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Technic of Fishing

ASSESSMENT OF THE FISH SHOAL ABUNDANCE
FROM THE NET SOUNDER AND VERTICAL SOUNDER RECORDS

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DETERMINATION OF FISH SHOAL SIZE

Abstract

The geometric parameters of fish shoals were determined according to the echogrammes of sounded fish shoals. For analyses used the material collected between 17.12.1972 and 25.02.1973 by m/t „Kantar” at Georges Bank fishing grounds. The analysed echogrammes relate to fishing of mackerel.

INTRODUCTION

The fishing vessel's main task is to catch, in an appropriate time unit, and to draw out upon the deck a quantity of fish in a proper condition ensuring the continuous operation of the vessel's processing equipment. An extensive and comprehensive knowledge of the object pursued is required to accomplish this task. This knowledge determines the exploiter's (i.e., the captain's) decisions frequently resulting in serious economic consequences.

Looking from the point of view of the fishing technique, the informations required are concerned with the fishing gear characteristics, and on the other hand with the object

fished. The latter concern mainly the species composition of fish shoals, their vertical and horizontal distribution in water, geometric parameters and density (concentration), directions of their translocation in water as well as prediction of the fish reactions to stimuli coming from the external environment and those caused by the fishing gear.

A number of researchers have dealt with the fish shoal structure and abundance; here the works of **Breder** (1959), **Cullen** (1965), **Baldwin** (1965) and **Radakov** (1968) are considered to be worth mentioning.

The hydroacoustic devices applied to fisheries have created new possibilities of a direct evaluation of the fish resources, based on hydroacoustic methods (**Berdičevskij** and **Jermolčev**, 1973; **Truskanov** and **Zaferman**, 1973; **Elminowicz**, 1973; **Elminowicz**, 1971; **Świniarski** and **Elminowicz**, 1973). Informations on the object tracked (i.e., single fish individuals, fish shoals) are transmitted by echo signals recorded as so called traces on the echo sounder recorder.

Diversity of the hydroacoustic devices used as well as variety of fish shoals presents many problems to the exploiter as to his decision of starting the fishing operation, its duration and predicted results. Since echo signals more or less deform the informations on the object sounded, a proper identification of traces is essential when using an echo sounder (**Elminowicz**, 1971). The aim of the present study is to determine the geometric parameters of the fish shoals basing on the appropriate interpretation of their traces obtained from the recorded echo signals coming from the shoals detected.

MATERIAL AND METHOD

Material

Material for studies was collected during the fishing cruise of the B 29 type vessel, m/t „Kantar” over the period 17. December 1972 to 25. February 1973. The region surveyed is determined by the following positions:

$$\begin{array}{ll} \varphi = 40^{\circ}58' \text{ N} & \lambda = 072^{\circ}48' \text{ W} \\ \varphi = 39^{\circ}52' \text{ N} & \lambda = 068^{\circ}39' \text{ W} \end{array}$$

M/t „Kantar” was equipped with a vertical sounder of LAZ 17 ADT 3 type enabling searching and detection of fish shoals as well as allowing to determine the depth of occurrence, thickness and density of the detected fish shoal, the latter feature being assessed roughly from the traces intensity.

The net sounder mounted on the trawl headline records the fish entering the gear, gives an orientation as to precision of directing the trawl to the shoal detected by the vertical sounder, and permits to determine roughly the cod-end fulfillment with fish.

Some technical parameters of the vertical sounder are as follows:

– type	LAZ 17 ADT 3
– operating frequency	30 kHz
– transducer type	LSE 23
– paper band length	25 m
– paper band width	204 mm

Values of the other parameters necessary for the final calculations of results, determined indirectly, are presented in the chapter on methods, together with the description of the way of determining them.

Fig. 2. Gear for pelagic trawl WP 64/112x61/92 – 160 floats

The net sounder has been equipped with the NES 2 type transducer. The remaining net sounder parameters necessary for calculations are the same as for the vertical sounder (ranges, paper band shift speed, amplification, scale, etc.) on account of identity of the both sounder recorders.

One pelagic trawl, WP 64/112x61/92 (Fig. 1) was operated throughout the whole sampling period. The table below presents kinds of data collected.

Data collected	Subsequent hauls
	1 n
Number of haul	
Date, hour, duration of trawling	
Position	
Cloudiness and precipitation	
air	
Temperature of	surface water
	water of operating depth
Wind direction and strength	
Fishing ground depth	
Trawling depth	
Nature of bottom	
Warp length	

Trawling direction and speed

Current direction and velocity

Fishing gear position against the vessel axis

Spread between the doors

Catch (species composition in %)

Gonad maturity stage according to the Meier scale

Fish shoal movement direction

Fish reaction to gear and vessel

Fish behaviour in the trawl mouth

Directing the trawl to the shoal

Damages of the gear

The moments of starting and completing the haul, haul number, time of recording, pulse frequency, measurement range, amplification and paper band shift speed were marked directly on the records of the vertical and net sounders.

Rys. 3. Sondowanie szerokości ławicy rybnej

Fig. 3. Sounding the width of fish shoal

- Echosounder beam
- Fish shoal
- Beam cross-section

Fig. 4. Sounding the depth of fish shoal

METHOD

Preliminary analysis of results

After the preliminary analysis had been made, only the hauls and echo sounder records related to the mackerel catches (amounting to 98.8% of the total catch) were selected; the other criterion of selection was the undisturbed work of the fishing gear and hydro-acoustic devices.

It should be explained that the concept of „shoal” as accepted in the present paper is not wholly identical with the biological meaning of the term. Here we use the term in a narrower sense because of the subdivision of a biologically uniform shoal into smaller units. The reasons are following:

- the differences in the shoal heights and the occurrence depths of various parts of the shoal are well-marked, resulting in great errors which would appear in further calculations (Fig. 5);
- the differences in traces intensities of various parts of the shoal are too conspicuous; an erroneous interpretation of the results would take place if the shoal was treated as a whole (Fig. 6).

However, instances exist when several biologically distinct shoals, most often small or very small ones showing one entry on the net sounder record are treated as one unit. The concept of „shoal” applied then becomes broader than its biological meaning (Fig. 7). The shoals fulfilling both conditions has been encountered as well (Fig. 8).

The fish concentrations just described constitute commercial shoals in both instances.

Smaller units separated from the biologically uniform shoals as well as the uniform ones not subject to subdivisions were given subsequent numbers. The biologically uniform shoals subdivided into the smaller parts were denoted with capital letters, the parts forming the shoal being connected with a bracket.

Fig. 5. Biologically uniform fish shoal dispersed into smaller units owing to high differences in height.

2, 3, 4, 5, 6, 7, 8 – markings of units into which the fish shoal was dispersed

A. marking of biologically uniform fish shoal (Marking of whole)

Certain parameters of the echo signals appearing as black spots or traces on the vertical sounder record are presented numerically. They are concerned with the depth of the shoal occurrence, shoal height, width, its height within the vertical gape of trawl, densities on the vertical and net sounder records.

The preliminary analysis has been made in the following way:

Shoal height

Data placed in table under such a heading (Table 1) determine in mm the distance between the upper and lower borders of the shoal as measured directly on the sounder record.

Shoal width

The shoal width is also expressed in mm and likewise it is measured directly from the recorder readings as a distance between the both ends of the shoal trace.

Shoal height in trawl vertical gape

Since only sporadically the shoal height is equal to the vertical gape of the trawl mouth, and the shoal lower and upper borders are equally seldom on the same level as the groundrope and headline, respectively, determination of the shoal height in the vertical gape of the trawl seems to be necessary. The required shoal height was obtained after the „trawl path” had been laid out on the vertical sounder record.

Fig. 6. Biologically uniform fish shoal dispersed into smaller units owing to differences of density.

5, 6, 7, 8, 9, 10, 11 – markings of units into which the fish shoal was dispersed.

A. marking of biologically uniform fish shoal (Marking of whole)

Fig. 7. Two biologically separate fish shoals considered as whole owing to one input at nett sounder

4, 5 – marking of biologically separate fish shoals

Intensity of vertical sounder record

Intensity of the shoal trace was evaluated according to the following scale:

mist-like trace	1
very small intensity	2
small intensity	3
intermediate intensity	4
intense trace	5

Intensity of fish entries record

Intensity of the fish entries record was read from the net sounder record and evaluated according to the scale described above.

Comparing the corresponding records of the net and vertical sounders, capturing of the shoal was ascertained. The caught shoals were denoted with (+), the missed ones with (–).

Fig. 8. Dispersion of fish shoal into smaller units owing to differences in height and density
 1, 2 – marking of units into which the fish shoal was dispersed
 A – marking of biologically uniform fish shoal (marking of whole)

Materials resulting from 42 hauls were worked out and summarized in Table 1 as a result of the preliminary analysis of the whole cruise effects.

Proper interpretation of echo sounding records

Since the information on the tracked object, transmitted by the echo signals is more or less deformed, a proper interpretation of traces is necessary when using an echo sounder.

Shoal width B

The shoal width denoted width B (Fig. 3) depends on:

- the width of this shoal's trace appearing on the paper band of the vertical sounder;
- the paper band shift speed;
- the trawling speed.

The trace width represents the shoal width as defined during the preliminary analysis of the echo sounding records.

The value of „B” was calculated from the following: $B = V_s \cdot V_p \cdot \text{shoal width as measured on the record (1)}$

where: V_s – vessel speed; V_p – paper band shift speed.

Table 1

Results of catches and data from preliminary analysis of echo sounding records

Vessel's name, type m/t „Kantar” B 29			Trawl type pelagic WP 64/112x61/92					Echo sounder type LAZ 17 ADT 3			Amplification		5 vertical sounder 6 net sounder	
No	No of haul, efficiency, species composition	Hour of recording haul duration	Trawling speed (kn)	Echo sounder operating range	Depth of shoal submergence (m)	Shoal height (m)	Shoal width (m)	Shoal height in the trawl mouth path (m)	Shoal caught (+), shoal missed ()	Record intensity of vert. sound. of net sound.		Shoal denotation Remarks		
1	No 30	1955-2005	4.5	A I 10-75	56-67	27	30	19	+	1	2	1	28 XII 72	
	45 t				49-64	39	17	39	+	2	3	4		
		44-67	56	31	49	+	3	4	2	A				
		37-67	72	10	51	+	4	4	3					
		47-65	44	20	44	+	1	4	6					
	15.9 t/h	2255-2320	50-56	16	4	16	+	1	4	7	B			
			50-68	43	14	40	+	1	3	8		C		
	100% mackerel	2 ^h 50 ^m	48-68	48	6	39	+	2	4	9	C'	picture of C after turning		
			51-68	41	17	32	+	1	4	10				
			40-62	52	8	52	+	3	4	11	B'	picture of B after turning		
			45-58	30	7	20	+	3	4	12				
			35-51	40	23	29	+	4	4	13				
			41-51	22	11	22	+	4	4	14				
									3	x -	so called „blind record” - without trace on vert. sounder			
			22	No 60	1530-1545	4.0	A I II 0-150	68-103	42	8	23	+	4	2
25 t	1815-1840	61-103		49	7			23	+	4	3	2		
		82-94		15	1			12		5		3		
10 t/h	96-103	8		1	8		5		4	x - „blind record”				
100% mackerel	2 ^h 30 ^m	88-99		12	3	12	+	5	1		5			
		70-91		24	2	13	+	5			6			
		68-86		21	3	9	+	2			7			
													entries visible only on „fishlupe”	

The following trawling speeds were employed when collecting the material:

$V_s = 3.5 \text{ kn} = 108.0 \text{ m/min.}$; $V_s = 4.0 \text{ kn} = 123.4 \text{ m/min.}$;
 $V_s = 4.5 \text{ kn} = 138.9 \text{ m/min.}$; $V_s = 5.0 \text{ kn} = 154.3 \text{ m/min.}$

The paper band shifted with following speeds:

for the 1. sub-range of 0–75 m: 0.1 min./mm;
 for the 2. sub-range of 0–150 m: 0.2 min./mm;
 for the 3. sub-range of 0–300 m: 0.4 min./mm;

Shoal width Bw (Fig. 3)

An influence of the beam width on the shoal trace length is taken into account when determining the shoal width Bw. The latter was calculated from the following (Elmi-nowicz, 1971):

$$Bw = B - 2h \operatorname{tg} \frac{Q}{2} \quad (2)$$

where:

h – mean shoal depth

Q – effective beam angle

The effective beam angle depends on the projector parameters and can be calculated as follows:

$$\mathcal{H} = \frac{\sin \left(\pi \frac{1}{\lambda} \sin \frac{Q}{2} \right)}{\pi \frac{1}{\lambda} \sin \frac{Q}{2}} \quad (3)$$

where: $\mathcal{H}$ – power loss (in dB); 1 – projector size (in cm); λ – wave length (in cm);
 Q – beam angle for desired power loss.

For the comparatively dense shoals occurring at small depths a power loss value should be assumed as 15 dB. Then

$$\pi \frac{1}{\lambda} \sin \frac{Q}{2} = 2.118$$

The ELAC sounder projectors have the following values of $\frac{1}{\lambda}$:

$$\frac{1_1}{\lambda} = 1,7 \quad \text{for a smaller diameter;}$$

$$\frac{1_2}{\lambda} = 2,8 \quad \text{for a greater diameter.}$$

The effective beam angle values will then amount respectively:

$$Q_1 = 47^\circ; \quad Q_2 = 28^\circ.$$

The beam angle along the vessel is $Q_2 = 28^\circ$

Finally the shoal width Bw should be calculated from the following formula:

$$Bw = B - 2h \operatorname{tg} \frac{Q_2}{2} \quad (4)$$

Shoal width Bs

Assuming the shoal area being much greater than that of the beam cross-section, the shoal width as measured through the sounding is not accurate and unequivocal on

account of its dependence upon the vessel path above the shoal (the vessel may pass above the centre or the border of the shoal).

Considering a statistic correlation existing between a trace length and an actual shoal width, the latter can be calculated as follows:

$$B_s = \frac{4}{\pi} B_w \quad (5)$$

Shoal height H

The shoal height H was calculated from the following dependence:
for the 1. sub-range $H = 4.2$ measured from the echo sounding record;
for the 2. sub-range $H = 8.4$ measured from the echo sounding record;
for the 3. sub-range $H = 16.8$ measured from the echo sounding record.

The above values indicate the number of metres in nature corresponding with 1 cm on the record (vertically); they are given in operating instructions of the echo sounding recorder.

The shoal height was determined in millimetres; a distance between the upper and lower borders of the shoal measured directly on the record and applied to the above mentioned dependences should be expressed in cm.

Shoal height ΔH (actual)

An effect produced by the transducer beam angle was considered when measuring the shoal height ΔH (Fig. 4).

The actual shoal height (thickness) can be calculated according to the following formula (Elminowicz, 1971):

$$\Delta H = \cos \frac{Q_1}{2} (H + h - v T_n) - h \quad (6)$$

where: ΔH – actual shoal height, Q_1 – transducer beam angle. H – shoal height provided by the record, h – depth of shoal occurrence, v – velocity of sound in water, T_n – length of transducer pulse.

In cases of negative values of the actual shoal heights the following formula was used to calculate ΔH :

$$\Delta H = H - T_n v$$

Shoal volume V

Assuming the ellipsoidal shape of the shoal with the shoal height being one of the axes and the remaining two being equal to the shoal width B_s , calculation of the shoal volume can be made from the following expressions:

$$V = \frac{\pi}{6} B_s^2 \Delta H \quad (7)$$

$$V \cong 0.5 B_s^2 \Delta H \quad (8)$$

Height of the caught part of the shoal, H_z

The height of the caught part of the shoal was determined in the following way: the actual shoal height was drawn on the detected shoal trace (on the vertical sounder record), then the „trawl path” was laid out on the same trace. The part of the actual

shoal height comprised within the trawl mouth was taken for the caught fraction of the shoal.

Volume of the caught part of the shoal, V_z

The volume of the caught part of the shoal was calculated from the following:

$$V_z = B_w \cdot H_z \cdot R \quad (9)$$

where:

B_w — shoal width when the beam angle effect is considered

H_z — height of the caught fraction of the shoal

R — horizontal gape of the trawl mouth $R = 31.7$ m

In cases of a greater horizontal gape of the trawl mouth than the shoal width ($R > B_w$), the volume of the caught fraction of the shoal was calculated in the following way:

$$V_z = 0.5 \cdot B_w^2 \cdot H_z \quad (10)$$

Width of the biologically uniform shoal or of a number of shoals treated as a single unit because of their simultaneous entry on net sounder, B_{f}

The shoal width B_{f} was calculated from the following interrelations:

for the 1. sub-range $B_{\text{f}} = V_s \cdot 0.2 \cdot \text{shoal width measured from the record.}$

for the 2. sub range $B_{\text{f}} = V_s \cdot 0.2 \cdot \text{shoal width measured from the record.}$

for the 3. sub-range $B_{\text{f}} = V_s \cdot 0.4 \cdot \text{shoal width measured from the record.}$

The shoal width as measured from the echo sounding record is the width of a biologically uniform shoal; when a number of shoals are treated as a single unit on account of their simultaneous entering recorded on the net sounder, the shoal width covers also the gaps between them.

Lengths of entries into trawl — L

The length of fish entries into the trawl was determined from the net sounder records according to the following dependences:

for the 1. sub-range $L = V_s \cdot 0.1 \cdot \text{entry length measured from the record;}$

for the 2. sub-range $L = V_s \cdot 0.2 \cdot \text{entry length measured from the record;}$

for the 3. sub-range $L = V_s \cdot 0.4 \cdot \text{entry length measured from the record;}$

RESULTS AND DISCUSSION

42 hauls from the cruise investigated have been selected for the detailed analysis. The catches from the hauls examined as well as the preliminary record analysis are summarized in Table 1. It should be stated that the hauls summarized in Table 1 gave high catches and that the echo sounding records obtained during the fishing operations on dense shoals were easily recognizable. Echo signals recorded by the vertical sounder as traces were converted in the way previously described into the numerical form and summarized in Table 1 under headings Nos 6–12. This procedure facilitated the linear presentation (in metres) of fish shoals recorded as traces.

The results summarized in Table 1 were used for a proper interpretation of the echo sounding records. Table 2 comprises the results of this interpretation and contains the results related to the geometric parameters of shoals, expressed in m.

Table 2

Geometric parameters of shoals calculated from records of vertical sounder

No	Shoal denotation	Whole shoal width (m)	Length of entries into trawl L (m)	Shoal width B (m)	Shoal width Bw (m)	Shoal width Bs (m)	Shoal height H (m)	Shoal height Δh (m)	Shoal volume V ($10^3 m^3$)	Height of caught part of shoal Hz (m)	Volume of caught part of shoal Vz (m)	
1	2	3	4	5	6	7	8	9	10	11	12	
1	1	416.7	834.0	416.7	386.3	490.6	11.3	4.4	529.51	4.4	53.88	
	4	236.1	625.5	236.1	207.9	264.0	16.4	9.6	334.54	9.6	63.27	
	2	A	569.5	1251.0	430.6	402.9	511.7	23.5	16.5	2160.15	16.5	210.74
	3											
	6	B	486.2	1668.0	277.8	249.9	317.4	18.5	12.0	604.46	12.0	95.06
	7											
	8	C	194.5	430.9	194.5	165.1	209.7	18.1	11.1	244.06	11.1	58.09
	9	C'	319.4	973.0	83.3	54.4	69.1	20.2	13.2	31.51	13.2	22.76
	10											
	11	B'	680.6	4003.2	111.1	85.7	108.8	21.8	15.3	90.56	15.3	41.57
	12											
	13											
	14											
	x			1584.6								
22	1	197.4	24.6	197.4	154.8	196.6	35.3	25.4	490.87	9.8	48.09	
	2	172.8	172.2	172.8	131.9	167.5	41.2	31.4	440.48	9.8	40.98	
	3	24.7		24.7	8.0	8.0	12.6	11.0	0.33	8.1	2.05	
	4	24.7		24.7	8.0	8.0	6.7	5.1	0.15	5.1	1.29	
	x		110.7									
	5	74.0		74.0	27.4	34.8	10.1	7.5	4.55	7.5	6.54	
	6	49.4		49.4	17.9	17.9	20.2	19.9	3.19	10.0	5.67	
7	74.0		74.0	35.6	45.2	17.6	15.0	23.91	7.3	8.24		

Totally, 187 biologically uniform shoal were examined. 342 smaller units, with geometric parameters being calculated, were obtained employing the described criterions for the biologically uniform shoals subdivision, when the records differed as to the traces intensities and heights.

The widths of the shoals analysed ranged within 0.9–2,384.3 m. Abundances and percentages of each length class within 342 shoals examined are given below:

0.9	—	50 m,	83	shoals amounting to	24.27%	of the total number
50	—	100 m,	69	shoals amounting to	20.18%	of the total number
100	—	200 m,	83	shoals amounting to	24.27%	of the total number
200	—	300 m,	46	shoals amounting to	13.45%	of the total number
300	—	400 m,	22	shoals amounting to	6.43%	of the total number
400	—	500 m,	16	shoals amounting to	4.68%	of the total number
500	—	1000 m,	17	shoals amounting to	4.97%	of the total number
more than		1000 m,	6	shoals amounting to	1.75%	of the total number

342	shoals	100.00%
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The extreme limits of the analysed shoal height values have also a wide range: the smallest and the greatest heights are 0.1 m and 71.6 m, respectively.

Each height class had the following numerical and percentage values within the shoals examined:

0.1	—	5 m,	9	shoals amounting to	27.19%	of the total number
5	—	10 m,	72	shoals amounting to	21.05%	of the total number
10	—	15 m,	57	shoals amounting to	16.67%	of the total number
15	—	20 m,	36	shoals amounting to	10.53%	of the total number
20	—	30 m,	45	shoals amounting to	13.16%	of the total number
30	—	40 m,	23	shoals amounting to	6.72%	of the total number
40	—	50 m,	7	shoals amounting to	2.05%	of the total number
more than		50 m,	9	shoals amounting to	2.63%	of the total number

342	shoals	100.00%
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The most frequently found shoal widths ranged within 0.9–50 m (24.27%) and 100–200 m (24.27%), while the heights occurring most frequently were within the range of 0.1–5 m (27.19%). That means, however, that the shoals encountered most frequently during the fishing operations had not necessarily to have widths and heights comprised within the 0.9–50 m, 100–200 m, and 0.1–5 m ranges, respectively.

Usually the shoals of width ranging within 0.9–50 m and 100–200 m were of heights exceeding 5 m.

The abundance of the shoal cannot be estimated solely from its length or width. A shoal of a smaller width often occupies a greater volume than that of a greater width; similar can be the case of a shoal of a smaller height against that of a greater one. The abundance of the shoal should be evaluated mainly from its volume. The volume range of

the shoals examined proved to be very extended; the volume of the smallest shoal was $0.01 \cdot 10^3 \text{ m}^3$ while that of the greatest one was $26,569.13 \cdot 10^3 \text{ m}^3$.

Each volume class had the following numerical and percentage values within the shoals investigated:

0.01 —	$10 \cdot 10^3 \text{ m}^3$,	98	shoals amounting to	28.65%
10 —	$50 \cdot 10^3 \text{ m}^3$,	75	shoals amounting to	21.93%
50 —	$100 \cdot 10^3 \text{ m}^3$,	27	shoals amounting to	7.89%
100 —	$500 \cdot 10^3 \text{ m}^3$,	56	shoals amounting to	16.37%
500 —	$1\,000 \cdot 10^3 \text{ m}^3$,	28	shoals amounting to	8.19%
1000 —	$10\,000 \cdot 10^3 \text{ m}^3$,	50	shoals amounting to	14.62%
more than	$10\,000 \cdot 10^3 \text{ m}^3$,	8	shoals amounting to	2.34%
<hr/>				
342 shoals			100.00%	

When considering the fishing efficiency, one must emphasize the role played by the fish concentration expressed by the extent of obscuring of traces on the echo sounding records. Investigations carried out by Świniarski and Elminowicz (1973) showed that for haitail the result of fishing could not be predicted from measurements of the blackened area on the echo sounding record. The correlation coefficient value was only 0.0726, while using the fish density coefficients of 1, 2, 3, 4 of the fourgraded scale for traces blackening, the correlation coefficient obtained was 0.161. When only the records with 3. and 4. grades of blackening were considered, the correlation coefficient for the catches, calculated theoretically and the actual one was 0.91.

CONCLUSIONS

1. The hydroacoustic devices used on the Polish fishing vessels at present allow to determine, with a high degree of probability, the geometric parameters of shoals (after the proper interpretation of traces) as well as their concentration.
2. The evaluation of geometric parameters of shoals, an assessment of their density from the echo sounding records in particular, should be related to the monospecific shoals exhibiting the similar stage of the life cycle and living on the same area.

To make the results obtained comparable, the ichthyolocating equipment of the same type should be employed.

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OKREŚLANIE WIELKOŚCI ŁAWIC RYBNYCH
NA PODSTAWIE ECHOGRAMÓW SONDY
PIONOWEJ I SIECIOWEJ

Streszczenie

W pracy podjęto próbę określenia parametrów geometrycznych ławic rybnych przez odpowiednią interpretację ich śladów uzyskiwanych przez zarejestrowanie echogramów pochodzących od wykrywanych sondą ławic ryb.

Materiał do badań zebrano na statku m/t „Kantar” w okresie od 17 XII 1972 r. do 25 II 1973 r. na łowiskach Georges Bank. Analizowane echogramy dotyczą połowów makreli.

W oparciu o zastosowane wzory określano następujące parametry ławic rybnych: szerokość, długość, wysokość, objętość. Wyniki zestawiono w tabelach.

ОПРЕДЕЛЕНИЕ ВЕЛИЧИНЫ КОСЯКОВ РЫБЫ НА ОСНОВАНИИ ЭХОГРАММ
ВЕРТИКАЛЬНОГО И СЕТЕВОГО ЛОТОВ

Р е з ю м е

В настоящей работе сделано попытку определить геометрические параметры косяков рыбы на основании соответствующей интерпретации следов этих косяков, получаемых регистрированием эхограмм происходящих от обнаруженных лотом косяков рыбы.

Материал для исследований был собран суном м/т „Кантар” в период 17.12.1972–25.02.1973 г.г. на месте ловли Georges Bank. Анализированные эхограммы касаются ловли скумбрии.

Исходя из применяемых формул, были определены следующие параметры косяков рыбы: ширина, длина, высота и объем. Полученные результаты составлено по таблицам.

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