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INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Document No. 5

ANNUAL MEETING - JUNE 1955

Report of the Scientific Advisers to Panel 4

15 December 1954

The Scientific Advisers to Panel 4 held a meeting at St. Andrews, N.B., on December 7 and 8, 1954. The following were present:

Canada	Spain	United States	ICNAF
J. L. Hart (Chairman)	A. Rojo	L. Walford	E. M. Poulsen
W. R. Martin		H. Graham	R. S. Keir
F. D. McCracken		C. Taylor	
A. C. Kohler		J. Clark	
J. E. Paloheimo		A. Jensen	
L. M. Lauzier		J. P. Wise	
Y. Jean		L. Scattergood	
A. Marcotte			
W. Templeman			
E. J. Sandeman			
R. W. Ellis			

United States biologists reported progress in the study of haddock data accumulated in previous years from Subarea 4. Age and length composition has not significantly changed on Browns Bank since 1948. The abundance as indicated by catch per day has fluctuated around 22,000 pounds per day, indicating that the fishery is fairly stable. A similar analysis is now being made for Sable Island. The necessity of obtaining small fish from these areas for growth rate studies was pointed out, but facilities for collecting this material are not likely to be available in the forseeable future. A preliminary analysis of the Canadian data from the Lockeport area indicates that the optimum age at first capture is higher here than on Georges Bank.

Although data on Browns Bank are not nearly so complete as for Georges Bank, United States biologists are attempting to estimate optimum age at first capture for that area, and will report further on the results of these efforts at the next meeting.

The Marine Biological Laboratory of Grand River, Quebéc, reported briefly on the operation of the six small trawlers working around the Gaspé Peninsula. The most important species caught are cod, American plaice and witch. Large numbers of small cod and plaice (i.e. 24.6% and 87%, respectively) are discarded. A 4½-inch mesh can reduce these quantities by about two thirds. Fishermen of that area would willingly accept a 4½-inch regulation. Catches of line fishermen have fewer discards than those of trawlers.

Canadian biologists presented reports on investigations in Subarea 4 as follows:

A. Factors Affecting Annual Yield, by W.R. Martin (App. 1)

B. Gear Selection in Relation to Sizes Caught and Landed, by F.D. McCracken (App. 2)

Canadian scientists described a method of determining optimum mesh size based on estimates of mortality from length frequency distribution. The method is still being developed and will be reported upon further at a later meeting.

Mr. Rojo reported that large Spanish trawlers now use trawls with a cod-end/size of 110 mm. which is the equivalent /mesh of 4.4 inches. Pair trawlers use cod-ends with a mesh size of 80 mm. (3.2 inches) or greater.

The general conclusion of the group was that according to all evidence submitted at this meeting, a mesh regulation would be beneficial in Subarea 4. It appears that for optimum size at first capture a mesh larger than that now in use in Subarea 5 seems indicated. A 4½-inch mesh regulation is a step in the right direction. This size would save large quantities of fish which are now discarded at sea, and it would not adversely affect landings of cod, haddock or plaice.

This size conforms approximately with that now used by all countries fishing the subarea except Canada.

The group pointed out the desirability of fishing experimentally with a wide range of sizes of meshes larger than 4½ inches in order to establish selectivity data and relation between fishing efficiency and mesh size.

The Chairman named a working party to draft a recommendation concerning regulations and appropriate exemptions. The draft as adopted by the Groups of Advisers is attached as App. 3.

Canadians reported on plankton surveys by research vessels in Subarea 4. The principle of co-operation in planning and executing oceanographic research by Canada and the United States, and in interpreting the results, was affirmed.

The group agreed to make the following preparation for the March meeting:

1. Obtain legal opinion on the wording of the proposed mesh regulation.

2. Test the method of determining optimum mesh size from length composition on Georges Bank data where sampling for age as well as length has been systematic and long continued. Further application with Canadian data will be attempted.

3. Continue and report studies pertinent to the problem of exemptions.

4. Obtain industry reaction to proposed new gear regulation.

5. Continue studies to determine optimum size at first capture for Browns Bank.

6. Report on comparison between age determination of haddock by scales and by otoliths.

In addition, the group advised that the following lines of research are desirable for future work:

1. Studies of the action of chafing gear for retaining fish in the net.

2. Comparison of size selection by hooks and by trawls.

3. Comparison of size selection by nets made of nylon with those made of cotton and manilla.

4. Continuation of tagging experiments to estimate fishing and natural mortalities.

5. Studies of growth rates of haddock. This requires special collections of small fish.

6. Studies to determine effect of $4\frac{1}{2}$-inch meshed codends on the catches of redfish.

7. Studies to determine relation between fishing efficiency and mesh size.

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Appendix 1

Canadian Investigations of Subarea 4

Stocks of Cod and Haddock

A. Factors Effecting Annual Yield - by W.R. Martin

Introduction

The cod and haddock stocks of Subarea 4 produce combined annual landings of over 300 million pounds, fresh-gutted weight (150 thousand metric tons, round-fresh weight). Most of the cod are landed by Canada. The much smaller haddock landings are shared about equally by Canada and the United States. Large fluctuations in annual yield (Figure 1) have been related to changing political, economic, climatic and fishing conditions. During war years, fishing effort by countries other than Canada was greatly reduced. The market value of groundfish has fluctuated in a pattern similar to that of Canadian cod landings (Figure 2). Water temperatures have increased during the past decade (see Hachey, Hermann and Bailey, ICNAF Ann. Proc. Vol. 4) and the changing climate has undoubtedly affected groundfish abundance. Traditional line fishing methods are being replaced by otter trawling with striking effects on the quantities and sizes of groundfish caught. The United States conversion to otter trawling in the mid thirties and the post-war increase in Canadian otter trawling had significant effects on landings of haddock (Figures 3 and 4).

The Atlantic Biological Station has recently been studying the effects of fishing on abundance and landings of Subarea 4 cod and haddock in order to assess the need and means to regulate the fisheries for maximum yields. Studies of landings, abundance, size composition, age composition, growth and tagging demonstrate that yields of both cod and haddock can probably be increased by beginning to capture these species at a larger size.

Division of Stocks

Extensive studies of cod and haddock stocks by tagging, vertebral counts, growth and parasite infestation permit identification of the major cod and haddock stocks in Subarea 4 (see summary ICNAF Ann. Proc. Vol. 3). A number of discrete stocks are defined, all distinct from stocks of adjacent subareas. Extensive seasonal movements have been described within Subarea 4.

Landings

Total landings of cod and haddock by Canada and the United States are shown in Figure 4 in relation to landings of other groundfish species. Small, unknown quantities of cod have been landed in Europe from Subarea 4 and in 1953 these were reported to exceed 50 thousand metric tons, round-fresh weight.

Statistics of landings for 1952 and 1953 (Table 1) show the relatively high importance of Subarea 4 cod and haddock landings to Canada, excluding Newfoundland. A decrease of 50 million pounds may be noted for Subarea 4 cod in 1953.

Canadian mainland landings for 1953 from Subarea 4 by gear and sub-division (Table 2) show the more southerly distribution of haddock and the high importance of line fishing for haddock and especially for cod.

Cod and haddock are culled by commercial size categories for marketing purposes. The weights, lengths, quantities and landed price of these size categories are listed in Table 3. The Industry's interest in large fish is shown by the relatively high landings and landed values of fish over 2½ pounds, gutted weight.

Landings in Relation to Abundance

Landings of cod and haddock from Subarea 4 have been replotted in Figure 5 in relation to abundance by size categories as measured by landings per trip for Nova Scotia offshore vessels. Landings and availability of cod increased while those of haddock were reduced during war years. The only large increase in cod landings appeared in 1945 and 1946. During war years, fishing effort was reduced by countries other than Canada and the abundance of large steak cod increased. This accumulation of cod contributed higher landings at the end of the war. Availability of cod, particularly steak cod, has decreased during the post-war period to a low level (see also Figure 6). Availability and landings of haddock have been relatively stable. During the post-war period, fishing effort increased with the return of United States trawlers and with increased use of otter trawlers by Canada. Total landings have been increasing but this has only been true for the scrod size category. The industry is now accepting smaller haddock and about two million pounds of small, round haddock were landed in Nova Scotia from St. Pierre Bank in October, 1954. Trawlers fish abundant, strong year-classes of haddock at as small a size as the market permits.

During the post-war period, fishing in the southern Gulf of St. Lawrence (Subdivision 4T) has changed rapidly from line fishing to small otter trawlers. In the northern part of this area, emphasis is on cod and on the southern grounds, haddock is the dominant species in landings. Statistics of landings in northern New Brunswick are shown in Figure 7. Cod landings increased in 1946 before the introduction of draggers in 1947 and they have remained high during the transition period. The availability of cod has decreased since 1948 and the draggers have maintained their high landings by taking other species, namely plaice, some haddock and a small amount of redfish.

Smaller Fish Caught and Landed

The conversion from line fishing to otter trawling has increased the variety of species landed but it has reduced the average size of fish caught. Large quantities of cod, plaice and especially haddock are discarded at sea because they are below commercial size. The sizes of cod and haddock landed have decreased as noted above in discussion of the relative quantities of commercial size categories.

The younger ages of cod now landed in Gloucester County, northern New Brunswick are shown in Figure 7. A similar reduction in average age of Banquereau cod may be seen in Figure 8. On the other hand, the cod fishery off western Nova Scotia has continued to depend on hook and line and no downward trend in ages of cod landed is apparent (Figure 9).

The haddock catch from Western Bank has been taken by otter trawlers during the period studied and no decrease in the average age of landed fish is apparent (Figure 8). Similarly the haddock fishery at Lockeport, N.S., has depended on hook and line fishing and a downward trend in ages of haddock has not been observed (Figure 9).

Growth

Growth rates of representative stocks of cod and haddock are shown in Figures 10-13.

Cod growth rates vary within Subarea 4; the fastest-growing cod are found off western Nova Scotia and the slowest-growing fish are in the Gulf of St. Lawrence. Percentage growth by weight for Banquereau cod approximates 36% from ages six to seven, 29% from ages seven to eight, 26% from ages eight to nine and 22% from ages nine to ten years.

Haddock growth rates within Subarea 4 are less variable than those of cod. Growth is intermediate between Georges Bank and the North Sea. Percentage growth by weight for Western Bank haddock approximates 83% from ages three to four, 44% from ages four to five, 39% from ages five to six and 26% from ages six to seven years.

Off Lockeport, N.S., cod reach "market" size (2.5lb. gutted) at four years and maturity (70 cm. or 6 lb. gutted) at seven years. Lockeport haddock grow more slowly, reaching "large" size (2.5 lb. gutted) at five years and maturity (45 cm. or 1.8 lb. gutted) at four years.

Mortalities

Average total mortalities may be determined from average age compositions of the type shown at the bottom of Figures 8 and 9. These data have been plotted on semilog scales to give total mortality rates (see Figure 14 and refer to Figure 5, Doc. 39, Third Annual Meeting, ICNAF).

Similar annual total mortality rates are found for Lockeport line-caught and Banquereau trawler-caught cod, namely 37 and 38%. In both populations, cod appear to be fully recruited at about 2½ lb. gutted weight (four years off Lockeport and six years on Banquereau).

Annual total mortality rates for haddock differ for Lockeport line samples (40%) and Western Bank otter-trawl spawning-concentration samples (52%). In both populations, haddock do not appear to be fully recruited until they reach six years of age (3-3½ lb. gutted weight). It is probable that haddock are fully recruited at a smaller size on some of the grounds of Subarea 4 where otter trawlers fish for scrod haddock.

Cod and haddock tagging has been carried out off western Nova Scotia in 1953 and off eastern Nova Scotia in 1954 in order to obtain information on fishing mortalities. Results of the 1953 tagging are summarized in Tables 4 and 5. Recaptures of cod have been high with 52 and 58% of the two most successful tag types returned up to September 15, 1954. Recaptures of haddock during the same period have been about 20% for the most successful types of tag. The high recovery of cod of all sizes tagged is apparent in Figure 15.

In the period of 11 months which elapsed since cessation of tagging, 34 and 39% of all possible disk-tagged cod left in the water were recovered. About 90% of these were taken in the tagging region (radius 40 miles). The results indicate that a high proportion of the total mortality is attributable to fishing.

Recaptures of haddock during the 11-month period following tagging were 12 and 16% of all possible disk-tagged haddock left in the water at the beginning of this period. During winter months, many of the recaptures were taken offshore, chiefly from LaHave and Browns Banks. The results indicate that at least half of the total mortality may be attributed to fishing. Since tagging mortality is believed to be higher with haddock than cod, the fishing mortality for Lockeport haddock may be well above 20%.

Can annual landings be increased?

A. Cod

Pertinent findings concerning Subarea 4 cod stocks may be summarized as follows:

1. North American landings increased following early war years when fishing effort was reduced and decreased following the post-war development of otter trawling;

2. Availability increased during war years and decreased during post-war period below pre-war level;

3. The decline in availability during post-war years was particularly apparent for "steak" cod (over eight pounds gutted weight);

4. Age studies show a post-war reduction in the proportion of older fish where otter trawling developed;

5. Market value is "nil" below 1-1½ lb. fresh-gutted weight and landed price more than doubles above 2½ lb. fresh-gutted weight;

6. Rate of growth by weight is greater than probable natural mortality rate, as measured by difference of total and fishing mortality rates, at least for scrod and small market size categories;

7. Size at first capture is only 1 lb. fresh-gutted weight.

It is accordingly predicted that cod landings can be increased in volume & landed value by reducing fishing intensity and/or increasing size at first capture. Regulatory action to achieve this goal should be developed by steps in order that effects on landings and changes in recruitment, growth, natural mortality, food and competing species may be assessed.

B. Haddock

The following observations concerning Canadian fishing for Subarea 4 haddock stocks are significant:

1. Otter trawling is more efficient than line fishing for small-mouthed haddock and landings have increased with conversion to dragging;

2. The proportion of scrod and small, round haddock in landings has increased since the war;

3. There is a large-scale wastage of baby haddock at sea by small-mesh otter trawls;

4. Landed value of "large" fish (over 2½ lb. gutted weight) is more than double that of "scrod";

5. Rate of growth by weight is greater than probable natural mortality rate, at least for scrod size category;

6. Size at first capture is only ½ lb. fresh-gutted weight.

It is accordingly predicted that haddock landings can be increased in volume and landed value by increasing size at first capture. As in the case of cod, regulatory measures should be introduced in stages in order that temporary decreases in landings may be avoided and predictions evaluated after each restriction on fishing.

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Table 1

Summary of 1952 and 1953
landings of principal species of groundfish
in Canada, excluding Newfoundland - by subarea

thousands pounds fresh

Subarea	Year	Cod[1]	Haddock[1]	Pollock[1]	Halibut[2]	Redfish[3]	Flounders[4]	Other Groundfish[5]	Total Groundfish
1 (Greenland)	1952	1,228	-	-	-	-	-	-	1,228
2 (Labrador)	1952	1,038	-	-	-	-	-	-	1,038
	1953	35	1	-	-	13	22	10	81
3 (Grand Banks)	1952	44,674	5,328	193	1,112	4,719	17,973	2,185	76,184
	1953	47,011	11,855	622	782	4,638	20,703	2,396	88,007
4 (Nova Scotia and Gulf of St. Lawrence)	1952	185,674	49,529	25,645	2,870	3,212	24,413	30,706	322,049
	1953	135,801	46,196	28,971	3,338	13,856	24,914	29,683	282,759
5 (New England)	1953	8	20	110	-	-	-	-	138
Total	1952	232,614	54,857	25,838	3,982	7,931	42,386	32,891	400,499
	1953	182,855	58,072	29,703	4,120	18,507	45,639	32,089	370,985

1. Head on, gutted. 2. Head off, gutted. 3. Round. 4. Head on, gutted - plaice (Hippoglossoides), round - yellowtail (Limanda), witch (Glyptocephalus) and winter flounder (Pseudopleuronectes).
5. Head on, gutted - catfish (Anarchichas), cusk (Brosme), hake (Urophycis) and skate (Raja).

Table 2

1953 Landings in Canada (excluding Newfoundland) from Subarea 4 by gear and subdivision

thousands pounds fresh gutted

Subdivisons	Cod				Haddock			
	Total	Otter Trawl	Dory Schooner	Inshore Mainly Line	Total	Otter Trawl	Dory Schooner	Inshore Mainly Line
4 R	65	65	-	-	31	31	-	-
4 S	12,959	-	-	12,959	-	-	-	-
4 T	57,137	20,881	-	36,256	8,488	8,172	-	316
4 V	23,161	4,453	5,907	12,801	6,404	3,221	403	2,780
4 W	18,889	5,381	2,768	10,740	16,908	11,807	1,216	3,885
4 X	23,590	306	714	22,570	14,365	2,401	662	11,302
4 Total	135,801	31,086	9,389	95,326	46,196	25,632	2,281	18,283
		31,086 22.9% by otter trawl		104,715 77.1% by line fishing		25,632 55.5% by otter trawl		20,564 44.5% by line fishing

Table 3

1953 Landings in Canada (excluding Newfoundland)

by fresh-fish size categories

Cod

Size Category	Size Range Gutted Weight	Approximate Length Range	Landings	1953 Price per lb. Lunenburg, N.S.
		cm.	'000 lb.	
Scrod	1-2½ lb. in. 1½-2½ lb. off.	37-51 43-51	4,026 or 9%	1-1½¢ (avg. 1¼)
Market	2½-10 lb. in 2½-8 lb. off.	52-82 52-77	40,257 or 91%	2½-3½¢ (avg. 3)
Steak	over 10 lb. in. over 8 lb. off.	over 82 over 77		2½-4½¢ (avg. 3)

Haddock

Small round	1-2 lb. off.	38-47	-	1¾¢ in fall, 1954
Scrod	1-2½ lb. in. 1½-2½ lb. off.	37-49 42-49	9,855 or 26%	2-3¼¢ (avg. 2½)
Large	over 2½ lb.	over 49	28,366 or 74%	4-5¾¢ (avg. 5)

Table 4

Recaptures of cod and haddock tagged in 1953 at Lockeport, N.S.

Type of tag	Number tagged	Number left in water Nov./53	Recoveries Nov./53 to Sept./54 (11 months following end of tagging) Number	% of possible tags in water	Total recoveries June/53 to Sept./54 (includes tagging period) Number	%
Cod						
Hydrostatic	933	773	138	18	298	32
Yellow disk	303	209	82	39	176	58
Red and white disk	305	225	77	34	157	52
Strap	263	244	46	19	65	25
Haddock						
Hydrostatic	276	268	34	13	42	15
Yellow disk	98	93	15	16	20	20
Red and White disk	87	82	10	12	15	17
Strap	119	118	15	13	16	13

Table 5

Distribution of recaptures from Lockeport.

Region	Cod 1953 No.	Cod 1953 %	Cod 1954 No.	Cod 1954 %	Haddock 1953 No.	Haddock 1953 %	Haddock 1954 No.	Haddock 1954 %
*Tagging area	427	94	216	88	27	90	23	40
East - along shore	21	5	6	2	1	3	7	12
West - along shore	1	0.5	2	1	1	3	-	-
Offshore Banks								
Banquereau	-		-		-		1	
Western	-		1		-		1	
Emerald	-		1		-		-	
Lahave	-		3	4	-	3	9	45
Browns	-		1		-		14	
Georges	-		3		1		1	
Cape Cod	-		1		-		-	
Unknown	1	0.5	12	5	-		2	3

*Tagging area considered synonomous with Subarea 0, extending about 40 miles east and west from the tagging center.

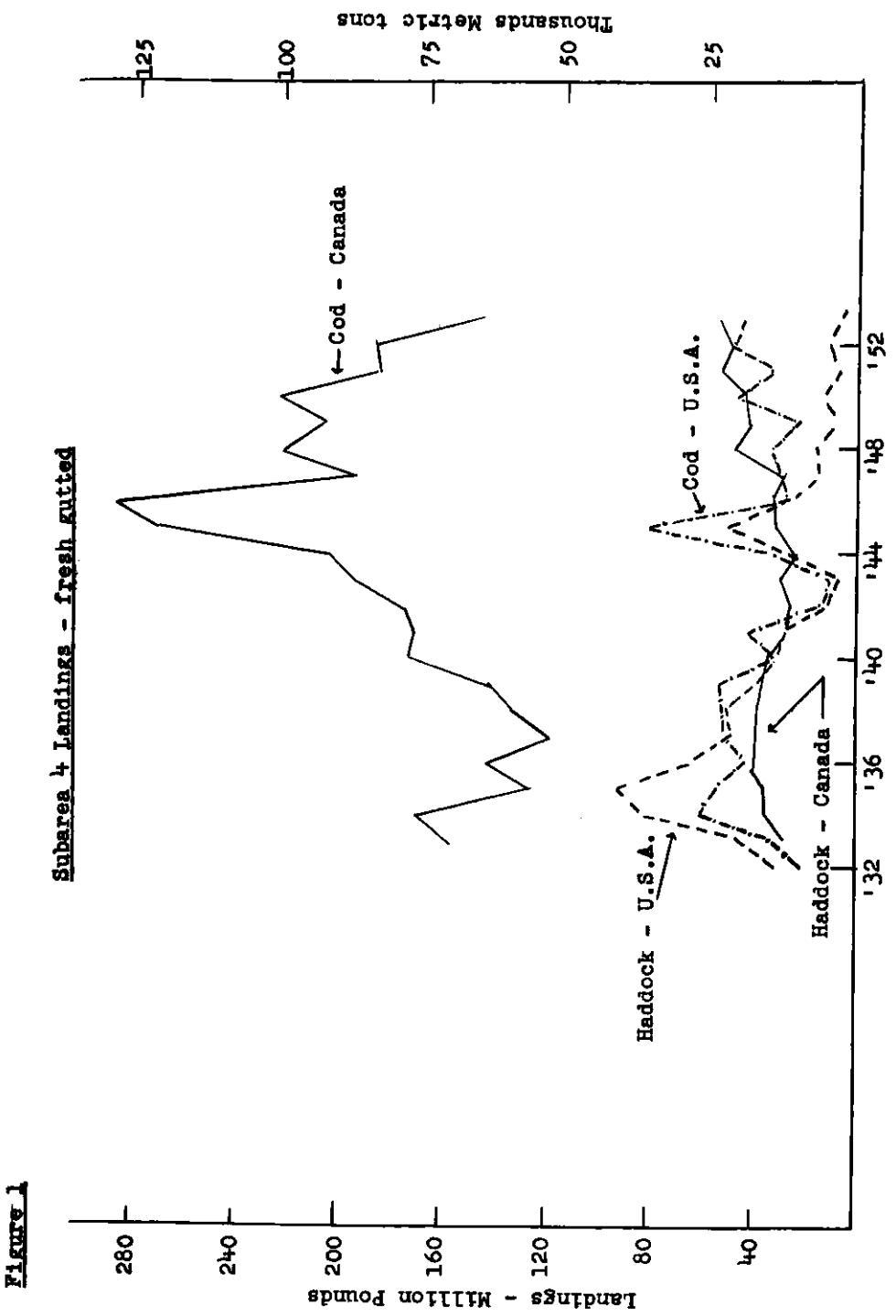

Subarea 4 Landings - fresh gutted
Landings - Million Pounds
Thousands Metric tons
280
240
200
160
120
80
40
125
100
75
50
25
'32
'36
'40
'44
'48
'52
Cod - Canada
Cod - U.S.A.
Haddock - Canada
Haddock - U.S.A.

Figure 1

Figure 2

Cod

Canadian Atlantic, excluding Newfoundland

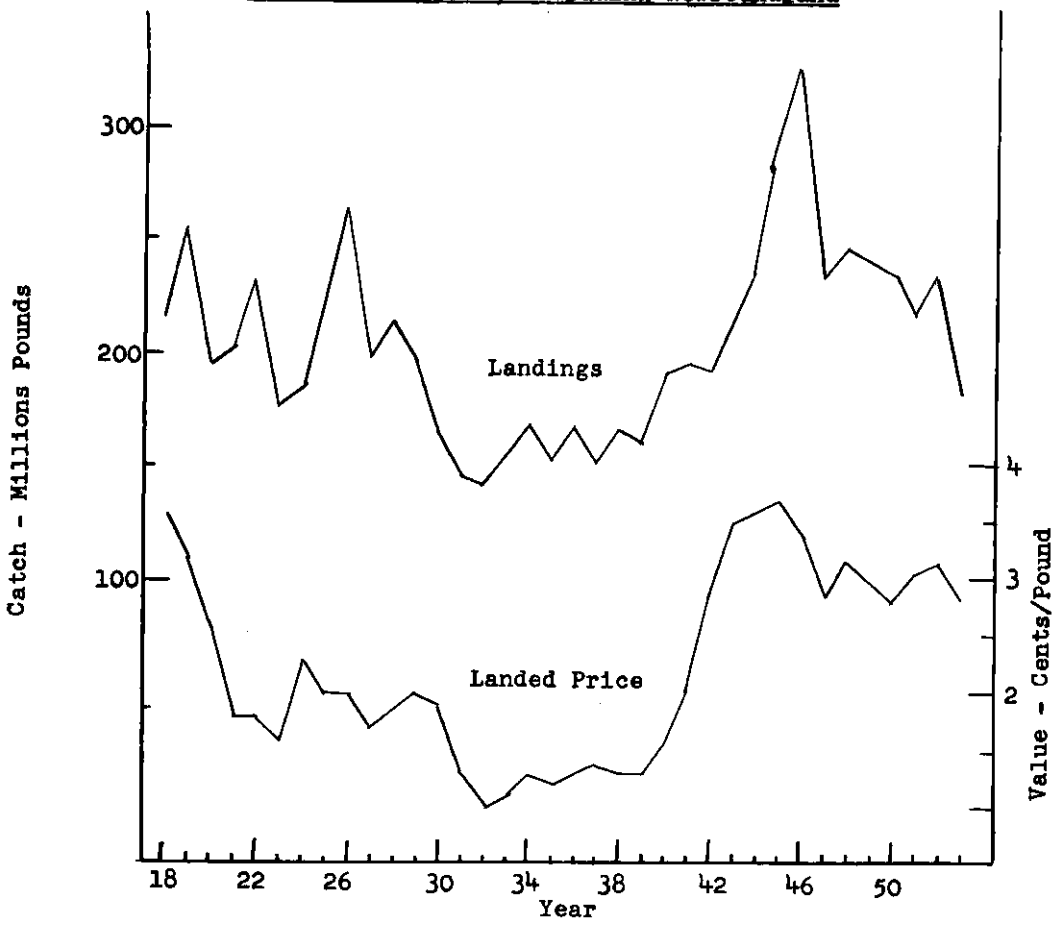


Figure 3

Canadian otter trawler landings from Subarea 4
in relation to total Canadian catch

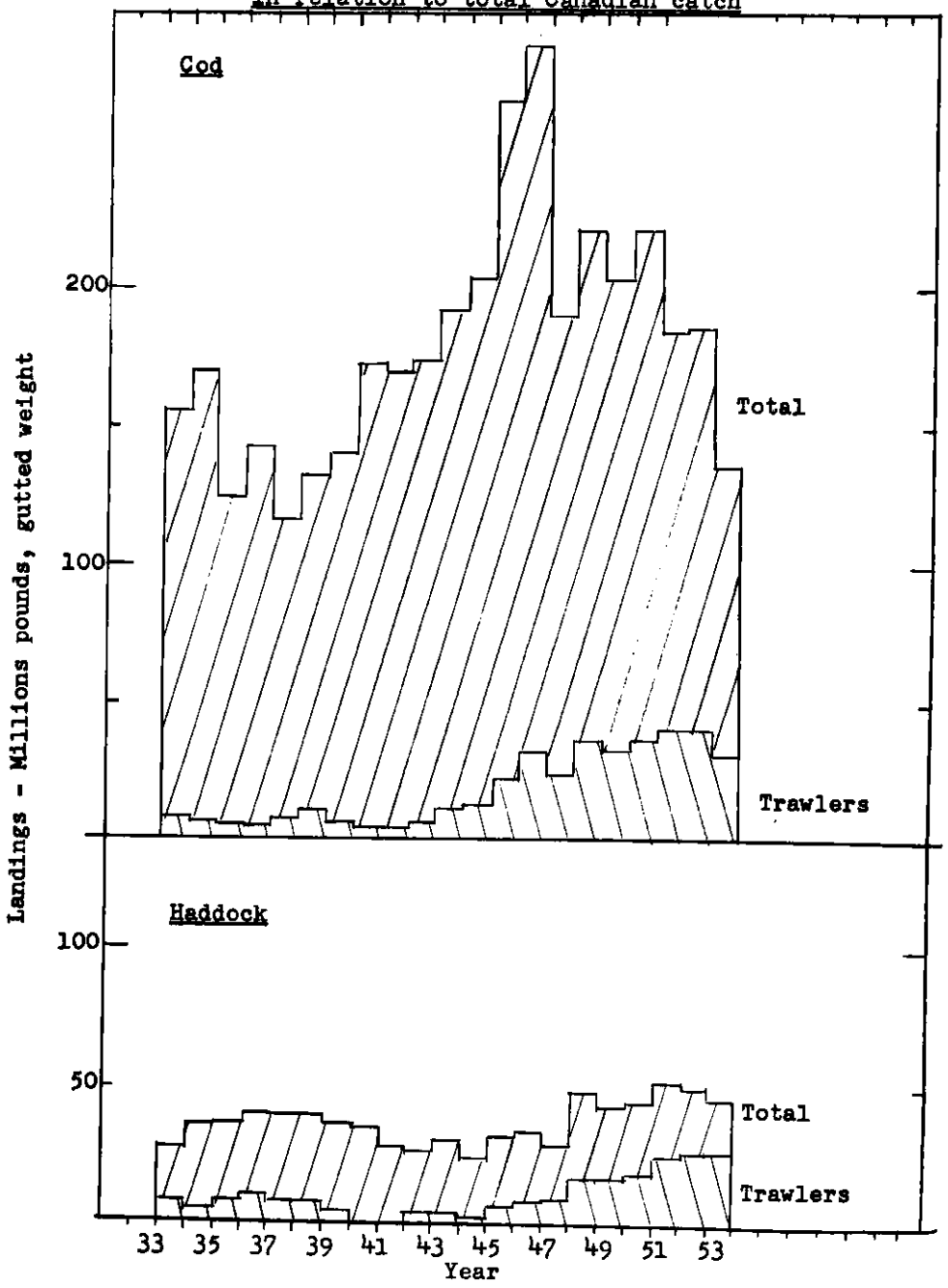


Figure 4

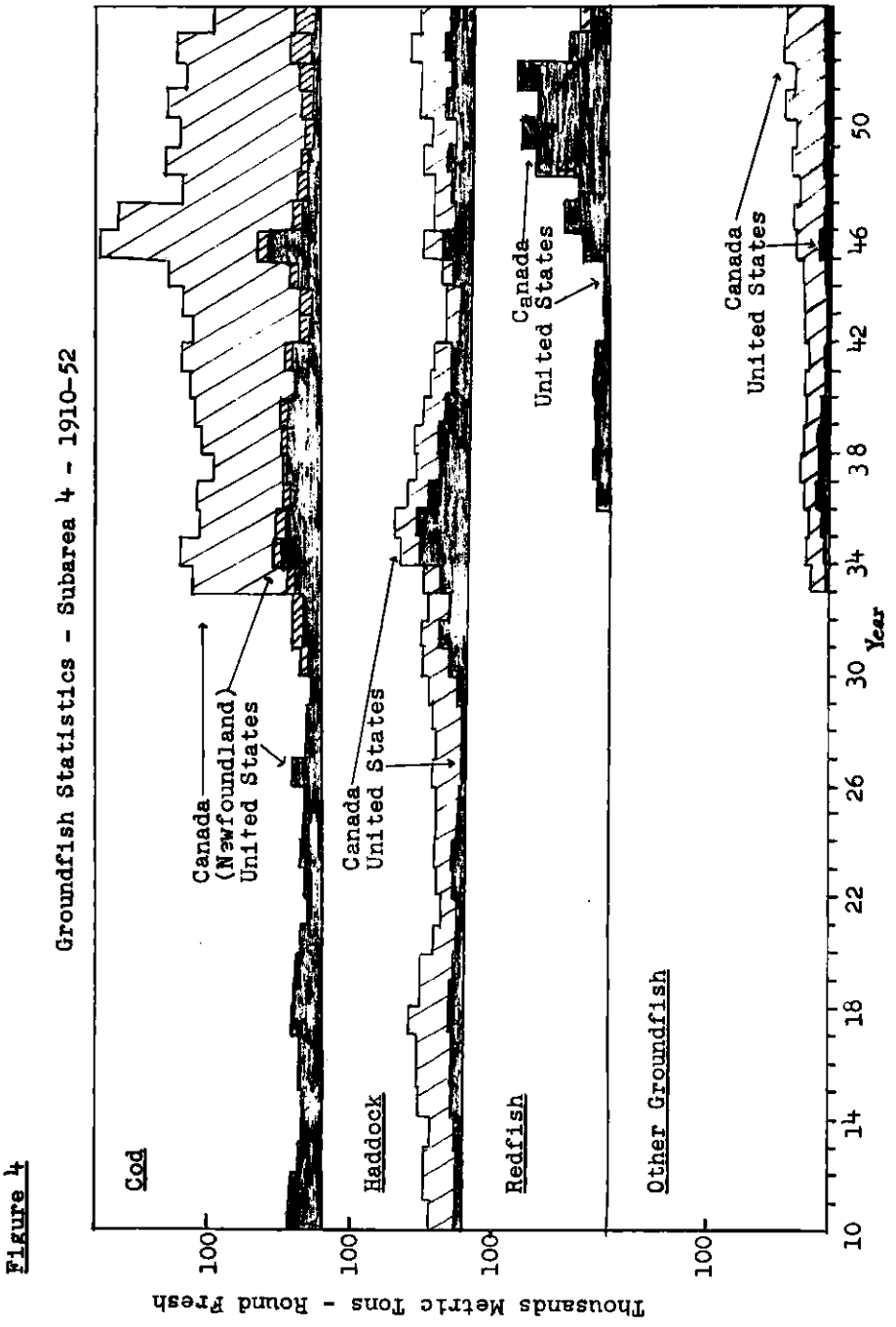

Groundfish Statistics - Subarea 4 - 1910-52
Thousands Metric Tons - Round Fresh
Cod
Haddock
Redfish
Other Groundfish
Canada
(Newfoundland)
United States
Canada
United States
Canada
United States
Canada
United States
100
100
100
100
10
14
18
22
26
30
34
38
42
46
50
Year

Figure 5 Abundance of groundfish in Subarea 4 as measured by landings per one-week fresh-fish trip

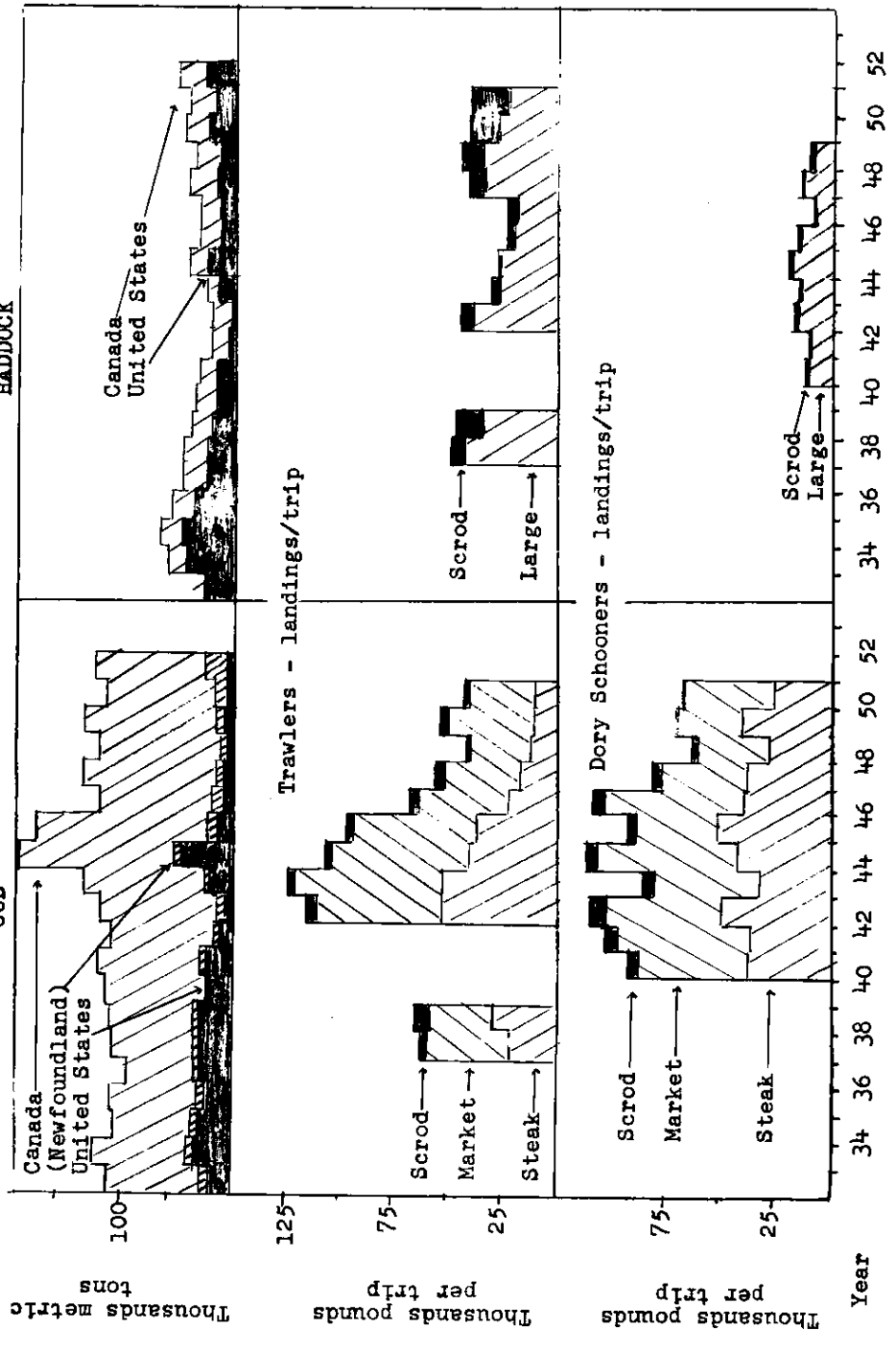
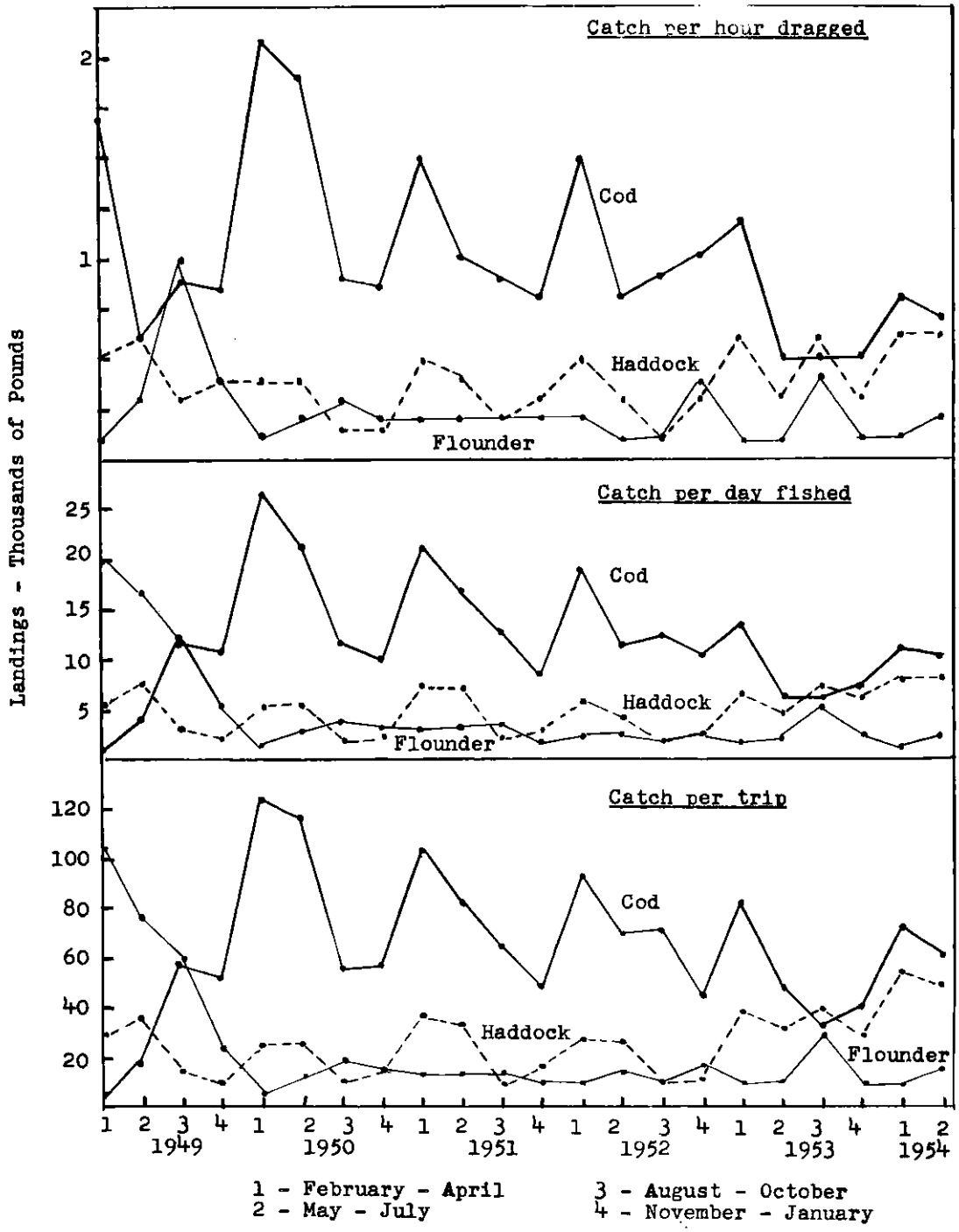


Figure 6

Abundance indices for cod trips (40% or more cod) by four large otter trawlers operating from Halifax on Nova Scotia banks



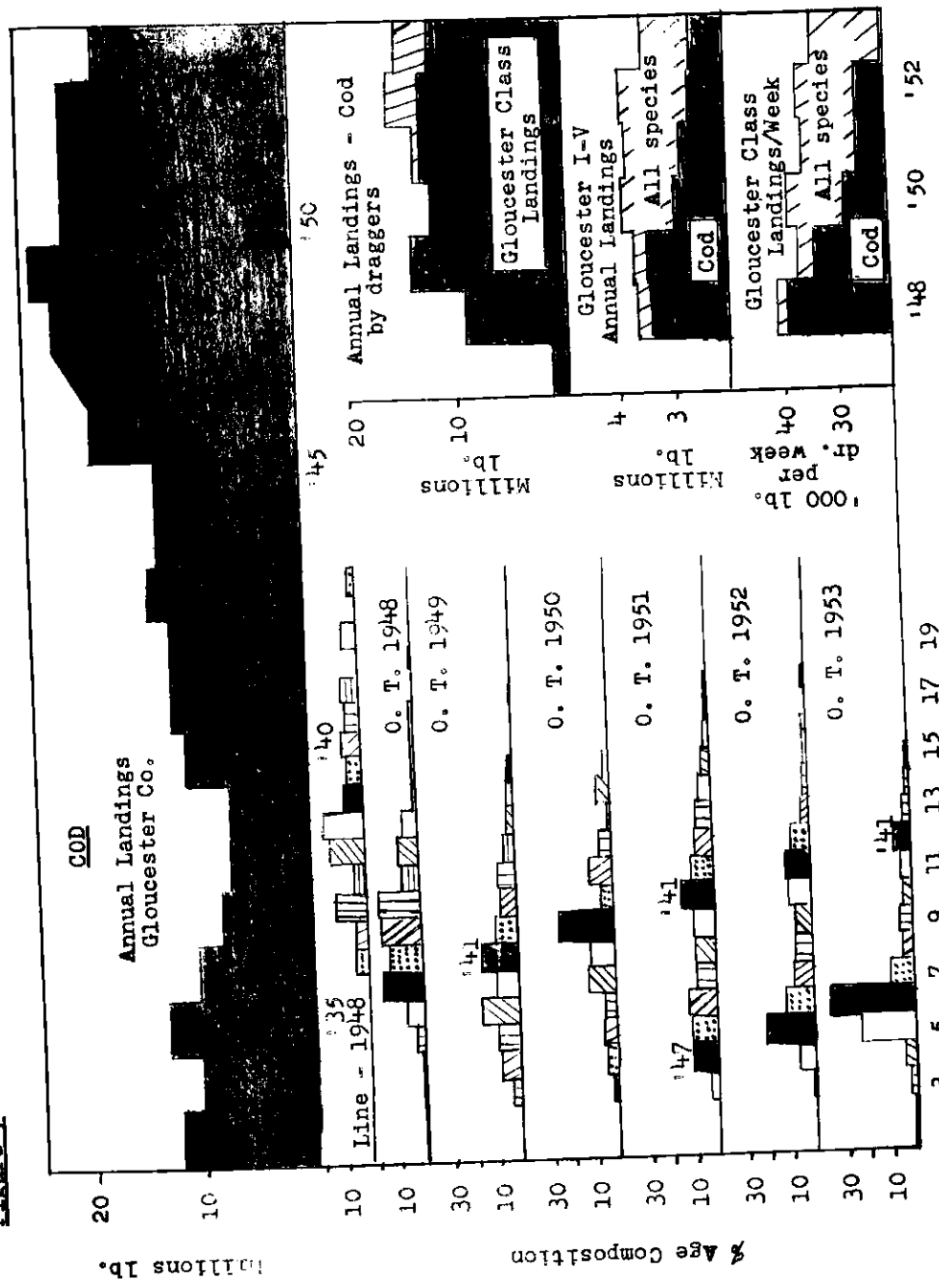

COD
Annual Landings
Gloucester Co.
Millions lb.
20
10
'35
'40
'45
'50
Line - 1948
O. T. 1948
O. T. 1949
O. T. 1950
O. T. 1951
O. T. 1952
O. T. 1953
'41
'47
'41
'41
% Age Composition
10
30
3 5 7 9 11 13 15 17 19
Annual Landings - Cod
by draggers
Gloucester Class
Landings
20
10
Millions
lb.
Gloucester I-V
Annual Landings
All species
Cod
4
3
Millions
lb.
Gloucester Class
Landings/Week
All species
Cod
'000 lb.
per
dr. week
40
30
'48
'50
'52

Figure 7

Figure 8

Percentage Age Composition of Otter-trawl Catches

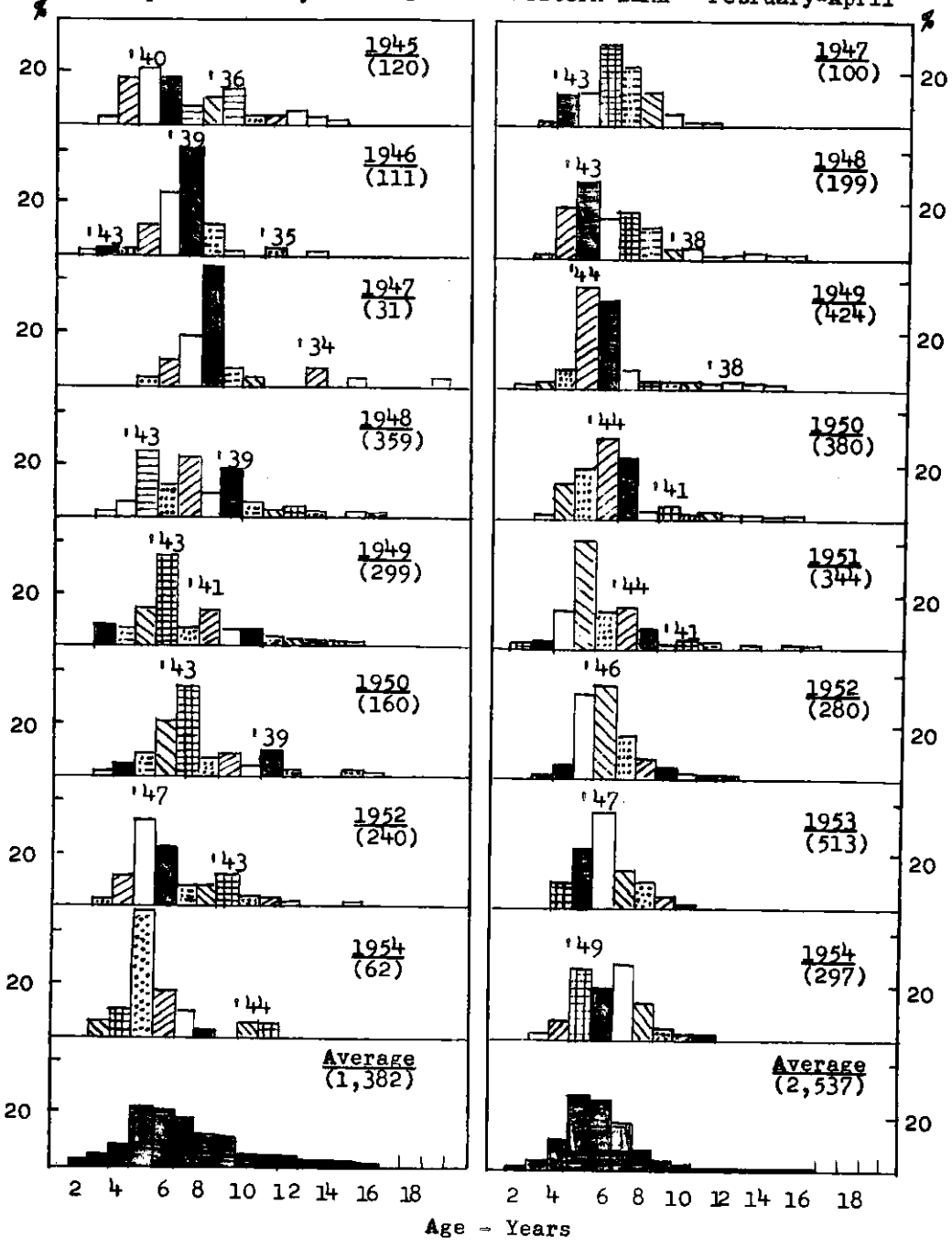


Figure 9

Variation in year-class strength and average age-composition as number landed per tub fished

Lockeport, LaHave and Roseway

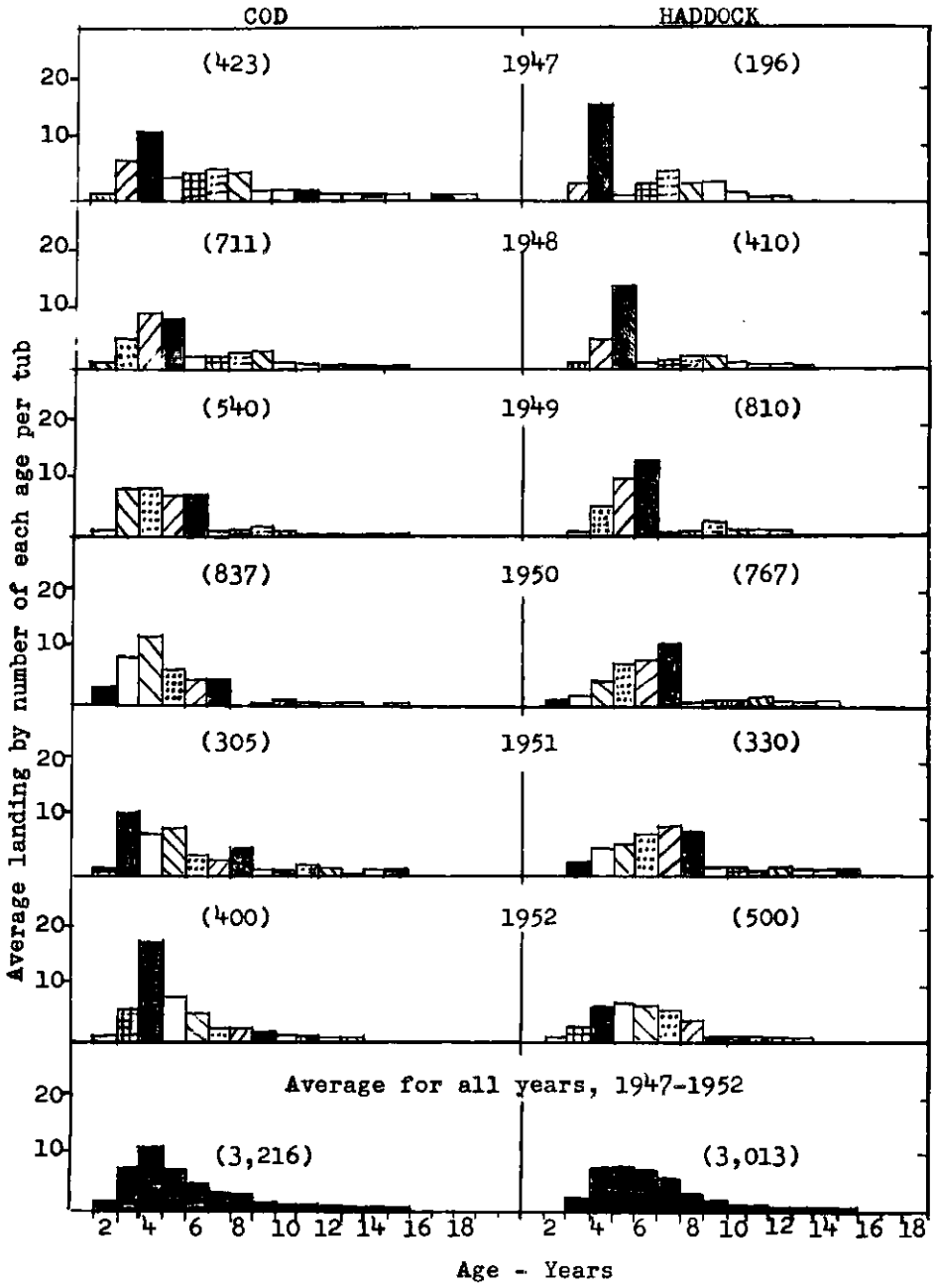


Figure 10

Growth Rate - Cod
(Feb.-April)

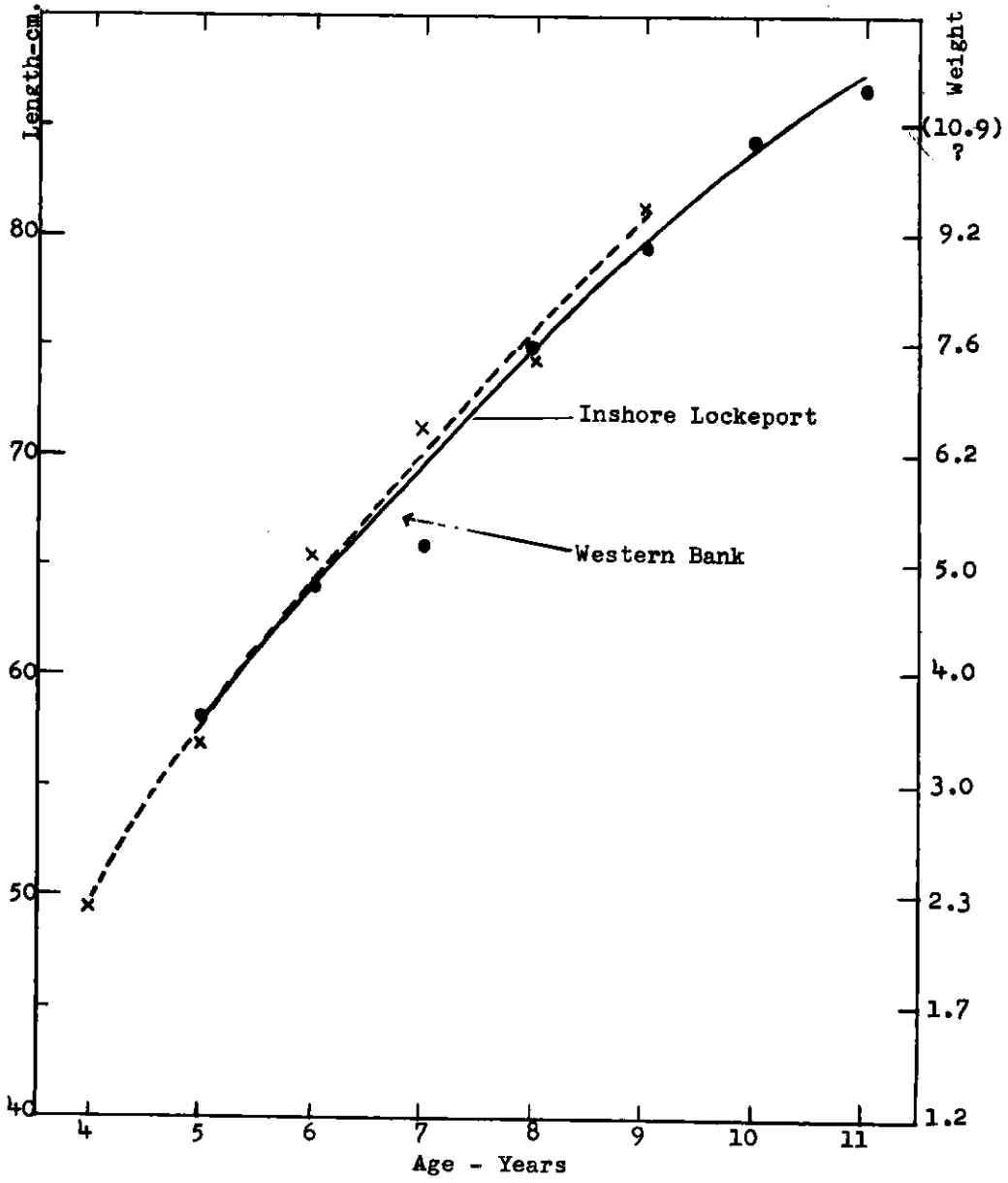


Figure 11

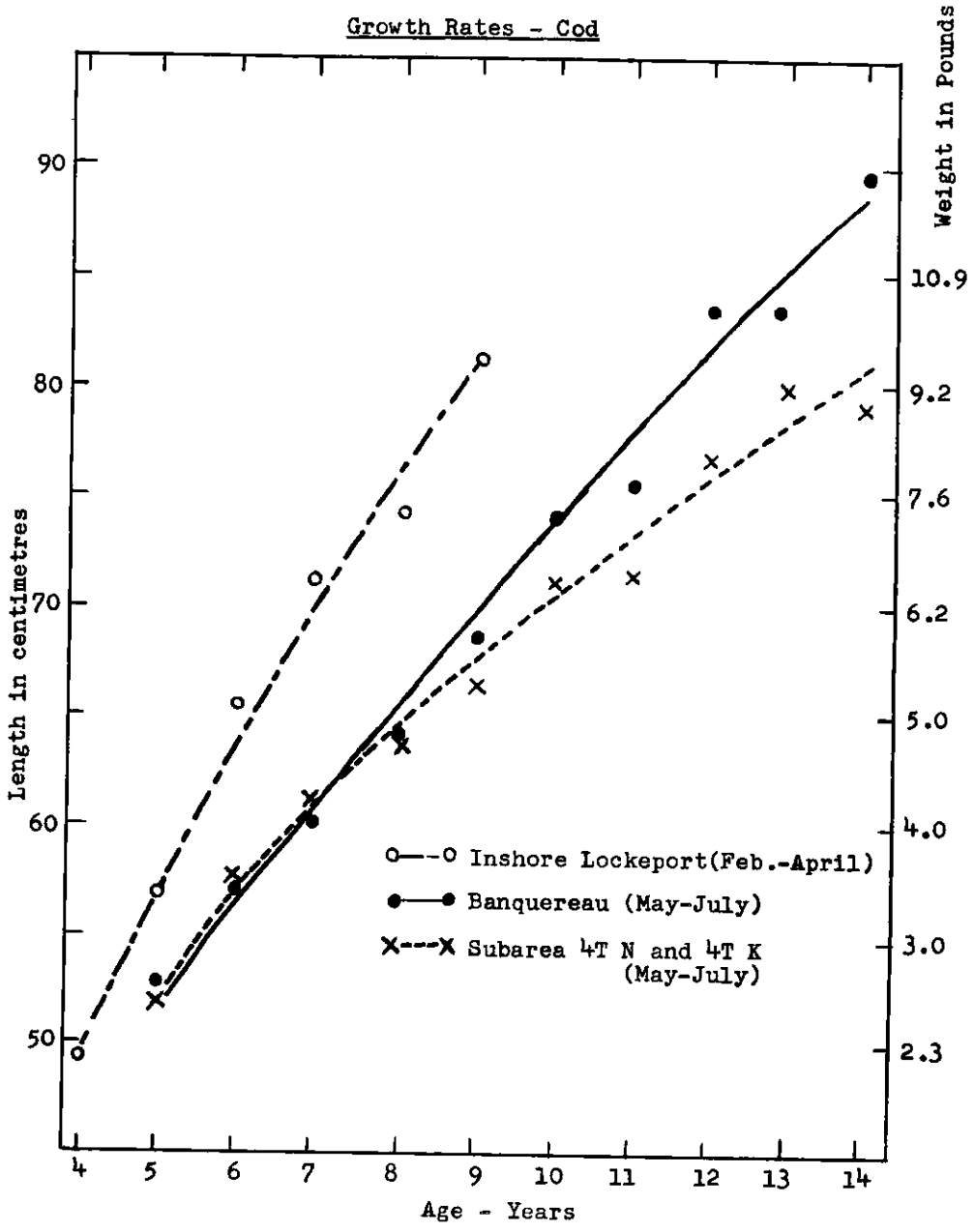

Growth Rates - Cod
Length in centimetres
Weight in Pounds
90
80
70
60
50
10.9
9.2
7.6
6.2
5.0
4.0
3.0
2.3
4
5
6
7
8
9
10
11
12
13
14
Age - Years
o—o Inshore Lockeport(Feb.-April)
●—● Banquereau (May-July)
×---× Subarea 4T N and 4T K (May-July)

Figure 12

Haddock Growth Rates

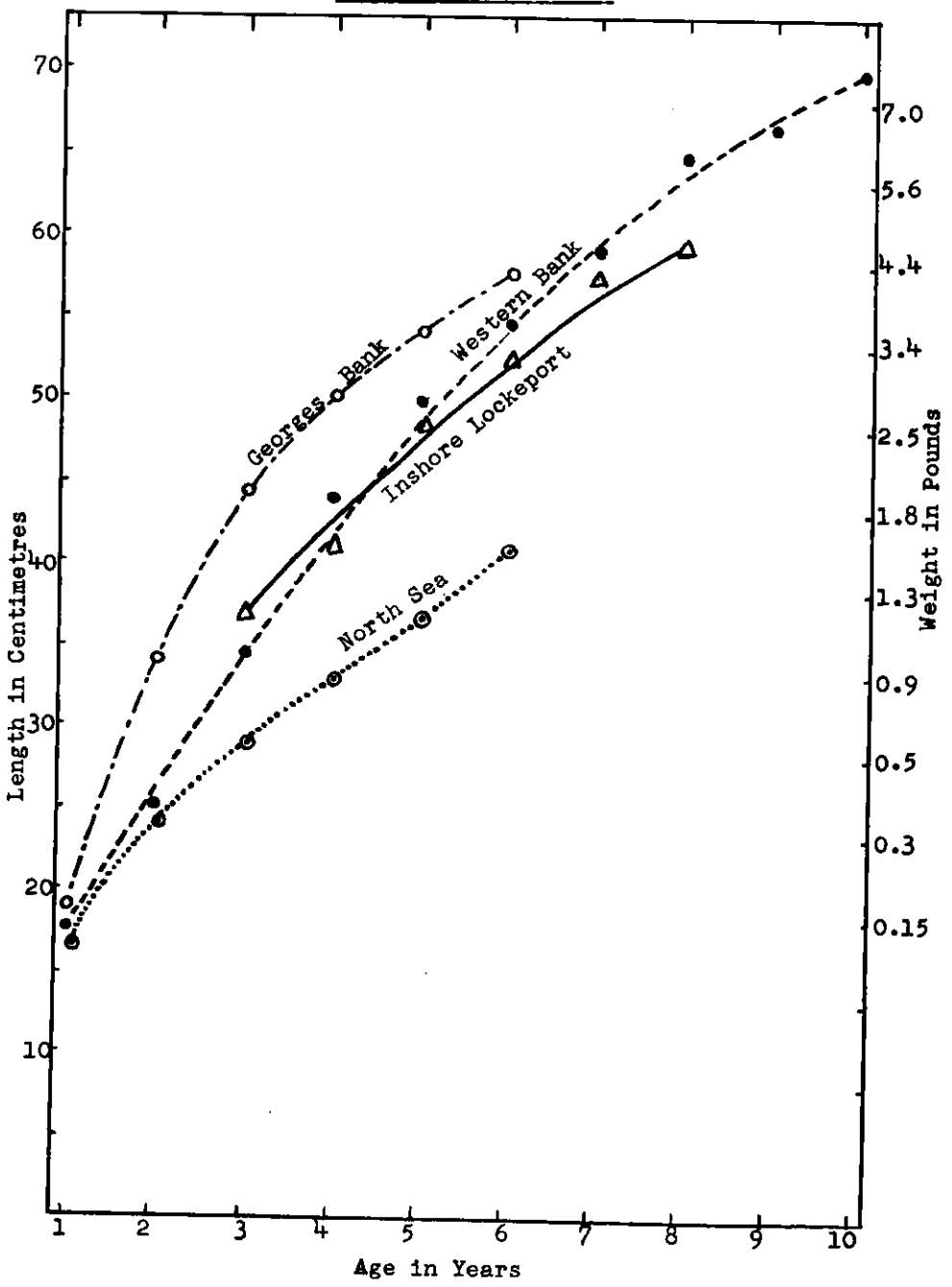


Figure 13

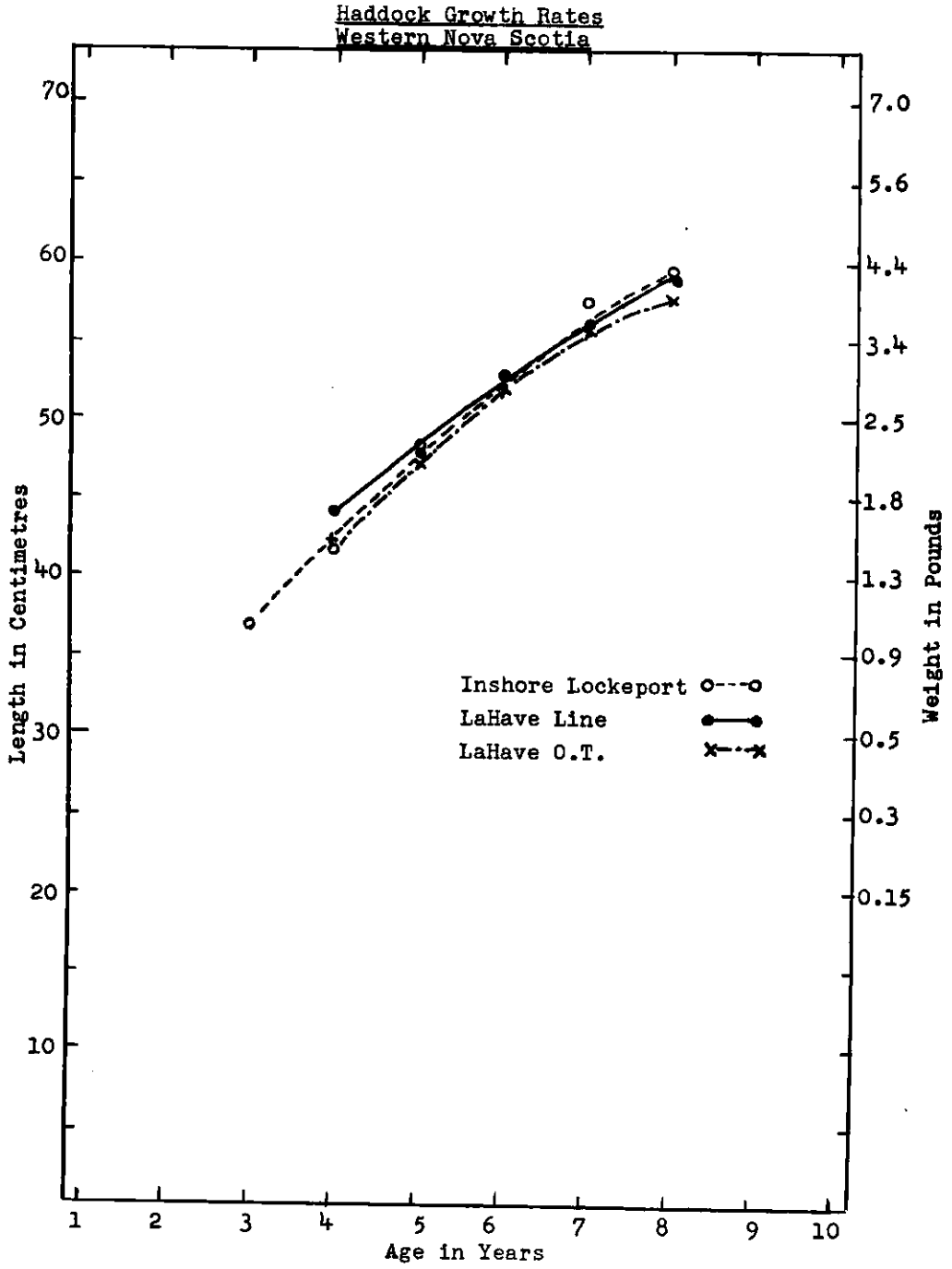
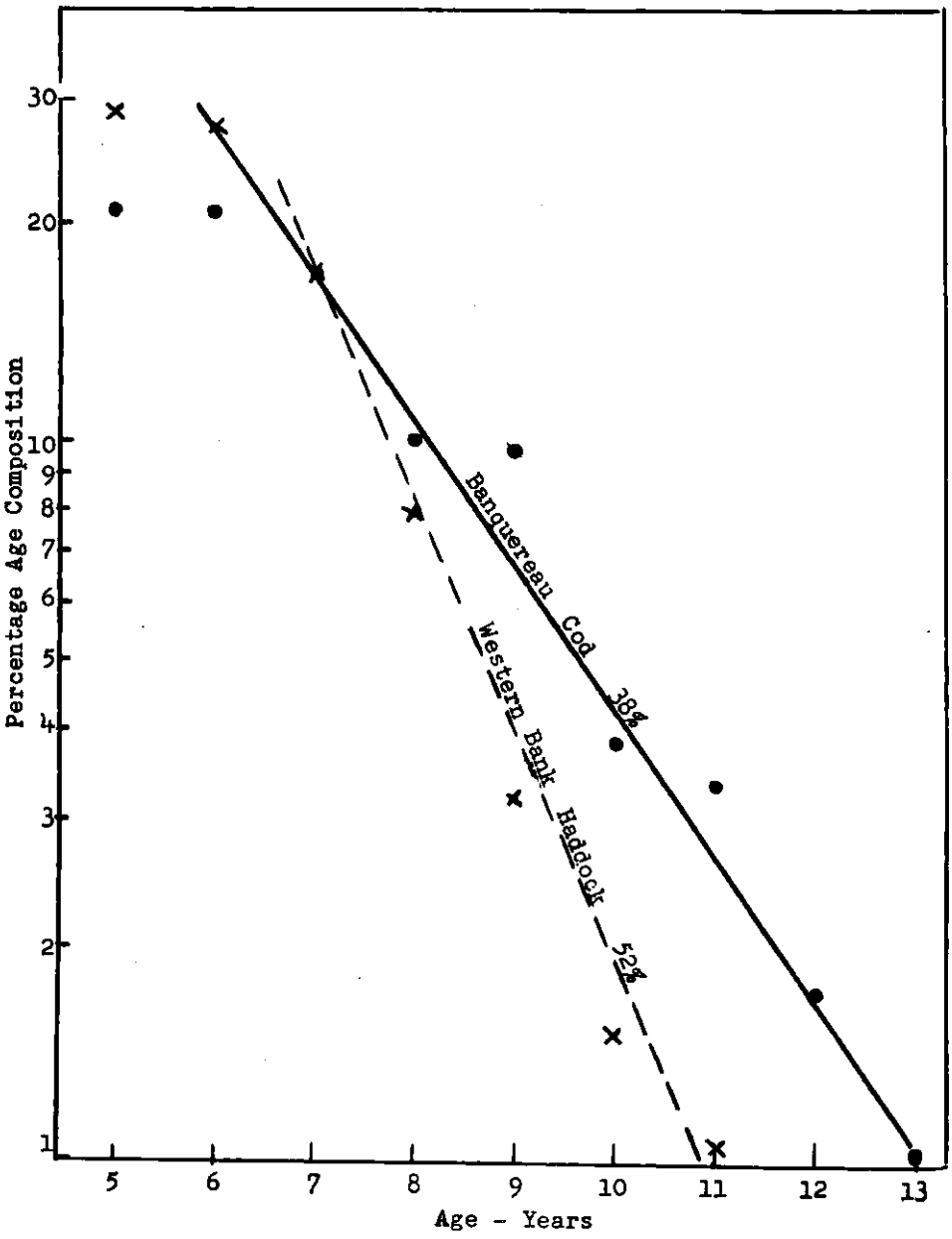

Haddock Growth Rates
Western Nova Scotia
Length in Centimetres
Weight in Pounds
Age in Years
Inshore Lockeport
LaHave Line
LaHave O.T.
70
60
50
40
30
20
10
7.0
5.6
4.4
3.4
2.5
1.8
1.3
0.9
0.5
0.3
0.15
1
2
3
4
5
6
7
8
9
10

Figure 14

Average Total Mortalities
Offshore cod and haddock - 1945-54



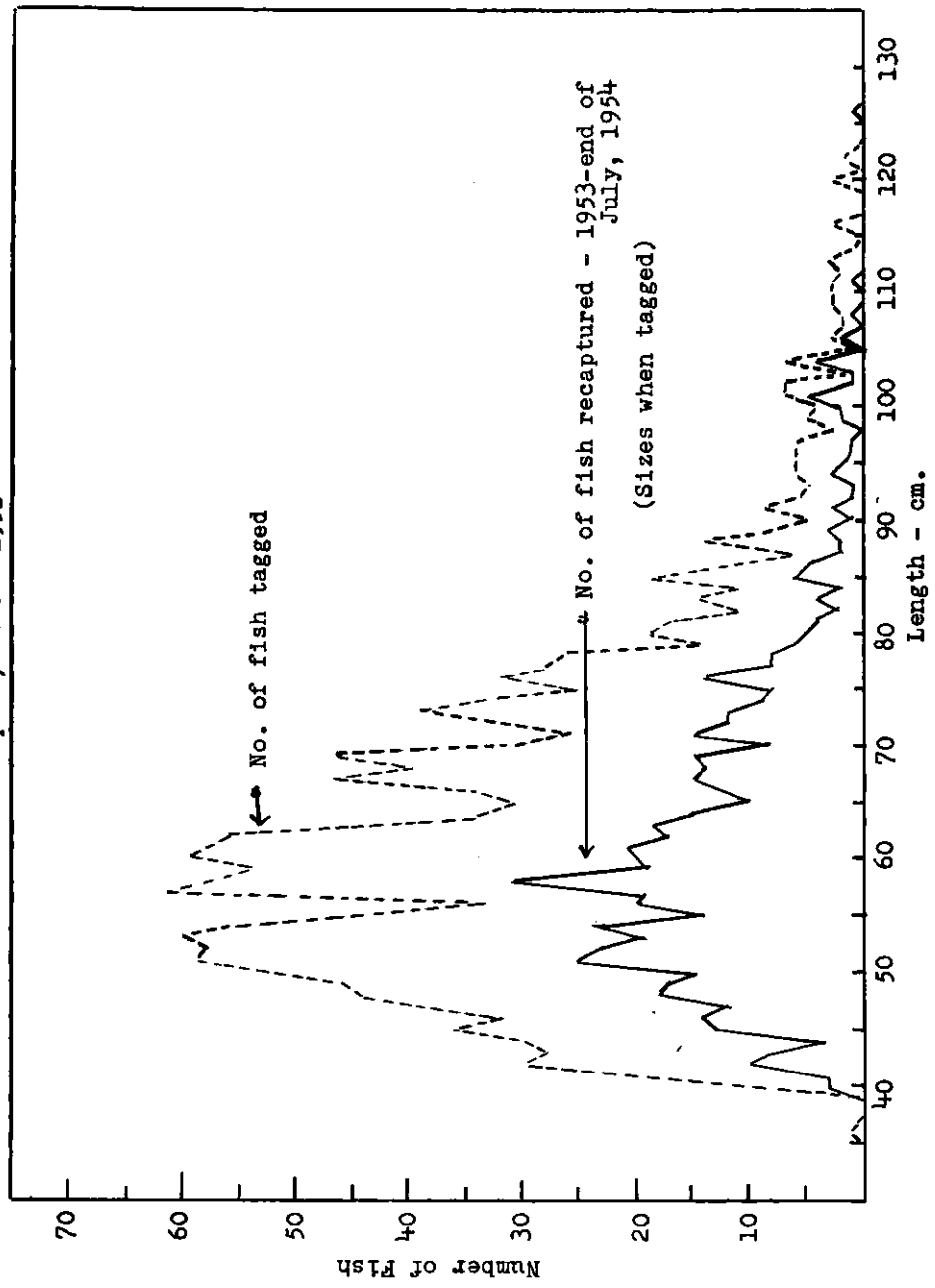

Cod Tagging Experiment
Lockeport, N.S. - 1953
No. of fish tagged
No. of fish recaptured - 1953-end of July, 1954
(Sizes when tagged)
Number of Fish
Length - cm.
10
20
30
40
50
60
70
40
50
60
70
80
90
100
110
120
130

Figure 15

Canadian Investigations of Subarea 4

Stocks of Cod and Haddock

B. Gear Selection in Relation to Sizes Caught and Landed

by F. D. McCracken

Sizes of Cod and Haddock Caught

The size of both cod and haddock caught varies in relation to gear, season, year and area fished. With present fishing practice, otter trawls catch many more small fish than hook and line and in general take much larger quantities of small haddock than small cod. From the offshore banks in Subarea 4, most of the haddock landed are taken by otter trawls. The size composition of their catch, from sampling at sea during 1951-53, is presented in Figure 1. In winter, only small quantities of haddock below the present minimum commerical size, about 42 cm., enter the catch. During the remainder of the year, the quantities of small haddock caught and discarded increase markedly. The number and size of these small haddock varies from bank to bank and from year to year, apparently in relation to recruitment and fishing practice. While the present gear can take appreciable quantities of haddock between 20-30 cm., it appears that during the period considered, haddock are first exploited at a length of about 30 cm. Samples of the landings corresponding with sampling at sea show that almost all haddock below 40 cm. are discarded along with considerable of haddock between 40 and 45 cm.

In the Gulf of St. Lawrence, otter trawling for haddock is a relatively recent development. Samples of the catch in the spring of 1953 and summer of 1954 show that practically all the haddock caught were of commercial size, Figures 1 and 2. Trawler operators in this region indicate that small haddock have not been abundant there since the inception of the fishery shortly after the last war.

In the coastal regions of Subarea 4, particularly off south-western Nova Scotia, the fishery for haddock is typically by hook and line. From the size composition of catches by hook and line off Lockeport, N.S., Figure 14, it is apparent that the hooks now used are effective in taking the larger scrod haddock but take relatively few small scrod and waste haddock compared to otter trawls.

On trips to offshore banks in Subarea 4 during the period 1951-54, in which observers measured samples of the otter-trawl catch, cod were never numerous below a size of about 46 cm. Wastage of small cod on the offshore banks appears to be much less than that of small haddock but there is evidence that on occasions large quantities of small cod are taken, particularly on Banquereau. During mesh experiments, in the southwestern Gulf of St. Lawrence, small cod were numerous on grounds fished for flounders and large cod, Figure 3. In this region, with present otter-trawl gear, cod would enter the catch in numbers between 20-30 cm. in length. Considerable wastage of small cod in other regions of the Gulf is also known to occur.

As pointed out in Section A, the hook and line fishery for cod is of major importance. The sizes of cod caught by hook and line off Lockeport, N.S., are illustrated in Figure 13. The hooks used take cod effectively in the scrod size range with some fish down to about 30 cm. The number of small cod caught and discarded in the hook and line fishery is greater than the number of small haddock caught and discarded with the same gear but is relatively small compared to the number of small haddock discarded in the offshore otter-trawl fishery

Sizes of Cod and Haddock Landed

Size categories, with a differential price structure and a minimum acceptable commercial size, are established for both cod and haddock, Table 3, Section A. The minimum size varies slightly according to region and in general inshore boats land both species down to smaller sizes than offshore boats. For haddock, the minimum acceptable size varies from about 37 cm. for inshore boats to 42 cm. for offshore boats, while for cod the same variation is from about 37 to 43 cm. The proportion of each size category landed varies in relation to area, gear, season and year.

Otter trawlers land a higher proportion of small scrod haddock than do hook and line fishermen, Figure 14, even when fishing in the same region. Seasonal changes in the proportion of small and large haddock landed by otter trawlers from offshore banks and variation between areas is illustrated in Figure 1. It is also apparent from these data that some haddock above the minimum acceptable size are discarded by culling at sea.

Long-term changes in the proportion of the different size categories of cod and haddock in the total landings of each species have been pointed out in Section A. Changes in the size composition of cod and haddock caught by hook and line and landed at Lockeport, N.S., in the period 1947-54 are illustrated in Figures 4 and 5. These changes appear to be related to recruitment and mortality rather than to differences in fishing practice.

Demand, particularly for haddock, has altered accepted landing practice at specific times. During 1954, haddock have been landed round from offshore banks at slightly smaller sizes than are usually acceptable. Some of these landed at Halifax, N.S., ranged from 36-48 cm. with a modal length of 42 cm. Sizes of fish available have also governed the sizes accepted in specific areas. For example, in St. Mary Bay, N.S., about half the haddock landings of small draggers in the years 1951-53 were fish 42 cm. and less in length.

In general, landings of cod and haddock from the hook and line fishery reflect closely the sizes caught but landings from the otter-trawl fishery often do not indicate the quantity of small fish caught.

Mesh Selection

At the present time, all the small and medium Canadian otter trawlers use trawls with cod-end meshes of from 2½ to 3¼ inches, inside diameter, wet and used. Large trawlers in the past used trawls with cod-end meshes of similar size but recently a number of the large otter trawlers have begun using cod-ends with a mesh size of about 4⅞ inches. This change has resulted from experiments with large mesh cod-ends carried out on commercial trawlers during the summer of 1953 (see circular letter attached).

Cod and Haddock

Experiments during 1953 and 1954 have compared the selective action of large-mesh manilla cod-ends for cod and haddock on large, medium and small otter trawlers. During 1954, experiments also included other species and cotton cod-ends. The 50% selection points for haddock obtained in covered-net trials with cod-ends of various mesh sizes are presented in Figure 6. Results for cod in similar trials are presented in Figure 7. The selection points for

both cod and haddock follow closely the regression formula developed by Beverton and Holt describing the relation between 50% selection point for haddock and internal mesh size. No differences related to the size of trawl are apparent. In general, with manilla cod-ends the 50% selection points for both species tend to be less than those described by the formula. With cotton cod-ends, the points lie above the selection line. Comparative tows for haddock, presented in Figure 8, gave results similar to those of the covered cod-end trials.

The effects of using a 4½ inch mesh manilla cod-end, similar to that of the Subarea 5 regulation, on the catch and landings of haddock from Subarea 4 by season and region are presented in Figures 2, 9 and 10. In the winter of 1953 on Western Bank, the use of such a mesh would have released scarcely any haddock and would have had practically no effect on landings. Similarly, in the Gulf of St. Lawrence the effect would be negligible. In the summer of 1953, however, such a mesh size would have released considerable quantities of fish now discarded with scarcely any effect on those landed.

Other Species

Since the Canadian fishery in Subarea 4 takes a variety of species other than cod and haddock, it is important to know how increased mesh size would affect landings of other species. In mesh trials during the summer of 1954, witch, hake, yellowtail, winter flounder and plaice were caught. For plaice, the 50% selection points are presented in Figure 11. They lie much below those of cod and haddock and even with a 5 inch mesh manilla cod-end, none of commercial size were released, Figure 3. Small fish in the other species were virtually absent and 50% selection points were not obtained. Sufficient data were obtained for the winter flounder to show that a 4½ inch mesh would release scarcely any fish of acceptable commercial size, Figure 3. From the data obtained, it appears that increasing mesh size even up to 5 inches would release few commercial-sized fish of these species.

Redfish were virtually absent from the catches in all mesh trials. It seems probable, however, that the large-mesh cod-ends considered would be too large for fishing redfish. A consideration of the discreteness of the redfish fishery is thus essential. Table 1 presents information on the quantities of redfish landed, incidental to the fishery for other groundfish species.

Table 1

Quantities of redfish landed in mixed groundfish trips by trawlers over 50 gross tons - Jan. 1 - Sep. 30, 1954

Port	Redfish '000 lb.	Total Catch '000 lb.	Trips	No. of Craft
Halifax	555	46,977	345	18
Lunenburg	375	23,745	159	11
Louisburg	570	9,791	68	12
	1,500	80,513	572	

Redfish landed incidental to other groundfish species made up only about 2% of the total landings. Loss of incidental redfish landings would thus have little effect on total catch of redfish.

Use of "Chafing Gear"

The mesh regulation introduced in Subarea 5 specifies that no device shall be used to obstruct the mesh openings in any part of the trawl except on the underside of the cod-end. Canadian fishing practice includes a covering over the upper end of the cod-end bag to prevent chafing of the bag against the side of the vessel. This cover is usually a piece of old cod-end. Those large trawlers which have adopted a large mesh cod-end voluntarily still retain the chafing gear. Samples of their catch indicate, in some instances, that the chafing gear has had a marked effect on the release of small fish. In other instances, it apparently has had little effect. Whether or not it affects the release of small fish is probably related to the manner of attachment and to the size of mesh of the chafing gear. The effect of such chafing gear requires further study.

Hook Selection

Various sizes of hooks are used in the fishery for cod and haddock depending upon local circumstances. Hook selection experiments, carried out off Lockeport, N.S., in 1954, show that these hooks take very different sizes of cod and haddock and that, as might be expected, larger hooks take fewer small fish.

Of four hook sizes used, the #17, #14 and #11 Mustad hooks are shown in Figure 12. The #15 hook, not shown, lies between the #17 and #14 in size. Results of these hook experiments are presented in Figure 13 for cod and Figure 14 for haddock.

The #17 hook is comparable to the hooks used in the fishery off Lockeport where haddock make up an important part of the catch. This hook catches some haddock and cod below acceptable commercial size and appears to catch more small cod than small haddock. This hook is effective in taking scrod sizes of both cod and haddock although some selection seems to occur up to about 49 cm. Available data suggest that the selection with #17 hook is close to that of a 4½ inch mesh, possibly approximating a slightly smaller mesh for cod and a slightly larger mesh for haddock.

The #11 hook, used for handlining and approximating the size of a halibut hook, caught practically no haddock and only in the largest sizes of cod equalled the catch of the #17 hook. The #14 hook, used extensively where hooks are baited while setting, caught fewer haddock at all sizes than the #17 hook. It caught fewer cod than the #17 hook up to about 70 cm. but actually surpassed the #17 hook in the weight of cod taken since more large cod were caught. Catches with the #15 hook approximated those of the #17 hook, with some suggestion of selection in the smallest sizes.

It appears then that if mesh size were increased to 4½ inches in Subarea 4, the smallest hook used would approximate the selection to be obtained by this increase in mesh size. Further increase in mesh size would necessitate a consideration of increasing the minimum hook size as well. An increase in hook size, at least with hooks now available, presents problems in operation of the gear. With small hooks, fish are easily removed when they are brought aboard; large hooks increase the effort necessary for this operation. The effect on efficiency and fishing practice must be carefully considered before advocating any increase in hook size.

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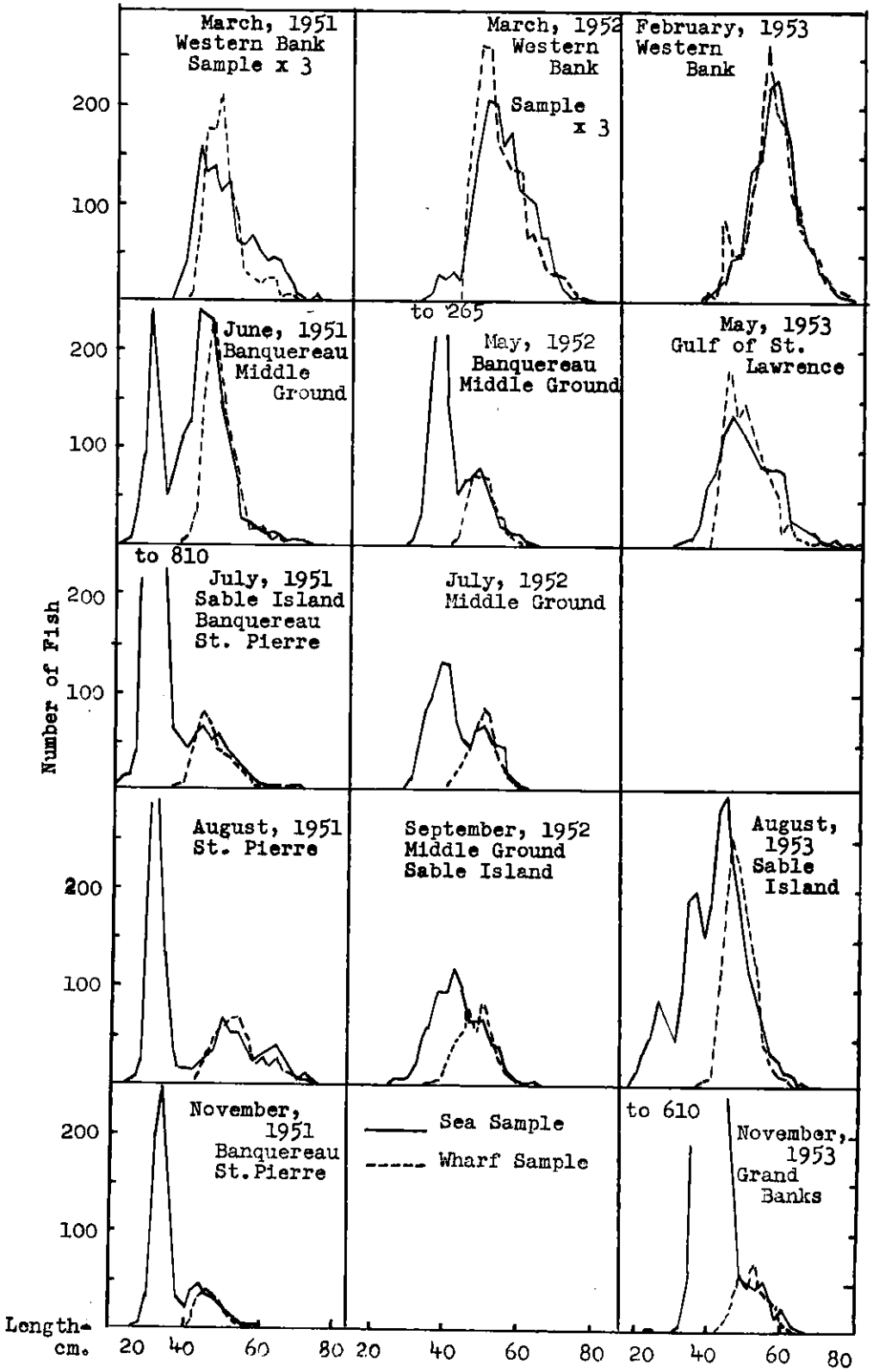
Figure 1 Haddock discarded at sea by Nova Scotian trawlers



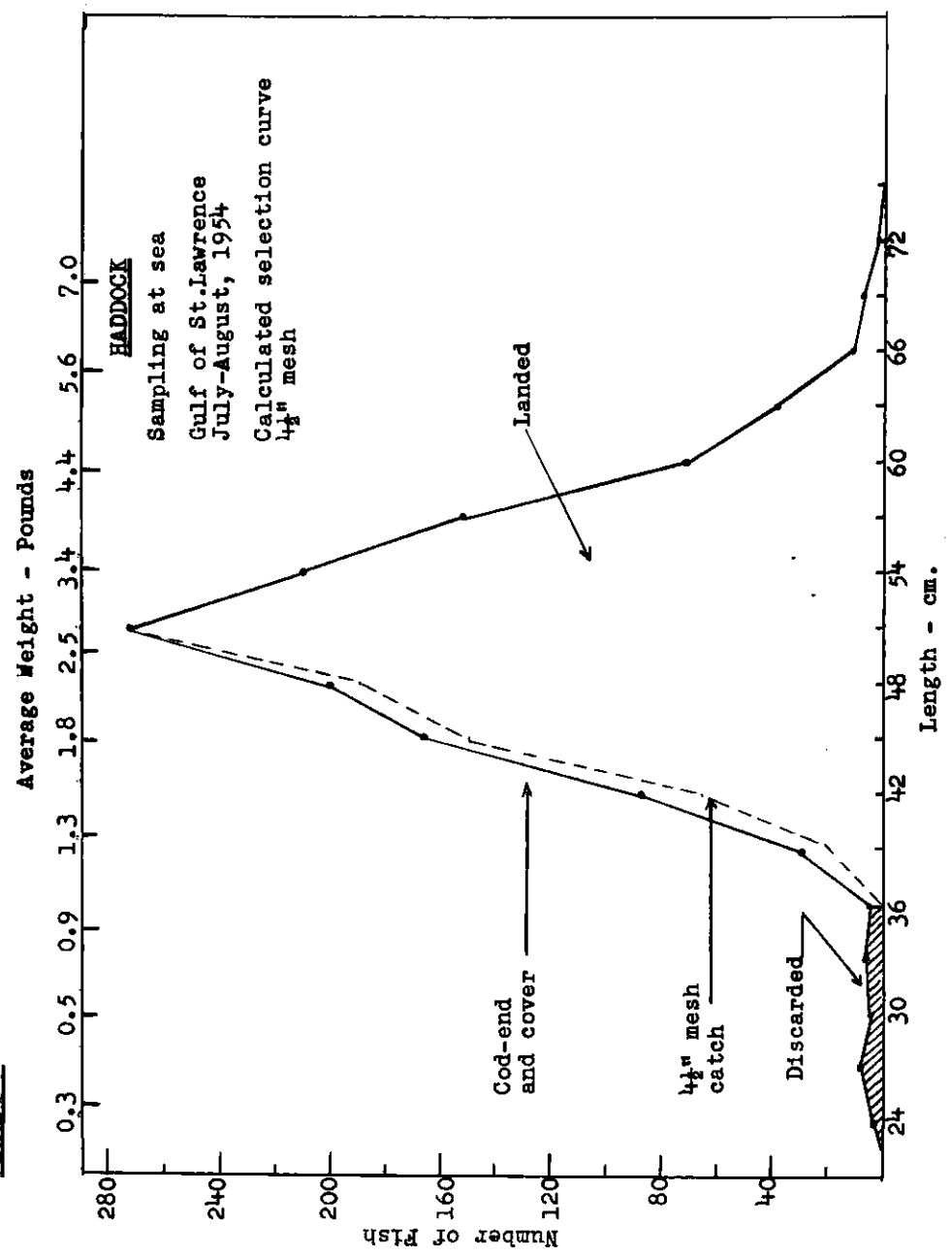

HADDOCK
Sampling at sea
Gulf of St.Lawrence
July-August, 1954
Calculated selection curve
4½" mesh
Landed
Cod-end
and cover
4½" mesh
catch
Discarded
Average Weight - Pounds
0.3
0.5
0.9
1.3
1.8
2.5
3.4
4.4
5.6
7.0
Number of Fish
280
240
200
160
120
80
40
Length - cm.
24
30
36
42
48
54
60
66
72

Figure 2

Figure 3

Typical length composition of haddock, cod, plaice and winter flounder taken in the southeastern Gulf of St.Lawrence in 1954 showing release of small fish with various mesh sizes

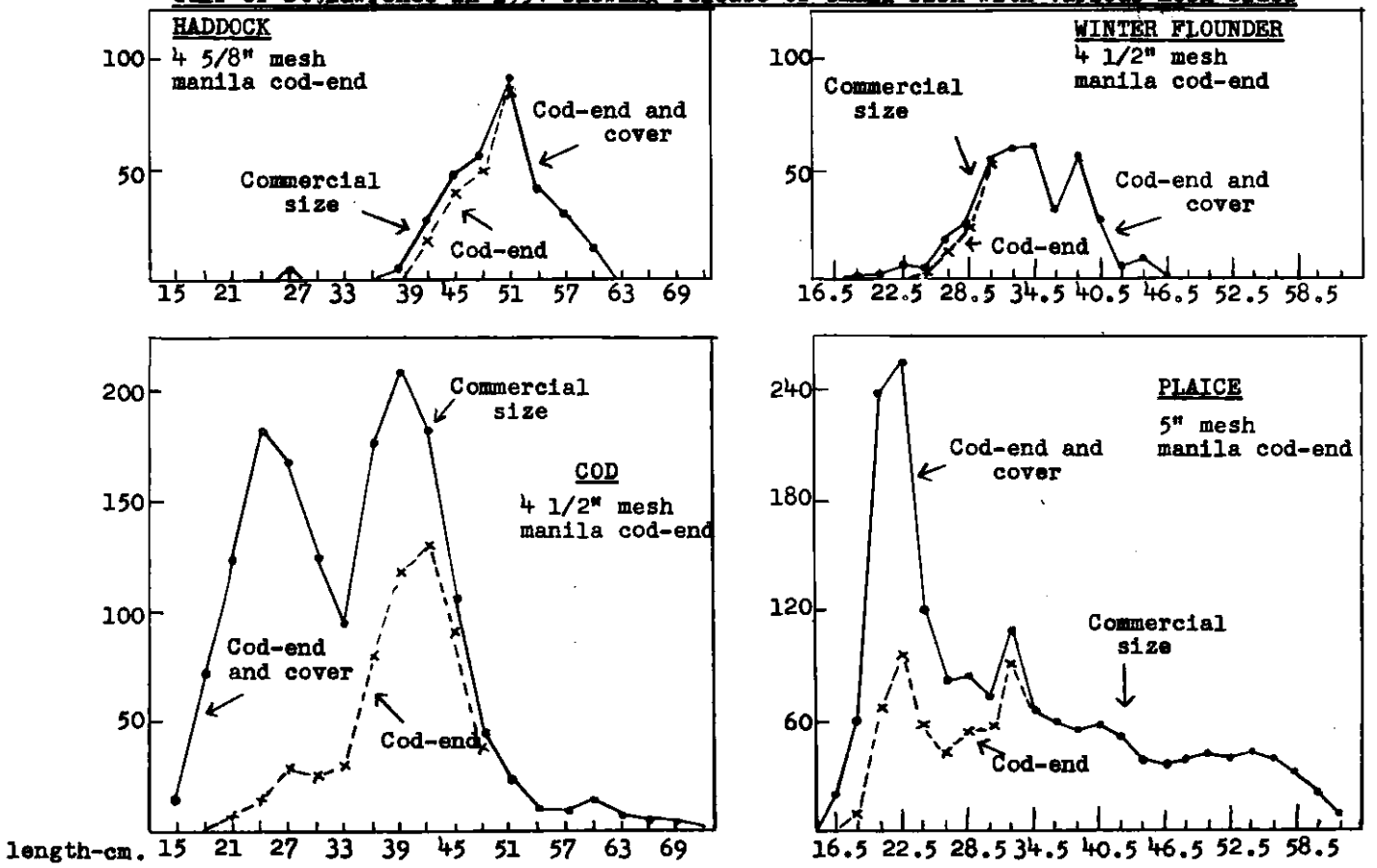


Figure 4

Percentage length composition of cod landings at Lockeport, N.S.

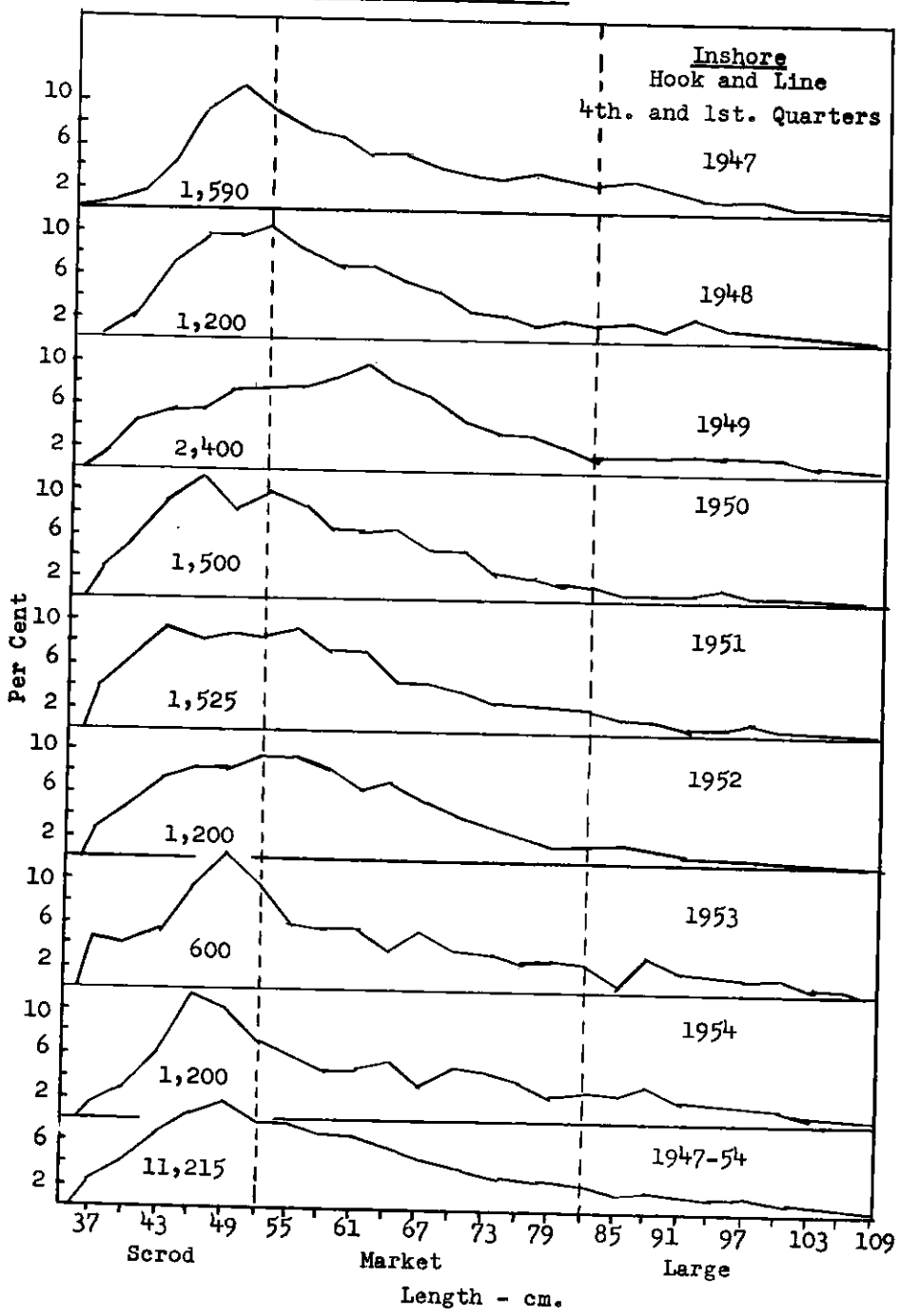


Figure 5

Percentage Length Composition of Haddock Landings at Lockeport, N.S.

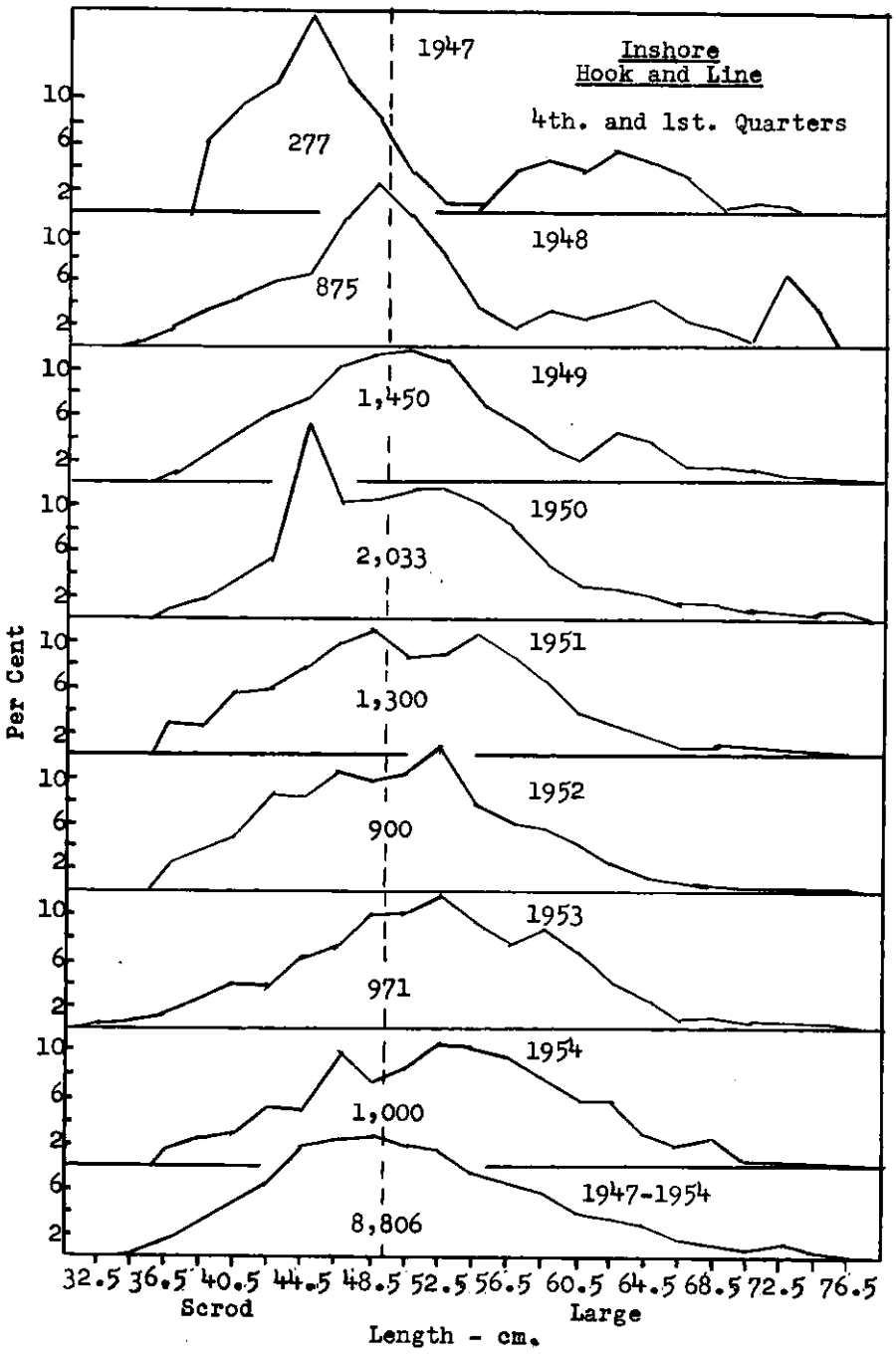


Figure 6

Fifty per cent Selection Points for Haddock in Relation to Material and Internal Mesh Size of Cod-end

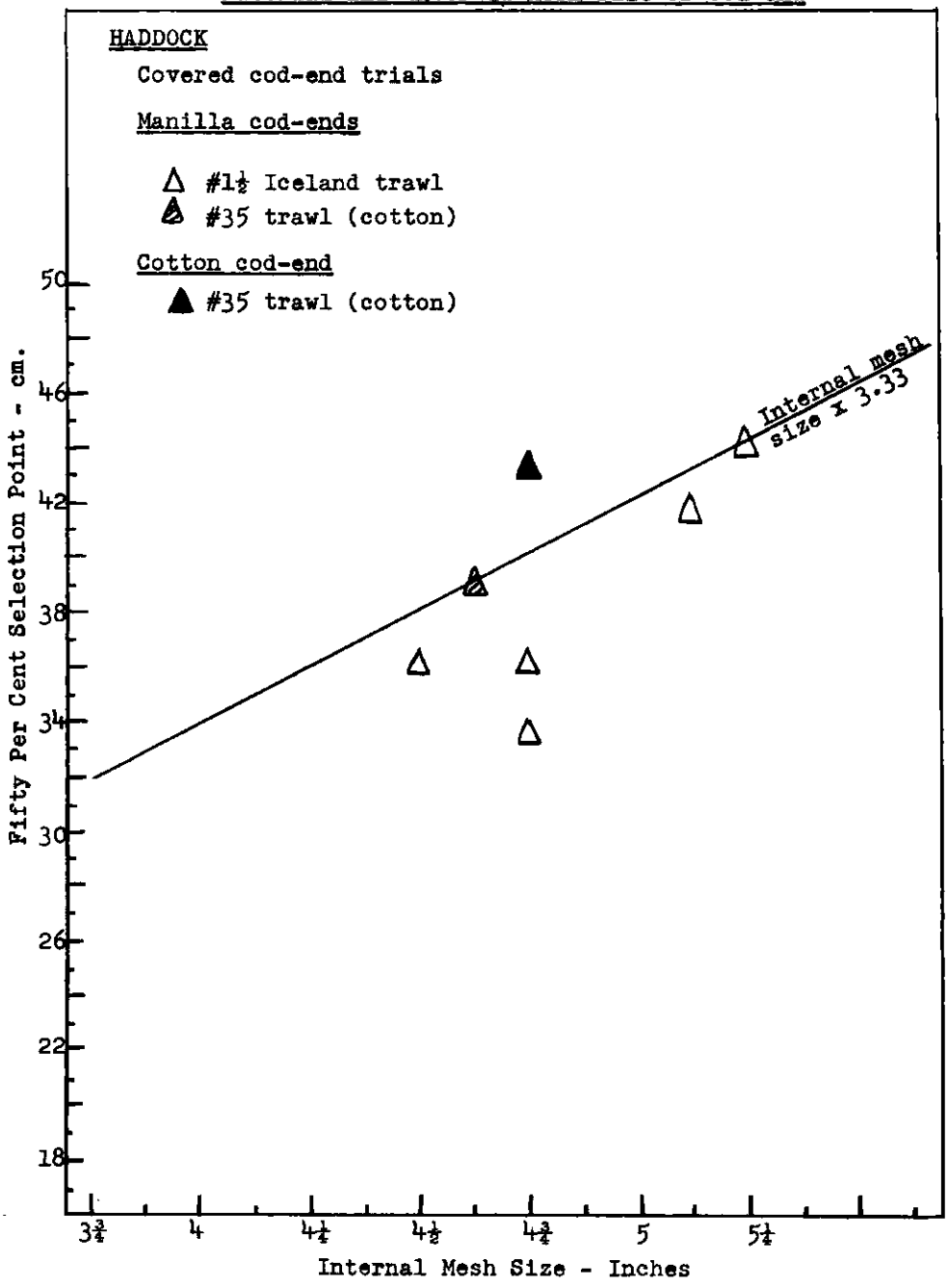


Figure 7

Fifty per cent Selection Points for Cod in Relation to Material and Internal Mesh Size of Cod-end

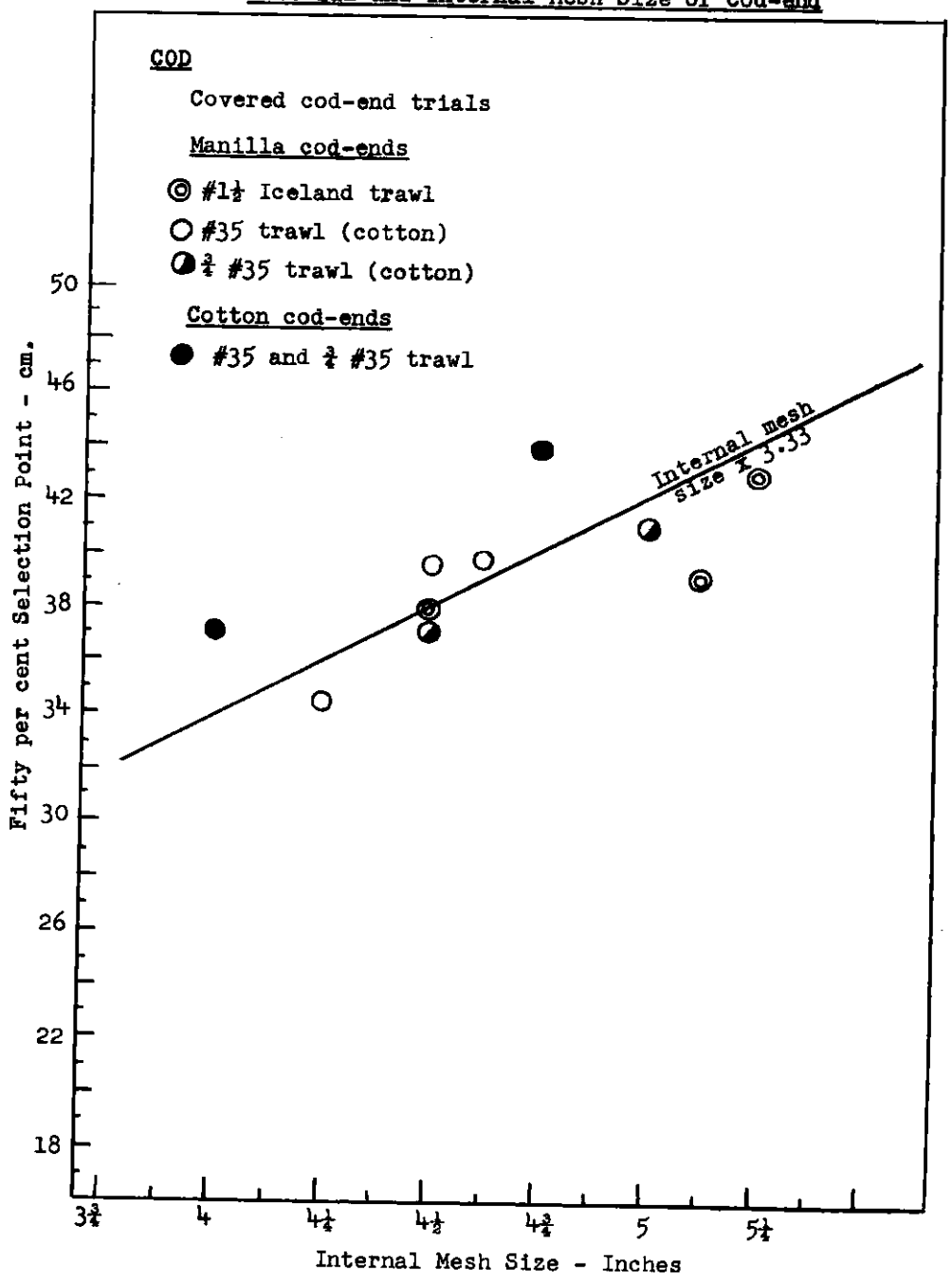
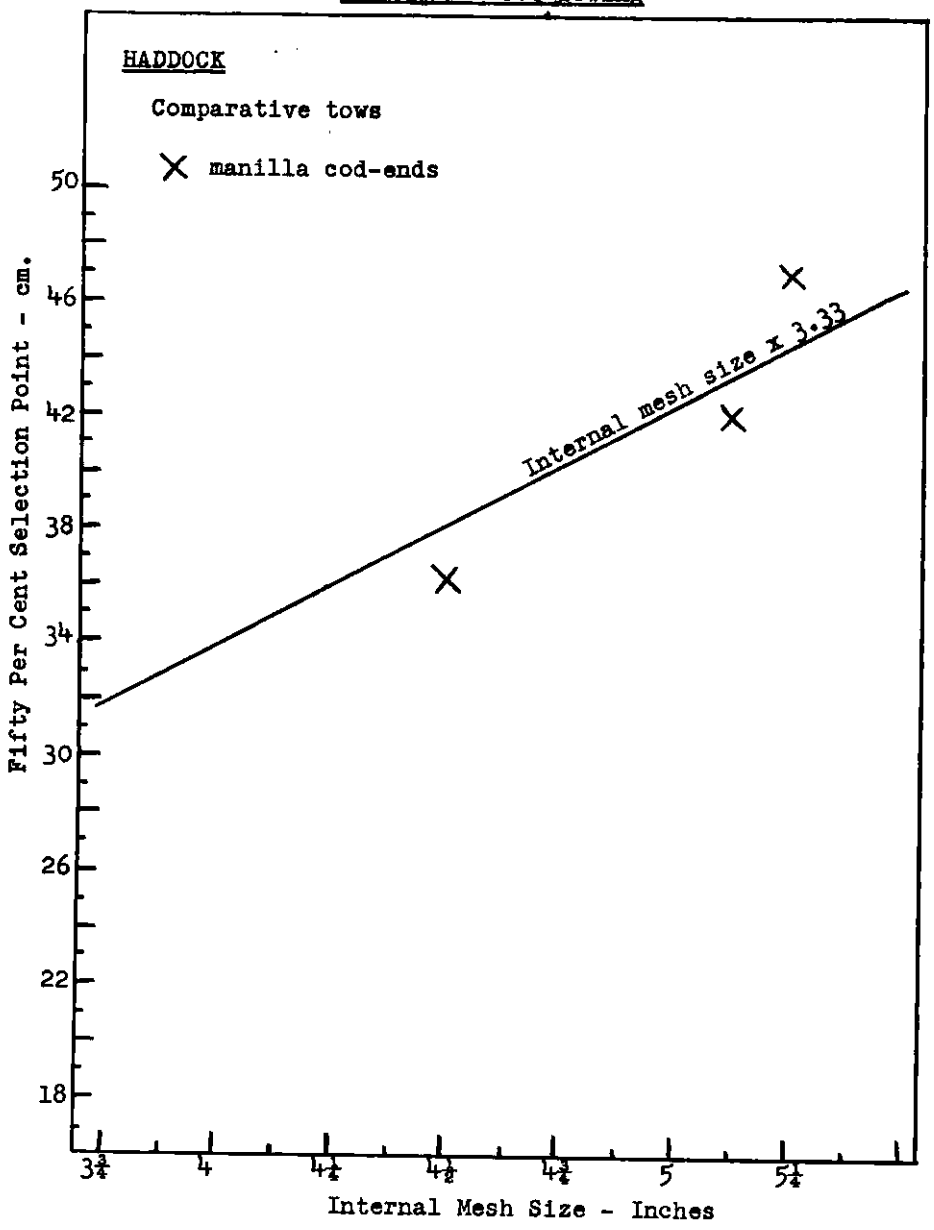


Figure 8

Fifty per cent Selection Points for Haddock Determined by Comparative Towing



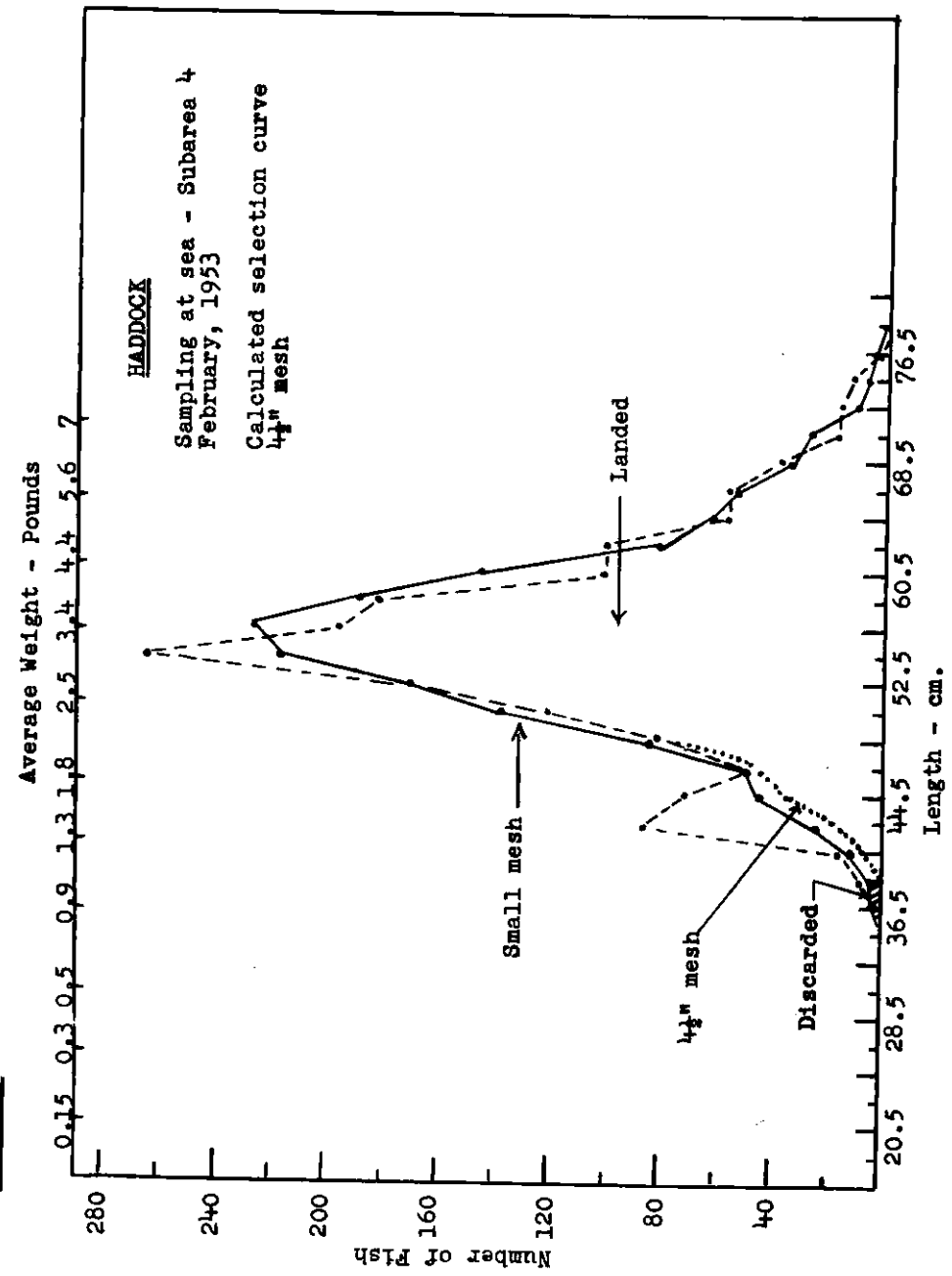

HADDOCK
Sampling at sea - Subarea 4
February, 1953
Calculated selection curve
4½" mesh
Landed
Small mesh
4½" mesh
Discarded
Number of Fish
Average Weight - Pounds
Length - cm.
0.15 0.3 0.5 0.9 1.3 1.8 2.5 3.4 4.4 5.6 7
20.5 28.5 36.5 44.5 52.5 60.5 68.5 76.5
280 240 200 160 120 80 40

Figure 9

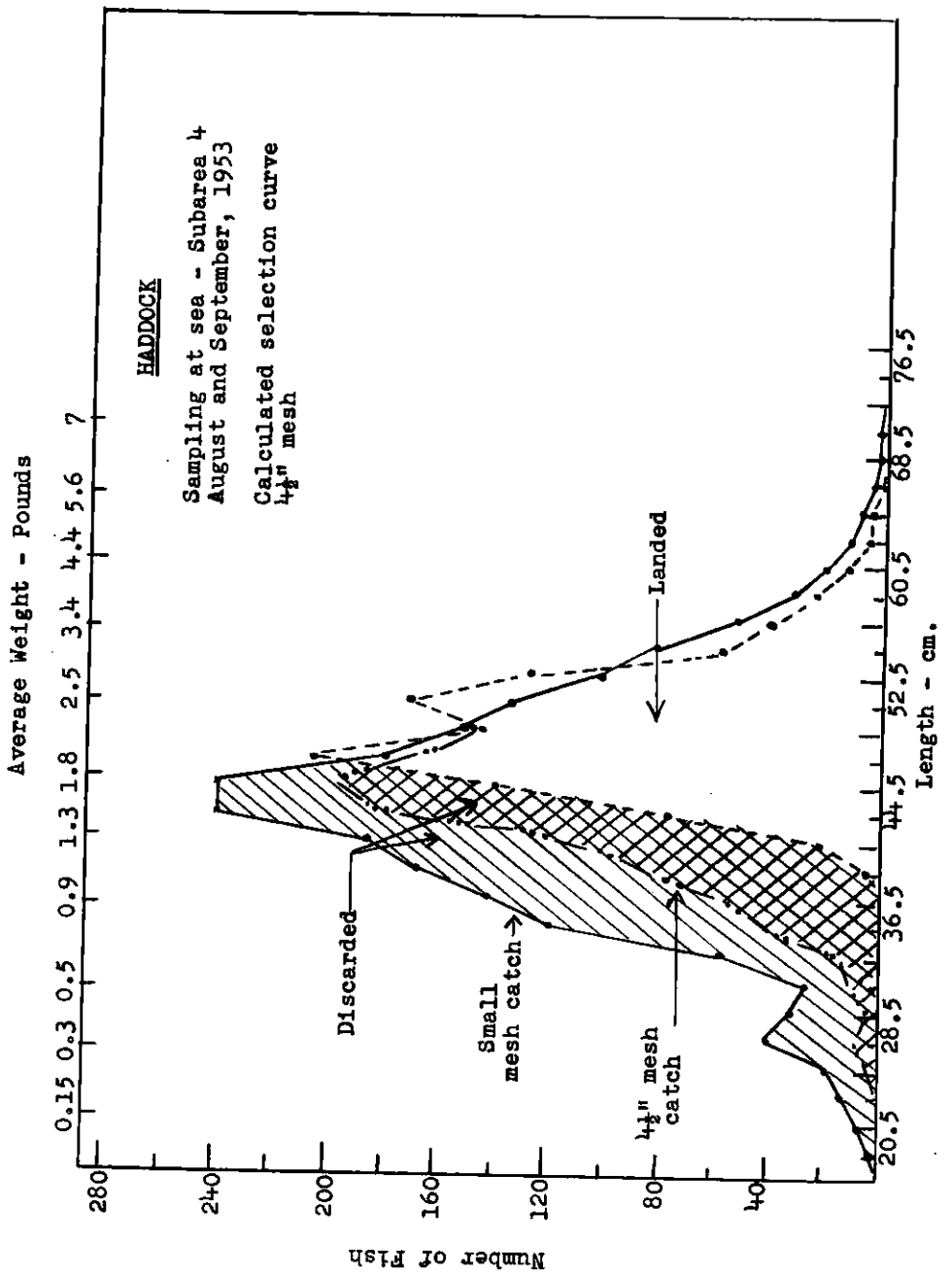

HADDOCK
Sampling at sea - Subarea 4
August and September, 1953
Calculated selection curve
4½" mesh
Average Weight - Pounds
0.15 0.3 0.5 0.9 1.3 1.8 2.5 3.4 4.4 5.6 7
Length - cm.
20.5 28.5 36.5 44.5 52.5 60.5 68.5 76.5
Number of Fish
280 240 200 160 120 80 40
Landed
Discarded
Small mesh catch
4½" mesh catch

Figure 10

Figure 11

Fifty per cent Selection Points for Plaice in Relation to Material and Internal Mesh Size of Cod-end

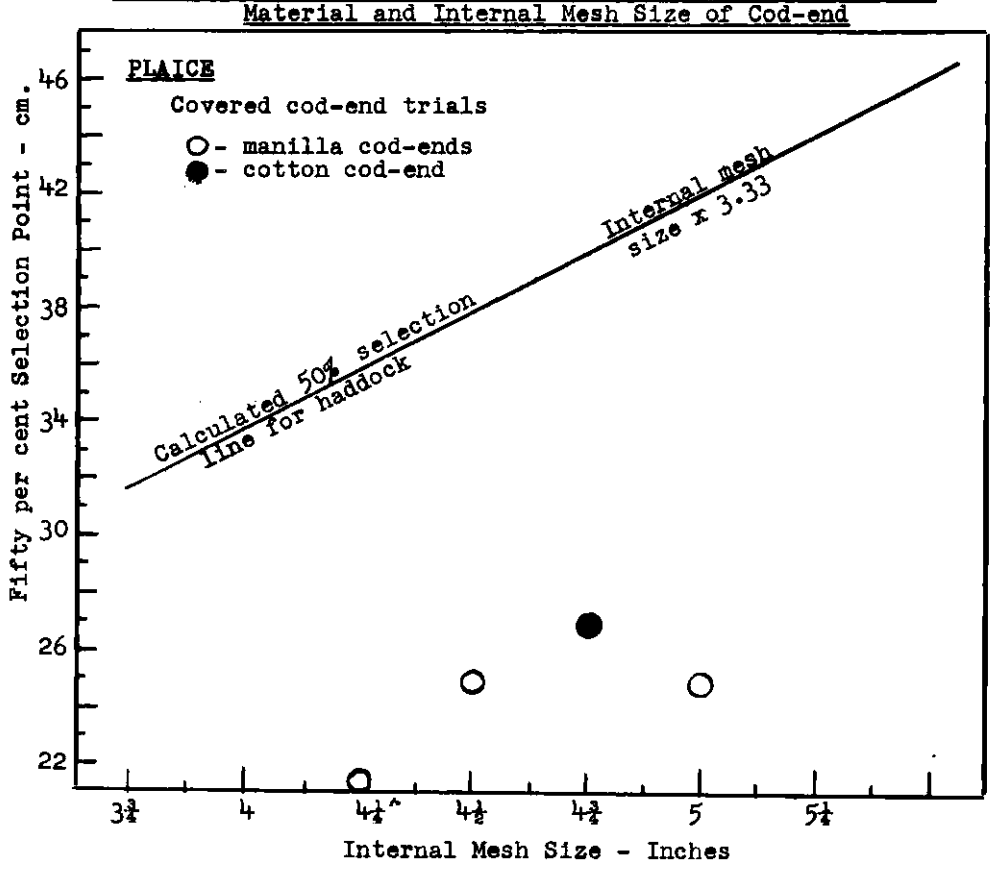
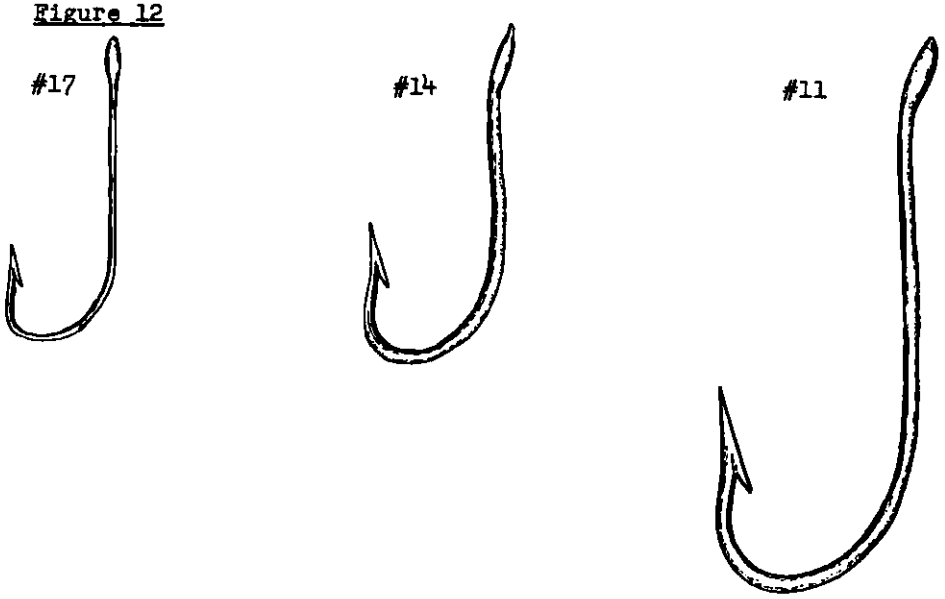


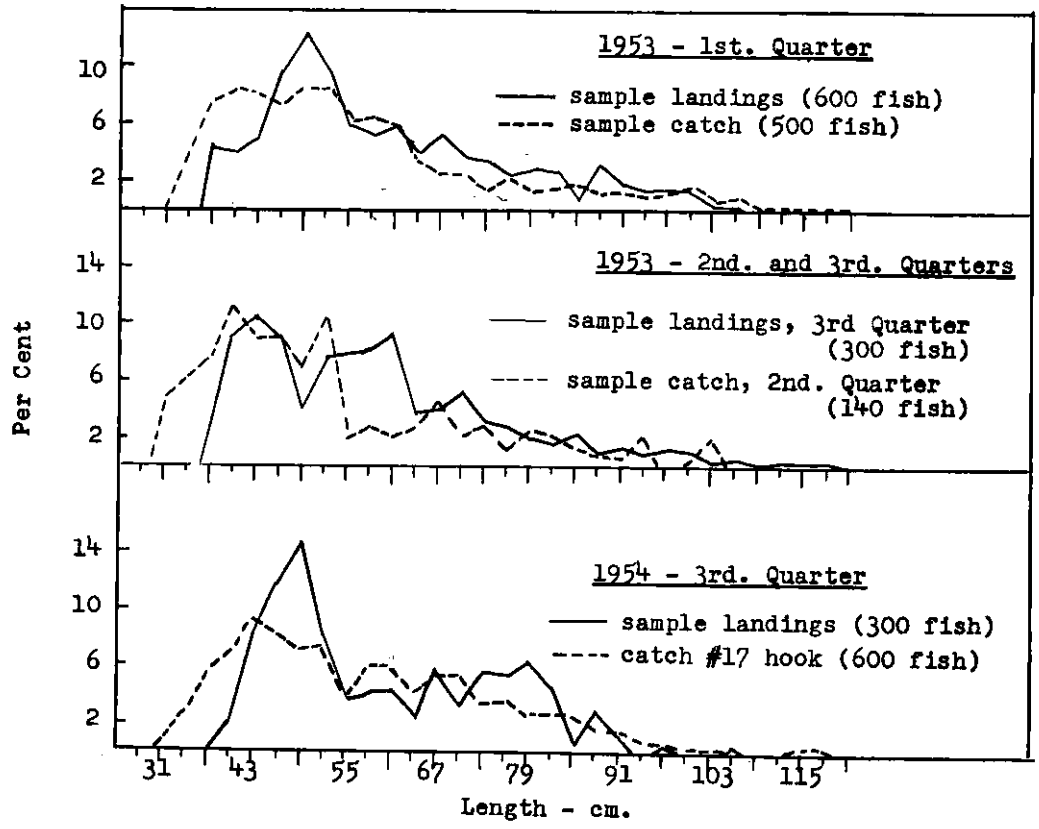
Figure 12



Type and size (actual) of hooks used in hook selection experiments

Figure 13

Percentage length composition of landings and catch of cod by hook and line at Lockeport, N.S.



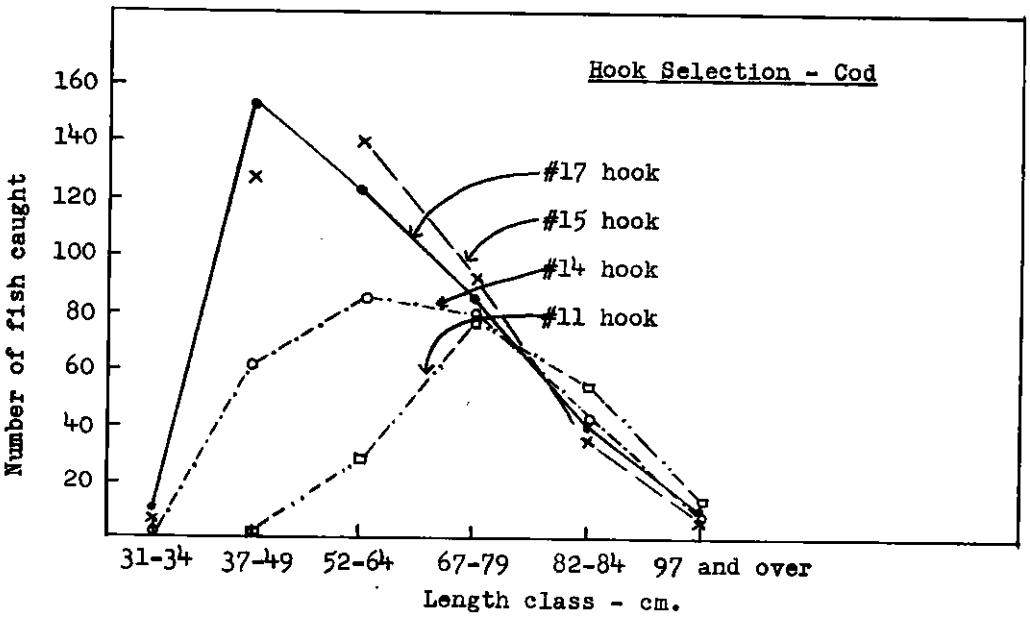
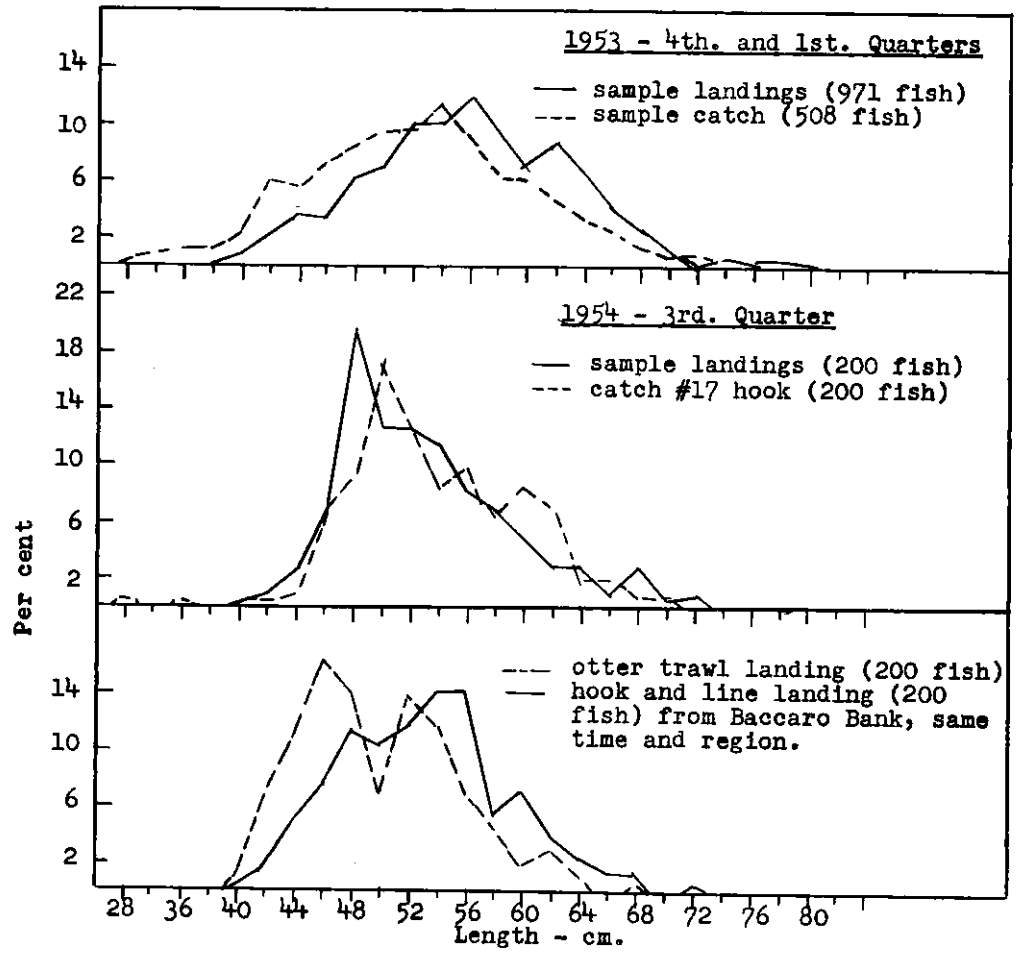
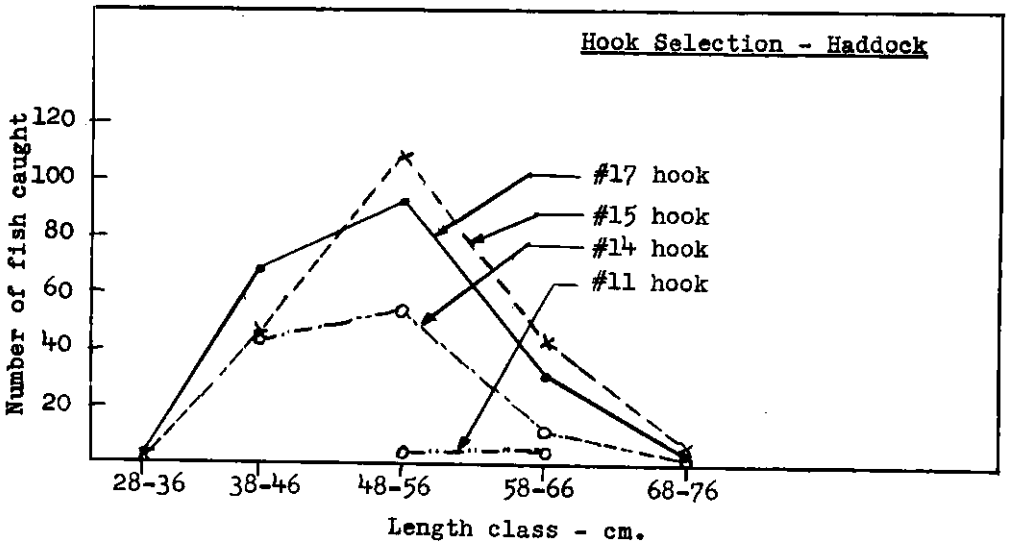


Figure 14

Percentage length composition of landings and catch of haddock by hook and line at Lockeport, N.S.





CIRCULAR LETTER TO THE CANADIAN OTTER TRAWLER INDUSTRY FROM THE ATLANTIC BIOLOGICAL STATION, ST. ANDREWS, N.B.

IT PAYS TO USE LARGE-MESH OTTER TRAWLS

Large quantities of small haddock are wasted at sea - On the Canadian Atlantic Coast otter trawlers catch large quantities of small unmarketable fish, particularly haddock, and run them out through the scuppers dead. This interferes with fishing operations by creating unnecessary work on deck, and the destruction of small, fast-growing fish reduces future landings. It is accordingly of immediate concern to fishermen and of long-term concern to the fishing industry to reduce catches of baby scrod.

For more than 50 years fisheries scientists have studied this problem by testing methods of releasing small fish from otter trawls. The methods tested have included square meshes, "windows" of large meshes, supports in the cod-end, specially designed cod-ends and large meshes in various parts of the trawl. It has been clearly shown that use of large-mesh trawls is the best way to let small fish go and still keep the large, marketable fish.

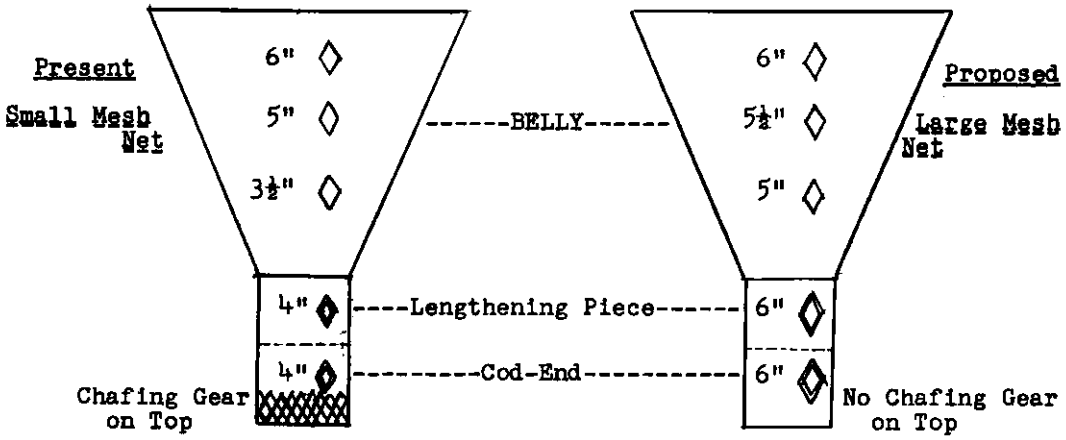
Small fish are released alive on the bottom by large-mesh trawls. British workers have provided the most convincing demonstrations of the value of large-mesh cod-ends. In the 1930's they used covers over the cod-ends which could be throttled off before hauling the net, and during recent years they have produced underwater films of trawls in operation, to show that small fish escape through the wide-open meshes while the net is fishing on the bottom. Studies of escapement through various parts of the trawl have shown that most fish are released through the top half of the cod-end.

Canadian mesh trials have shown that small fish escape even when the catches are large. Three experimental trips on the otter-trawlers Cape North and Cape LaHave during 1953 tested cod-ends and lengthening pieces of different mesh sizes, from 6 to 7 inches between knot centres as purchased. Even when small fish were very numerous, as on St. Pierre Bank, large numbers of baby scrod escaped. The largest meshes used released many fish below scrod size, a few scrod and negligible numbers of large haddock. The sizes of cod released were comparable with those of haddock. Chafing gear was not used over the top half of the cod-end and the cod-ends did not show serious signs of wear.

United States trawlers fishing in the Northwest Atlantic now use large-mesh nets. A careful study of the Georges Bank haddock fishery since 1931 has shown that the use of large-mesh cod-ends in otter trawls may be expected to increase annual landings. The International Commission for the Northwest Atlantic Fisheries accordingly recommended that Governments prohibit the taking of haddock from the Georges Bank area with a trawl net which has a mesh size of less than 4½ inches (as measured with a flat gauge inserted into the mesh when the trawl is used and wet). On the basis of this action, United States trawlers are now required by regulation to use large meshes throughout the trawl with belly meshes not less than 5 inches single twine and with lengthening piece and cod-end meshes of about 6 inches double twine.

Chafing gear on top of the cod-end stops mesh selection. The new Georges Bank mesh regulation states that no device may be used to obstruct or diminish the mesh size, except on the underside of the cod-end. The use of such chafing gear cuts down the selective action of the open meshes and reduces the efficiency of the net. Although United States trawlers have not used chafing gear on the top half of the cod-end for many years, Canadian trawlers continue to do so in order to protect the bag as it is hauled in over the side of the vessel. This chafing gear should not be used on the top half of the cod-end if the industry is to take full advantage of the use of large meshes to release small fish.

Large-mesh nets increase landings. In several fisheries it has been demonstrated that large meshes catch more marketable fish than small meshes. This is probably the result of elimination of small, unmarketable trash with increased flow of water and speed of gear. During the first six months of the Georges Bank mesh regulation, New England trawlers have increased their landings by about 10 percent. This improvement, based on a comparison with a group of trawlers licensed to use the old small-mesh nets, is calculated to be worth one million dollars per year to New England trawler fishermen.



A 6-inch mesh is recommended for Canadian trawlers. The 1¼ Iceland trawl commonly used by Canadian trawlers has a belly of single twine which decreases from about 6-inch mesh where it joins the square to 3 or 3½ inches at the lengthening piece. The lengthening piece and cod-end meshes are about 4-inch double twine. It is proposed that the belly meshes should not decrease to less than 5 inches single twine and the lengthening piece and cod-end meshes should have 6-inch mesh, double twine manilla, as purchased (see Figure). The best mesh size is believed to be still larger but adoption of 6-inch mesh is a step in the right direction which would put Canadian meshes in line with those used by other countries fishing on the same fishing grounds. It is a safe step in that nothing will be lost and there is much to gain.

By using a 6-inch cod-end baby scrod will be saved to be caught later; work on deck will be reduced; nets will be less costly to make and repair; and more marketable fish in catches will increase landings and earnings. The following table, based on results of actual use of large-mesh nets by New England trawlers during 1953, compares a typical catch by a standard 4-inch mesh net with that of a 6-inch mesh cod-end, without chafing gear on top.

Haddock trip of 50,000 lb. or 20,000 fish
during the period May to December

Size of Fish	Present 4" mesh		New 6" mesh		Remarks
	Number of Fish	Landing Pounds	Number of Fish	Landing Pounds	
Baby haddock discarded	20,000		8,000		Many baby scrod saved
Scrod	12,000	25,000	12,000	25,000	Similar scrod catches
Large	8,000	25,000	9,000	30,000	More large fish
TOTAL	40,000	50,000	29,000	55,000	Higher landings

April 23, 1954.

--ooOoo--

Draft Mesh Regulation for Cod and Haddock Fishing in Subarea 4

15 December 1954

(Prepared and adopted at the meeting of the group of Scientific Advisers to Panel 4 in St. Andrews, N.B., 7 and 8 December 1954.)

I. That the Contracting Governments take appropriate action to prohibit by persons under their jurisdiction the taking of cod, Gadus callarias, and haddock, Melanogrammus aeglefinus, in Subarea 4 with a manilla trawl net having a mesh size less than four and one-half inches when measured wet after use, or with trawl nets of other material than manilla having a selectivity equivalent to that of a four and one-half inch manilla trawl net. For the purposes of this proposal, the four and one-half inch mesh size when measured wet after use shall be taken to be:

a. In the cod-end of the net, the average of any series of fifty mesh measurements of each mesh in a series of consecutive meshes running parallel to the long axis of the net and beginning at the after end of the cod-end or, if the cod-end is less than fifty meshes, running the full length of the cod-end, such series to be at least ten meshes from the lacings and to be measured with a flat, wedge-shaped gauge having a taper of two inches in nine inches and a thickness of three thirty-seconds of an inch, inserted into the meshes under a pressure of not less than tennor more than fifteen pounds, and;

b. In any part of the net other than the cod-end, the average of the measurements of each mesh in any series of twenty consecutive meshes, such series to be at least ten meshes from the lacings and to be measured with a flat, wedge-shaped gauge having a taper of two inches in nine inches and a thickness of three thirty-seconds of an inch, inserted into the meshes under a pressure of not less than ten nor more than fifteen pounds.

II. In order that the provisions of the immediately preceding paragraph shall not interfere seriously with lucrative fisheries which are primarily for other species and in which cod and haddock are caught incidentally, each country may exempt a maximum of ten per cent of the landings of cod and a maximum of ten per cent of the landings of haddock for vessels fishing in Subarea 4, providing that each country reports to the Commission what regulations are enforced and what landings are made by the exempted fishing operations. It shall not apply to government fishery research vessels or to other vessels authorized by a Contracting Government to use a smaller mesh for purposes of scientific investigation. Such Contracting Government shall report to the Commission the number and names of such research vessels or other vessels so authorized.

III. (1) No vessel while operating in Subarea 4 shall use any device by means of which the mesh in any part of a trawl net is obstructed or otherwise in effect diminished.

(2) Notwithstanding the provisions of the foregoing sub-paragraph, it shall not be deemed unlawful to attach to the underside of the cod-end of a trawl net any canvas, netting, or other material, for the purpose of preventing or reducing wear and tear.

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