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EFFECT OF BOX NET MESH ON THE SMELT CAUGHT

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Introduction.

The effect of the size of mesh in smelt box nets on the size of fish caught was investigated during February and March, 1942, in the Point au Car region of Miramichi bay, N. B. Information on other matters connected with this important fishery was also obtained.

Methods and Gear

Three different sizes of mesh, 1 1/8, 1¼, and 1½ inch, were used in the three "double-end" box nets with which the experiment was conducted. These nets, similar except for size of mesh, were approximately 40' x 10' x 8' in size and made from 12/6 material throughout. The inclusion of 1 3/8 inch mesh size would have been desirable, but this was unobtainable in time for the experiment. The leaders of 10/6 material were approximately 88' long outside the "box", 10' deep, and had a mesh of 2 3/8 inches.

As the experiment began after the commercial season was well under way, a limited choice of desirable locations for the nets was available. Two were set in a line on and off shore while the third was set by itself a short distance away. The leaders extended from the shallower shore water with the trap or "box" attached to the outer end, and where the two nets were set in line, the second leader extended from close behind the first "box" out still farther. All three were in water about 10 to 12 feet in depth.

To miximize the effect of different locations on the catches, the nets were moved from one position to another about every ten days. Thus, each net fished approximately ten days in each position during the course of a month and when the experiment terminated, one shift more was required to complete two circuits of the positions.

When possible, the nets were hauled daily, but sometimes they were not hauled for two days and even three on occasions.

After each hauling, the catch from each net was divided into the four commercial grades--small, (under 4"), medium (4"-5.5"), number one (5.5"-7"), extra (over 7"). Size was measured from the tip of the snout to the end of the scales at the base of tail. Once per week an ungraded sample of about fourteen pounds from each net was measured in detail, as well as all the fish that were "gilled."

Acknowledgment.

Appreciation is expressed to Mr. Allison MacDonald, Napan Bay, N. B., for his care in tending the nets, commercially grading the catches, and recording the details.

Results.

(a) Catch per Net.

The total number of pounds of smelt caught in the 1½ inch mesh net (hereafter for brevity the words "inch mesh" will be omitted) was scarcely three quarters ("gilled" smelt excluded) of that caught in either of the other nets. Including the "gilled" smelt, as would be the case commercially, the proportion is a little higher. That the 1½ net caught only about three quarters as much as the others may

be attributed to fish escaping through this large mesh. Some tried and were "gilled" while no doubt others succeeded in escaping. The actual quantities and percentages per net are seen in table I.

The proportion of fish in a single catch of the different grades varied from net to net. An increase in the size of mesh resulted in a change from 13 to 15 per cent in the extra catch. The percentage of the number one grade changed slightly, 78 to 79, while the percentage of the medium grade decreased from 9 to 6 with the increase in mesh size. No smelt of the small grade were taken at all.

Table II shows that compared to the 1 1/8 net the 1¼ caught slightly more extra smelt, the same quantity of the number one grade but only 73 per cent as many of the medium grade. The 1½ net caught less smelt of every size category than the 1 1/8, only 86 per cent as many extra, 73 per cent as many number one, and only 45 per cent as many medium.

In tables III and IV the graded catch per week per net is shown in pounds and percentages. During the first two weeks of the experiment the medium in the catch were relatively numerous, while during the second and third week of February there was a higher proportion of extra than at any other period. The greatest proportion of number one occurred during the first half of March.

(b) Gilled Smelt

Our findings support the contention of many fishermen that more smelt are "gilled" in the larger mesh nets. Table V indicates that the 1½ net gilled 114.7 lb., the 1¼ net 86.8, and the 1 1/8 net 16.9. These results are even more striking when it is remembered that the 1½ net caught only about three-quarters as many

smelt as either of the other two nets. Because of this 11 per cent of the complete catch of the 1½ net was gilled as compared to 7 per cent in the 1¼ net and 1 per cent in the 1 1/8 net. In other words, the 1¼ net had about 5 times as many gilled smelt as the 1 1/8 net, while the 1½ net, in spite of its reduced catch, had about 7 times as many.

Moreover, a higher percentage of better grade smelt were gilled in the larger size mesh. By weight in the 1 1/8 net, 40 per cent were number one and 58 per cent medium. In the 1¼ net, there were about 50 per cent of each of these grades, while in the 1½ net, 84.8 per cent were number one and 14.5 per cent medium. Thus an increase of 3 8 inches in the size of the mesh brought about a change in the gilled catch from about 58 per cent medium to 85 per cent number one by weight. This fact is reflected in the larger averagessizes of the gilled fish in these nets, which were respectively 5.4", 5.6", and 5.9".

It is seen thus, that with an increase in size of mesh, larger and larger fish are gilled and it is possible also for larger and larger smelt to escape through the meshes.

(c) <u>The Effect of Length of Time between Hauls on the Amount of the Catch</u>.

Lifting the nets every other day yielded more fish on the average during the two months' experiment than lifting them either every day or every third day. Comparative yields were 16.4 lb. for daily hauls or lifts, 21.5 lb. for the lifts made every second day and 10.0 lb. for lifts every third day.

The actual results vary, of course, from net to net as seen

Table I. Yield from the Nets of Different Size Mesh.

	Pounds					Per Cent.		
Nets	Ext.	No.1	Med.	Total (Excl. gilled)	Gilled	Ext.	No.1	Med.
1 1 8	161.8	952.7	110.0	1224.5	16.9	13	78	9
1¼	175.1	953.4	80.2	1208.7	86.8	14	79	7
1½	138.7	700.7	49.9	889.3	114.7	15	79	6

Table II. Comparison in Per Cent of the total catch of the Different Grades One Net with another.

	1 1/8 net	1¼ net	1½ net
Extra	100	108	86
No. 1	100	100	73
medium	100	73	45

Table III. Graded Catch in Pounds of Smelt per Net per Week.

Weeks ending.	1 1/8 net Med.	No.1	Ext.	Total	1¼ net Med.	No.1	Ext.	Total	1½ net Med.	No.1	Ext.	Tota
Jan.31 42	1.6	9.3	1.9	12.8	5.7	38.5	3.3	47.5	2.5	24.4	1.1	28.0
Feb. 7 42	5.9	35.8	7.4	49.1	9.0	60.1	5.2	74.3	2.6	25.4	1.2	29.2
" 14 42	8.0	44.8	20.6	73.4	6.3	45.0	23.7	75.0	4.1	34.8	24.1	63.0
" 21 42	5.6	26.2	12.6	44.4	5.7	44.6	17.1	67.4	4.0	33.5	5.2	42.7
" 28 42	5.8	55.0	7.7	68.5	5.1	62.2	11.2	78.5	2.1	43.2	9.2	54.5
Mar. 6 42	11.3	146.5	17.3	175.1	7.8	173.7	27.8	209.3	1.7	68.4	13.7	83.8
" 14 42	27.5	287.0	38.6	353.1	12.1	195.2	23.0	230.3	5.2	110.5	17.5	133.2
" 21 42	16.7	166.5	25.6	208.8	12.1	168.5	32.9	213.5	11.8	166.0	29.2	207.0
" 28 42	27.6	181.6	30.0	239.2	16.5	165.5	30.9	212.9	15.9	194.5	37.5	247.9
	110.0	952.7	161.7	1224.4	80.3	953.3	175.1	1208.7	49.9	700.7	138.7	889.3

Table IV. Graded Catch of Smelt in Percentage per Net per Week.

Weeks ending.	1 1/8 net			1¼ net			1½ net		
	Med.	No.1	Ext.	Med.	No.1	Ext.	Med.	No.1	Ext.
Jan. 31 42	12	73	15	12	81	7	9	87	4
Feb. 7 42	12	73	15	12	81	7	9	87	4
" 14 42	11	61	28	8	60	32	6	55	39
" 21 42	13	60	27	8	66	26	9	78	13
" 28 42	8	80	12	7	79	14	4	79	17
Mar. 6 42	6	84	10	4	83	13	2	82	16
" 14 42	8	81	11	5	85	10	4	83	13
" 21 42	8	80	12	6	79	15	6	80	14
" 28 42	12	76	12	8	77	15	6	79	15
	9	78	13	7	79	14	6	79	15

Table V. Number and Weight of Smelts Gilled in Nets of Different Mesh.

	1 1/8 net				1¼ net				1½ net			
Grades	Ext.	#1	Med.	Total	Ext.	#1	Med.	Total	Ext.	#1	Med.	Total
Number	3	98	212	313	3	642	794	1.439	5	1.285	277	1.567
Percentage by number	1	31	68	---	.2	44.6	55.2	-----	.3	82.1	17.6	-----
Weight (lb.)	.4	6.7	9.8	16.9	.6	43.4	42.8	86.8	.7	97.3	16.7	114.7
Percentage by weight	2	40	58	-----	.3	50.2	49.5	-----	.7	84.8	14.5	-----

in table VI. In the case of the 1 1/8 net, the catch per day's fishing increased from 18.9 to 24.1 or 27%, by leaving the net unhauled for two days. With the 1¼ net, it increased from 17.3 to 23.6 or 36%, and with the 1½ net, it increased from 13.1 to 16.9 or 29%. Thus, by leaving the nets unhauled for two days instead of hauling d daily, an increase of almost one-third was obtained in the average per day's fishing. This increase would not necessarily hold for a further increase in time between hauls, for the data, though very meagre, indicates that when lift three days, the catch, instead of increasing per day's fishing, decreases to almost one-half of the catch obtained when hauled daily.

This difference between daily hauls and hauls every second day is in direct opposition to the results obtained by the U. S. Bureau of Fisheries in fishing trap nets on the Great Lakes. In volume 65 (1935), 71 - 75, of the Transactions of the American Fisheries Society, Dr. John Van Oosten reported that their nets when lifted every second day yielded only 58.5% as many fish per day's fishing as when lifted every day. However, the number of lifts on which this conclusion was based was not indicated.

Their findings thus indicate that by hauling every second day there is a decrease of about 41 per cent in the comparative yield while ours show an increase of about 31 per cent.

(d) The effect of Length of Time between Hauls on the Size of Fish in the Catch.

Our results do not support the belief of many smelt fishermen that the longer a box net (not a tide-set bag net) remains in the water without hauling the greater the proportion of large fish in

Table VI.

Yield of Different Nets Depending on Number of Days between Hauls.

Net of	Net hauled or lifted daily			Net hauled or lifted every second day.				Net hauled or lifted every third day.			
	Total catch in lb.	Av. daily catch in lb.	Number of hauls.	Total catch in lb.	Av. catch per haul in lb.	Av. catch per day's fishing in lb.	Number of hauls	Total catch in lb.	Av. catch per haul in lb.	Av. catch per day's fishing in lb.	Number of hauls.
1 1 8 net	322.2	18.9	17	820.0	48.2	24.1	17	82.9	27.6	9.2	3
1¼ net	293.2	17.3	17	851.3	47.5	23.6	18	64.4	32.2	10.7	2
1½ net	222.5	13.1	17	606.7	33.7	16.9	18	60.1	30.1	10.0	2
All nets	837.9	16.4	51	2278.0	43.0	21.5	53	207.4	30.0	10.0	7

the catch.

Tables VII and VIII show the pounds and percentages of smelt of the different grades depending on the number of days between hauls. Comparison between the three groups,- "hauled daily", "hauled every second day", and "hauled every third day" in table VII, of amounts of fish caught should be made reservedly due to the different lengths of time the nets were fishing between hauls. In table VIII it is seen that as the time interval between hauls increased the percentage of extra in the catch decreased,- 17, 14, 9. On the other hand, the percentage of number one increased,- 76, 79, 83, as did also the percentage of medium,- 7, 7, and 8.

In table IX, the catch of the different grades of smelt per net per day's fishing and according to the time elapsing between hauls has been calculated. The average catch per day's fishing shown in table VI has thus been subdivided into the three grades. The increase in the catch obtained per day's fishing by hauling every second day is seen to have been obtained rather by an increase in the smaller sizes than the extra grade, while the total catch per day's fishing when hauling every third day is only about 60 per cent of that when hauling daily, still there is less decrease in the smaller than in the larger size.

In table X, the catches in per cent for the two day and three day intervals in all the nets and grades have been compared with those of the one day interval. It is seen that in the two day interval on the average there was 7 per cent more extra per day's fishing, 35 per cent more number one and 52 per cent more dedium than taken when the time interval was one day. In the three day interval, though a much smaller total catch than with a one day interval, there was also a greater saving in the smaller sizes.

Table VII. Pounds of Smelt of Different Grades Depending on Number of Days between Hauls.

Nets of	Hauled daily. Ext.	No.1	Med.	Hauled every second day. Ext.	No.1	Med.	Hauled every third day. Ext.	No.1	Med.
1 1 8 net	48.0	248.2	26.0	107.0	637.1	75.9	6.9	67.6	8.4
1¼ net	50.9	225.0	17.2	118.4	674.4	58.6	5.7	54.2	4.5
1½ net	44.4	167.1	11.0	87.6	484.1	35.1	6.7	49.5	3.9
Sub-Totals	143.3	640.3	54.2	313.0	1795.6	169.6	19.3	171.3	16.8
Totals		837.8			2,278.0			207.4	

Table VIII. Percentage of Smelt of Different Grades Depending on Number of Days between Hauls.

Nets	Hauled daily.			Hauled every second day			Hauled every third day		
	Ext.	No.1	Med.	Ext.	No.1	Med.	Ext.	No.1	Med.
1⅛	15	77	8	13	78	9	8	82	10
1¼	18	76	6	14	79	7	9	84	7
1½	19	76	5	14	80	6	11	82	7
Totals	17	76	7	14	79	7	9	83	8

TableIX. Pounds of Smelt of Different Grades per Days Fishing According to Number of Days between Hauls.

Net	Hauled daily			Hauled every second day			Hauled every third day		
	Ext.	No.1	Med.	Ext.	No.1	Med.	Ext.	No.1	Med.
1⅛	2.8	14.6	1.5	3.1	18.7	2.2	.8	7.5	.9
1¼	3.0	13.2	1.0	3.3	18.7	1.6	1.0	9.0	.7
1½	2.6	9.8	.6	2.4	13.4	1.0	1.1	8.3	.7
Average	2.8	12.5	1.0	3.0	16.9	1.6	.9	8.2	.8
Average day's catch		16.4			21.5			9.9	

Table X. Comparison in Per Cent per Day's Fishing According to Grade of Fish and Time Interval between Hauls.

Time between Hauls	1 Day			2 Days			3 Days		
Nets	Extra	No.1	Med.	Extra	No.1	Med.	Extra	No.1	Med.
1⅛	100	100	100	111	128	147	29	51	60
1¼	100	100	100	110	142	160	33	68	70
1½	100	100	100	93	137	167	42	85	117
Average	100	100	100	107	135	152	32	66	73

Discussion.

While the total amount of fish taken by the three nets was small and the duration of the experiment short, indications were obtained of significant differences in such features as total catch, size of fish taken, size and quantity of fish gilled as affected by size of mesh and size and quantity of fish taken in respect to length of time between hauls.

Since the nets were the same in all respects except size of mesh and were rotated in their fishing positions, it may be concluded that the increase in size of mesh was responsible for the 1½ net catching only about three-quarters as many fish as either of the other nets. The main difference in the 1¼ net compared to the 1⅛ was in its taking only 73 per cent as many medium grade smelt. The 1½ net, on the other hand, not only had a distinctly smaller total catch, but there was a reduction in quantity of all the size categories. Compared to the 1⅛ net, the extra showed a decrease to 86 per cent, the number one to 73 per cent, and the medium to 45 per cent.

As the average size of the gilled fish in the 1⅛ net was 5.4 inches, it may be concluded that many medium grade (4 to 5.5 inches) could escape. The same is true for the 1¼ net where the average gilled fish size was 5.6 inches. In the 1½ net, all the medium could escape if they desired and some of the number one grade also, because the average gilled fish size of 5.9 inches in this net is higher than the minimum size of 5.5 inches for the number one grade of smelt. Our results show that in the 1½ net even 14 per cent of the extra escaped, as well as 27 per cent of the number one grade. However, as opposed to the fact that all the medium could escape (medium grade 4 to 5.5 inches and average size of gilled fish in 1½ net 5.9 inches) from

this net, only 55 per cent actually did. That more did not escape must be attributed to their not trying to go out through the netting.

Further proof in respect to their not trying to go through netting is found in the fact that the leaders of most commercial nets have a mesh size of 2 to 2½ inches, a size through which all smelt could pass. However, that they do not try to go through is amply proven by the fact that a huge fishery has been established because they "lead" along this netting into the traps.

Reduction in the catch of medium grad e smelt is desirable from several standpoints. Many smelt dealers complain now that the market is glutted with this low price grade (average wholesale price about 7 cents per pound) and that there is a consequent decline in the price and sales of the better grades of smelt. Biologically, a large proportion of this grade (4 to 5.5 inches) have never spawned, for few smelt under 4.9 inches have reached maturity. To take out such fish is injurious to a fishery in the opinion of many biologists.

From the fishermen's immediate standpoint, the reduction in his catch of any grade is equally important, as the smelt are sold by weight on the ice irrespective of the size of the fish. In the Miramichi area where the percentage of medium in the catch is not large, a reduction to about one-half of this grade in the catch, together with smaller reductions in the extra and number one by the use of 1½ inch mesh would reduce the total weight of the catch about 25 per cent, but where the medium grade makes up as much as two-thirds of the catch, a 50 per cent reduction in this grade, together with small reductions in the other two grades, would mean a decline of about 40 per cent in the fishermen's revenue.

The contention that larger mesh nets gill more smelt than the 1⅜ inch mesh, which is the present minimum legal size limit, is

justified by the results of our experiment. Gilled smelt are undesirable both from the fishermen's and the packer's standpoint. Clearing the net of gilled smelt is a cold tedious job under the winter weather conditions in which the fishermen operate. As a result, most of such fish are damaged, the usual result being the loss of the head. This is a very slight loss to the fishermen in weight sold, but to the packer it is more serious, since the grading law reads "fish with a head or tail broken off may be placed in the next lower grade." Such a reduction in grade means on the average a loss of 10 cents per pound (average price of extra 22 cents and number one 12 cents) if the change is from extra to number one or five cents per pound if the fish is shifted from the number one to medium grade (average price of number one 12 cents and medium 7 cents.)

An increase in the time interval between hauls of from one to two days increased the catch per day's fishing about one-third but a further increase to three days caused a decline in the catch to about two-thirds that taken when the interval was one day. However, in the latter instance, the amount of data is very meagre.

The increase was more pronounced in the medium than in the extra grade size.

Some factor was thus acting to produce a greater and greater proportion of smaller smelt in the nets with an increase in the time interval between hauls. It acted also in all the nets. The daily hauls, hauls every second day, and hauls every third day were interspersed one with another throughout the two month period, while the n nets were alike, except for mesh size, and rotated in their fishing positions. With all these features in common, one of the main apparent differences was the fact that as the time interval between

hauls increased the number of actual acts of hauling decreased per day's fishing.

During the actual hauling of the net the fish are frightened and greater or less numbers are seen to escape through the netting. Thus, when hauling daily, more fish would escape in this way in two days of fishing than would in two days of fishing with only one hauling. It is thus possible that the fish saved in this way in hauling after a two day interval are responsible for the 31 per cent increase in the day's fishing under these circulstances. If such is the case the greater saving should be in smaller sizes, since the smaller the fish the more readily they can escape when frightened. It does not necessarily follow, however, that with a further increase in the time interval a still greater saving will be brought about and that a greater catch per day's fishing will follow. Our meagre data for a three day interval shows a poorer catch than for the one day interval.

It has been shown that there was a greater increase in the proportion of medium grade fish than in the extra in the case of the two day interval and a smaller decrease in the medium than the extra in the three day interval group.

This seems to bear out the conclusion that a distinct increase is brought about through hauling once per two day day's fishing instead of twice. It would also appear that the faster the net could be hauled the better.

Summary.

An experiment to determine the effect of size of mesh in box nets on the catch of smelt was carried out during February and March, 1942, at Point au Car, Miramichi bay, N. B.

In addition to the 1⅛ in. mesh of which most commercial nets are made, 1¼ and 1½ were also used.

During this period the complete catch of the 1⅛ net was 1241.4 lb., the 1¼ net, 1295.5 lb. and the 1½ net 1004.0 lb. The reduction in the catch of the 1½ net was produced by 14 per cent less extra grade smelt, 27 per cent less number one, and 55 per cent less medium.

The contention that large mesh nets gill more smelt is supported by the fact that compared to the 1⅛ net, our 1¼ net gilled 5 times as many smelt and the 1½ net gilled about 7 times as many.

Lifting the nets (hauling the nets) every other day yielded more fish on the average during the experiment than lifting them either every day or every third day.

The belief that increasing the time interval between lifts results in a greater proportion of larger fish, is not borne out by our experiment. In fact the percentage of the extra grade in the catch decreased while the number one and medium increased.

It is believed that through frightening the fish when hauling a certain portion escape and the smaller sizes can dart through the netting more readily. Thus, by hauling once per two day's fishing instead of twice, a saving results, more especially in the smaller sizes.

Abstract.

During February and March, 1942, three box nets, all similar except in the size of mesh which was 1⅛, 1¼, and 1½ inches respectively, were fished and rotated every ten days at three fishing positions at Point au Car, Miramichi bay, N. B.

Increasing the size of the mesh increased the larger sizes somewhat and decreased the proportion of small smelt in the catch. The total catch decreased to 73% with the increase in mesh size from 1⅛ to 1½ inches.

Allowing the nets to fish one and two days between hauls showed that hauling every second day gave 31% more fish per day than hauling daily. Increasing the time between hauls increased the catch of the smaller fish more than that of the larger.