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Trawl Codend Selectivity Relative to Fishing
for Roundnose Grenadier in NAFO Division 3K

by

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Abstract

The materials on determination of selectivity of the trawl bags
with 117 and 134 mm mesh sizes when fishing roundnose grenadier
(Macrourus rupestris) are presented.

Introduction

Until now the investigations on determination of the trawl bags
selectivity when fishing roundnose grenadier were of incidental
character, that's why there are no comprehensive data to draw
thorough and detailed conclusions on the subject. In this connec-
tion it is necessary in the nearest future to enlarge the volume
of investigations on selectivity of the trawl bags with different
mesh sizes when fishing roundnose grenadier by both bottom and
mid-water trawls. It is important that the works on selectivity
be carried out simultaneously with the fishery of roundnose gre-
nadier and the conditions of investigations be similar to those
of fishery as much as possible (by fishing gears used, equipment,
tactics of fishing, area and date of works). When conducting in-
vestigations under the conditions different from those of fishery
the link is broken with the length frequency indices of the fishes
caught, density of fished concentrations, biological state and
behavoir of fishing object during its fishery which affects the
escapement of fishes through the bag and thus increases the
inaccuracy of the results obtained during surveys.

Considering the inside mesh size as an important factor of

selection of fishes in their fishery it is essential to correlate
the decision on reasonable change for larger mesh size with the
length frequency indices of the fishes escaped through the bag.

If among the fishes escaped through the bag with a certain
mesh size the number of fishes of commercial length exceeds
greatly the number of fishes of small size, the rationality of
using the mesh size which caused such an escapement would be
doubtful.

Material and methods

The material was obtained on the stern trawler "Nikolai
Kononov" used during the survey. The investigations were carried
out in the NAFO Division 3K. Two sets of hauls were made by a
bottom trawl.

The first set of hauls was made in July 1980. The trawl bag
with the inside 117 mm mesh size was used. The second set of hauls
was made in January 1981, the trawl bag with 134 mm mesh being
used. The trawl bags were fitted with nettings made of double-
polyamide yarn (a 3.1 mm diameter, R - 5700 tex).

The inside mesh size was measured with a wedge-shaped plate
(the ICNAF gauge) 2 mm thick at a pressure of 5 kg. The measure-
ment of the mesh was done after the catch was taken out of the
bag. The inside mesh size was determined as an average value of
measurements of 25 meshes at each of three positions along the
length of the bag.

A cover codend of the ICES type was used to retain the fishes
escaping through the top side of the bag cylindrical part. The
cover was made of kapron netting with a 40 mm mesh size (R -
2700 tex). The front edge of the cover was fixed at the joint of
the conic part with the bag cylindrical part. The side edges of
the cover were connected with the bag pennants. The width of the
cover in plait was approximately 1.4 times as large as that of the
top side of the bag. The back part of the cover being 3.5 m longer
than the trawl bag was made in the form of a bag with laced open-
ing for taking the catch out of the cover. To prevent the fishes
escaping through the bottom side of the trawl bag the latter was

fitted along its length with an inside netting (a 40 mm mesh size).

The hauls were made at depths 900-1000 m. The duration of one trawling was about 1.5-2 hrs at the speed of the vessel being 3 knots.

During the first set of hauls (117 mm mesh) there were made 9 successful trawlings. The total catch in the bag and cover was 43207 fishes weighing 17457 kg.

In the second set of hauls (134 mm mesh) there were made 7 trawlings. The total catch was 17000 fishes weighing 7900 kg.

The treatment of roundnose grenadier catch had its peculiarities since there was, as a rule, a certain number of fishes with partially torn tails both in the bag and cover.

Due to this the length of the fishes without tails was measured to the anal fin and then according to definite methods their number was converted to that of fishes with tails. The methods of converting the number of fishes without tails to the number of fishes with tails considered that among the fishes of the same length to the anal fin there were fishes of different length to the end of the tail; the methods also considered a certain distribution of this group fishes relative to their mean length. There were used a diagram of Fig.1 and data of Table 1 where the relationship between the length of fishes to the anal fin l_a and mean length of fishes with tails l_x was given and also ratios (in %) were recommended for conversion the number of fishes with length l_a to the number of fishes with length l_x.

Discussion

Tables 3, 4 and 5 and diagrams of Figs 2-4 list the data obtained during trawlings of roundnose grenadier by a bottom trawl using bags with 117 and 134 mm meshes. It is seen that the investigations were carried out on the fish concentrations usually fished by the commercial vessels.

The length frequency of fishes caught with 117 mm mesh was very similar to that of fishes caught with 134 mm mesh. The fishes caught in the second case were on the whole by 5-10% longer than those in the first case. It is confirmed by the fact that the mode

of fishes caught with 134 mm mesh was 3-4 cm larger and the height of the length frequency peak was by 25% greater than that of fishes caught with 117 mm mesh. The length of one fish caught was 3.3 cm larger and the mean weight of it was 50 g higher.

Despite the above-mentioned small differences in the length frequencies of fishes caught the trawlings using the bags with 117 and 134 mm meshes were considered to be carried out under similar conditions and the results of determination of the trawl bags selectivity to be comparable.

When analysing Tables 3, 4, 5 and diagrams in Figs 2, 3, 4 it should be noted that a certain regularity was observed in the escapement pattern of roundnose grenadier through meshes of the trawl bags. So, the escapement of fishes of the same length depended on the length and number of fishes caught. The curve of relative abundance of the fishes escaped had its maximum. For 117 mm mesh the maximum corresponded to the fish length of 48 cm and for 134 mm mesh - 52 cm, i.e. with the increase of the mesh size the maximum number of escaped fishes included those of greater length. Single specimens above 70 cm in length escaped through the trawl bags with 117 and 134 mm meshes but the bulk of escaped fishes were 40 to 70 cm long. As regards lengths of round-nose grenadier to anal fin the bulk of escaped fishes were 10 to 15 cm, i.e. the difference in lengths was 5 cm.

When changing 117 mm mesh for 134 mm the retention was 80 to 85% in number of specimens and 85 to 89% by weight, i.e. it varied within 5 %. For reasons given the escapement through the meshes falling within 117-134 mm could be calculated by interpolation or extrapolation methods.

If to take fishes less than 47-50 cm in length for those of small size since their weight was 250-300 g, then with changing 117 mm mesh for 134 mm the escapement of fishes of small size increased from 24 to 32%, i.e. by 6%; in this case among the fishes escaped the number of specimens above 47-50 cm in length increased from 50 to 62% and its weight - from 70 to 78%.

Thus, among the fishes escaped through the bag with 117 mm mesh the bulk of them was of large and medium size. With changing

the mesh size for 134 mm the portion of large specimens among the escaped fishes increased.

When changing 117 mm mesh for 134 mm the loss of the catch was approximately 4-5%.

As a result of the analysis characterizing the retention and escapement of roundnose grenadier through the bags with 117 and 134 mm meshes we may conclude that during the fishery it is not reasonable to use bags with the mesh larger than 120 mm as it will cause the escapement of fishes mainly of large and medium size.

Table 1 Distribution of roundnose grenadier with the length l_a by fish lengths with the tail l_x.

Length to anal fin l_a, cm	Mean length with tail l_x, cm	Distribution of fishes with the length l_a by lengths with the tail l_x (in % of the total number of fishes with length l_a)					
4	20	$l_{20\,cm} = l_{21\,cm}$ 50% each					
5	24	$l_{23} = l_{24} = l_{25} = l_{26}$ 25% each					
6	28	$l_{27} = l_{28} = l_{29}$ 20% each	$l_{25} = l_{26} = l_{30} = l_{31}$ 10% each				
7	32	$l_{31} = l_{32} = l_{33}$ 20% each	$l_{29} = l_{30} = l_{34} = l_{35}$ 10% each				
8	38	$l_{37} = l_{38} = l_{39}$ 20% each	$l_{35} = l_{36} = l_{40} = l_{41}$ 10% each				
9	43						
10	48	$l_i = l_{i\pm1}$	$l_{i\pm2}$	$l_{i\pm3}$	$l_i \pm 4$	$l_{i\pm5}$	
11	54	13% each	10% each	8% each	6% each	$l_{i\pm6}$	
12	58					3% each	
13	62						
14	66						
15	70						
16	74	$l_{73} = l_{74} = l_{75}$ 20% each	$l_{71} = l_{72} = l_{76} = l_{77}$ 10% each				
17	78	$l_{77} = l_{78} = l_{79}$ 20% each	$l_{75} = l_{76} = l_{80} = l_{81}$ 10% each				
18	81	$l_{79} = l_{80} = l_{81} = l_{82} = l_{83}$ 20% each					

Table 2 Lengths and weights of roundnose grenadier

Relation between length and weight		Relation between length and weight		Relation between fish length and weight	
Length,cm	Weight,g	Length,cm	Weight,g	Length,cm	Weight,g
10	13	37	129	64	588
11	14	38	140	65	610
12	16	39	149	66	632
13	17	40	157	67	655
14	19	41	166	68	682
15	20	42	175	69	708
16	22	43	190	70	735
17	24	44	205	71	765
18	26	45	220	72	795
19	28	46	235	73	828
20	30	47	250	74	860
21	33	48	267	75	893
22	36	49	284	76	925
23	39	50	300	77	958
24	42	51	320	78	990
25	45	52	340	79	1035
26	50	53	360	80	1080
27	55	54	380	81	1118
28	60	55	400	82	1155
29	65	56	420	83	1210
30	70	57	440	84	1265
31	80	58	460	85	1320
32	85	59	480	86	1370
33	92	60	500	87	1420
34	97	61	522	88	1470
35	107	62	544		
36	118	63	566		

Table 3 The catch of roundnose grenadier according to total number of trawlings using the bag with 117 mm mesh

Length groups, cm	Number of spec.			Retention factor (corrected)	Weight of fishes, kg		
	Bag	Cover codend	Total		Bag	Cover codend	Total
21-23	10	29	39	0,26		1	1
24-26	79	83	162	0,38	3	3	6
27-29	124	182	306	0,47	7	10	17
30-32	234	228	462	0,51	16	16	32
33-35	320	194	514	0,62	29	18	47
36-38	671	234	905	0,69	79	28	107
39-41	822	328	1150	0,74	122	49	171
42-44	1791	506	2297	0,76	313	98	411
45-47	2351	614	2965	0,80	517	135	652
48-50	3747	818	4565	0,81	1000	218	1218
51-53	3512	700	4212	0,83	1124	224	1348
54-56	3848	678	4526	0,85	1462	258	1720
57-59	4941	665	5656	0,88	2174	293	2467
60-62	4670	501	5171	0,90	2335	250	2585
63-65	4169	340	4509	0,92	2360	192	2552
66-68	2518	198	2716	0,94	1591	125	1716
69-71	1568	70	1638	0,96	1110	50	1160
72-74	685	16	701	0,98	545	13	558
75-77	390	4	394	0,99	348	4	352
78-80	203	1	204	0,99	201	1	202
81-83	86		86	1,00	96		96
84-86	15		15	1,00	19		19
87-89	14		14	1,00	20		20
Total	36818	6389	43207		15471	1986	17457

Table 4 The catch of roundnose grenadier according to total number
of trawlings using the bag with 134 mm mesh

Length groups, cm	Number of spec.			Retention factor (corrected)	Weight of fishes, kg		
	Bag	Cover codend	Total		Bag	Cover codend	Total
I5-I7		I	I				
I8-20		5	5				
2I-23	24	I2	36	0,66	I		I
24-26	35	39	74	0,57	2	2	4
27-29	44	32	76	0,52	3	2	5
30-32	32	44	76	0,52	3	4	7
33-35	44	33	77	0,56	4	3	7
36-38	55	24	79	0,60	7	3	I0
39-4I	86	78	I64	0,62	I4	I2	26
42-44	25I	I24	375	0,65	48	24	72
45-47	604	304	908	0,67	I42	7I	2I3
48-50	II38	4I6	I554	0,72	323	II8	44I
5I-53	IIII	379	I490	0,76	378	I29	507
54-56	I569	334	I903	0,8I	628	I34	762
57-59	2058	34I	2399	0,85	947	I57	II04
60-62	2496	336	2832	0,88	I303	I75	I478
63-65	2I0I	222	2323	0,90	I235	I30	I365
66-68	I265	I09	I374	0,92	829	72	90I
69-7I	7I3	43	756	0,93	524	32	556
72-74	243	I8	26I	0,95	20I	I5	2I6
75-77	I73	4	I77	0,97	I60	4	I64
78-80	54	I	55	I,00	56		56
8I-83	7		7	I,00	8		8
84-86							
Total	I4I03	2899	I7002		68I6	I087	7903

Table 5 The main results of determination of the trawl bags
selectivity when fishing roundnose grenadier

| Main characteristics			117 mm mesh	134 mm mesh
Minimum length of fishes caught		cm	20	17
Maximum length of fishes caught		cm	88	83
Mode of the fish length frequency		cm	57	61
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	0,41	0,47
Mean values of one fish escaped	Length	cm	48	52,7
	Weight	kg	0,27	0,36
Minimum length of fishes retained		cm	21	21
Maximum length of fishes escaped		cm	79	79
Retention of fishes %	in number		85,2	82,9
	by weight		88,6	86,2
Selection factor			2,39	2,24
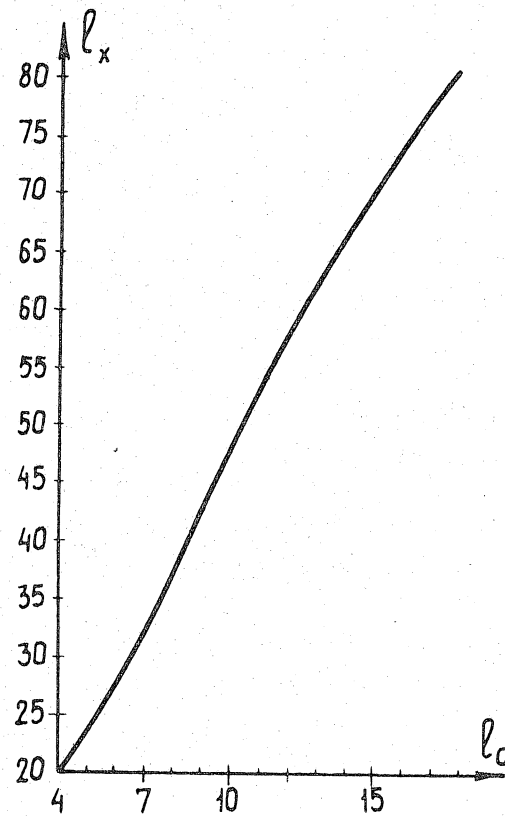
Fig. 1. Diagram of relationship between roundnose grenadier length to the end of the tail (ℓ_x) and length to anal fin (ℓ_a).
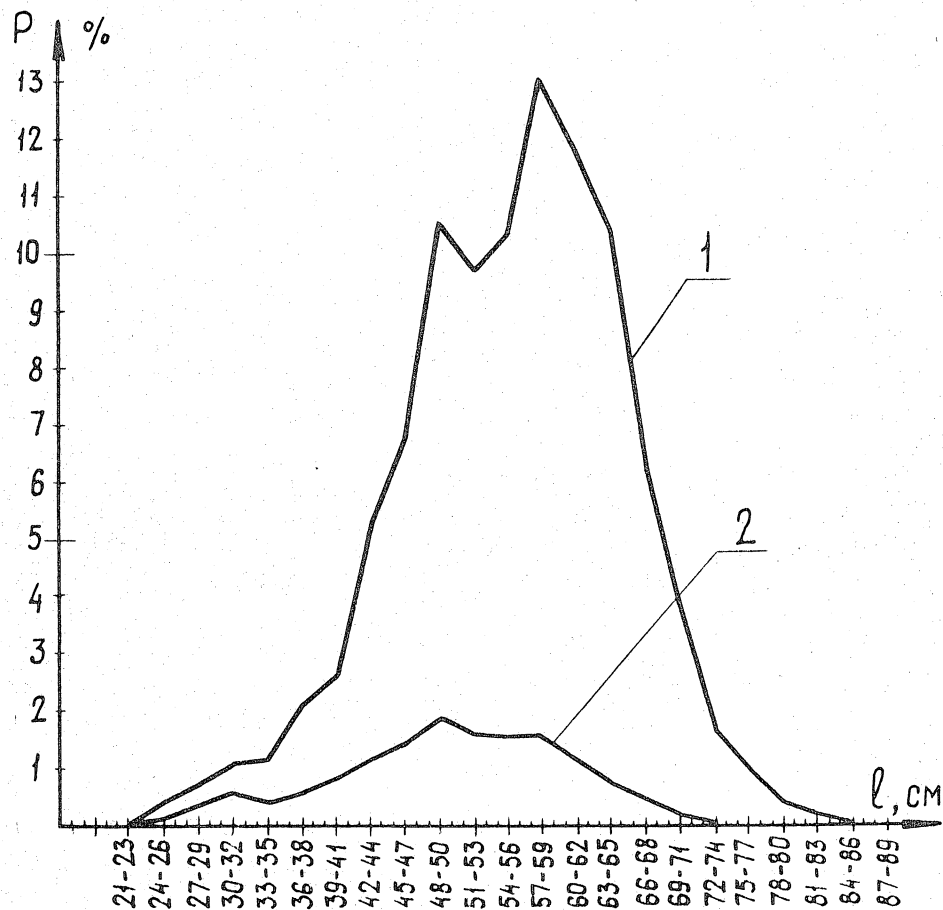

Fig. 2. Percentage of roundnose grenadier of different lengths caught (1) and escaped (2), for codend with 117-mm mesh.
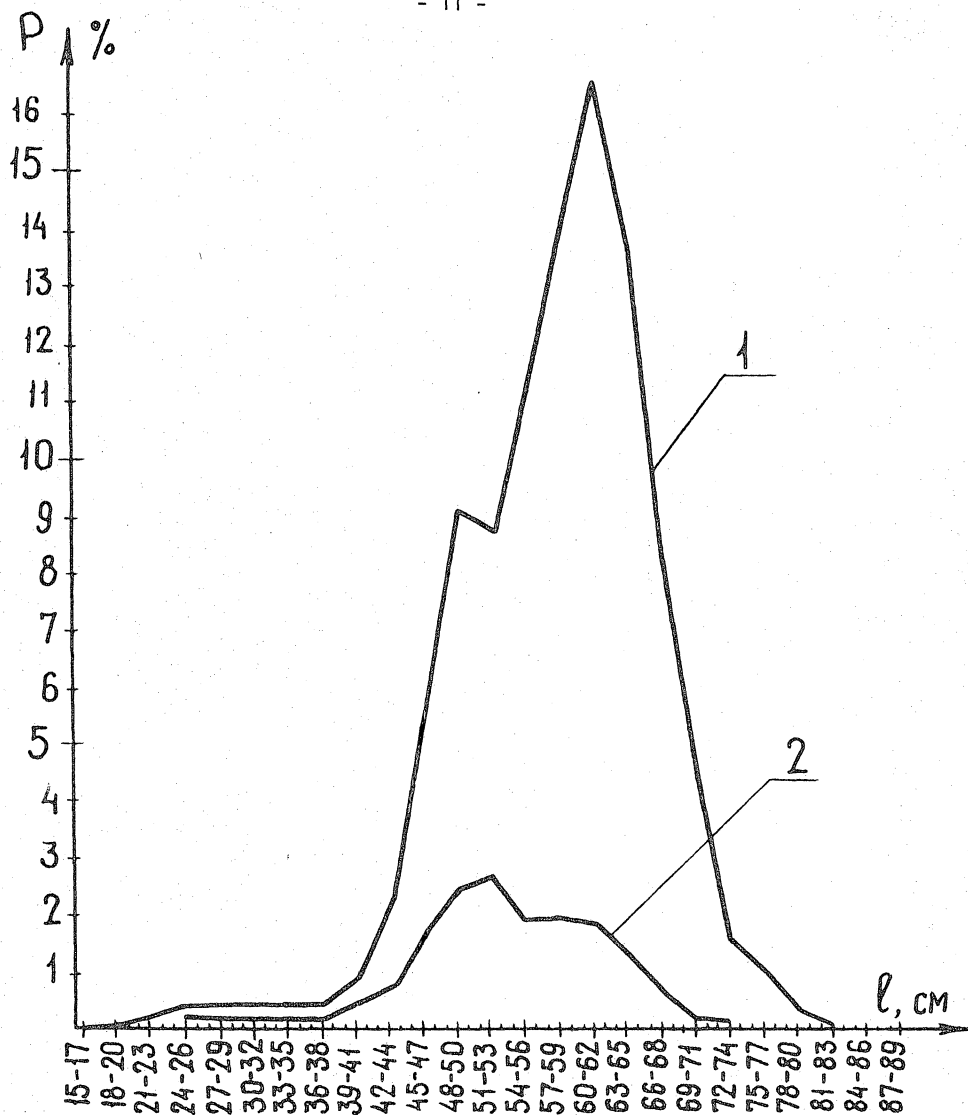
Fig. 3. Percentage of roundnose grenadier of different lengths caught (1) and escaped (2), for codend with 134-mm mesh.
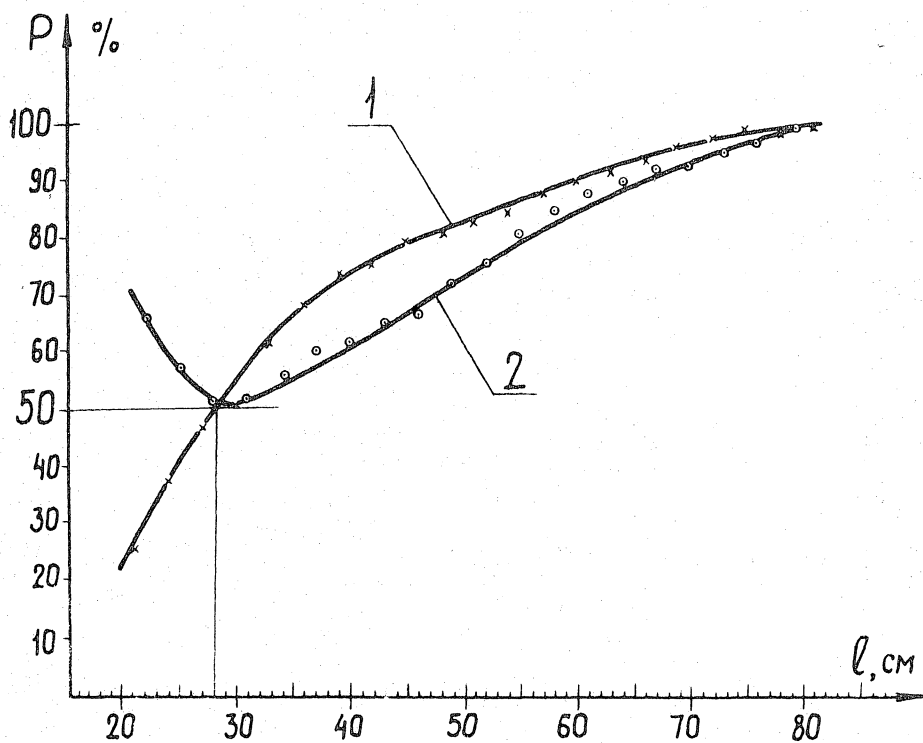

Fig. 4. Diagram of the bottom trawl selectivity relative to roundnose grenadier in 117-mm mesh codend (1) and in 134-mm mesh codend (2).