Northwest Atlantic Fisheries Organization

Serial No. N502

NAFO SCR Doc. 82/VI/14

SCIENTIFIC COUNCIL MEETING - JUNE 1982

On Validity of Trawl Mesh Size Used in Fishing Areas of the Northwest Atlantic

by

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Abstract

The validity of mesh size in trawl bags in relation to redfish (Sebastes mentella), Greenland halibut (Reinhardtius hippoglossoides), roundnose grenadier (Macrourus rupestris), yellowtail flounder (Limanda ferruginea), American plaice (Hippoglossoides platessoides) is proved on the basis of selectivity estimation.

Introduction

At present the development of rational fisheries is impossible without introduction of measures aimed at safeguard and growth of commercial fish stocks to ensure the yearly maximum allowable yield, fishing efficiency being satisfactory. It should be emphasized that measures of fisheries management are versatile and may imply a number of requirements and conditions limiting and restraining fishing activity within certain scientifically substantiated limits. The rational exploitation of commercial stocks is not likely to be attained with introduction of incomplete set of measures of fisheries management, the more so, as these mesures are not substantiated appropriately. For instance, the absence of requirements for limiting the minimum mesh size in trawl bags may result in overfishing of the small fish; and a groundless increase in the mesh size may result in loss of practical sense in fishing because of low fishing efficiency or may produce the undesirable effect on reproducibility of the fished-off population because of extreme mortality in its spawning

part, as with the increase in the mesh size a greater amount of larger or older specimens are caught. The length frequency of retained fish depends mainly on the mesh size in trawl bags, as the front half of the trawl netting has larger meshes than the trawl bag, and the attempt of fish to escape the trawl is most prominent in the trawl bag.

The paper carries the advice on minimum allowable mesh size while fishing for Greenland halibut, roundnose grenadier, redfish Sebastes mentella, yellowtail flounder and American plaice based on PINRO data relating the results of trawl bag selectivity estimation in the main fishing areas of the Northwest Atlantic.

If after the escape from the trawl bag fish are viable, then afterwards they again may be fished, their size and weight being greater than during the first haul. All this produces prerequisites for the growth of catches at the expense of an increasing the amount of larger specimens among caught fish.

The change of the mesh size in trawl bags affects the catch either immediately after the change (immediate losses, profits), or after a certain period of time (long-term losses, profits), on the reproducibility of fished-off species and on the quality of the catch, determined by the portion of large fish in it.

The optimum mesh size should ensure the maximum escape of small fish and the minimum one of fish of commercial length. If among fish escaped through the bag of a certain mesh size the amount of fish of commercial length exceeds the amount of relatively small fish, then the rationality of applying this mesh size should be subject to doubt. Long-term profits for fisheries are the criterion of mesh size effectiveness.

While studying the effect of fisheries on the state of fish stocks and the prospects of the yield, not only the retained and escaped fish should be considered, but fish meshed in the trawl bag as well as in the nets ahead of the bag. The bag inmeshing to a certain degree affects the fish escape owing to the decreased total space in all meshes of the net. While estimating the selection factors these fish are shaken off into the bag and are considered as retained. The amount of fish meshed in the net ahead of the bag is as high as the number and

weight of fish escaped from the bag and retained by the cover. While estimating the selectivity the meshed fish in the trawl net are usually not counted. The problem arises regarding counting of fish. It would be wrong to consider these fish retained, as part of fish would escape from the bag net. It would be more correct to consider that the meshed fish except those in the trawl bag form a specific portion of the catch which should be counted while determining the mortality of fish of the corresponding length caused by fisheries.

The materials on determination of selectivity parameters of trawl bags in relation to Greenland halibut, roundnose grenadier and redfish Sebastes mentella are presented in the NAFO reports (Chumakov et al., 1981, Nikeshin et al., 1981).

In this paper the reports are briefly commented on, and some additional conclusions are given based on calculations and more detailed analysis of the obtained results. Data on selectivity of trawl bags in relation to yellowtail flounder and American plaice are given a fuller account of, because they were not presented earlier.

It should be noted that for the subsequent substantiating of requirements for fishing gears for the main fishing objects in the NAFO areas it is necessary to estimate the selectivity of trawl gears under conditions approximating to commercial gears. In this connection the authors hope that Canada will agree to carrying out special investigations within Canadian zone in 1983 and 1984, which will deal with marine fisheries management by means of the mesh size regulations.

Methods

Methods of the trawl bag selectivity estimation in relation to Greenland halibut, roundnose grenadier and redfish Sebastes mentella are given in the reports mentioned in the Introduction.

The trawl bag selectivity estimation in relation to yellowtail flounder and American plaice was performed in Divisions 3O and 3N by RV "Menzelinsk" in February/March 1981. Two sets of hauls were performed. American plaice were fished in the

first one. The catches taken during the second set included both yellowtail flounder and American plaice. The portion of that or other species per haul varied from 30 to 60%. The by-catch comprised about 10% of skates and sea-cucumbers. In Division 3O catches varied from 400 to 600 kg, and in Division 3N they amounted to 3.5 t.

Hauls were made by bottom trawls, one being rigged with a 127 mm mesh-sized bag and the other - with a 134 mm mesh-sized bag. After each haul performed by the 127 mm mesh-sized trawl the haul with the 134 mm mesh-sized trawl was made. The trawl bags were made of kapron netting (polyamide), plaited of double twine 3.1 mm in diameter, R 5700 tex.

The inner size of the mesh (referred to as "mesh size" in the text) in trawl bags was measured by the wedge-shaped plate 2 mm thick under pressure of the load 5 kg in mass. The mesh was measured immediately after shaking off the catch from the bag. The inner mesh size was estimated as the average for the sizes in three positions longwise the bag and with 25 meshes in every position.

To retain fish escaping from the net of the upper side of the cylinder part of the trawl the ICES cover was used, made of kapron netting with the mesh size of 78 mm. The width of plait of the net cover was approximately 1.4 times as high as that of the upper side of the bag. The back of the cover was 3.5 m longer than the trawl bag. To prevent fish from escaping through the bottom side of the trawl bag, its inside was covered with the netting having the same mesh bar as the cover. Experimental hauls were performed at the depths from 50 to 100 m. The duration of hauls - from 1 to 3 hours, the speed of the tow - 2.8 knots. The maximum girth, length and weight of fish were measured during experimental hauls. The maximum girth of fish was measured with a special device of a band with a cm-division scale. Immediate losses were determined by comparing catches taken with bags of different mesh sizes as well as by calculations using retention coefficients for separate length groups of fish. The long-term profits, losses of commercial fisheries resulting from the change

of mesh size in trawl bags are determined by the equations expressing the relationship between the change in fish abundance caused by natural and fishing mortality in the differential and integral form.

Results

American plaice and yellowtail flounder

The data obtained during experimental hauls, are given in Tables 1-9 and in Figs. 1-8. The summarized amount of fish in valid hauls are presented in Table 1.

The length and weight of American plaice and yellowtail flounder given in Table 2 show that yellowtail flounder being of the same length as American plaice have a greater weight than American plaice. This difference is more prominent when the length is more than 35 cm.

The comparative length and maximum girth of American plaice and yellowtail flounder given in Figs. 1 and 2, permit to conclude that fish of the same length may have different girth and, on the contrary, fish of the same girth may have different length:

- with growth of fish length the range of girth variation increases;

- the variation of maximum girth of American plaice is greater than that of yellowtail flounder, the centre of American plaice dispersion is dislocated towards smaller variation classes.

The main characteristics of the caught fish and the results of the trawl bag selectivity estimation are given in Tables 3-9 and in Figs. 3, 5 and 7.

In Division 3O the experiments were conducted while fishing for small and medium American plaice, and in Division 3N while fishing mainly for large and medium fish. Such concentrations of American plaice and yellowtail flounder are fished mainly in specialized fisheries. The obtained data show that small fish escape from trawl bags actively, fish having escaped from the bag and retained by the cover had no notable damages and were quite viable.

Apparently, stocks of American plaice and yellowtail flounder can be managed by decreasing the catch of small fish by means of increasing the mesh size in trawl bags.

The similarity of the shape, the relationship between the maximum length and height of the body, characteristics of fish being of the same length for American plaice and yellowtail flounder are the reasons of the approximately equal amount of fish escaping from the bag with a 127 and 134 mm mesh size (the maximum length being about 37-40 cm).

For the bag with a 127 mm mesh size the retention of American plaice in two sets of hauls amounted to 63.6 and 67%, and the retention of yellowtail flounder - to 69.4%. For the bag with a 134 mm mesh size the same retention of American plaice amounted to 44.7 and 51%, and that of yellowtail flounder - 49.4%.

The increase of mesh size from 127 to 134 mm does not produce the notable growth in length of escaping fish, but the amount of escaping fish grows by 25% with the decrease of the total catch by less than 5%. The bulk of escaped fish is about 30-33 cm long and less than 300-350 g in weight and have no high food value. The notable change in the trawl bag selectivity with the increase of mesh size from 127 to 134 mm is well seen in the selectivity charts shown in Figs. 4, 6 and 8. The minimum retention corresponding to fish length from 20 to 24 cm is characteristic of these charts.

Considering all these data we may conclude that the specialized fishing for American plaice and yellowtail flounder should be performed by bags with a 130 mm mesh size, as in this case with a slight decrease in catch as compared with fishing with bags having a 125 mm mesh size, the escape of small fish grows notably, which will affect favourably the state of stocks.

Roundnose grenadier

The data were collected in two sets of hauls.

In the first set (a 117 mm mesh) 9 valid hauls were performed. The total catch in the bag and in the cover made up 43207 fishes weighing 17457 kg.

In the second set (a 134 mm mesh) 7 valid hauls were performed. The total catch in the bag and in the cover made up 17000 fishes weighing 7900 kg.

The escapement of roundnose grenadier through the net mesh of trawl bags has a certain regularity. The number of escaped fish of each length group depends on the amount of caught fish and on their size. The curve of relative abundance of escaped fish has a maximum. For the 117 mm mesh the maximum corresponds to the fish length of 48 cm while for the 134 mm mesh - to that of 52.7 cm (Table 10), i.e. when increasing the mesh size the maximum of the number of escaped fish is shifted towards the greater length groups. Single specimens above 70 cm escape through the 117 and 134 mm meshes, the bulk of escaped fish are 40 to 70 cm long.

It may be considered that when changing the 117 mm mesh size for 134 mm one the retention is equal to 80-85% in number and 85 to 89% by weight, i.e. it changes within 5% (Table 11). On these grounds the loss for the mesh sizes within 117 to 134 mm can be determined by means of interpolation or extrapolation.

If to regard the fishes below 47 to 50 cm as the small ones since their weight is 250 to 300 g, with changing the 117 mm mesh size for 134 mm one the loss of small fish increases from 24 to 32%, i.e. by 8%. At the same time the number of escaped specimens above 47 to 50 cm increases from 50 to 62% in number and from 70 to 78% by weight.

Thus, many large and medium fishes escape through the 117 mm mesh, when changing the mesh size for 134 mm their portion even more increases. The loss of the catch is about 4 or 5%.

Comparing the loss of roundnose grenadier when fishing with bags having 117 and 134 mm mesh sizes we may conclude that usage of bags with the mesh more than 120 mm is not reasonable since it causes mainly the loss of large and medium fishes.

Besides, the excessive increase in mesh size will result in the selective loss of mature males which are smaller than females almost in all bottom fishes from the Northwest Atlantic. In this way the natural sex ratio in the fished population and,

thereby, its normal reproduction will be broken (Blagoderov, 1980).

Redfish Sebastes mentella

Selectivity of the trawl bags when fishing for redfish Sebastes mentella was investigated in the NAFO Divisions 2H, 3M and 3N in 1979 and 1981.

Trawl bags with the 98, 127 and 134 mm meshes were tested.

The data obtained showed that redfish Sebastes mentella escaped actively through the bag nets when fishing with both bottom and mid-water trawls. The escapement of redfish through the 98 to 134 mm meshes of trawl bags comprised in fact all the lengths except for a small group of fishes 41 to 47 cm long, the total number of which was about 2 or 3%.

The bulk of fishes were above 27 or 28 cm, i.e. they are regarded as medium or large specimens. The number of escaped fishes of this size was 70 to 81%.

Changing the 127 mm mesh size for 134 mm one did not affect essentially the retention of fishes below 32 cm but decreased notably the retention of fishes 33 to 39 cm long, in this case the increase in the loss of large specimens was observed. The selectivity of bags was considerable in redfish fishery with the midwater trawls. Thus, the loss of redfish Sebastes mentella when fishing with the above trawl bags having 124 mm mesh was 58.3% by weight.

It follows from the mentioned that mainly fishes which have a high food value escaped through the 98 to 134 mm meshes of trawl bags. About 10% of fish escaped through the 98 mm mesh and 26 to 40% - through the 127 and 134 mm meshes of the bottom trawl bags whereas 71% of fish escaped through the 124 mm mesh of the midwater trawls.

It is known that the portion of redfish Sebastes mentella which escapes through the bag mesh dies during the lift of the trawl as it cannot stand a sharp change in hydrostatic pressure. Thus, the escapement of redfish through the 98 to 134 mm meshes of trawl bags leads to the inadmissible losses of catches and

to the decrease in fishing efficiency which compels to enlarge the fishing effort for catching the quota. In so doing there are no prerequisites for the reserve and increase of fish stocks because to catch the quota redfish of the same length frequency should be fished.

The 100 mm mesh size may be recommended as the minimum allowable one in the bottom and midwater trawl bags since the number of escaped redfish will be about 10% and the quota will be actually caught.

Greenland halibut

The investigations showed a considerable escapement of small specimens through the trawl bag nets and also enmeshing of fish in trawl nets ahead of the bag. Bags with the 117, 124, 127 and 134 mm meshes were tested. The results of selectivity estimation are given in Table 12. The number of enmeshed Greenland halibut made up on the average 20 to 23% of the catch in the trawl bag and 70 to 370% of the amount of fish escaped through the trawl bag. Investigations carried out in the NAFO Divisions 3K and 2JH revealed the differences in fish escapement through the trawl bag nets both on the shelf and continental slope. The fishes below 35 cm being about 400 g in weight which have no high food value may be regarded as small ones. The trawlings made on the continental slope with the bags having 124 to 133 mm meshes showed that the amount of escaped specimens 35 cm long and more constituted 70 to 80%.

A relative number of small fishes caught on the continental slope did not exceed 10% and the retention of them was about 30 to 50%, that is the by-catch of small fish was not significant.

Thus, considering:

- the length composition of Greenland halibut on the continental slope;

- the number and length composition of escaped and retained fish;

- the fact that the trawl bag mesh is in fact always larger than the minimum allowable one by 3 or 4 mm,

the 120 mm mesh size may be regarded as an optimum one in Greenland halibut fishery on the continental slope. On the shelf in Divisions 3K and 2J the length composition of Greenland halibut caught included about 30% of small fish below 35 cm. The investigations carried out in these areas with the bags having 117 to 127 mm meshes showed that the number of escaped fish of commercial length accounted for 15 to 40% and the total loss of small fish was about 48 to 72%. While estimating the optimum mesh size in the trawl bags the peculiar feature of selectivity curves should be considered. This feature implies that selectivity curves have the minimum which falls within 28 to 34 cm fish lengths. At smaller length the selectivity curves show the increase in small fish retention, in this case the bags with 127 mm mesh do not posess an advantage in fish escapement over the bags with 117 mm mesh.

There exists an opinion that Greenland halibut escaped through the trawl bags are not viable since they are bruised heavily. The problem of viability of fishes escaped through the trawl mesh is not exhaustively studied, however, and calls for special investigations (Konstantinov, 1981).

It may be concluded from the foregoing that the same minimum allowable mesh size as the one applied on the continental slope, that is 120 mm, should be used in Greenland halibut fishery on the shelf in Divisions 3K and 2J.

For the small fish reservation it is reasonable, in our mind, to discuss the question on a partial limit of trawl fishery on the shelf or even its complete closure prior to the comprehensive studying the viability of fish escaped through the trawl bag meshes.

Conclusions

5.1 The investigations carried out on selectivity estimation of the trawl bags with different mesh sizes proved the escapement of fish of all species through the trawl bag nets.

5.2 The selection pattern of fish with the trawl bag nets enables to discuss the question on the optimum mesh size for fishing one or another species of commercial fish. In addition,

it should be noted that the developing of measures on fishery regulation concerning the requirements and fishing gears must be based on extensive studies of the trawl bag selectivity estimation performed under conditions approximating to the time, area, techniques and tactics of fishery carried out by commercial vessels.

5.3 The 120 mm mesh size used in the trawl bags in roundnose grenadier and Greenland halibut fisheries is the optimum one.

5.4 For the small fish reservation it is expedient to discuss the question on a partial limit of Greenland halibut fishery or even its complete closure on the shelf in Divisions 3K and 2JH.

5.5 The 130 mm mesh size is the optimum one in the specialized fishery for yellowtail flounder and American plaice whilst the 100 mm mesh - in redfish Sebastes mentella fishery with both the bottom and midwater trawls as in the case of catching the quota there are prerequisites for the minimum damage of the fish stocks.

5.6 For the subsequent substantiating of requirements for fishing gears for the main fishing objects in the NAFO areas it is necessary to carry out experimental investigations in 1983/1984 aimed at solving different problems concerning the marine fisheries management by means of the mesh size regulations. It is advisable to obtain the consent of Canadian authorities to carrying out the above researches by the Soviet scientists within the Canadian zone.

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Table 1 The amount of fish taken when estimating the selectivity of trawl bags

Division	Species	Mesh size,mm	No.of spec.	Weight,kg
3.0	American plaice	I27	I7400	4470
		I34	I7980	4650
"	Yellowtail flounder	I27	72000	32000
		I34	58000	26000
3N	American plaice	I27	I6944	9099
		I34	II678	6348

Table 2 Lengths and weights of American plaice and yellowtail flounder

American plaice				Yellowtail flounder			
Length, cm	Weight, g	Length, cm	Weight, g	Length, cm	Weight, g	Length, cm	Weight, g
I5	40	4I	675	I5	50	4I	740
I6	49	42	730	I6	56	42	800
I7	58	43	785	I7	62	43	867
I8	67	44	852	I8	68	44	963
I9	76	45	920	I9	74	45	I000
20	85	46	990	20	80	46	I070
2I	98	47	I060	2I	95	47	II40
22	III	48	II30	22	II0	48	I243
23	I24	49	I205	23	I27	49	I345
24	I37	50	I280	24	I43	50	I450
25	I50	5I	I370	25	I60	5I	I575
26	I67	52	I460	26	I75	52	I700
27	I83	53	I550	27	I90		
28	200	54	I660	28	2I7		
29	225	55	I770	29	243		
30	250	56	I874	30	270		
3I	280	57	I9I8	3I	300		
32	3I0	58	208I	32	330		
33	340	59	2I85	33	363		
34	375	60	2289	34	397		
35	4I0	6I	2392	35	430		
36	447	62	2496	36	475		
37	483	63	2600	37	520		
38	520	64	2704	38	573		
39	570	65	2808	39	627		
40	620	66	29I5	40	680		

Table 3 Total catch of American plaice when fishing with bags with the 134 mm mesh size (Division 3O)

Length cm	Retained spec.			Escaped spec.			Caught spec.		
	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
I4–I7		I0	I0		8	I8		28	28
I8–I9		59	59	II	I34	I45	II	I93	204
20–2I	I0	I42	I52	33	558	59I	43	700	743
22–23	24	I89	2I3	68	7I8	786	92	907	999
24–25	56	278	334	I96	726	922	252	I004	I256
26–27	I85	8I9	I004	345	I439	I784	530	2258	2788
28–29	295	869	II64	46I	I723	2I84	756	2592	3348
30–3I	635	II74	I809	654	I362	20I6	I289	2536	3825
32–33	308	775	I083	I93	509	702	50I	I284	I785
34–35	25I	555	806	69	I63	232	320	7I8	I038
36–37	I39	479	6I8	8	56	64	I47	535	682
38–39	62	320	382	4	7	II	66	327	393
40–4I	29	207	236				29	207	236
42–43	I0	I30	I40				I0	I30	I40
44–45		I40	I40					I40	I40
46–47	5	70	75				5	70	75
48–49		44	44					44	44
50–5I		63	63					63	63
52–53		77	77					77	77
54–55		53	53					53	53
56–57		24	24					24	24
58–59		I3	I3					I3	I3
60–6I		I4	I4					I4	I4
62–63		I0	I0					I0	I0
Σ	2009	65I4	8523	2042	74I3	9455	405I	I3927	I7978

Table 4 Total catch of American plaice when fishing with bags with the 127 mm mesh size (Division 30)

Length, cm	Retained spec.			Escaped spec.			Caught spec.		
	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
14–17		25	25		24	24		49	49
18–19		87	87	3	107	110	3	194	197
20–21	8	108	116	25	261	286	33	369	402
22–23	48	253	301	54	401	455	102	654	756
24–25	118	272	390	138	603	741	256	876	1132
26–27	174	851	1025	172	1010	1182	346	1861	2207
28–29	379	1699	2078	309	1334	1643	688	3033	3721
30–31	738	1696	2434	331	821	1152	1069	2517	3586
32–33	365	1124	1489	60	186	246	425	1310	1735
34–35	268	893	1161	15	35	50	283	928	1211
36–37	128	677	805	5	14	19	133	691	824
38–39	50	372	422		4	4	50	376	426
40–41	23	294	317				23	294	317
42–43	11	146	157				11	146	157
44–45	3	140	143				3	140	143
46–47		173	173					173	173
48–49	4	71	79				4	71	75
50–51		68	68					68	68
52–53		57	57					57	57
54–55		67	67					67	67
56–57		35	35					35	35
58–59		38	38					38	38
60–61		15	15					15	15
62–63		4	4					4	4
64–65		4	4					4	4
Σ	2311	9175	11486	1112	4800	5912	3423	13975	17398

Table 5 Total catch of yellowtail flounder when fishing with bags with the 127 mm mesh size (Division 3N)

Length cm	Retained spec.			Escaped spec.			Caught spec.		
	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
14-17		22	22	1	22	23	1	44	45
18-19		114	114	63	274	337	63	388	451
20-21	24	141	165	211	584	795	235	725	960
22-23	52	221	273	384	1029	1413	436	1250	1686
24-25	432	1037	1469	1369	2526	3895	1801	3563	5364
26-27	1365	2980	4345	2075	3904	5979	3440	6884	10324
28-29	2059	4384	6443	1339	2867	4206	3398	7251	10649
30-31	1572	2628	4200	707	475	1182	2279	3103	5382
32-33	1353	1841	3194	28	51	79	1381	1892	3273
34-35	2097	1782	3879	6	29	35	2103	1811	3914
36-37	3103	2652	5755	3	3	6	3106	2655	5761
38-39	4056	3499	7555				4056	3499	7555
40-41	2513	5725	8238		3	3	2513	5728	8241
42-43	559	3382	3941				559	3382	3941
44-45	85	2319	2404				85	2319	2404
46-47	77	1457	1534				77	1457	1534
48-49		679	679					679	679
50-51		178	178					178	178
52-53		23	23					23	23
54-55		23	23					23	23
Σ	19347	35087	54434	6186	11767	17963	25533	46854	72387

Table 6 Total catch of yellowtail flounder when fishing with bags with the 134 mm mesh size (Division 3N)

Length, cm	Retained spec.			Escaped spec.			Caught spec.		
	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
14–17		40	40	39	176	215	39	216	255
18–19		48	48	95	347	442	95	395	490
20–21	26	96	122	66	450	516	92	546	638
22–23	43	189	232	268	679	947	311	868	1179
24–25	316	740	1056	919	1988	2907	1235	2728	3963
26–27	793	1699	2492	1621	3429	5050	2414	5128	7542
28–29	913	2935	3848	1516	3099	4615	2429	6034	8463
30–31	1032	1758	2790	566	1051	1617	1592	2809	4407
32–33	1106	1734	2840	162	328	490	1268	2062	3330
34–35	1601	1746	3347	31	22	53	1632	1768	3400
36–37	2724	2102	4826				2724	2102	4826
38–39	3171	2837	6008				3171	2837	6008
40–41	1968	4152	6120				1968	4152	6120
42–43	567	2619	3186				567	2619	3186
44–45	53	1903	1956				53	1903	1956
46–47	29	1451	1480				29	1451	1480
48–49	14	585	599				14	585	599
50–51		178	178					178	178
52–53		88	88					88	88
54–55		8	8					8	8
Σ	14356	26908	41264	5283	11569	16852	19639	38477	58116

Table 7 Total catch of American plaice when fishing with bags with the 127 mm mesh size (Division 3N)

Length cm	Retained spec.			Escaped spec.			Caught spec.		
	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
14-17		5	5	I	10	II	I	15	16
18-19	II	12	23	9	96	105	20	108	128
20-21	12	22	34	90	171	261	102	193	295
22-23	28		28	122	145	267	150	145	295
24-25	161	115	276	335	303	638	496	418	914
26-27	240	244	482	448	380	818	688	624	1312
28-29	283	278	561	311	301	612	594	579	1173
30-31	525	323	848	265	147	412	790	470	1260
32-33	710	416	1126	151	53	204	861	469	1330
34-35	900	682	1582	33	18	51	933	700	1633
36-37	1158	773	1931	1	6	7	1159	779	1938
38-39	867	899	1766				867	899	1766
40-41	524	867	1396				524	867	1391
42-43	117	512	629				117	512	629
44-45	135	621	756				135	621	756
46-47	105	534	639				105	534	639
48-49	25	399	424				25	399	424
50-51	18	291	309				18	291	309
52-53	23	163	186				23	163	186
54-55		131	131					131	131
56-57		111	111					111	111
58-59		90	90					90	90
60-61		60	60					60	60
62-63		53	53					53	53
64-65		53	53					53	53
66-67		52	52					52	52
Σ	5842	7706	13548	1766	1630	3396	7608	9336	16944

Table 8 Total catch of American plaice when fishing with bags with the 134 mm mesh size (Division 3N)

Length cm	Retained spec.			Escaped spec.			Caught spec.		
	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
14-17		6	6	6	58	64	6	64	70
18-19	24	58	82	89	249	338	113	307	420
20-21	51	37	88	174	331	505	225	368	593
22-23	29	19	48	89	117	206	118	136	254
24-25	91	74	165	248	255	503	339	329	668
26-27	88	42	130	269	249	518	357	291	648
28-29	115	137	252	291	189	480	406	326	732
30-31	279	140	419	316	151	467	595	291	886
32-33	314	148	462	304	97	401	618	245	863
34-35	838	267	1105	150	64	214	988	331	1319
36-37	689	427	1116	3	1	4	692	428	1120
38-39	660	398	1058				660	398	1058
40-41	389	546	935				389	546	935
42-43	106	245	351				106	245	351
44-45	159	230	389				159	230	389
46-47	116	268	384				116	268	384
48-49	41	168	209				41	168	209
50-51	34	172	206				34	172	206
52-53	6	125	131				6	125	131
54-55		101	101					101	101
56-57		59	59					59	59
58-59		97	97					97	97
60-61		48	48					48	48
62-63		41	41					41	41
64-65		43	43					43	43
66-70		53	53					53	53
Σ	4029	3949	7978	1939	1761	3700	5968	5710	11678

Table 9 Selectivity of trawl bags when fishing for American plaice and yellowtail flounder

Main characteristics			Am. plaice (Div. 3O)		Y.-t. flounder (Div. 3N)		Am. plaice (Div. 3N)	
			127 mm mesh	134 mm mesh	127 mm mesh	134 mm mesh	127 mm mesh	134 mm mesh
Minimum length of fish caught (cm)			I4	I4	I6	I6	I5	I5
Maximum length of fish caught (cm)			65	65	54	54	70	70
Mode (cm)			3I	3I	29 & 40	29 & 40	34	37
Mean values of one fish	Caught	Length(cm)	29	29	33,2	33,3	35,8	34,7
		Weight(kg)	0,260	0,246	0,44	0,45	0,45	0,54
	Retained	Length(cm)	3I	32	35,6	36,0	38,I	38,7
		Weight(kg)	0,30	0,33	0,53	0,56	0,62	0,70
	Escaped	Length(cm)	26	26	24,8	26,5	26,9	26,2
		Weight(kg)	0,I7	0,I7	0,I7	0,I9	0,I9	0,2I
Minimum length of fish retained (cm)			I7	I6	I6-I9	I6-I9	I7	I7
Maximum length of fish escaped (cm)			37	37	35	42	37	36
Retention of fish in re the total catch (%)	In size		66	47,4	75	7I	79,9	68,3
	By weight		78,I	63,9	90	88	93,0I	87,5
Retention of fish in re the number of ones escaped within lengths (%)	In size		63,6	44,7	69,4	49,4	67	5I
Selectivity coefficient			2,I5	2,44	2,I6	2,I5	2,20	2,23

Table 10 Selectivity of trawl bags when fishing for roundnose grenadier

Main characteristics		117 mm mesh	134 mm mesh
Minimum length of fish caught (cm)		20	I7
Maximum length of fish caught (cm)		88	83
Mode (cm)		57	6I
Mean values of one fish caught	Length (cm)	54,2	57,5
	Weight (kg)	0,39	0,45
Mean values of one fish retained	Length (cm)	55,4	58,4
	Weight (kg)	0,4I	0,47
Mean values of one fish escaped	Length (cm)	48	52,7
	Weight (kg)	0,27	0,36
Minimum length of fish retained (cm)		2I	2I
Maximum length of fish escaped (cm)		79	79
Retention of fish (%)	In size	85,2	82,9
	By weight	88,6	86,2
Selectivity coefficient		2,39	2,24

Table 11 Retention of roundnose grenadier (%) by length groups when fishing with bags with 117 and 134 mm mesh sizes

Length, cm	117 mm mesh	134 mm mesh
2I-23	27,0	66,0
24-26	37,0	58,0
27-29	47,0	52,0
30-32	54,0	52,0
33-35	60,0	54,0
36-38	67,0	57,0
39-4I	72,0	6I,0
42-44	76,0	64,0
45-47	79,0	67,0
48-50	82,0	7I,0
5I-53	83,0	75,0
54-56	86,0	78,0
57-59	88,0	82,0
60-62	90,0	84,0
63-65	92,0	87,0
66-68	94,0	88,0
69-7I	96,0	9I,0
72-74	97,0	93,0
75-77	99,0	94,0
78-80	I00,0	97,0
8I-83	I00,0	98,0

Table 12 Selectivity of trawl bags when fishing for Greenland halibut on the shelf and continental slope

Main characteristics		2J shelf 117mm mesh	2J shelf 127mm mesh	3K shelf 127mm mesh	2H continental slope 124mm mesh	0 continental slope 124mm mesh	0 continental slope 127mm mesh	0 continental slope 133mm mesh
Minimum length of fish caught, cm		I4	I4	I4	20	25	28	28
Maximum length of fish caught, cm		97	97	93	II9	I07	I03	95
Mode, cm		32-33	48-49	46-47	62-63	50-5I	56-57	58-59
Mean length of fish, cm	Caught	4I,60	44,0I	40,42	58,I7	48,55	54,29	57,72
	Retained	44,27	48,83	42,34	58,83	49,60	55,29	58,78
	Escaped	3I,05	32,86	34,78	40,77	36,57	40,I4	42,66
Minimum length of fish retained, cm		I4	I4	I4	20	25	28	28
Maximum length of fish escaped, cm		53	49	53	5I	49	55	67
Retention of fish in re the total catch, %	In size	76,9	69,8	74,4	97,0	9I,9	93,4	93,4
	By weight	92,3	89,9	84,5	99,3	97,3	97,6	97,5
Retention of fish in re the number of ones escaped within lengths, %	In size	73,0	57,7	72,9	90,3	85,7	87,7	92,3

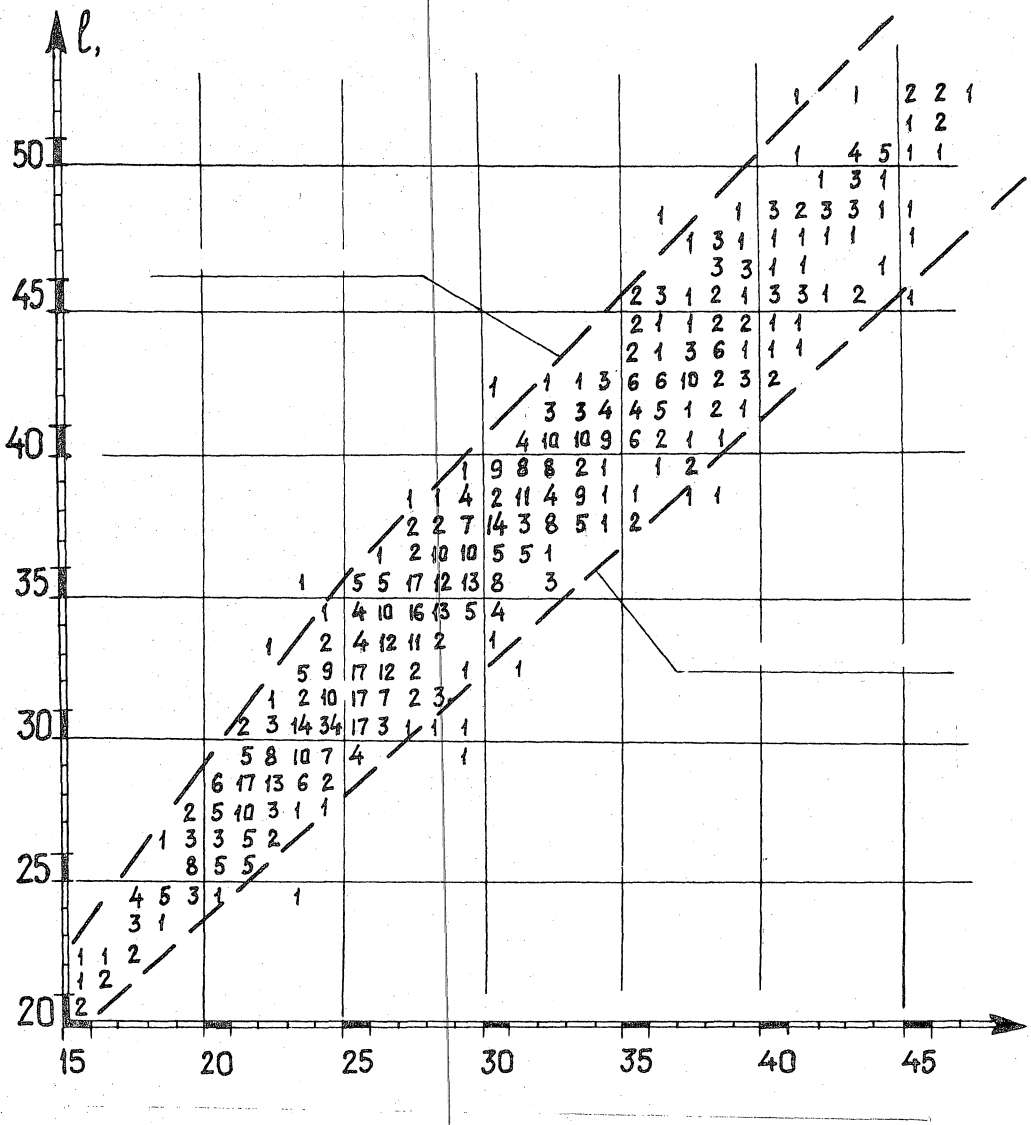

Fig.1 Relationship between the length and maximum girth of American plaice

(The total number of measured fish is 800 specimens. Figures on the margin stand for the number of fish at the given length and girth of the amount of fish measured).

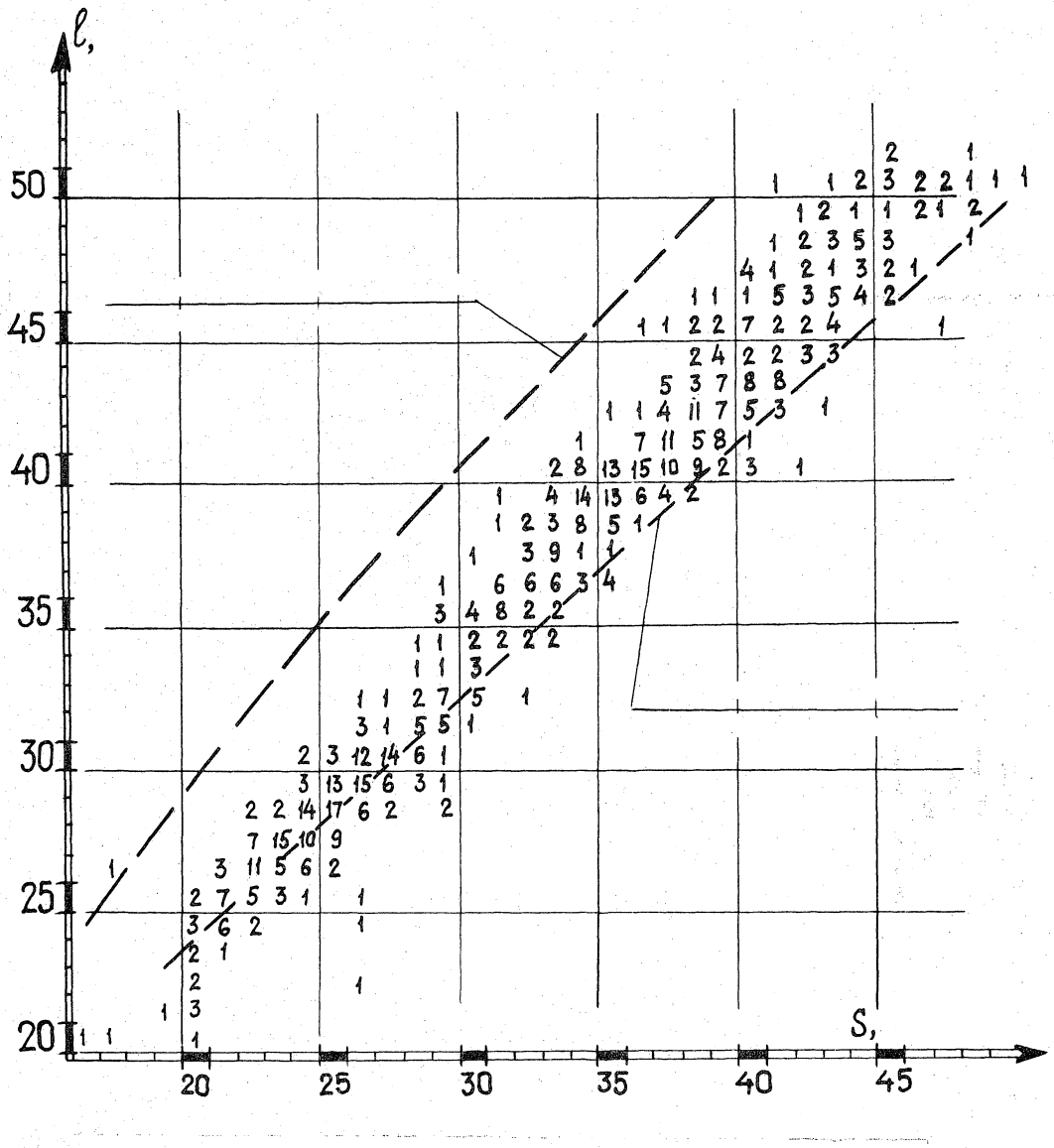

Fig.2 Relationship between the length and maximum girth of yellowtail flounder

(The total number of measured fish is 700 specimens. Figures on the margin stand for the number of fish at the given length and girth of the amount of fish measured).

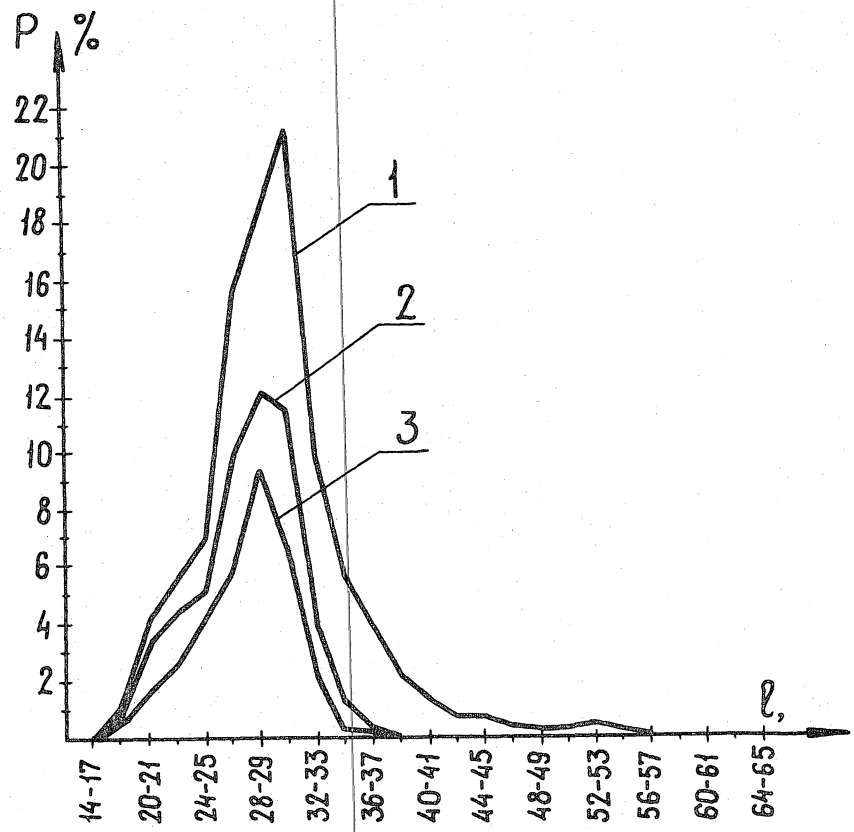

Fig.3 Percentage of caught and escaped American plaice of different length groups when fishing with bags having 134 and 127 mm mesh sizes (Division 30)

1 - fishes caught with the bag having 134 mm mesh (the line for fishes caught with the bag having 127 mm mesh is close to line 1);

2 - fishes escaped through the 134 mm mesh;

3 - fishes escaped through the 127 mm mesh.

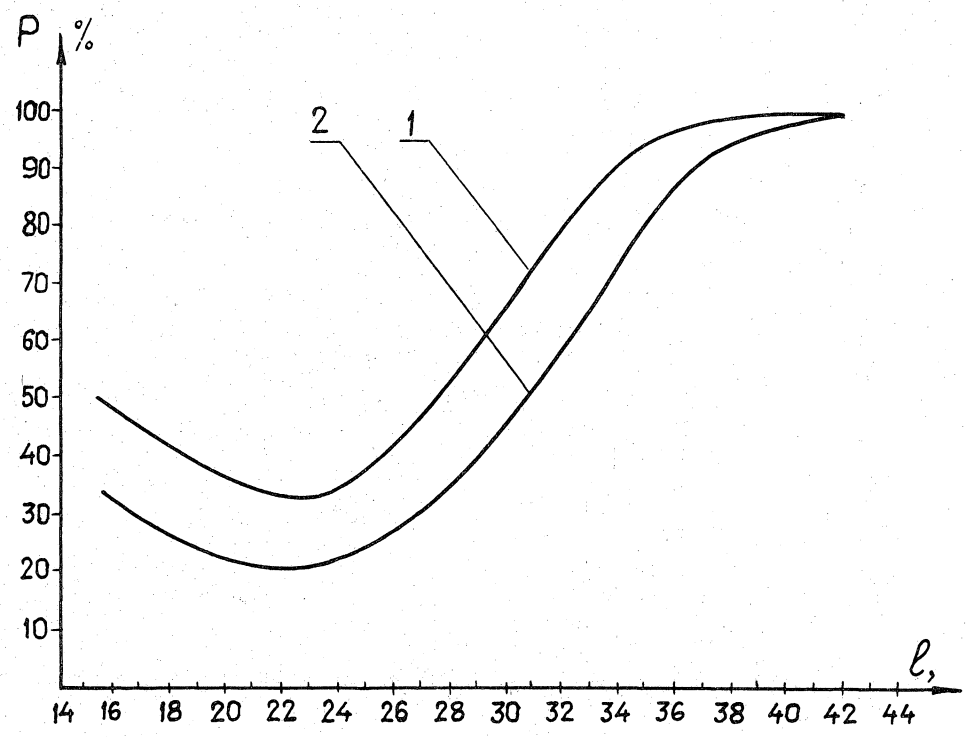

Fig.4 Diagram of selectivity of American plaice (Division 30)

1 - using the bag with 127 mm mesh size;

2 - using the bag with 134 mm mesh size.

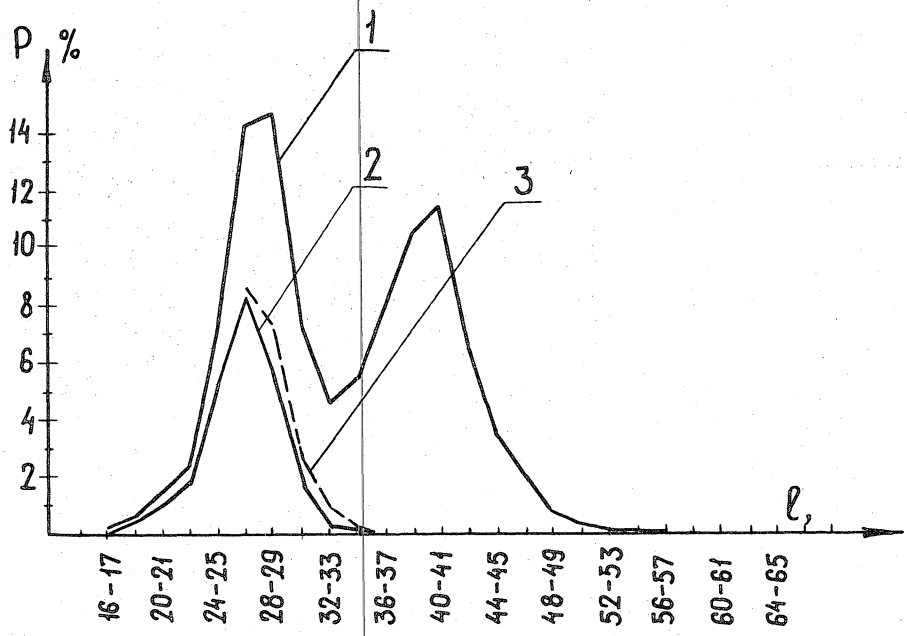

Fig.5 Percentage of caught and escaped yellowtail flounder of different length groups when fishing with bags having 134 and 127 mm mesh sizes (Division 3N)

1 - fishes caught with the bag having 134 mm mesh (the line for fishes caught with the bag having 127 mm mesh is close to line 1);

2 - fishes escaped through the 134 mm mesh;

3 - fishes escaped through the 127 mm mesh.

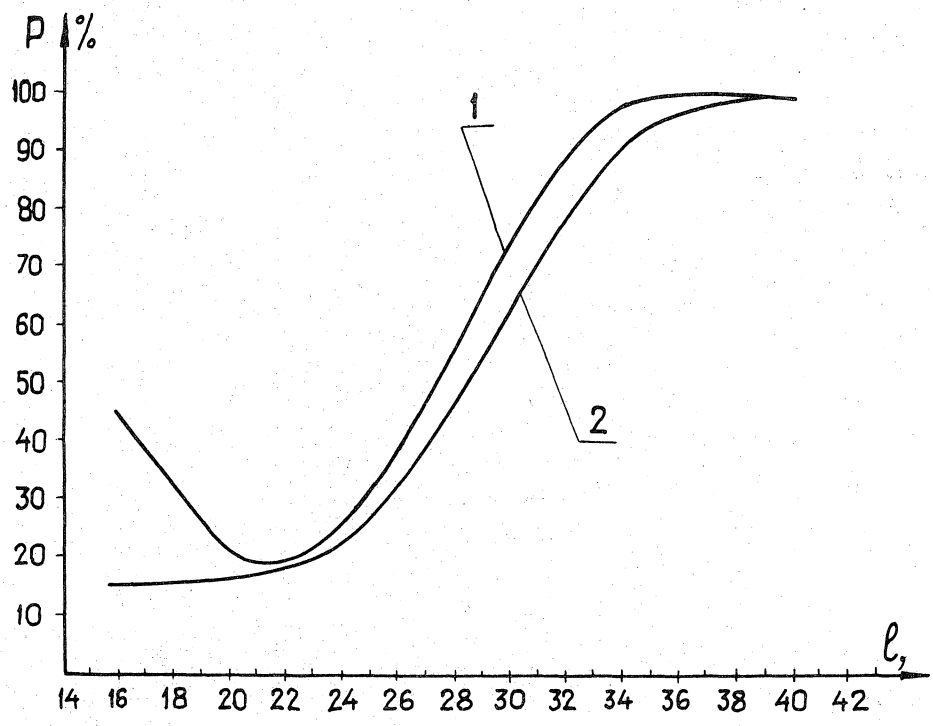

Fig.6 Diagram of selectivity of yellowtail flounder (Division 3N)

1 - using the bag with 127 mm mesh size;

2 - using the bag with 134 mm mesh size.

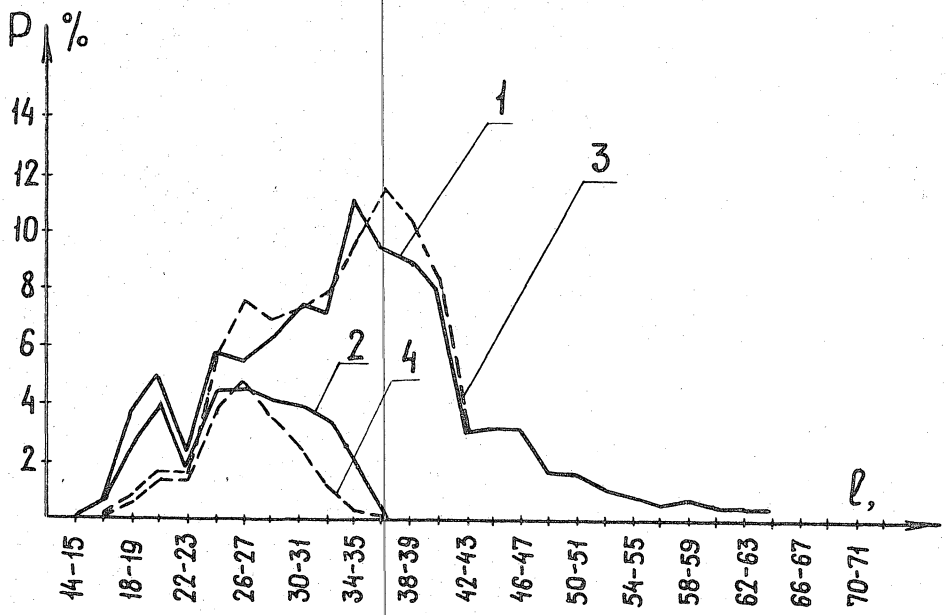

Fig.7 Percentage of caught and escaped American plaice of different length groups when fishing with bags having 134 and 127 mm mesh sizes (Division 3N)

1 - fishes caught with the bag having 134 mm mesh;

2 - fishes escaped through the 134 mm mesh;

3 - fishes caught with the bag having 127 mm mesh;

4 - fishes escaped through the 127 mm mesh.

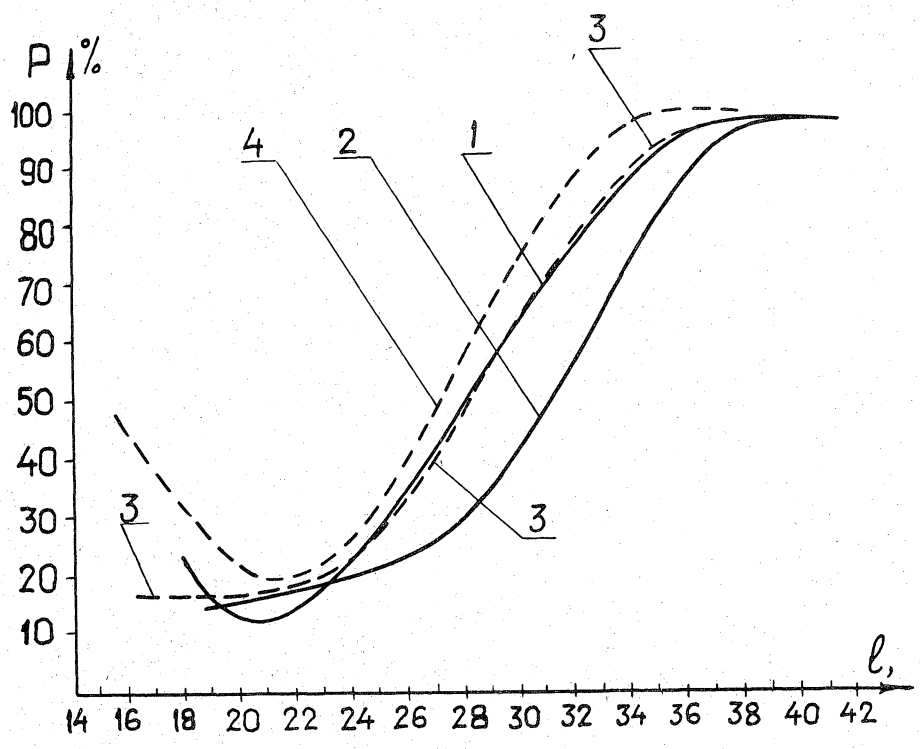

Fig.8 Diagram of selectivity of American plaice (Division 3N)

1 - using the bag with 127 mm mesh size;

2 - using the bag with 134 mm mesh size;

3 - diagram of selectivity of yellowtail flounder with the 134 mm mesh (given for comparison);

4 - diagram of selectivity of yellowtail flounder with the 127 mm mesh (given for comparison).