Northwest Atlantic Fisheries Organization

Serial No. N2533

NAFO SCR Doc. 95/25
CORRIGENDUM

SCIENTIFIC COUNCIL MEETING - JUNE 1995

On Minimum Mesh-Size During Deepwater Redfish Fishery with Mid-Water Trawl in NAFO Divisions 3NO

by

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PLEASE CORRECT THE FOLLOWING ERRORS:

PAGE 1, INTRODUCTION, LINE 10:

"maximum escape of small commercial fishes should be"

SHOULD READ

"maximum escape of small fish and those of the minimum legal size should be".

PAGE 2, LINE 12:

Reference to (Vaskov, 1995)

SHOULD READ

(Savvatimsky and Borovkov, 1995)

PAGE 3, REFERENCES, LINES 16, 17:

DELETE REFERENCE "VASKOV, A. A. Assessment of deepwater redfish stock in Div. 3L by the......"

REPLACE WITH REFERENCE:

SAVVATIMSKY, P. I., and V. A. BOROVKOV. Russian research report for 1994. NAFO SCS Doc. 95/4, Part II, Serial No. N2500, 11 p.

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Abstract

The results of estimates of selectivity of trawl codends with mesh-size 88, 118 and 132 mm during deepwater redfish fishery with mid-water trawls in NAFO Div. 3N are disputed. Long-term advantages from enforcing 88,118 and 132 mm mesh mid-water trawls calculated by the Beverton-Holt method indicate that during the first 10 years of a transition period the long-term advantages will be from 0.9 to 9.7%.

These advantages will not indemnify the losses in catches due to increase of trawl mesh-size over 88 mm.

Considering possible mortality of fish escaping through a trawl bag during heaving and dying from sharp changes in hydrostatic pressure, and also taking into account advantages of the redfish fishery in Divs 3NO with mid-water trawl we recommend a minimum 90 mm mesh in trawl bags.

Introduction

During the most recent years the catch of deepwater redfish in Divs 3LN was 27-29 x 10^3 tons, i.e. considerably higher than the TAC (Power, 1994). A decrease in the commercial stock size made it urgent to scrutinize the effectiveness of the existing regulation measures. The NAFO Scientific Council recommended to introduce in the NAFO Regulation Area a common minimum mesh size firstly 120 mm and later 130 mm. During the redfish fishery in Divs 3 N and 3O the minimum mesh-size in codends was increased from 60 mm to 120 mm which made it impracticable to carry out fishery in those divisions. In November 1993 the Scientific Council (STACFIS) supported Russian proposal to carry out experiments with 90, 120 and 130 mm mesh in mid-water trawls during redfish fishery in Divs 3NO and using the results obtained try to estimate the effectiveness of mesh-size changes.

That mesh-size which provides the maximum escape of small commercial fishes should be considered as the optimum one. Instantaneous losses in catch and long-term advantages are the main criteria of effectiveness of changing for any new mesh size.

At substantiating the minimum mesh-size in trawl bags considerable difficulties are connected with lack of data on survival of fish escaped from the trawl during its hauling and heaving up. Some authors (Konstantinov, 1981; Konstantinov et al., 1983) consider that deepwater redfish escaping from the trawl during its heaving up will perish. That is why is is important to estimate the quantity of redfish escaping from the codend during heaving up.

Methods

Experimental works on selectivity were carried out by a trawler "Vaigach" in September 1994 in Div.3N.A standard mid-water trawl trawl 76/336 m was used during this esperiment. Trawl bags were removable and had the actual mesh size of 88, 118 and 132 mm. The mesh size was measured with a 2 mm thick ICNAF plate inserted into the mesh with 5 kg force. Bags were made of polyamid netting with resulting linear density of 2 x 5.7 kTex. Trawl rig corresponded to that used during commercial fishery. Speed of hauling was 3.5 - 3.6 knots, duration 40-60 min.

Trawl bag selectivity was estimated by covering it with a fish-capturing netting around the whole bag. Its perimeter was by 50% larger than the bag's cylindric part. The front edge of the catcher was attached to the conical part of the bag 7 m away from its cylindric part, rare edge was 4 m behind the codend. The catcher was made of polyamid with linear density of 5.7 kTex and mesh size of 50 mm.

Before the experiment codends were in operation and their mesh stabilized.

Fish from both bag and catcher were measured and counted separately. The representative portion of a catch was measured, the rest was counted. Altogether 5 haulings with 88 mm, 5 haulings with 132 mm mesh and 4 haulings with 118 mm mesh were made.

Instant losses were calculated using retention coefficients for some length-groups. Long-term losses and advantages were estimated by the Biverton-Holt method (Treshchov, 1974).

Data on mean weight and length by age were taken from a paper by Vaskov (1995). Natural mortality coefficient was taken 0.1 for all age-groups, fishing mortality coefficient used was 0.15, 0.20, 0.25, 0.30 and 0.35. Growth rate, age at which length of fish equals to 0 and maximum weight of one specimen were estimated by von Bertalanffy's growth curve. Age at which fish recruited the commercial stock was estimated by actual data on selectivity and age-length composition in 1994 after every new regulation measure (change of mesh-size) was introduced. The maximum age of fish was 23 years. An intermediate period of 15 years was chosen.

Instant losses were estimated by comparing actual results of selectivity of codends with various mesh-size and with regard of data on weight of one specimen of fish of a proper length in 1994 (Vaskov,1995).

Experimental works on assessment of number of fish escaping the trawl bag during hauling and heaving up were undertaken in 1990 by RV "Krenometr". The technique used was grounded on the fact that the above fine-mesh covering was separated into two parts. During hauling redfish which escaped from the trawl bag were collected by the tail part of the covering. Before the trawl heaving up this part was locked and fish escaping during heaving up were collected in the second part of the fish catcher. After the trawl and fish-catcher are heaved up the catch in each part was measured and counted. The quantity of fish escaped from the trawl bag during hauling and heaving up was also counted. Trawlings were made by bottom trawls 45/47m at speed 3.5-3.7 knots, duration of haulings was 2 hours, speed of heaving up 2.0-2.5 m/sec.

Results

Results of compatible trawlings are presented in Tables 1,2,3. Catches in trawl bags and coverings varied from 0,4 to 1,2 t.

Fish of 19-20 and 23-28 cm in length were predominant in catches. During trawling with bags with both 88 and 132 mm mesh-size the length composition of fish in catches was similar.

Using the results obtained we have drawn selectivity curves (Fig.1) and from the plot determined their principal parameters: for 88 mm mesh the selectivity corfficient K_s = 2.8, fish length corresponding to 50% retention l_{50} = 24.5 cm, selectivbity range d_s =4.4 cm, for 118 mm mesh K_s =2.5; l_{50} =29.4 cm; for 132 mm mesh K_s =2.6, l_{50} =34.6 cm d_s =9.0 cm. Trawl bag with 88 mm mesh released 47%, of fish, 118 mm and 132 mm - 76 and 90% of fish, respectively. Losses in biomass were 31, 65 and 85%, respectively.

In December 1990 investigations on estimation of quantity of redfish escaping through a bottom trawl bag with a 128 mm mesh were carried out in the Barents Sea. These investigations revealed that during the trawling time from 18 to 30% of fish escape the trawl during its heaving up.

The results of long-time advantages from mesh-size changes are presented in Tables 4,5,6. The calculations show that at changing mesh-size from 88 to 118 mm, from 88 to 132mm and from 118 to 132 mm an insignificant effect will take place in 6-8 years and during a 15-year intermediate period it will not exceed 12% at intensity of fishery from 0.15 to 0.35. At lesser intensity long-lime advantages will be even less, and at intensity of 0.15 they will not be larger than 3-5%.

Discussion

The materials on selectivity of mid-water trawl bags relative to deepwater redfish are similar to those obtained previously in the NW Atlantic (Konstantinov et al., 1983) and Irminger Sea (Kondratyuk et al.,1988).

In fact, by our data the selectivity coefficient for a 132 mm mesh K_s = 2.6, selectivity range d_s=9.0 cm, in the NW Atlantic for 132 mm mesh K_s =2.5 and d_s=8.0 cm, and in the Irminger Sea for 130 mm mesh K_s=2.6 and d_s=5.4 cm. More narrow selectivity range for the Irminger Sea redfish is conditioned probably by the fact that there were no redfish in catches less than 28 cm long which made up the bulk of catches in Div.3N and in the NW Atlantic.

Fish of practically whole range of lengths escape through mid-water trawl bags with mesh from 88 to 132 mm; fish over 34 cm long are unable to escape through a 88 mm mesh, and those over 39 and 41 cm long - through 118 and 132 mm mesh, respectively.

Increase of mesh size results in increase of escape of that fish which make up the main portion of fishery. Some scientists (Chekhova, Konstantinov, 1977; Chekhova et al., 1979) the commercial length for deepwater redfish should be from 23 to 25 cm. Redfish over 23 cm in length are best fished with trawl bags with 88 mm mesh which are very efficient in selecting smaller fish and retaining larger ones.

Calculations of long-term advantages from enlargening mesh size in trawl bags over 88 mm show that during an intermediate period of 10 years these long-term advantages will not compensate losses caused by larger mesh size.

The total effect for fishery during this intermediate period will be at fishing mortality over 0.25-0.30. A change from 88 mm mesh for 118 mm and 132 mm mesh during redfish fishery will result in lower productivity of the fishery by 1.9 and 3.8 times, respectively. To take the TAC a considerable fishing effort will be required which will result in multiple withdrawal of smaller redfish and, therefore in their multiple escaping through the mesh with possible traumatic consequences and even death of fish due to sharp decrease of hydrostatic pressure.

Some scientists came to the same conclusion that mesh size over 100 mm is inefficient during redfish fishery (Konstantinov; 1981, Konstantinov et al., 1983; Kondratyuk et al., 1988). In a limited area of the Barents Sea the redfish is fished since 1983 with trawls with a 100 mm minimal mesh-size.

Conclusion

Mid-water trawls with mesh-size from 88 mm to 132 mm select redfish making up practically 98%

of the stock length composition. Only redfish over 34 cm do not escape through a 88 mm mesh, and 118 mm and 132 mm mesh retain fish over 39 cm and 41 cm, respectively.
The amount of such fish among the fishable stock does not exceed 0.5-2.2%. Mesh size from 88 mm to 132 mm select from 31 to 85% of redfish biomass. A considerable amount of redfish (from 18 to 30%) escapes the trawl bag during its heaving up and most probably dies due to sharp change of hydrostatic pressure.

Calculations of long-term advantages of redfish fishery using the Beverton and Holt technique indicate that at increasing a mesh from 88 mm to 118 mm and 132 mm the advantages during a 10-year intermediate period will be 0.9% - 9.7% and during a 15-year intermediate period they will fluctuate from 5.6% to 11.5% depending on intensity of fishery. During a 10-year intermediate period the advantages will not indemnify losses from mesh-size increase at any fishing mortality from 0.15 to 0.35.

Increase of mesh-size from 88 to 118 and 132 mm will result in decrease of fishery productivity by 1.9 and 3.8 times, respectively. To take the quota much more fishing effort will be required which will result in multiple passing of small-size fish through the net, especially during heaving the trawl up.

Thus, fishing for redfish with over 90 mm mesh size trawls is practically inexpedient for fishermen, will not result in considerable long-term advantages, and extra mortality of fish escaped through the mesh during heaving the trawl up will lead to considerable losses.

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Results of investigations on selectivity of trawl codend, mesh-size 88 mm, during deepwater redfish fishery in NAFO Div. 3N

Fish length, cm	Catch				Selectivity	
	Codend, spec.	Cover, spec.	Total catch,		actual,	upgraded,
			spec.	%	%	%
15		14	14	0.1		
16		56	56	0.2		0.5
17	7	423	430	1.8	1.6	2.3
18	87	1592	1679	6.9	5.2	4.4
19	155	2262	2417	10.0	6.4	7.9
20	170	1226	1396	5.7	12.2	13.2
21	191	724	915	3.8	20.9	18.2
22	238	871	1109	4.6	21.5	25.7
23	699	1308	2007	8.3	34.8	35.4
24	1087	1097	2184	9.0	49.8	45.6
25	984	906	1890	7.8	52.1	60.1
26	1277	354	1631	6.7	78.3	72.4
27	1790	272	2062	8.5	86.8	86.3
28	2010	131	2141	8.9	93.9	91.5
29	1251	83	1334	5.5	93.8	94.3
30	752	39	791	3.3	95.1	94.6
31	432	23	455	1.9	94.9	95.1
32	546	27	573	2.4	95.3	96.5
33	332	2	334	1.4	99.4	98.0
34	247	2	249	1.0	99.2	99.5
35	158		158	0.7	100.0	99.7
36	143		143	0.6	100.0	100.0
37	90		90	0.4	100.0	100.0
38	46		46	0.2	100.0	100.0
39	23		23	0.1	100.0	100.0
40	15		15	0.1	100.0	100.0
41	7		7	+	100.0	100.0
42	18		18	0.1	100.0	100.0
43						
44	5		5	+	100.0	100.0
45	7		7	+	100.0	100.0
Boero	12767	11412	24179			

Tabl. 2

Results of investigations on selectivity of trawl codend, mesh-size 118 mm, during deepwater redfish fishery in NAFO Div. 3N

Fish length, cm	Catch				Selectivity	
	Codend, spec.	Cover, spec.	Total catch,		actual,	upgraded,
			spec.	%	%	%
15						
16		6	6	0.1	0	
17	2	104	106	1.2	1.8	3.1
18	47	592	639	7.2	7.4	5.1
19	58	875	933	10.5	6.2	6.2
20	25	508	533	6.0	4.7	6.5
21	32	339	371	4.2	8.6	7.9
22	45	387	432	4.8	10.4	9.1
23	64	714	778	8.7	8.2	9.9
24	86	682	768	8.6	11.2	10.8
25	87	578	665	7.4	13.1	15.2
26	136	501	637	7.1	21.4	21.9
27	227	501	728	8.2	31.2	32.7
28	353	421	774	8.2	45.6	41.8
29	213	225	438	4.8	48.6	49.9
30	185	149	334	3.7	55.4	54.6
31	135	91	226	2.5	59.7	61.7
32	126	53	179	2.0	70.0	68.8
33	105	32	137	1.5	76.7	76.1
34	76	17	93	1.0	81.7	81.8
35	47	7	54	0.6	87.0	88.1
36	22	1	23	0.1	95.6	94.2
37	15		15	0.2	100.0	98.5
38	8		8	0.1	100.0	96.7
39	9	1	10	0.1	90.0	96.7
40	1			+	100.0	96.7
41	7		7	0.1	100.0	100.0
42	15		15	0.2	100.0	100.0
43	7		7	0.1	100.0	100.0
44	2		2	+	100.0	100.0
45	5		5	0.1	100.0	100.0
46	3		3	+	100.0	100.0
47	1		1	+		100.0
Всего	2144	6784	8928			

Tabl. 3

Results of investigations on selectivity of trawl codend, mesh-size 132 mm, during deepwater redfish fishery in NAFO Div. 3N

Fish length, cm	Catch				Selectivity	
	Codend, spec.	Cover, spec.	Total catch,		actual,	upgraded,
			spec.	%	%	%
16	1	32	33	0.2	3.0	
17	3	361	364	1.8	0.9	1.6
18	13	1444	1457	7.3	0.9	1.2
19	37	2181	2218	11.0	1.7	1.8
20	36	1260	1296	6.5	2.8	2.1
21	15	758	773	3.9	1.9	2.4
22	24	935	959	4.8	2.5	2.6
23	55	1527	1582	7.9	3.5	3.4
24	74	1679	1753	8.8	4.2	4.7
25	93	1380	1473	7.4	6.3	7.1
26	167	1398	1565	7.8	10.7	9.8
27	216	1538	1754	8.8	12.3	10.5
28	315	1396	1711	8.5	18.4	18.2
29	264	845	1109	5.6	23.8	23.0
30	164	447	611	3.1	26.8	26.0
31	122	321	443	2.2	27.5	29.7
32	107	200	307	1.5	34.9	33.7
33	79	125	204	1.0	38.7	39.0
34	76	99	175	0.9	43.4	45.4
35	74	63	137	0.7	54.0	52.7
36	63	41	104	0.5	60.6	60.1
37	40	21	61	0.3	65.6	64.6
38	16	7	23	0.1	67.5	69.4
39	27	9	36	0.2	75.0	73.4
40	14	4	18	0.1	77.8	80.6
41	8	1	9	+	88.9	88.9
42	8		8		100.0	87.9
43	3	1	4	+	75.0	91.7
44	4		4	+	100.0	
45	1		1		100.0	
Boero	2119	18073	20192			

Tabl. 4

Long - time effect at variable mesh-size from 99 mm to 119 mm and different intensity of deepwater redfish fishery in NAFO Div. 3N

Period, years	Fishing mortality rate			
	0.15	0.20	0.25	0.30
1	-9.4	-12.1	-15.2	-18.3
2	-7.8	-9.5	-11.1	-12.6
3	-6.2	-7.0	-7.4	-7.6
4	-4.7	-4.6	-4.3	-3.6
5	-3.3	-2.6	-1.5	-0.2
6	-2.0	-0.8	+0.7	+2.4
7	-0.8	+0.8	+2.6	+4.4
8	+0.3	+2.1	+4.1	+6.0
9	+1.2	+3.2	+5.3	+7.2
10	+2.0	+4.2	+6.2	+8.1
11	+2.7	+4.9	+7.0	+8.7
12	+3.3	+5.5	+7.5	+9.2
13	+3.8	+6.0	+7.9	+9.6
14	+4.2	+6.4	+8.3	+9.8
15	+4.6	+6.7	+8.5	+10.0

Tabl. 5 Long - time effect at variable mesh-size from 88 mm to 132 mm and different intensity of deepwater redfish fishery in NAFO Div. 3N

Period, years	Fishing mortality rate			
	0.15	0.20	0.25	0.30
1	-28.7	-35.5	-42.2	-48.7
2	-7.8	-9.5	-11.1	-12.6
3	-6.2	-7.0	-7.4	-7.6
4	-4.7	-4.7	-4.3	-3.5
5	-3.3	-2.6	-1.5	-0.2
6	-2.0	-0.9	+0.7	+2.4
7	-0.8	+0.9	+2.6	+4.4
8	+0.3	+2.1	+4.1	+6.0
9	+1.2	+3.2	+5.3	+7.2
10	+2.0	+4.2	+6.2	+8.1
11	+2.7	+4.9	+7.0	+8.7
12	+3.3	+5.5	+7.5	+9.2
13	+3.8	+6.0	+7.9	+9.6
14	+4.2	+6.4	+8.3	+9.9
15	+4.6	+6.7	+8.5	+10.0

Tabl. 6 Long - time effect at variable mesh-size from 118 mm to 132 mm and different intensity of deepwater redfish fishery in NAFO Div. 3N

Period, years	Fishing mortality rate			
	0.15	0.20	0.25	0.30
1	-21.4	-26.6	-31.9	-37.2
2	-9.0	-10.8	-12.5	-14.0
3	-7.3	-8.1	-8.7	-9.0
4	-5.7	-5.8	-5.5	-4.9
5	-4.3	-3.7	-2.8	-1.7
6	-3.0	-1.9	-0.6	+0.8
7	-1.8	-0.4	+1.1	+2.7
8	-0.8	+0.9	+2.5	+4.2
9	+0.1	+1.9	+3.6	+5,2
10	+0.9	+2.7	+4.5	+6.1
11	+1.5	+3.4	+5.2	+6.6
12	+2.1	+4.0	+5.7	+7.1
13	+2.6	+4.4	+6.1	+7.4
14	+3.0	+4.8	+6.4	+7.6
15	+3.3	+5.1	+6.6	+7.8

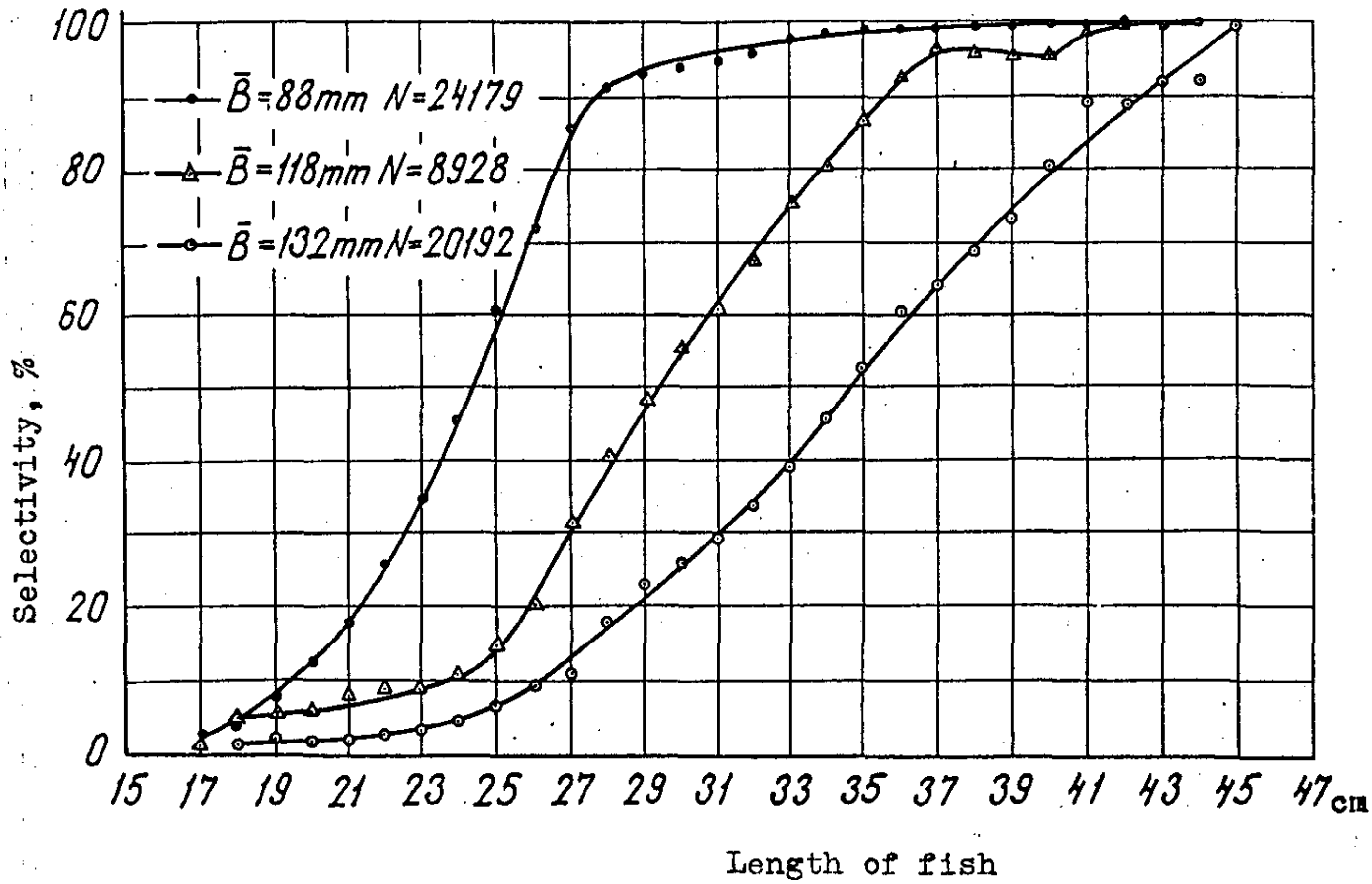

Fig.1. Selectivity of trawl bags with various mesh-size in relation to deepwater redfish from NAFO Div. 3N