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Assessments of the effects of increases in the mesh sizes of trawls on the cod fisheries in Subareas 2 and 3

by

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Abstract

Assessments were made of the effects of increases in the mesh sizes of trawls on the fisheries supported by the cod stocks in ICNAF Divisions 2J, 3KL and 3Ps using combined data for the 1964-68 period. Results from a previous mesh assessment on 3NO cod for 1963-66 are recalculated assuming a 4½-inch mesh in use in the commercial fishery rather than a 4-inch as was previously assumed. The greatest long-term gain to the otter trawl fishery in Divisions 2J, 3KL and 3Ps and to the total fishery in Division 2J would have occurred at 5-inch mesh for the highest value of M (0.30) considered, at 5½-inch mesh for the intermediate value of M (0.20) and at 6-inch mesh for the lowest value of M (0.10). The greatest gains to the total fishery in Divisions 3KL and 3Ps were indicated at 5½-inch mesh for the highest value of M and at 6-inch mesh for the other values of M. Greatest gains to the otter trawl fishery in Division 3NO, the inshore and offshore line fishery in all divisions in which they occurred and the total fishery in Division 3NO would have occurred at 6-inch mesh for all values of M. The only long-term losses recorded were at 5½- and 6-inch mesh for both the otter trawl and total fishery in Division 2J and at 6-inch mesh for the trawl fishery in Divisions 3KL and 3Ps, the losses in all cases occurring at the highest assumed value of M.

Introduction

Results of assessments of the effects of increases in the mesh size of trawls on the fisheries in 3NO during 1959-62 and 1963-66 were presented at the 1969 ICNAF Annual Meeting (Pinhorn, 1969). It was suggested at this meeting that mesh assessments should be updated for the remaining major cod stocks in Subareas 2 and 3. New assessments have been made based on 1964-68 combined data for ICNAF Divisions 2J, 3KL and 3Ps and the results are presented here.

Materials and methods

The method used to compute the effects of increases in mesh size and the assumptions made concerning M, E, etc. are identical to those used in the previous 3NO assessments. Estimates of growth parameters and total mortality were taken from Wells and Pinhorn (1970).

Division 2J

During the 1964-68 period there were approximately 600,000 length measurements of catches before discards and 8,000 measurements of landings after discards from the commercial cod fishery by otter trawl. In addition, there were 37,000 length measurements from the Newfoundland inshore fishery.

Since the measurements of landings after discards represented two years only, they were not used in the assessments. Length measurements before discards were adjusted to numbers caught, as determined from a knowledge of discard rates (ICNAF Discard Documents) and average weights, in the following manner: The per thousand length frequencies by each country reporting length measurements were adjusted by month to the numbers caught by the country in that month as reported in the ICNAF Sampling Yearbooks. Catch frequencies of the countries represented were then combined by quarters and the resulting frequencies adjusted to the numbers caught by all countries in each quarter. Catch frequencies for each quarter were combined to produce a representative catch frequency for each year. The frequencies

for the five years were then averaged to produce an average catch frequency for the 1964-68 period. Knife-edge discarding was assumed, on the basis of per cent discard by weight, to have taken place between 39-41 cm and 42-44 cm (Fig. 1).

Since the landings from the Newfoundland inshore fishery in 2J could not be separated by gear, the per thousand frequencies for each gear in each month were combined and averaged for the entire year, in the one case including only codtrap and jigger and in the other case including codtrap, jigger and gillnet. These average per thousand frequencies were then adjusted to the total numbers landed in each year by the inshore gears and the frequencies for the five years averaged. This produced one average frequency for the 1964-68 period including gillnets giving a minimum estimate and one excluding gillnets giving a maximum estimate of the numbers landed (Fig. 1).

Divisions 3KL

The method of adjusting the monthly cod length measurements contained in the Sampling Yearbooks for the 1964-68 period was the same as for Division 2J. Length measurements before discards amounted to about 70,000 and there were about 55,000 length measurements of landings after discards. Nearly 240,000 measurements were available from the Newfoundland inshore fishery.

The resultant average annual landing frequency was adjusted by a factor of .92 so that the weight derived from applying a length-weight key to the frequency would be the same as the average annual weight landed as derived from Statistical Bulletins.

The apparent weight of discards as derived from the differences between the catch and landing curves was much greater than the amount calculated from the relevant Commission documents listed in the references. The catch curve was therefore adjusted to produce the amount of discards shown in these documents. The right limb of the curve was considered to coincide with the right limb of the landing curve at lengths of 52 cm and greater. The left limb was arbitrarily moved to the right by shifting the numbers at length up to the next length group, and a final adjustment

made by multiplying the resulting left limb by a factor of .92. The weight of the average annual catch derived from this catch frequency and a length-weight curve was greater by a factor of .004 than the average annual weight caught as derived from the catch curve and Commission Discard Documents (Fig. 1).

The length frequencies for the inshore fishery were adjusted as for the otter trawl frequencies. Gillnet and longline frequencies were adjusted separately from the frequencies of the other inshore gears on a yearly basis. The total inshore frequency was obtained by combining these three groups of inshore gears (Fig. 1).

Data for the offshore line trawl fishery were scanty. The average annual landing for the period was considered to contain 6 million fish. It was assumed that this fishery would have received the full benefit of an increase in mesh size in otter trawls.

Division 3Ps

Since there were very few measurements of catches before discards for the 1964-68 period, a representative catch curve was obtained by applying a 4½-inch selection curve to Canada (Nfld.) research length frequencies in each year, adjusting these to the numbers caught in that year and averaging these frequencies for the 1964-68 period. Measurements of landings after discard totalled 10,000. The frequency for each country reporting length measurements in each month was adjusted to the numbers landed by that country in that month. These were then combined for each country for the entire year and adjusted to the numbers landed by that country in that year. Catch frequencies for these countries were then combined and the resulting frequency adjusted to the total numbers landed by all countries in each year. The frequencies for the five years were then averaged to produce an average landing frequency for the 1964-68 period. Knife-edge discarding was assumed to have taken place between 39-41 cm and 42-44 cm.

On comparing the average annual catch and landing frequencies (Fig. 1), it was obvious that the small fish (<49 cm) were overestimated in the research catches in relation to the proportion of discards as determined from the ICNAF Discard Documents. This was also evidenced by the fact that applying a length-weight key to the research catch frequency resulted in an apparent catch considerably greater than the true catch. From a comparison of this apparent catch with the true catch, it was calculated that the small fish in the research catch curve exceeded those in the true catch curve by a factor of 2.1. Consequently, the numbers of fish at each length below 49 cm were reduced by 2.1X and the resultant curve taken to represent the true catch curve (Fig. 1).

In arriving at representative landing frequencies for the various groups of inshore gears, codtrap, handline and jigger were considered together since all three catch similar sizes of fish. Also longline and linetrawl were combined for the same reason. Gillnet, however, which catches different sizes than any of the other two groups, was considered alone (Fig. 1). A breakdown by type of gear was available for each year from a series of Manuscript Reports of the St. John's Biological Station. Therefore, the per thousand frequency for each month was adjusted to the numbers landed by the particular gear combination in each month, the resultant frequencies for the various months combined and this frequency adjusted to the numbers landed for the entire year by the gear in question. These were then averaged for the 1964-68 period to produce an average landing frequency for each gear combination for the entire period (Fig. 1).

Results

Tables 1-4 summarize the assessments for ICNAF Divisions 2J, 3KL and 3Ps during 1964-68 together with the previous assessment for 3NO for 1963-66. For Division 2J the greatest long-term gain for both otter trawl and total landings would have occurred at 5-inch mesh for the highest value of M, at 5½-inch mesh for the intermediate value of M and at 6-inch mesh for the

lowest value of M. Long-term losses would have occurred to both otter trawl and total landings at 5½-inch and 6-inch mesh for the highest value of M. The greatest gain to the inshore gear landings would have occurred at 6-inch mesh for all values of M. Immediate losses to otter trawl landings ranged from 7% at 5-inch mesh to 37% at 6-inch mesh and to total landings from 7 to 34%.

For Divisions 3KL the greatest long-term gain to the otter trawl fishery was predicted at 5-inch mesh for the highest value of M, at 5½-inch mesh for the intermediate value of M and at 6-inch mesh for the lowest value of M. At the highest value of M the otter trawl fishery would have sustained a long-term loss of 1% at a mesh increase to 6 inches. The greatest gain to the inshore fishery and the offshore line fishery was predicted at 6-inch mesh for all values of M. Greatest long-term gains to the total landings would have occurred at 5½-inch mesh for the highest value of M and at 6-inch mesh for the other values of M. Immediate losses to the trawl landings would have ranged from 4% at 5-inch mesh to 22% at 6-inch mesh and to total landings from 3 to 15%.

In the previous mesh assessment for 3NO cod it was assumed that the mesh size in use in the commercial fishery during 1963-66 was 4 inches. In the present assessments a 4½-inch mesh was assumed. Therefore, to facilitate comparisons between areas, the 3NO data were reassessed assuming a 4½-inch mesh size and the results are presented in Table 3.

The greatest long-term gains for otter trawl landings, offshore line landings and total landings were predicted at 6-inch mesh for all values of E. The immediate loss to trawl landings ranged from 4% at 5-inch mesh to 18% at 6-inch mesh and to total landings from 4 to 17%. By assuming a 4½-inch mesh instead of a 4-inch mesh as in the previous assessment, the immediate losses to the total landings decreased by 10 to 37% and the long-term gains by 28 to 56% from the 4-inch mesh level but this did not affect the general conclusions.

For Division 3Ps the greatest long-term gain for otter trawl landings was predicted at 5-inch mesh for the highest value of M, at 5½-inch mesh for

the intermediate value of M and at 6-inch mesh for the lowest value of M. A long-term loss to the otter trawl fishery would have resulted at 6-inch mesh for the highest value of M. The greatest gain to all inshore gear landings was predicted at 6-inch mesh for all values of M. The greatest gain to total landings was predicted at 5½-inch mesh for the highest value of M and at 6-inch mesh for the other values of M. Immediate losses to otter trawl landings ranged from 5% at 5-inch mesh to 24% at 6-inch mesh and to total landings from 3 to 15%.

References

ICNAF. 1966. Summary of discards (ICNAF Statistics Form 4), 1964. ICNAF Annual Meeting, Res. Doc. 66/10. Serial No. 1664.

1967. Summary of statistics on discards (ICNAF Statistics Form 4), 1965. ICNAF Annual Meeting, Res. Doc. 67/7. Serial No. 1786.

1968. Summary of statistics on discards and industrial fish (ICNAF Statistics Form 4), 1966. ICNAF Annual Meeting, Res. Doc. 68/21. Serial No. 2003.

1969. Summary of statistics on discards and industrial fish (ICNAF Statistics Form 4), 1967. ICNAF Annual Meeting, Res. Doc. 69/23. Serial No. 2183.

1969. 1968 nominal catch from the ICNAF Convention and Statistical Areas and cod and haddock catches in the ICNAF area, 1958-68. ICNAF Annual Meeting, Res. Doc. 69/21. Serial No. 2234.

1966-69. ICNAF Sampling Yearbooks for the years 1964-67. Vols. 9-12.

1966-69. ICNAF Statistical Bulletins for the years 1964-67. Vols. 14-17.

Pinhorn, A. T. 1969. Assessments of the effects of increases in the mesh sizes of trawls on the cod fisheries in ICNAF Divisions 3N and 3O. 1969 ICNAF Annual Meeting, Res. Doc. 69/83, Serial No. 2249.

Pinhorn, A. T., R. Wells and E. Dunne. 1966. Breakdown of catch by type of gear in the Newfoundland inshore cod fishery in 1964. Fish. Res. Bd. Canada, MS Rept. Biol., No. 879, 8 p.

1968. Breakdown of catch by type of gear in the Newfoundland inshore cod fishery in 1965. Fish. Res. Bd. Canada, MS Rept. Biol., No. 987, 8 p.

Pinhorn, A. T., A. W. May and E. Dunne. 1969. Breakdown of catch by type of gear in the Newfoundland inshore cod fishery in 1966. Fish. Res. Bd. Canada, MS Rept. Biol., No. 1010, 6 p.

Pinhorn, A. T., A. W. May, R. Wells and E. Dunne. 1969. Breakdown of catch by type of gear in the Newfoundland inshore cod fishery in 1967. Fish. Res. Bd. Canada, MS Rept. Biol., No. 1058, 5 p.

Wells, R. W. and A. T. Pinhorn. 1970. Growth and mortality changes in cod from ICNAF Subareas 2 and 3. ICNAF Annual Meeting, Res. Doc. 70/ Serial No.

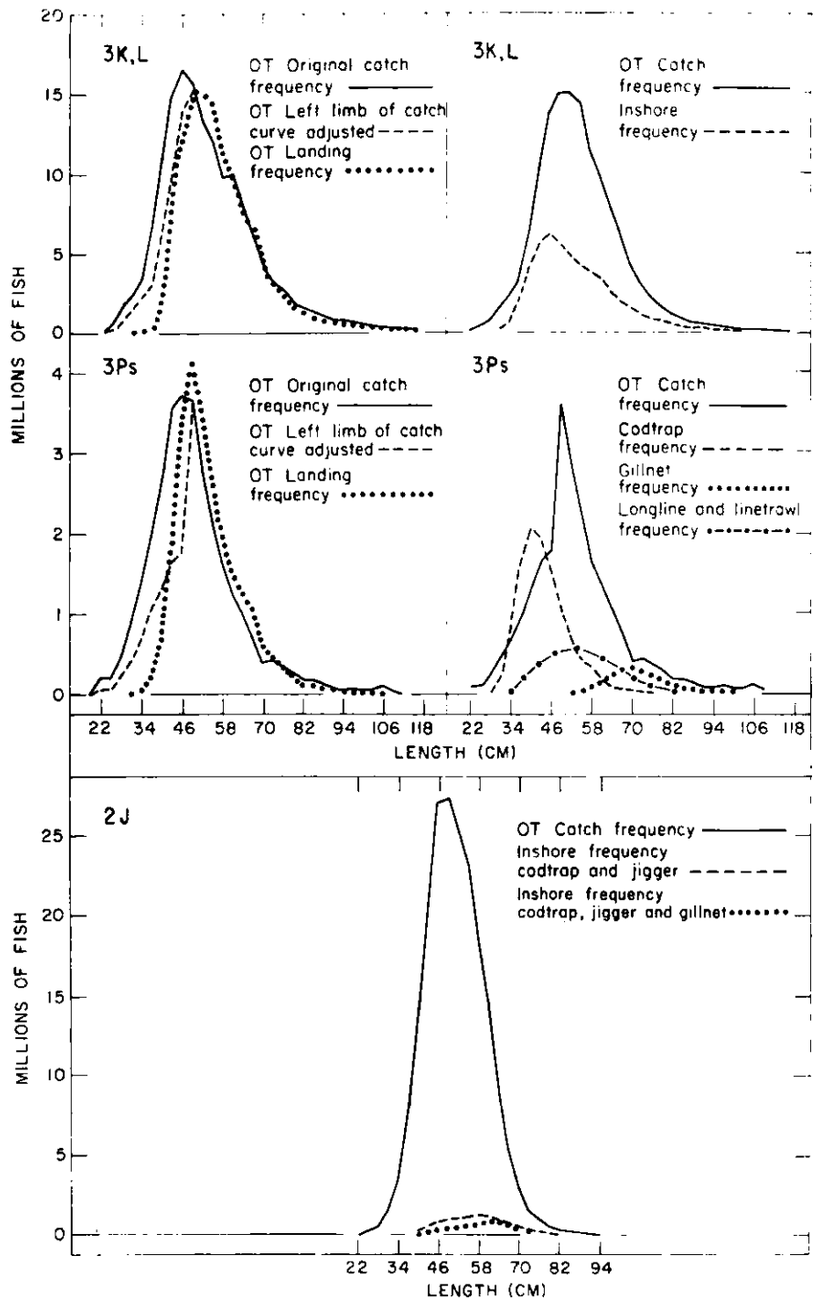

Fig. 1. Average annual catch and landing frequencies of the various gears used in mesh assessments for ICNAF Divisions 2J, 3KL and 3Ps, 1964-68. The original and adjusted otter trawl catch frequencies for 3KL and 3Ps are shown for comparison.

Table 1. Summary of assessments for 2J cod, 1964-68.

Mesh size change (inches) from 4½ to	l_c (cm) 39.2	t_c (yr) 4.3	Gear group	Percentage change in 1964-68 landings			
				Immediate loss	Long-term changes for 0.57 0.40 0.30	0.71 0.50 0.20	0.86 E 0.60 F 0.10 M
5	42.9	4.9	Trawl	-7.5	+1.6	+4.2	+7.0
			Inshore	0	+4.9	+6.3	+7.8
			Total	-6.9	+1.9	+4.5	+7.2
5½	48.3	6.0	Trawl	-22.8	-1.8	+5.8	+14.6
			Inshore	0	+13.3	+18.2	+23.8
			Total	-21.0	-0.5	+7.0	+15.6
6	52.6	7.0	Trawl	-37.2	-8.9	+3.3	+18.4
			Inshore	0	+22.0	+31.4	+43.2
			Total	-34.2	-6.3	+5.8	+20.8

Table 2. Summary of assessments for 3KL cod, 1964-68.

Mesh size change (inches) from 4½ to	l_c (cm) 39.8	t_c (yr) 3.7	Gear group	Percentage change in 1964-68 landings			
				Immediate loss	Long-term changes for 0.57 0.40 0.30	0.71 0.50 0.20	0.86 E 0.60 F 0.10 M
5	43.5	4.1	Trawl	-4.2	+2.2	+4.0	+5.9
			Inshore	0	+3.1	+4.0	+4.9
			Offshore line	0	+6.7	+8.6	+10.5
			Total	-2.9	+2.7	+4.2	+5.8
5½	48.6	4.8	Trawl	-13.3	+1.8	+6.8	+12.3
			Inshore	0	+7.9	+10.5	+13.3
			Offshore line	0	+17.5	+23.2	+29.5
			Total	-9.1	+4.2	+8.5	+13.4
6	52.7	5.5	Trawl	-22.5	-1.1	+6.8	+16.0
			Inshore	0	+12.1	+16.6	+21.8
			Offshore line	0	+27.7	+37.8	+49.7
			Total	-15.4	+3.8	+10.9	+19.1

Table 3. Summary of assessments for 3NO cod, 1963-66.

Assuming 4" mesh in use

Mesh size change (inches) from 4 to	l_c (cm) 33.21	t_c (yr) 3.08	Gear group	Percentage change in 1963-66 landings: Immediate loss	Long-term changes for: 0.33 / 0.15 / 0.30	0.56 / 0.25 / 0.20	0.78 E / 0.35 F / 0.10 M
5	42.60	3.99	Trawl	-6.1	+5.9	+14.9	+24.6
			Offshore line	0	+12.7	+22.3	+32.6
			Total	-5.7	+6.4	+15.4	+25.1
5½	48.44	4.60	Trawl	-13.3	+7.6	+24.4	+43.5
			Offshore line	0	+24.1	+43.4	+63.5
			Total	-12.4	+8.7	+25.6	+44.9
6	52.73	5.07	Trawl	-19.9	+7.8	+31.2	+59.1
			Offshore line	0	+34.6	+63.8	+98.6
			Total	-18.6	+9.5	+33.3	+61.6

Assuming 4½" mesh in use

Mesh size change (inches) from 4½ to	l_c (cm) 38.01	t_c (yr) 3.54	Gear group	Percentage change in 1963-66 landings: Immediate loss	Long-term changes for: 0.33 / 0.15 / 0.30	0.56 / 0.25 / 0.20	0.78 E / 0.35 F / 0.10 M
5	42.60	3.99	Trawl	-3.8	+2.5	+7.0	+11.7
			Offshore line	0	+6.6	+11.3	+16.1
			Total	-3.6	+2.8	+7.3	+12.0
5½	48.44	4.60	Trawl	-11.2	+4.1	+15.8	+28.6
			Offshore line	0	+17.2	+30.3	+44.8
			Total	-10.4	+5.0	+16.7	+29.6
6	52.73	5.07	Trawl	-18.0	+4.3	+22.1	+42.5
			Offshore line	0	+27.1	+48.8	+73.7
			Total	-16.8	+5.8	+23.8	+44.5

Table 4. Summary of assessments for 3Ps cod, 1964-68.

Mesh size change (inches) from 4½ to	l_c (cm) 41.6	t_c (yr) 4.0	Gear group	Percentage change in 1964-68 landings			
				Immediate loss	Long-term changes for 0.50 0.30 0.30	0.67 0.40 0.20	0.83 E 0.50 F 0.10 M
5	44.9	4.4	Trawl	-4.6	+2.1	+4.5	+6.9
			CT-J-HL	0	+2.6	+3.6	+4.6
			GN	0	+3.5	+4.8	+6.0
			LL-LT	0	+3.3	+4.5	+5.8
			Total	-2.8	+2.5	+4.4	+6.3
5½	49.4	4.9	Trawl	-14.4	+0.4	+6.3	+12.7
			CT-J-HL	0	+5.6	+7.8	+10.2
			GN	0	+8.6	+12.1	+15.8
			LL-LT	0	+8.0	+11.2	+14.6
			Total	-8.8	+3.1	+7.8	+13.0
6	53.1	5.4	Trawl	-23.8	-3.2	+5.7	+15.6
			CT-J-HL	0	+7.8	+11.1	+14.8
			GN	0	+13.5	+19.3	+25.8
			LL-LT	0	+12.5	+17.9	+23.9
			Total	-14.5	+2.4	+9.7	+17.8

CT = Codtrap
J = Jigger
HL = Handline
GN = Gillnet
LL = Longline
LT = Linetrawl