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Results of Experimental Fishing for Silver Hake on Scotian Shelf in July 1980

by

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Introduction

At a regular meeting of the Assessment Subcommittee in 1979 Canadian scientists made a proposal to increase the mesh size in bottom trawl codends to 90 mm in directed fishing for silver hake on Scotian Shelf. This led to an animated discussion of a possible effect of this regulatory measure on the silver hake catch size. It was noted that for the final solution of this problem pertinent investigations should be carried out on fishing ships. As a result, the STACRES adopted a recommendations(ICNAF Redbook, 1979, p.83), which was later affirmed by the NAFO Scientific Council, that an experimental fishing for silver hake be conducted on Scotian Shelf using bottom trawls with 60 and 90 mm mesh size codends with the purpose of gaining comparable information on the silver hake catch size and composition. Such an experiment was conducted in July 1980.

Methods

Experimental haulings were made during the period from 15 to 30 July 1980 in Div.4W in the area between 42°53-43°01 N and 63°01-62°01 W at 100-135 m depths. Two fishing stern trawlers of BMRT class were alloted for the experiment. The hauls were made with standard "Hake-2M" trawls. The codend mesh size of the control trawl (BMRT NB 398) was 60 mm, and that of the experimental trawl (BMRT KB 345) 90 mm. The ships were supplied with two trawls each, of same design and standard rigging (bridles, floats, footrope, boards). To achieve

the necessary shape of the netting each trawl was towed for 40 hours. To determine the mesh size the meshes in the tenth row of the codend running parallel to the rope belly line were measured immediately after hauling using a special gauge with a 5 kg press. When measured, a mesh was stretched towards a wider part of the codend; 30 meshes were measured and resulting values averaged. In the course of the above stated operations the netting was repaired if necessary. Following the stretching procedure the codend mesh sizes measured: B_1 =62 mm and B_2 =92 mm.

The experiment was conducted in the fishing grounds of the Soviet fleet. In order to provide similar experimental conditions the ships followed parallel courses; the pay out and haulback were made simultaneously; the hauling duration was 60 minutes at a ship speed of 4 knots; hauls were made during daylight hours. If there were tears and damage of the trawl, the haulings were invalidated. The catch size was determined using measuring baskets.

Biological objectives involved the determination of the catch species and size compositions according to the following procedure: a random sample weighting 150 kg was taken from the catch and sorted out by species; the proportion of each species was determined and at least 200 sp. of each measured; the length and number of silver hake were determined by sex.

Results

The catch data are given in tables 1 and 2. A comparative assessment of fishing characteristics of experimental and control gears was made by means of averaging the result with regard for the mean error calculated according to a generally adopted scheme:

— Mean standard deviation of the catches

$$\sigma = \sqrt{\frac{\sum_{i=1}^{i=n} (N_i - \bar{N})^2}{n-1}}$$

- mean standard error

$$M = \frac{\sigma}{\sqrt{n}}$$

where N_i , N_0 - are the catches of control and experimental gears,

$(N_k - \bar{N}_k)$, $(N_0 - \bar{N}_0)$ - are deviations of control and experimental gears,

$(N_k - \bar{N}_k)^2$, $(N_0 - \bar{N}_0)^2$ - are squared deviations,

$i = 1,2,3 \ldots n$ - is the haul number.

The data given in table 4 and fig.1 show that the silver hake catch composition considerably changed when taken with the trawl with 92 mm mesh size in the codend. First of all, the increased mean size of the males and females is evident and, as a result, the sex ratio changed in favour of the females. Among the fish measuring 35 cm or more the proportion of males taken with the trawl with mesh sizes of 62 and 92 mm amounted to 1 and 6% and of females to 14 and 30% respectively. The proportion of females caught with the 92 mm mesh size constituted 63% of the total catch.

The summed species composition in per cent is given in table 5 for the entire experimental period.

It is hardly possible to make definite conclusions from the by-catch data. To a certain degree, a large by-catch of the squids obscures the results of the experiment in terms of the silver hake selection. It can be expected that the fishing with the 92 mm mesh size gear will entail the increased by-catch of such large fishes

as cod, halibut etc. However, to check this hypothesis, more extensive, carefully planned and lengthy experiments will be needed involving at least two large vessels operating in the fishing regime.

Summary

1. The results of the experiment conducted with bottom trawls with 62 and 92 mm mesh sizes in the directed fishing for the silver hake show that:

- the increase of the mesh size from 62 to 92 mm reduces the catch by more than 50%;

- the bulk of the catches is made of females (63%) and the mean length of the males and females increases by approximately 3 cm.

2. The proportion of larger specimens will not compensate the losses because of the high natural mortality of older age groups, unless the fishing intensity (fishing mortality) is considerably increased at low catches per unit effort.

3. A change for the 90 mm mesh size will inevitably lead to alteration of the commercial stock structure with the prevailing male component. The commercial stock size will excessively increase due to underexploitation of an abundant group of the fish 26-32 cm in length. This situation may have an adverse effect on the abundance of year classes of the other important commercial species, for it will contribute to greater competition for food and greater predation on the young cod, haddock and other species by hake. Although this is only an assumption, it cannot be ignored when introducing such a serious measure as a considerable increase of the mesh size of the fishing gears.

4. For better knowledge of the processes taking place in the stock at varying fishing intensity and for determining of the optimal mesh size of the fishing gear it would be reasonable to conduct complex experiments on the selectivity and catchability for the determination of nominal losses or gains using the method of parallel hauling.

Table 1 Catches taken with "Make-2M" trawl with the minimum mesh size of 8=62 mm and deviations from the mean (T/hour)

Haul No.	Date	Total catch per trawl, N_{k1}	$(N_{k1} - \bar{N}_{k1})$	$(N_{k1} - \bar{N}_{k1})^2$	Including hake catch, N_{k2}	$(N_{k2} - \bar{N}_{k2})$	$(N_{k2} - \bar{N}_{k2})^2$	Hake proportion, %
I	2	3	4	5	6	7	8	9
I	18 Jul.	2.4	+0.0I	0.000	I.90	+0.449	0.202	79:17
2	- " -	4.6	+2.2I	4.884	I.40	-0.05I	0.003	30:4
3	- " -	5.I	+2.7I	7.344	5.00	+3.549	I2.595	98.0
4	- " -	2.I	-0.29	0.084	I.80	+0.349	0.I22	85.7
5	19 Jul.	0.5	-I.89	3.572	0.I3	-I.32I	I.745	26.0
6	21 Jul.	0.2	-2.I9	4.796	0.I6	-I.29I	I.667	30.0
7	- " -	0.2	-2.I9	4.796	0.I9	-I.26I	I.590	95.0
8	- " -	0.2	-2.I9	4.796	0.I7	-I.28I	I.64I	85.0
9	22 Jul.	I.3	-2.26	5.I08	I.I0	-0.35I	0.I23	84.6
10	- " -	I.2	-I.I9	I.4I6	I.00	-0.45I	0.203	83.3
11	- " -	5.5	+3.II	9.672	I.60	+0.I49	0.022	29.I
12	23 Jul.	3.5	+I.II	I.232	I.00	-0.45I	0.203	28.6
13	- " -	5.6	+3.2I	I0.300	2.30	+0.849	0.72I	4I.I
14	- " -	7.0	+4.6I	2I.252	5.50	+4.049	I6.394	78.6
15	- " -	3.7	+I.3I	I.7I6	I.30	-0.I5I	0.023	35.I
16	24 Jul.	5.0	+2.6I	6.8I2	4.90	+3.449	II.896	98.0
17	- " -	4.0	+I.6I	2.592	I.70	+0.249	0.062	42.5
18	- " -	2.0	-0.39	0.I52	I.40	-0.05I	0.003	70.0
19	- " -	2.0	-0.39	0.I52	I.90	+0.449	0.202	95:0
20	24 Jul.	I.0	-I.39	I.932	0.50	-0.95I	0.904	50:0
21	26 Jul.	I.5	-0.89	0.792	I.40	-0.05I	0.003	93:3
22	- " -	0.6	-I.79	3.204	0.40	-I.05I	I.I05	66.7
23	- " -	0.6	-I.79	3.204	0.40	-I.05I	I.I05	66.6
24	27 Jul.	I.5	-0.89	0.792	0.74	-0.7II	0.506	49.3
25	- " -	4.5	+2.II	4.452	2.87	+I.4I9	2.0I4	63.8
26	- " -	I.5	-0.89	0.792	0.78	-0.73I	0.534	48.0
27	- " -	I.4	-0.99	0.980	I.I2	-0.33I	0.I04	80.0
28	- " -	0.5	-I.89	3.572	0.42	-I.03I	I.063	84.0
29	28 Jul.	I.3	-I.09	I.I88	0.336	-I.II5	I.243	25.8
30	- " -	I.2	-I.I9	I.4I6	0.I87	-I.264	I.598	15.6
	$\sum$	7I.7		II3.000	43.543		59.596	
	Mean, (T/hour)	2.39			I.45			

Table 2 Catches taken with "Hake-2M" trawl with the minimum mesh size of B=92 mm and deviations from the mean (T/hour)

Haul No.	Date	Total catch per trawl, N_{01}	$(N_{01} - \bar{N}_{01})$	$(N_{01} - \bar{N}_{01})^2$	Including hake catch, N_{02}	$(N_{02} - \bar{N}_{02})$	$(N_{02} - \bar{N}_{02})^2$	Hake proportion, %
I	2	3	4	5	6	7	8	9
I	18 Jul.	I.000	-0.II9	0.0I4	0.980	+0.282	0.080	98.0
2	- " -	4.000	+2.88I	8.300	2.800	+2.I02	4.4I8	70.0
3	- " -	5.000	+3.88I	I5.062	4.850	+4.I52	I7.239	97.0
4	- " -	0.400	-0.7I9	0.5I7	0.390	-0.308	0.095	97.5
5	19 Jul.	0.500	-0.6I9	0.383	0.450	-0.248	0.062	90.0
6	2I Jul.	0.087	-I.032	I.065	0.067	-0.63I	0.398	77.0
7	- " -	0.I30	-0.988	0.977	0.0I0	-0.688	0.473	7.8
8	- " -	0.048	-I.07I	I.I47	0.008	-0.690	0.476	I6.7
9	22 Jul.	0.052	-I.067	I.I38	0.036	-0.662	0.438	69.2
I0	- " -	5.000	+3.88I	I5.062	2.000	+I.302	I.695	40.0
II	- " -	0.450	-0.669	0.448	0.0I3	-0.685	0.469	2.9
I2	23 Jul.	0.I00	-I.0I9	I.038	0.006	-0.692	0.479	6.0
I3	- " -	0.400	-0.7I9	0.5I7	0.091	-0.607	0.368	I5.2
I4	- " -	2.000	+0.88I	0.776	0.I8I	-0.5I7	0.267	9.0
I5	- " -	4.000	+2.88I	8.300	0.008	-0.690	0.476	0.2
I6	24 Jul.	0.030	-I.089	I.I86	0.02I	-0.677	0.458	70.0
I7	- " -	0.027	-I.092	I.I92	0.004	-0.694	0.482	I4.8
I8	- " -	I.000	-0.II9	0.0I4	0.950	+0.252	0.064	95.0
I9	- " -	0.007	-I.II2	I.237	0.00I	-0.697	0.486	II.3
20	24 Jul.	0.060	-I.059	I.I2I	0.003	-0.695	0.483	5.0
2I	26 Jul.	0.076	-I.043	I.088	0.0I5	-0.683	0.466	I9.7
22	- " -	0.06I	-I.058	I.II9	0.0I4	-0.684	0.468	22.9
23	- " -	0.075	-I.044	I.090	0.007	-0.69I	0.477	9.3
24	27 Jul.	0.500	-0.6I9	0.383	0.970	-0.328	0.I08	74.0
25	- " -	0.600	-0.5I9	0.269	0.430	-0.268	0.072	7I.7
26	- " -	0.I40	-0.979	0.958	0.0I8	-0.680	0.068	I2.9
27	- " -	0.I30	-0.989	0.978	0.006	-0.692	0.479	4.6
28	- " -	0.300	-0.8I9	0.67I	0.087	-0.6II	0.373	29.0
29	28 Jul.	0.400	-0.7I9	0.5I7	0.I40	-0.684	0.468	35.0
30	- " -	7.000	+5.88I	34.586	6.930	+6.232	38.839	99.0
	$\sum$	33.573		I0I.I53	20.886		7I.2I8	
	Mean	I.II9			0.698			

Table 3 Comparative indices of fishing characteristics of two trawls

Indices	Control trawl, B=62 mm		Experimental trawl, B=92 mm	
	Total catch per haul.hour	Includ.silver hake	Total catch per haul.hour	Includ.silver hake
Mean catch values with deviations (T/hour)	2.39 ± 0.36	I.45 ± 0.26	I.I2 ± 0.34	0.7 ± 0.28
Relative catches, %	I00	I00	46	48
Catch losses from a change from B=62 mm for B=92 mm, %	-	-	54	52

Table 4 Size composition of silver hake males and females in catches taken with experimental and control trawls

Size, cm	62 mm mesh size			92 mm mesh size		
	sex			sex		
	Males, %	Females, %	Total males and females, %	Males, %	Females, %	Total males and females, %
I	2	3	4	5	6	7
I4	+		+			
I5	+		+			
I6	0.3	0.2	0.2			
I7	0.5	0.2	0.3			
I8	I.0	0.8	0.9			
I9	I.2	I.3	I.3			
20	I.9	I.4	I.6	0.I	0.I	0.I
2I	3.5	2.0	2.6	0.3	0.2	0.2
22	3.0	I.9	2.4	0.7	0.2	0.4
23	2.7	I.6	2.I	0.7	0.3	0.5
24	3.8	I.3	2.4	0.6	0.6	0.6
25	6.7	I.6	3.9	I.5	0.4	0.8
26	I0.4	I.6	5.5	2.7	0.8	I.5
27	II.4	3.8	7.2	5.6	I.2	2.6
28	9.I	6.I	7.5	6.6	2.2	3.8

Table 4 (continued)

I	2	3	4	5	6	7
29	8.8	7.6	8.2	I2.0	4.2	7.I
30	I2.0	9.2	I0.5	I5.2	7.4	I0.3
3I	II.6	II.6	II.7	I6.4	I0.0	I2.4
32	6.4	II.3	9.I	I6.9	I0.7	I3.I
33	3.4	I0.7	7.4	I0.4	I5.5	I3.6
34	I.4	I0.6	6.5	4.7	I4.6	II.0
35	0.6	6.7	4.0	2.7	I3.2	9.3
36	0.2	3.0	I.8	I.5	6.8	4.9
37	0.I	2.2	I.3	0.7	4.4	2.9
38	+	I.0	0.6	0.2	I.9	I.
39		0.8	0.4	0.I	I.4	0
40		0.4	0.2	0.2	0.7	0
4I		0.4	0.2	-	0.2	0
42		0.I	0.I	0.I	0.4	
43		0.I	0.I	0.I	0.7	
44		+	+		0.6	
45	-	0.I	+	-	0.3	
46		0.I	+		0.I	
47		-			0.2	0.2
48		+	+		0.I	0.I
49		0.2	0.I		0.2	0.I
50		+	+		0.2	0.I
5I		-	-		0.I	+
52		-	-		0.I	+
53		+	+			

No.of meas.			Sex ratio			Sex ratio
sp.	573I	7I03	I:I.2	952	I607	I:I.7
Mean size, cm	27.56	30.68	29.29	30.50	33.28	32.26
Mean weight, kg	I66.80	234.30	204.I0	I88.30	256.20	230.9

Table 5 Species composition of the catches taken with experimental and control trawls

SPECIES	Mesh size, mm : 62	: 92
Silver hake	56.15	56.73
Shortfin squid	41.80	41.52
Cod	0.01	1.19
Haddock	2.03	-
Halibut	-	0.14
Other	0.01	0.42
Total:	100	100

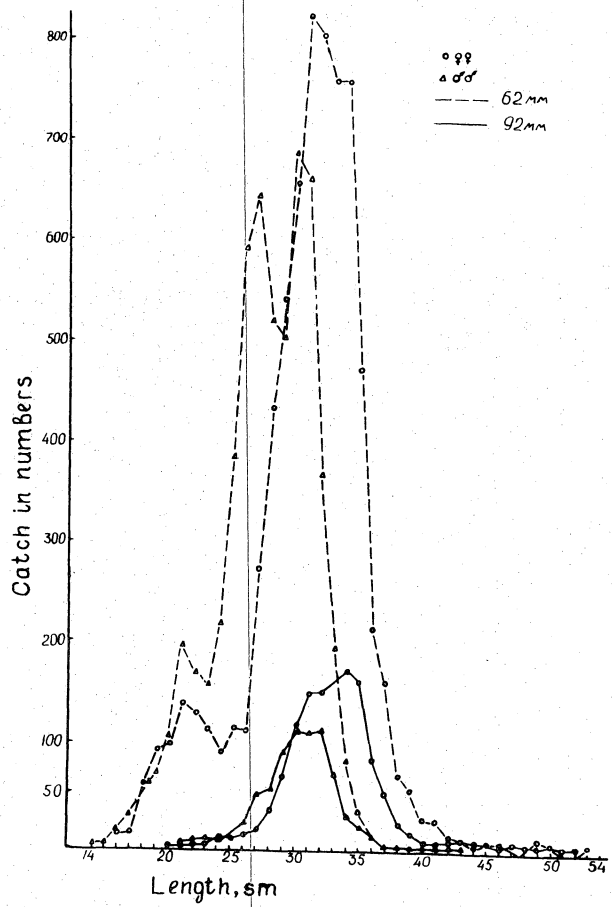

Fig.1. Comparison of silver hake catches taken with trawls with 62 and 92 mm mesh size.