For instance,the analogous calculations concerning the abundance and biomass of the Flemish Cap Bank long rough dab were conducted by Chekhova V.A. in 1974 (Chekhova,1975).

Summary

The investigations showed that by means of the automatic photocameras towed in front of the trawl it is possible to assess the absolute density of commercial fish concentrations on the way of the bottom trawl and to define its catchability coefficient with a rather high accuracy. This method of determination of the bottom trawls catchability provides with ample opportunities in studying of natural behavour and density of demersal fishes,their reaction to fishing gears,to effect of cables and bands of mud following the otter boards and promoting the concentration of fish on the trawl's way.

The practical use of K'f for assessment of the demersal fish stocks is allowable but requires the constant control of fluctuations of its value depending on biological condition and size composition of fish.

References

Bagenal,T.B. 1958. An analysis of the variability associated with the Vigneron-Dahe modification of the otter trawl by day and night and a discussion of its action. J.Cons.int.Explor.Mer.,24.

Bagenal,T.B. 1959. Letters to the Editor. J.Conseil.perman internat. Explor.Mer. 24 N3.

Chekhova,V.A. 1975. Trawl survey of demersal fishes in the Newfoundland area in 1974. Ann.Meet.Int.Comm.Northw.Atlant.Fish.Sum. Doc. 75/05.

Nikonorov,I.V.,A.P.Alekseyev,and K.G.Konstantinov. 1968. International FAO Conference on behavour of fish in connection with techniques and tactics of fishery. In book "Vsesoyuznaya konferentsiya po voprosu izucheniya povedeniya ryb v svyazi s tehnikoy i taktikoy promisla".Murmansk,PINRO.

Serebrov,L.I. 1974. Application of the quantitative methods for studying of the behavour of demersal commercial fish. "Rybnoye khozyaistvo,N9.

Treschev,A.I. 1974. Scientific bases of fishery selectivity. Izd. Moskva "Pishchevaya promyshlennost".

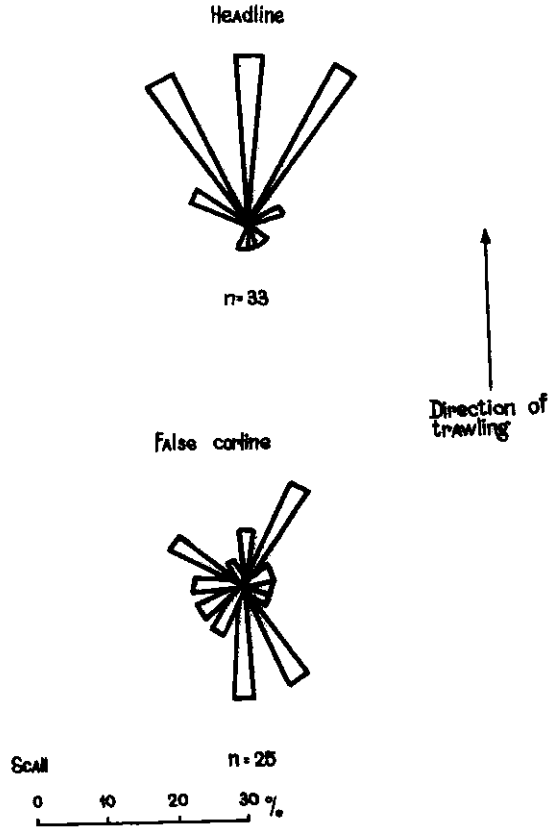

Fig. 3. Relationship between the cod catches and density of concentration close to the false corkline (1) and headline (2).

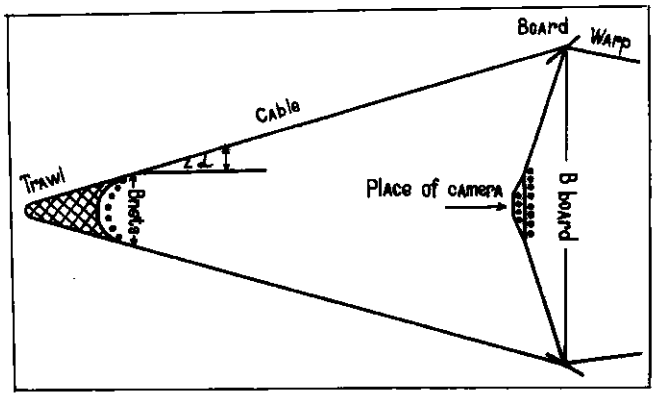

Fig. 1. The diagram of the false corkline disposition with photocameras installed on it.

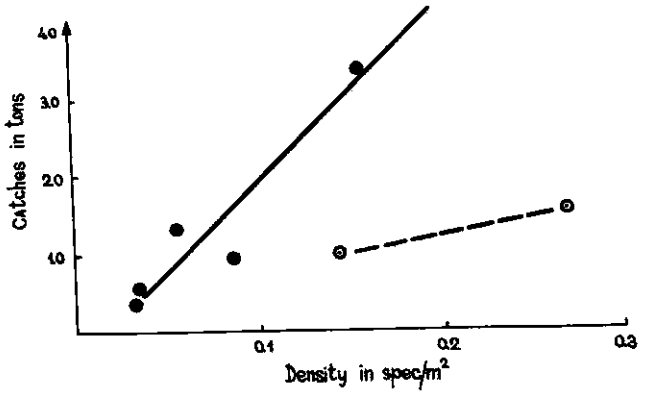

Fig. 2. Positions of cod's body with reference to the direction of trawling near by the headline and false corkline.