International Council for the Exploration of the Sea

ICES C.M.1980/J:6
Baltic Fish Cttee
Ref.Fish Capture Cttee

Selectivity of Trawl Cod-Ends for Flounder Fishery in the Baltic Sea.

by S.E.Shevtsov
Baltic Fishery Research Institute (BaltNIIRH),
Daugavgrivas 6,Riga-49, U S S R.

Introduction

Experimental catch was made annually in June in subdivision 28 of the Baltic Sea from small fish boats 150h.p. (MSTB)-150) in concentrations of flounder.Catch was made by commercial 39.1m bottom trawl in its usual commercial regime.

Method

Fish wich passed through the meshes of trawl cod-end were retained by a small-mesh outer covering (fish-catchers) which were 1.5 greater than cod-end and 1.5-2.0 m longer than the covered surface.

The coverings were made of kapron netting (polyamide A) with the inner mesh size 40 mm (thread 93.5, tex x 9).

Abstract

In 1975-1978 selective qualities of bottom trawls with inner mesh size in cod-ends 80,90,100,110 and 120 mm for flounder fishery were investigated. Connections between: length of fish with 50% sifting and inner mesh size (B); by-catch of non-commercial fish (P) and parameters of fish stock size composition (mode of length, juveniles abundance); total length of fish and biometrical sizes (girth behind gill covers and maximum girth, maximum height and thickmes of body) which are necessary for calculation of optimum catch for more rational usage of flounder stock.

R E S U M E

Aux années de 1975-1978 ont été étudiées les propriétés sélectives des chaluts de fonds à la dimension intérieure de la maille en encoches de 80, 90, 100, 110 et 120 mm à la pêche à la barbue d'eau douce. On a révélé les rapports entre: la longueur des poissons de 50% de refus et la dimension intérieure de la maille /B/; la prise des poissons sans valeur et les paramètres de la composition en dimensions des banc de poisson / le mode de longueur, l'effectif d'alevin /: la longueur totale des poissons et les dimensions biométriques / entre la circonférence derrière les couvercles branchiaux et la hauteur et l'épaisseur maximales du corps /, qui sont indispensables aux calculs de la pêche optimum dans le but d'assurer l'exploitation plus rationnelle des réserves de barbue d'eau douce.

The mass of flounder catch was determined with the help of measuring buckets. After that fish from the cod-end and fish-catchers was measured completely or partially (when the catches were big), but not less than 270-350 ind. from each sample with further recalculation for the whole catch. Total length of fish was measured (from nose-tip to the end of spread tail fin. Periodically groups of fish with equal length, from 12.0 to 25.0 cm in the interval 1.0 cm (deviation of fish length in groups from the limits could not surpass ± 0.5 mm) were selected. Beside total length, the commercial length (from nose-tip to the beginning of the middle rays of tail fin, the girth behind gill covers and maximum girth, maximum height and thickness of body. Length and maximum width of fish body were measured on the usual measuring board.(with further approximation to the nearest half cm).

Maximum thickness of body was measured by sliding callipers with special prolonged lips. Inner mesh size (B) was measured by ICES wedge-shaped probe, which was put into the mesh without measured effort (freely). Mean value of 20 measured meshes were used at calculation of selectivity parameters, running in the middle of the cod-end parallell to pennant (with the interval 1.0 - 1.5 m from Haifan).

Results of Investigations.

Kapron (polyamide) experimental cod-ends bad factory mesh size (2a) 80,90,I00,II0,I20 mm.

The results of the experiments and the main data on selective properties of cod-ends are shown in Table I.Groupped in one centimetre correlations of flounder size compositions obtained from the summary data of experimental catch by every cod-end are shown in Figure I, selectivity diagrams are shown in Figure 2.

As it is seen from the analysis of investigations results, the cod-end N I (mesh 80mm) had rather low selective properties,it retained on the average 90,4% (abundance) of fish of noncommercial sizes ($L_o < 2I.0$ cm) of their total number in cod-end catches plus the cover. Selective properties considerably improved (3 times) with the increase of mesh at comparatively small increase of passage of fish of commercial sizes (from 0.06 to I6.7 %). Fish length of 50% sifting changed in direct connection with the inner mesh size in cod-ends. It is approximated by the least square method by the following expression:

$$L_o\ 50\ \% = I.87 \quad B - I.II$$

The parameters of size composition of exploited fish concentrations influence the selective ability of trawl cod-ends at flounder as well as at other fish (herring, sprat,cod) fishery. The diagrams of dependences of fish bycatch (P) with the length $L_o < 2I.0$ cm on the change of

small fish abundance (N_m) and the product of total length mode ($L_{o\ max}$) by juveniles abundance (N_m) are shown in Figure 3. Mathematic interpretation of experimental data by the least square method allowed to represent these connections by the following expressions:

for 90 mm mesh -

$P=0.96\ N_m-5.0;$

$P=0.0609\ N_m L_{omax}- 16.0$

for 100 mm mesh

$P=0.6156\ N_m+ 0.1;$

$P=0.0305\ N_m \cdot L_{o\ max} - 1.56$

for 110 mm mesh -

$P=0.5\ N_m+ 2.0;$

$P=0.0278\ N_m \cdot L_{o\ max} - 0.26$

for 120 mm mesh -

$P=0.648\ N_m- 4.23;$

$P=0.0463\ N_m \cdot L_{o\ max}- 12.49$

The obtained dependences have negligible errors and are quite suitable for calculations in the investigated parameters diapason of size structures of flounder exploited stocks.

Flounder biometrical sizes (commercial length, the girth behind gill covers and maximum girth, body maximum height and thickness) were estimated in 1975 in the area of experimental catch.

Mean arithmetical values of the parameters are given in Table 2.

The analysis of these measurements shows that there is connection close to direct between the total length (L_o) and other parameters. This connection is graphically represented in Figure 4. Empiric expressions of the dependences were also obtained by the least square method. The data of Table 2 were used for working out normal equations (from I2.0 to 25.0 cm). Relative precision of measurements at the minimum number of measured fish in the group (I7for L_o=I2.0 cm) m de up 3.0%,in other size groups it was higher. After mathematic interpretation of these data we obtained the following empiric expressions:

- for fish commercial length:

$L_n = 0.845\ L_o - 0.35$ or $L_n = 0.83\ L_o$;

- for body girth behind gill covers:

$F_1 = 0.44I\ L_o + 4.92$

- for maximum body girth:

$F_{max} = 0.885\ L_o + 0.23$;

- for body width :

$M = 0.4I\ L_o - 0.03$;

- for body thickness :

$h = 0.084\ L_o - 0.I7$.

Flounder body thickness (h) in the investigated length range changed from 0.I7 H to 0.I94 H and was on the average 0.I8 H.

The results of the investigations permit to make the following conclusions:

1. Trawl cod-ends with 80 mm mesh for flounder fishery at commercial length L_c=21.0 cm have rather low selective properties (juveniles retaining made up 90.4% by count).

2. The increase of meshes in cod-ends to 110 mm considerably improves trawls selectivity (non-commercial fish retaining 26.6%) at negligible sifting of commercial fish (2.7-7.0%). Total length of 50% sifting increases proportionally to the increase of mesh size (direct connection).

3. Selectivity factors changed insignificantly - in the range 1.69-1.84.

4. Selectivity diapason changed in the range 2.4-5.1 cm.

5. Selective properties of trawls for flounder fishery depend on the parameters of fish stocks size composition (total length mode $L_{o\ max}$ and non-commercial fish abundance N_m). The connection of juveniles bycatch with these parameters for flounder as well as for other Baltic fishes is direct.

6. It is advisable for specialized flounder fishery to use trawls with mesh size in cod-ends 110 mm. Selective properties in this case are considerably improved at negligible (2.7-7.0%) sifting of fish of commercial sizes. This measure will favourably influence on the state of stock and reproductive ability of this fish.

In USSR Fishery Regulations the transition to this mesh in 28 subdivision of the Baltic Sea is stipulated since 1980. It is necessary to pass to the higher level of selectivity for flounder fishery also in other sea subdivisions.

Table I.

Ship: small trawl boat, power 150 h.p.

Species: flounder

Date: IY - 1975-1976

Type of the trawl: bottom trawl 39.1 m

Region: subdivision 28 (Irben Bay)

Material: kapron (polyamide)

Depth of fishing: 8-20 m

Semi-cod-end : none

Method: external small - mesh covering (B=40mm)

Results of Experiments.

Numb. of cod-end	Inner mesh size, mm	Thread size /tex/	Period of catches	Numb. of trawl-ings	Mean length of trawl-ings(t) in minutes	Number of fish (ind.) in trawls cod-end	in fish catcher (covering)	within the limits of selectivity ($L_0$75% -$L_0$25%)
I	84.0	93.5xϕ3.Imm	YI-I975	I0	I70	47945	I586	2384
2	88.0	93.5xϕ3.I	YI-I976	25	I50	74I77	I0329	II902
3	99.0	93.5xϕ3.I	YI-I976	53	I54	I37I57	25I90	5I5I9
4	I08.0	93.5xϕ3.I	YI-I976	9	I25	22464	7408	3097
5	I08.0	93.5x2ϕ3.I	YI-I978	48	I70	II4844	53528	29482
6	II9.8	93.5xϕ3.I	YI-I977	50	I75	85867	33204	46?II

Numb. of cod-end	Selective length of fish with 50% sifting (L_{8m} 50%)	By-catch of fish $L_o < 21$ cm (% by counting)	Retained fish in cod-end $L_o < 21$ cm (% by counting)	Sifting of fish $L_o \geq 21$ cm (% by counting)	Number of fish $L < 21$ cm in catcher by cod-end and covering (% by counting)	Coefficient of selectivity (K_s)	Limits of selectivity ($L_{o\ 75\%} - L_{o\ 25\%}$) cm
I	I4.5	32.0	90.4	0.06	32.8	I.78	3.5
2	I5.8	27.8	87.5	I.6	34.5	I.82	4.0
3	I7.3	I7.2	5I.4	2.2	28.7	I.77	4.0
4	I9.0	2I.4	43.9	7.0	37.2	I.8I	3.4
5	I9.7	20.2	26.6	2.7	4I.2	I.84	2.4
6	2I.0	7.9	3I.4	I6.7	I9.5	I.67	5.I

Table 2.

Mean Biometrical Sizes of the Baltic Sea Flounder.

General length of fish L_o (cm)	Number of measure-ments	Commer-cial size of fish L_n (cm)	Girth behind gill-covers F_1 (cm)	Maximum girth (cm) F_{max}	Width of bo-dy H (mm)	Thickness of body h (mm)
I2.0	I7	I0.0	-	I0.8	49.8	8.5
I4.0	27	II.5	-	I2.6	57.8	I0.0
I5.0	29	I2.3	-	I3.4	6I.0	II.0
I6.0	40	I2.9	I0.8	I4.5	65.5	II.7
I7.0	32	I4.I	I3.0	I5.5	7I.2	I2.8
I8.0	33	I4.8	I3.2	I6.7	73.7	I3.0
I9.0	25	I5.6	I3.4	I6.6	74.3	I4.3
20.0	24	I6.5	I4.0	I7.4	79.2	I4.8
2I.0	32	I7.3	I2.9	I9.5	86.7	I6.2
22.0	38	I8.3	I5.3	I9.4	89.0	I7.3
23.0	24	I9.2	I6.7	20.0	92.0	I7.3
24.0	30	20.0	I6.0	2I.4	99.6	I8.9
25.0	20	20.8	I4.I	22.9	I05.2	I8.8

FIGURES.

Figure I. Size Composition of Flounder.

I - by IO trawlings (cod-end I)
2 - by 25 trawlings (cod-end 2)
3 - by 53 trawlings (cod-end 3)
4 - by 9 trawlings (cod-end 4)
5 - by 48 trawlings (cod-end 5)
6 - by 50 trawlings (cod-end 6)

Figure 2. Curve of Flounder Selectivity.

I - cod-end 1
2 - cod-end 2
3 - cod-end 3
4 - cod-end 4
5 - cod-end 5
6 - cod-end 6

Figure 3. Dependence of Juvenile By-catch (P_J% by number) from the Parameters of Flounder Stocks.

I - cod-end 2
2 - cod-end 3
3 - cod-end 5
4 - cod-end 6

Figure 4. Dependence of Biometrical Sizes of Flounder from its Total Length (L_o).

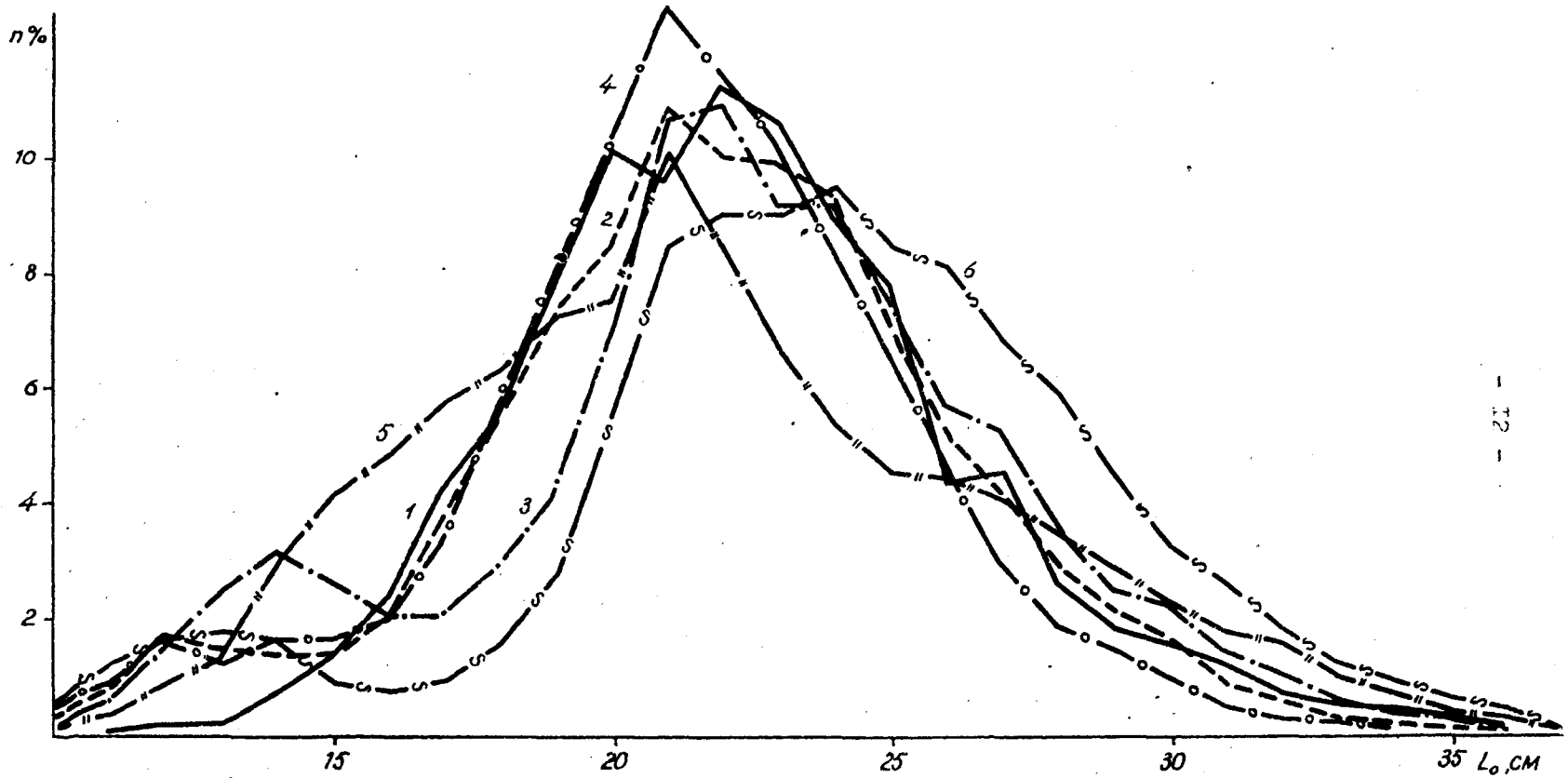


Fig. 1

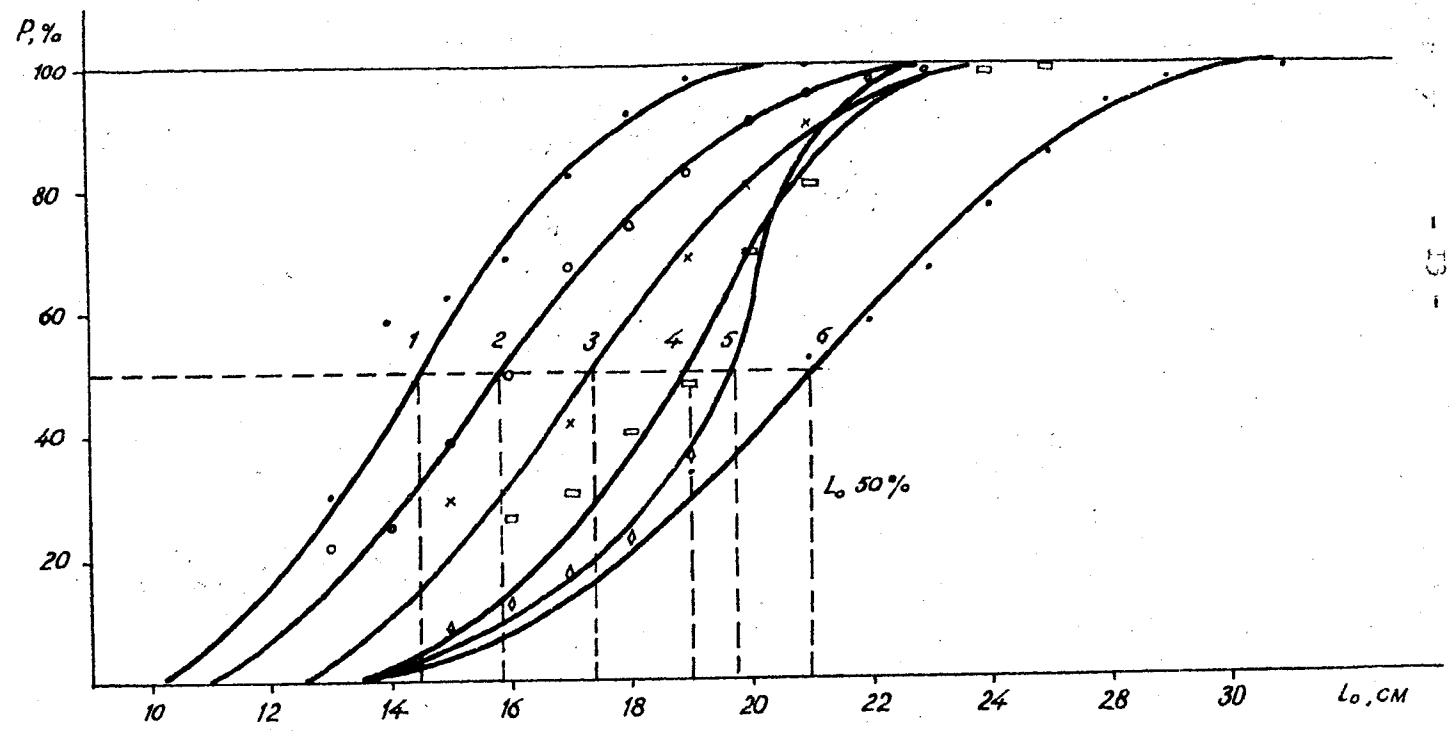


Fig. 2

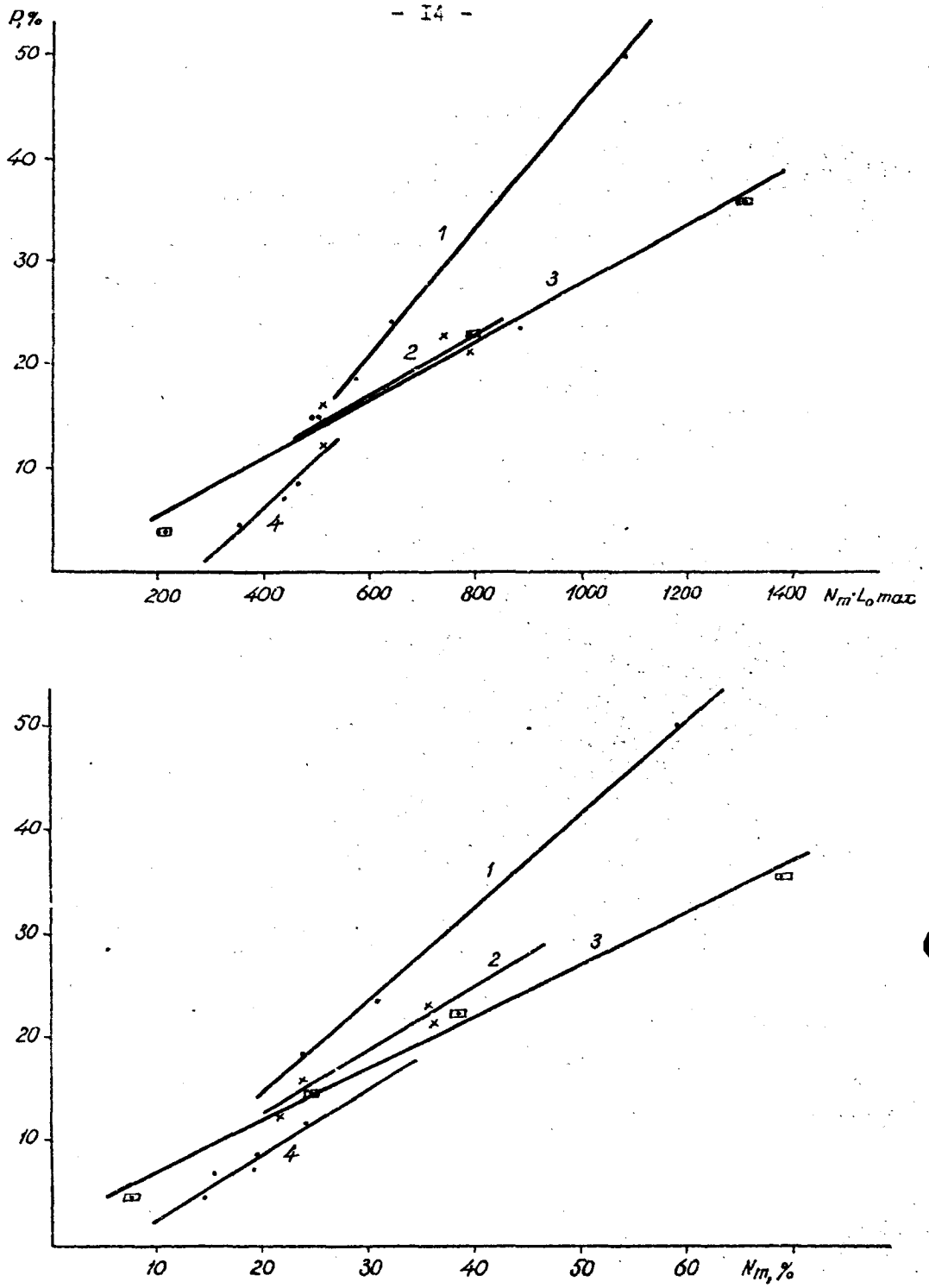
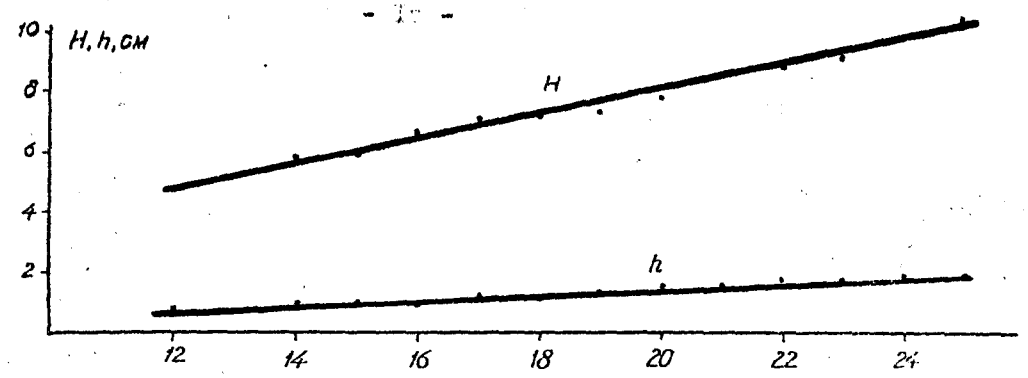
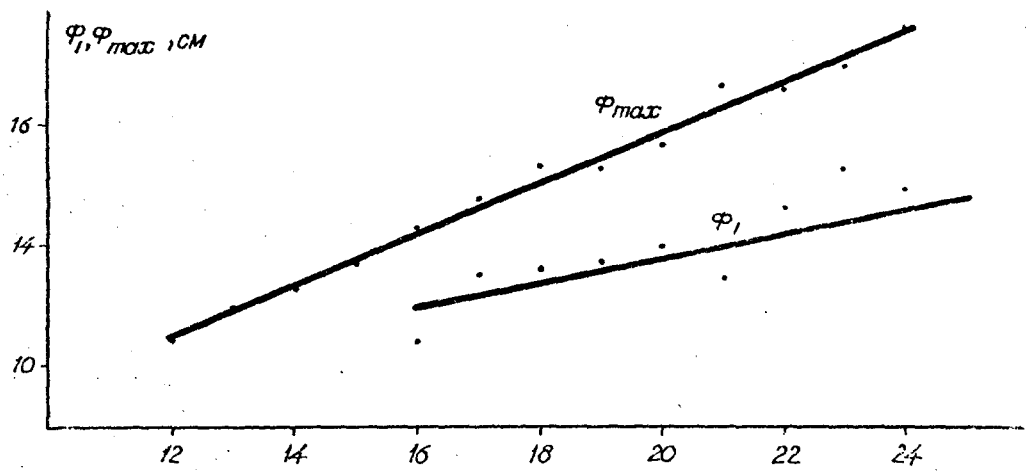
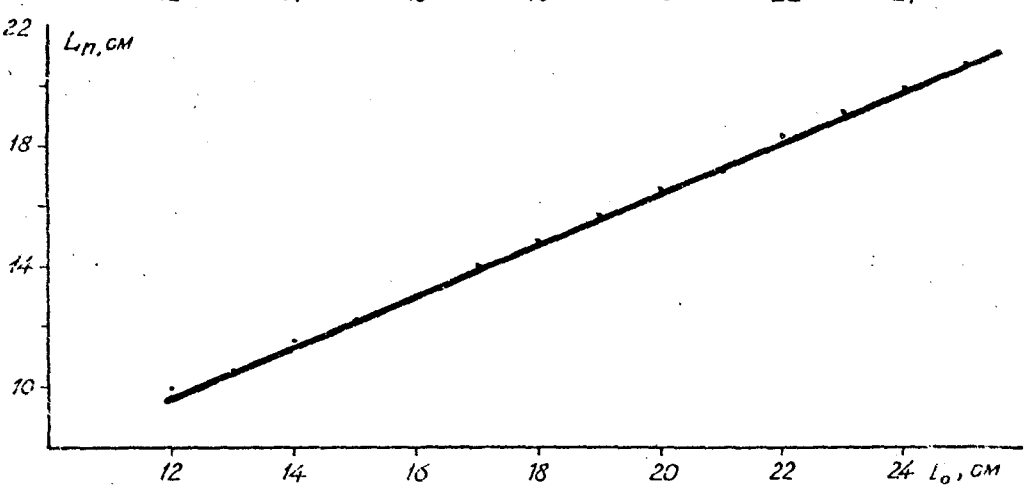

P,%
50
40
30
20
10
200
400
600
800
1000
1200
1400
$N_m \cdot L_o max$
1
2
3
4
50
40
30
20
10
10
20
30
40
50
60
N_m, %
1
2
3
4

Fig. 3


H, h, см
10
8
6
4
2
H
h
12
14
16
18
20
22
24


φ1, φmax, см
16
14
10
φmax
φ1
12
14
16
18
20
22
24


22
Lп, см
18
14
10
12
14
16
18
20
22
24
L0, см