INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

REDBOOK 1968 PART III

SELECTED PAPERS FROM THE 1968 ANNUAL MEETING

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Note

REDBOOK 1968 appears in 3 books. The first book contains Part I, Proceedings of the Standing Committee on Research and Statistics. The second book contains Part II, Reports on Researches in the ICNAF Area in 1967. The third book contains Part III, Selected Papers from the 1968 Annual Meeting.

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PART III. SELECTED PAPERS FROM THE 1968 ANNUAL MEETING

1. Change in Cod Distribution in the Labrador Area[1]

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The general pattern of cod migrations in the Labrador area is described by many ichthyologists; among Soviet investigators, A. Postolaky (1966) accomplished it in considerable detail. In the first half of the year, the densest cod concentrations keep to the Continental Slope at depths of 250-400 m. In summer, cod migrate to coastal shallow waters of the Labrador peninsula where they are exploited by Canadian fishermen. Statistical data of their catches are of special interest due to the fact that they probably reflect the level of cod stocks. Actually, operations of inshore fishermen in summer and autumn are not impeded by either meteorological or ice conditions; fishing gears (traps, gill nets, rods, longlines) did not essentially change in recent years. Periods and areas of coastal fishing remain rather invariable. Thus, the average annual catch per fisherman may be an appropriate characteristic of the level of cod stocks.

Hodder (1965) reports that, since 1954 to 1963, the average catch per Canadian fisherman in the Labrador area decreased from 23 tons to 17 tons, or by 26 percent; in other words, it decreased, on the average, about 3 percent annually. This continuous and gradual fall could not be caused by natural fluctuations of year-classes abundance. According to the data from Soviet investigations on regular quantitative analyses of small Labrador cod, the abundance of their year-classes changes insignificantly (Konstantinov and Noskov, 1967). One can characterize the strength of the Labrador cod year-class by the average number of the young caught with a special trawl per one hour trawling. The abundance of good Labrador cod year-classes is not more than 2.5 times greater than that of poor year-classes, whereas in the Barents Sea the abundance of rich year-classes is 10 times higher than the poor brood years (Table 1).

Table 1. Number of young cod caught by a special trawl per one hour trawling. (The average catch of young cod taken per one hour trawling and calculated for Div.3K by species at age 2+ and 3+; for the Barents Sea at age 1+ and 2+).

Year-class	Labrador cod stock (caught in Div.3K)	Southern Barents Sea	Bear Island-Spitsbergen area
1958	-	10	20
1959	18	12	13
1960	11	6	13
1961	22	2	2
1962	20	6	5
1963	26	14	84
1964	-	51	39

[1] submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/36

The relative stability of annual increase of Labrador cod is partly explained by the transport of their eggs and larvae southward (whereas eggs and larvae of the Barents Sea cod and West Greenland are brought to the north in areas where they can probably meet Arctic water masses).

Thus, a gradual decrease of cod stocks in the Labrador area is not caused by fluctuations but by the regular intensive fishery, primarily the trawl fishery, in offshore waters. The change in the length-age composition of trawl cod catches (Konstantinov and Noskov, 1967) and also a continuous decrease of a portion of the largest and oldest fishes should be considered as a result of the intensive fishery. The gradual reduction of Labrador cod stocks is also explained by May (1967) as a result of this intensive exploitation in the open sea.

If the trawl fishing efficiency in offshore waters is directly and strictly proportional to cod stocks (as it is evidently observed during the summer-autumn coastal fishery), then the catches taken by large European trawlers per hour trawling should decrease continuously and regularly from year to year. However, in fact, there is no direct and close relationship between the level of Labrador cod stocks and trawl fishing intensity. Not only the cod stocks but also features of the fish distribution affect the results of trawl fisheries in offshore waters. For instance, it is known that the eastern distribution of cod in the Barents Sea caused by hydrological conditions favourably influences upon the Soviet trawl fishing efficiency (Konstantinov, 1964, 1967*a*). There are reasons to believe that *the southern cod distribution* in the Labrador area results in the successful fishery which is carried out by European trawlers. This is shown by comparing operational conditions for the trawling fleet in the central and south Labrador divisions of ICNAF. In the central Labrador area, the ground very often damages bottom trawls; the ice and meteorological conditions are very difficult. The Continental Shelf in south Labrador is wider and is seldom covered with ice completely. The grounds in south Labrador are more favourable for trawling and meteorological conditions are somewhat milder compared to those in central Labrador. Consequently, the farther the cod concentrations move southward in winter and spring, the more favourable are the conditions observed for trawler operations.

Therefore, from the practical point of view, methods for predicting the Labrador cod distribution in winter and spring would be very useful.

Pre-spawning specimens are dominant in cod concentrations near Labrador. It is a well known fact that pre-spawning fish are very sensitive to even insignificant variations of water temperature; the chilling or warming of the sea can change fish migration paths and displace main spawning grounds. For instance, when the water temperatures are low, the Barents Sea capelin spawn more westerly than when water temperatures are higher. Thus, hydrological conditions registered early in winter make it possible to determine an area of spring concentrations of capelin and "capelin" cod (Konstantinov, 1961, 1964, 1965*a*, 1967*b*, 1967*c*; Prokhorov, 1965; Midttun, 1965).

It is natural to suppose that low water temperatures in the Labrador area result in a more southerly cod distribution and high temperatures contribute to a more northerly distribution. The temperature on the international hydrological Section 8A between 53°40'N, 55°44'W and 54°51'N, 54°32'W in the 50-200 m layer in the period before the beginning of cod trawl fishery can be taken as an index of the thermal sea condition in the Labrador area. Table 2 shows that, in 1965 and 1966, a comparatively high water temperature was observed in the Labrador area. The warming of the sea was due to slackening of the cold Labrador Current. It should be noted that, in 1965 and 1966, evidently many permanent currents of the Northwest Atlantic including the North Atlantic Current were somewhat slackened. According to Templeman (1965), the slackening of the North Atlantic Current was responsible for the low abundance of haddock in the southern part of the Grand Bank and also the extreme low abundance of year-classes of cod, haddock and herring in the Barents and Norwegian Seas. About the middle of 1967, the intensity of the main currents increased; water temperatures increased in the warm North Cape Current and decreased in the cold East Icelandic, East Greenland and Labrador Currents.

Table 2. Water temperature on hydrological Section 8A and the area off Labrador where Soviet trawlers (BMRT) started fishing, 1964-67.

Year	Date	Water temperature (50-200 m layer) (°C)	Location	
			Lat N	Long W
1964	23-24 October	-0.22	54°50'	54°15'
1965	12-13 November	1.49	56°30'	58°15'
1966	16-17 October	0.98	55°30'	57°00'
1967	21-22 October	0.66	55°10'	55°45'

In autumn 1967 on hydrological section 8A in the Labrador area, the water temperature was lower than in autumn 1965 and 1966. The paper by Burmakin (1968) reports this fact in some detail.

Table 2 indicates that the lower the temperature on Section 8A in October (or November), the more southerly the large Soviet trawlers (BMRT) begin their operations. It should be noted that hydrological conditions predetermine the distribution of fish (and parallel with this the dislocation of the fishing fleet) in both December and following months.

As mentioned above, the southern distribution of cod contributes to successful fishery by the fleet. For example, in January and February 1967, the average catch taken by large Soviet vessels (BMRT) per one hour trawling was 2.44 tons but during the same period in 1968 it amounted to 4.05 tons.

So observing hydrological conditions in the Labrador area, one can predict, several months in advance, peculiarities of the cod distribution, future dislocation of the trawling fleet and probable fishing efficiency.

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2. Report on the cod otolith photograph exchange scheme 1963-67[1]

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Introduction

Following the Report of the 1962 Ageing Workshop, and the development of a simple apparatus for photographing gadoid otoliths (Blacker, 1964), the Working Group on Ageing Techniques at the 1963 ICNAF Annual Meeting recommended "that future coordination of age-reading techniques take the form of exchange of sets of photographs marked by each country in the way that they would read them. The photos should be accompanied by the corresponding otoliths" (ICNAF, 1963*a*). Dr Messtorff and Dr Kohler were asked to supply a sample of cod otoliths from Subarea 4 and the Lowestoft Laboratory was asked to undertake the photography and distribution.

As a result, the cod otolith photograph exchange was started late in 1963. Since then, twelve sets of otoliths and photographs, totalling 233 otoliths, have been circulated. Samples from Div.1D, 1E, 1F, 2H, 2J, 3K, 3L, 3O, 3P, 4T and 4V have been used. Five of the samples were specially selected for this exchange and the remainder were chosen from those used in the 1962 exchange (DeBaie, 1964). At the start of the scheme, fourteen countries were on the circulation list, and for the first two series photographs only were sent out in the first instance because it was felt that circulation of the otoliths would take too long. A detailed report on the first two series was sent to all readers and the otoliths themselves were circulated after all the results had been received. However, at the 1964 ICNAF Annual Meeting the Subcommittee on Ageing Techniques asked for the otoliths to be circulated with the photographs, and the number of countries taking part in the scheme was reduced (ICNAF, 1964). The procedure for the remaining samples was then changed so that two sets of photographs for annotating were sent to each participant. The interpretations of the otoliths themselves were to be marked on the photographs, one set of which was returned to Lowestoft, and the other kept for future reference. When all the results for each series had been returned, a detailed report was prepared and sent to all participants (reports on Series 10, 11 and 12 are in preparation and will be sent out as soon as possible). Even with the reduced numbers of readers for each series, few of the series have completed their circulation in less than six months.

The samples from the 1962 exchange were sent to the countries on the normal circulation list for each subarea (ICNAF, 1964) and to any others of the five countries who took part in the 1962 exchange scheme. This allows a comparison of the 1963-67 exchange results with those of the 1962 exchange and gives a measure of the consistency of the age-readings of those five countries.

[1]submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/74

Results

The full results are given in Appendix I.* In some countries several readers took part and the figures given in the tables are the majority readings wherever there was a clear majority age. Where more than one age was given without any indication of preference, the age taken for the subsequent analyses is underlined in the tables.

For purposes of analysis, each otolith has been given a "best age" which has been decided after consideration of the otolith itself and all the interpretations given by other readers. The best age is not necessarily the majority reading nor is it the mean of the exchange readings because these ages may definitely be wrong for various reasons given below. Table 1 summarizes for all samples the compari n of all readings with the best age and this is shown graphically in Fig. 1; full details are given in Appendix II. In Table 1, the differences from the best age are given as percentages in two ways: firstly, for all fish of all ages (233 fish) and secondly for those fish younger than 10 years (best age) (187 fish). For the first group, the percentage of readings agreeing with the best age varies from 35.2 percent in Series 7 to 91.3 percent in Series 2, while for fish younger than 10 years, the variation is from 50.4 to 90.9 percent. However, for most samples, the numbers of fish of 10 years and older are small and the difference in the percentage agreement may not be significant. The one sample which showed the greatest difference (Series 7) consisted of only 12 fish, of which 7 were older than 9 years. Seventy-five to 99 percent of the readings for all ages agree with the best age, or differ from it by only one year.

A comparison of the readings obtained from the nine countries who read most samples is given in Table 2 and illustrated by Fig. 2. The results from the five other countries who read only one, two or three of the earlier series are too few for inclusion. The percentage of readings agreeing with the best age varies from 54.1 to 82.8, but the latter figure for the English readings is obviously biassed towards the writer's 'best' age. Excluding the English readings, the percentage agreement with the best age varies from 54.1 percent (USSR) to 73.3 percent (Iceland), and from 80.3 percent (USSR) to 93.4 percent (Canada, St. John's) of the readings agree with or are within one year of the best age. Apart from Norway (86.1 percent) and USSR (80.3 percent), about 90 percent or more of the readings are within one year of the best age. According to Gulland (1955), readings within one year of the correct age are reasonably acceptable for statistical calculations for stock assessments, and so are these results, assuming that these exchange samples are representative of the otoliths of cod populations in the ICNAF Area.

Comparison of the 1962 and 1963-67 exchange results

Canada (St. Andrews and St. John's), Germany, Norway and Spain took part in the 1962 exchange scheme, and seven samples from the same otoliths have been used in the present exchange. The results of the 1962 exchange given by DeBaie (1964) and those for the same otoliths in the 1963-67 exchange are given

*The appendices to this document (Tables 4-33) are on file in the Secretariat

Table 1. Comparison of the 1963-67 exchange results with the best age, for divisions of Subareas 1, 2 and 3.

	1DEF				2H		2J		3K			
Series Number	2		3		8		5		4		6&9	
Number of readers	15		8		8		7		6		9	
	All ages	<10	All ages	<10	All ages	<10	All ages	<10	All ages	<10	All ages	<10
Number of otoliths	29	25	20	18	26	18	23	17	15	10	25	22
% readings (0 yrs	91.3	90.9	73.1	74.2	58.5	66.2	67.7	67.3	70.0	71.7	68.2	72.2
differing (1 yr	7.6	8.0	20.4	22.1	30.5	27.9	24.8	23.5	26.7	26.6	28.5	25.0
from best (2 yrs	1.1	1.1	4.6	3.7	9.0	5.9	7.5	9.2	2.2	-	1.9	2.2
age by (3 yrs	-	-	2.0	-	1.0	-	-	-	1.1	1.7	0.5	-
(>3 yrs	-	-	-	-	1.0	-	-	-	-	-	0.5	-
Age range (yrs)	3-10	3-9	4-10	4-9	3-16	3-9	2-16	2-9	1-20	1-9	2-13	2-9
Average number of interpretations per otolith	2.0		3.0		3.6		2.6		2.0		3.4	
No of otoliths with complete agreement on age and interpretation	4		1		1		1		4		1	
Number with no best interpretation given	0		1		1		0		1		2	

Table 1 (continued).

	3L		30		3P		4TV		
Series Number	10		11		12		1	7	
Number of readers	9		8		7		18	9	
	All ages	<10	All ages	<10	All ages	<10	All ages <10	All ages	<10
Number of otoliths	28	22	25	22	15	13	15	12	5
% readings differing from best age by (0 yrs	57.1	64.4	70.5	72.7	51.5	53.9	50.4	35.2	63.0
(1 yr	29.9	31.4	24.5	23.9	41.9	39.5	34.4	39.8	32.6
(2 yrs	6.7	4.3	5.0	3.4	6.7	6.6	11.5	13.9	4.4
(3 yrs	1.8	-	-	-	-	-	3.7	11.1	-
(>3 yrs	4.0	-	-	-	-	-	-	-	-
Age range (yrs)	1-21	1-9	2-16	2-9	4-11	4-9	4-9	6-15	6-9
Average number of interpretations per otolith	3.8		2.9		3.8		5.5	5.5	
No of otoliths with complete agreement on age and interpretation	5		5		1		0	1	
Number with no best interpretation given	1		1		1		1	2	

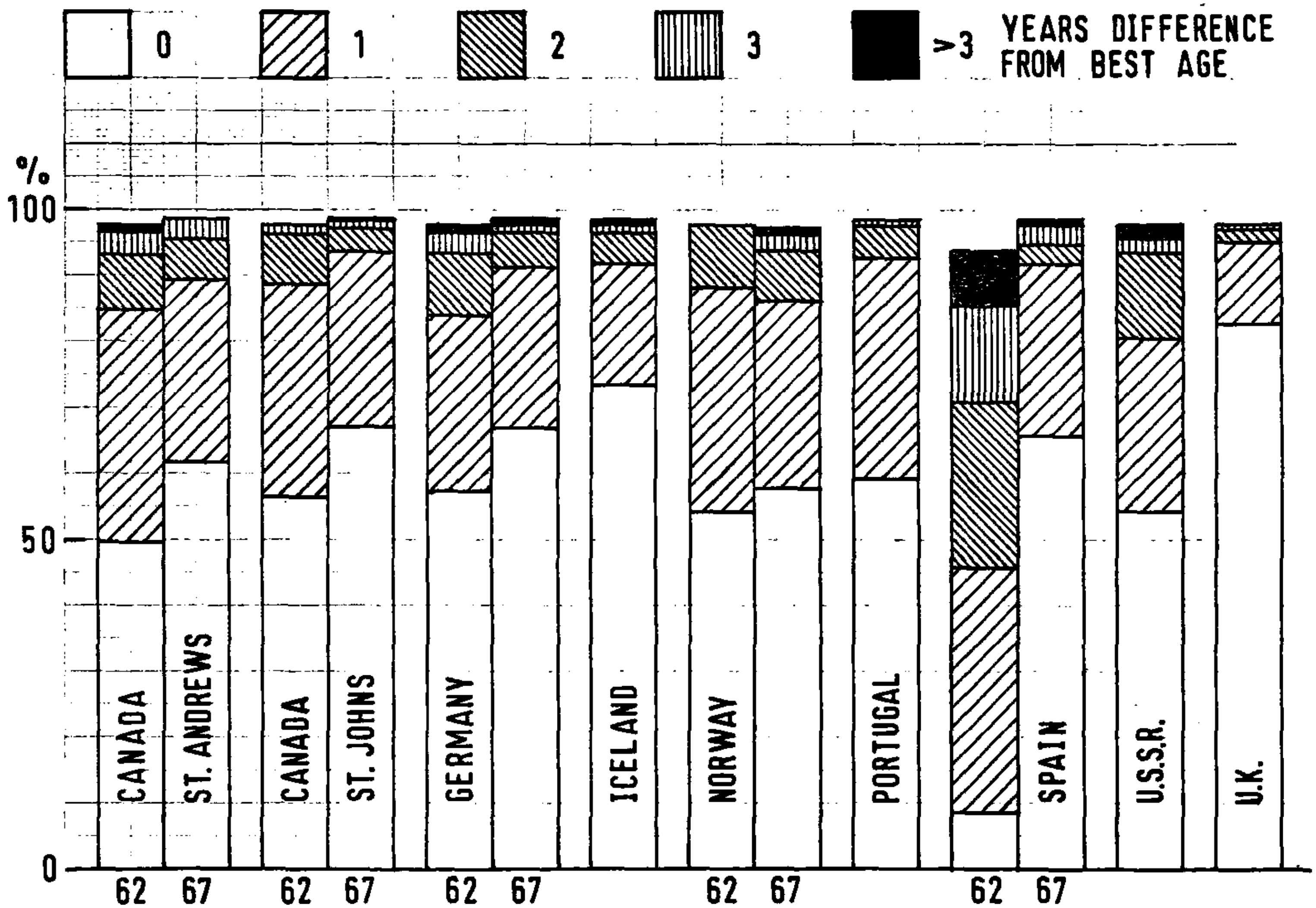

Fig. 1. Percentage agreement of the 1963-67 exchange results with the best ages, plotted for each subarea represented in the samples. The values for fish of all ages and those for fish nine years old or less are given.

Table 2. Comparison of all readings with the best age for the main participants. Percentage of total readings.

No. of years difference from best age	Canada St. Andrew's	Canada St. John's	Germany	Iceland	Norway	Portugal	Spain	USSR	England
0	61.7	67.1	67.0	73.3	57.8	59.2	65.7	54.1	82.8
1	27.4	26.3	24.5	18.6	28.3	33.5	26.3	26.2	12.2
2	6.3	3.8	5.1	5.0	7.8	4.7	2.9	13.3	2.2
3	2.9	0.9	0.9	0.9	2.2	0.9	2.9	2.1	0.7
>3	-	0.5	0.9	0.5	1.1	-	0.6	2.1	-
(No decision)	(1.7)	(1.4)	(1.7)	(1.8)	(2.8)	(1.7)	(1.7)	(2.1)	(2.2)
No. of otoliths read	175	213	233	221	180	233	175	233	139

Table 3. Comparison of the 1962 and 1963-67 exchange results for the five participants in both exchanges. Percentage of total readings.

No. of years difference from best age	Canada St. Andrew's		Canada St. John's		Germany		Norway		Spain	
	1962	1963/67	1962	1963/67	1962	1963/67	1962	1963/67*	1962	1963/67
0	49.6	57.3	56.5	61.1	57.3	63.4	54.2	45.0	8.4	61.8
1	35.1	31.3	32.0	32.0	26.7	25.2	34.4	33.6	37.4	28.2
2	8.4	6.1	7.6	3.8	9.2	6.9	9.2	3.8	25.2	3.1
3	3.1	3.1	1.5	-	3.1	0.8	-	1.5	14.5	3.8
>3	1.5	-	-	0.8	1.5	1.5	-	1.5	8.4	0.8
(No decision)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(3.1)	(6.1)	(2.3)

* only 6 series returned

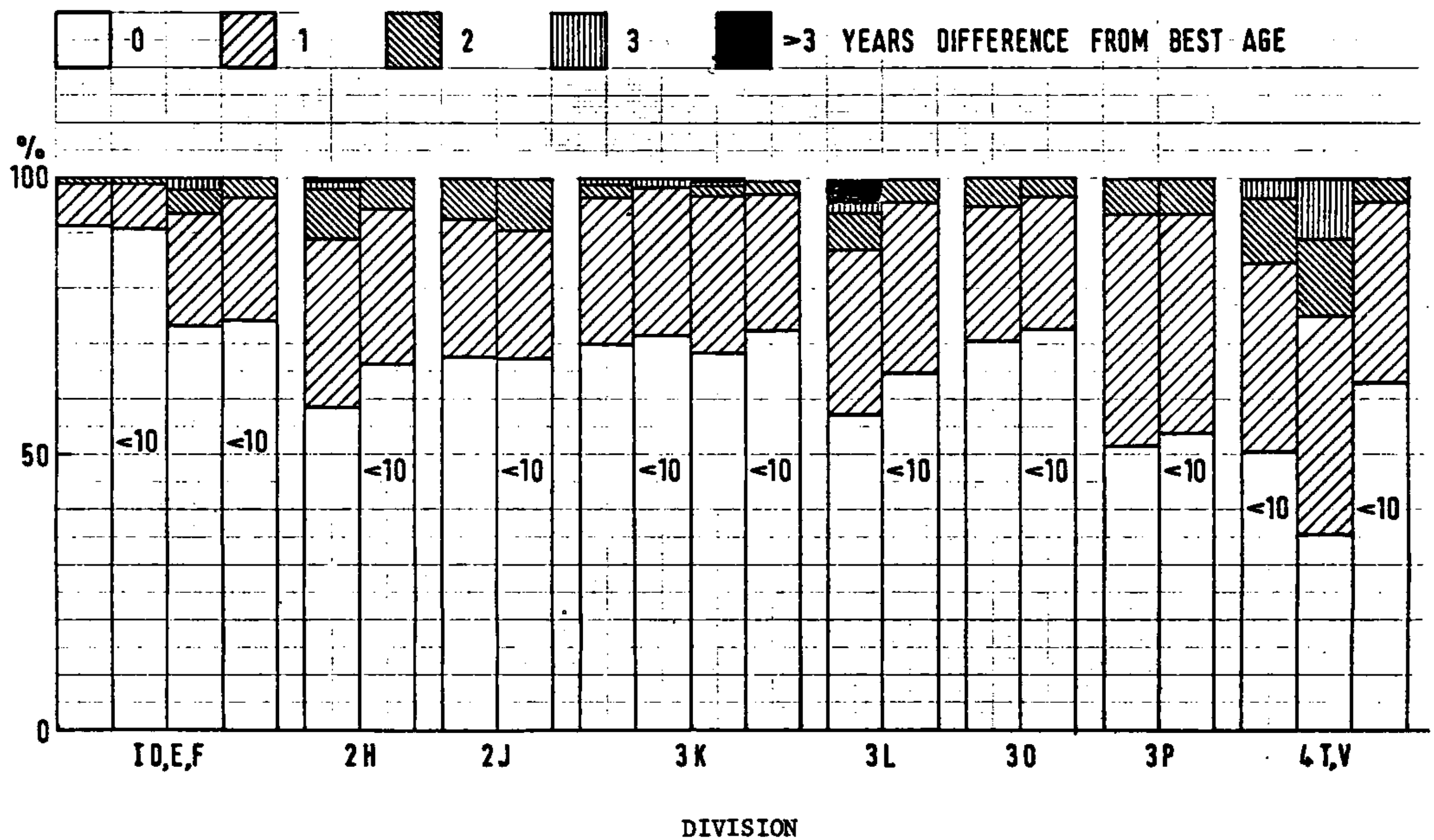

Fig. 2. Percentage agreement of the 1963-67 exchange results with the best age for the nine main participants. The comparison with the 1962 exchange results is given where appropriate.

in Appendix 3, and both have been compared with the best age. The comparison is shown in Table 3 as the percentage of readings from 0 to >3 years different from the best age and is also shown in Fig. 2 for the appropriate countries. Spain shows a striking improvement from 45.8 percent of readings within one year of the best age in 1962 to 90.0 percent in 1963/67. The two Canadian laboratories and Germany show nearly 5 percent improvement, but Norway's readings have deteriorated by 8.5 percent for these seven samples.

Discussion

The use of photographs for recording the interpretations of a large number of otoliths allows, for the first time, a detailed comparison of readings, and it is possible to find the actual causes of some of the differences between readers. The average number of different interpretations of the otoliths in each series is shown in Table 1. The figures for individual otoliths are given in the tables in Appendix 2. For one otolith there were twelve different interpretations giving five different ages, and in only 24 out of the 233 otoliths did all readers agree on both the age and the interpretation (Table 1). On eleven occasions nobody gave the best interpretation. The tables in Appendix 2 also show that the best age was sometimes arrived at by two, three or even four different interpretations, some of which indicate that the arrival at the best age was a chance occurrence, not a logical deduction from the otolith zones. Judging from these exchange results there are several important causes of error or of disagreements amongst otolith readers. These are:

1. Incorrect cutting of the otoliths. This is one reason why the best age often differs from all the readings in these samples. The report of the 1962 Workshop (ICNAF, 1963*b*) stressed the importance of breaking or cutting cod otoliths in the correct place (through the centre of the interruption in the *sulcus accusticus*). Several of the otoliths of the 1962 samples had to be reground to the correct plane, while others had already been ground too much. Few readers commented on these mistakes, although an error in ageing of one year may easily be caused by them.

2. The interpretation of the central zones. This has been one of the main causes of age differences in the exchange results, and the situation has been aggravated by (1) above. There are obviously widely differing opinions on which is the first annual hyaline zone. Series 6 (K16-25) illustrates the problem: nine out of the ten otoliths have a single well-marked hyaline zone in the centre, as in K17 (Fig. 3), which all readers except Norway counted as the first annual zone. Yet in Series 9 (K26-40) from the same subarea, the identical zone was counted by Norway as the first annual zone in all cases except one. Such lack of consistency is not entirely confined to Norway, and it is one of the main causes of discrepancy between the readings from the USSR and those from other countries.

This zone may be the so-called larval check ring that is laid down when the young cod change from being pelagic to demersal, but there is little published evidence to support this theory. Until evidence supporting or disproving this theory is obtained, greatest consistency will be obtained if all readers count such structures as annual zones.

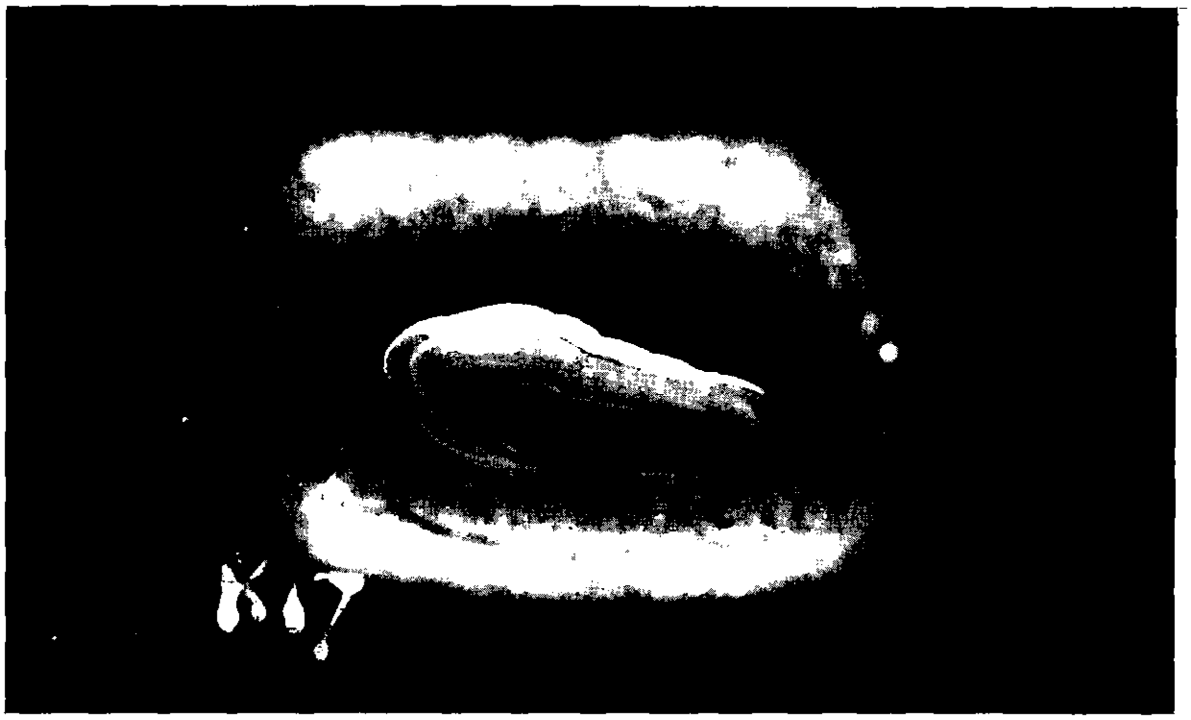

Fig. 3. Cod otolith K17 (17 cm, caught July 1961), showing a characteristic narrow but complete innermost hyaline zone, which all readers except Norway counted as the first annual zone.

The interpretation of the second winter zone has also caused difficulties. In some otoliths there is a complete broad hyaline zone which most readers have taken as the second winter zone as in O8 (Fig. 4), but others - Canada, St. Andrews, in particular - have sometimes taken such zones as checks. There may be unpublished evidence for discounting such zones, but if there is they should consistently be discounted. At present it seems better to count them always as annual zones.

In many of the otoliths, the first well-defined hyaline zone is followed by a succession of narrow opaque and hyaline rings which may be interpreted in many ways; then outside these the zones form a distinct pattern which cannot be missed. The only valid method of interpreting these inner zones is to examine them for repetition of a pattern. For example in H8 (Fig. 5), the innermost hyaline (zone 1) is split to form a definite double structure, which is followed by three more hyaline zones each containing a marked check. All readers counted zones 1 and 4 and some counted both zones 2 and 3, whereas others discounted one or both of them. These four zones are very similar in structure and the fact that zones 2 and 3 are close together does not seem to be a valid reason for discounting either or both of them.

Fig. 4. Cod otolith 08 (59 cm, caught June 1961), showing the type of broad second hyaline zone which should always be counted as an annual zone.

Fig. 5. Cod otolith H8 (60 cm, caught August 1960), showing four inner hyaline zones with the same structure, all of which should probably be counted as annual zones.

3. Interpretation of the otolith edge. Counting the current year's growth as an annual zone is a common cause of an error of one year in age reading. In Appendix 1 (Table 5), the readings which contain this error are marked with an asterisk. However, it is often very difficult to decide whether a hyaline edge is the current or previous year's growth in mature fish, in which the hyaline zone may be a single narrow ring laid down very late in the year and not completed until the following spawning season. As a general rule, the opaque zone is laid down earlier in the year in young fish than in older ones.

Related to this error is the failure to count spawning zones in otoliths where these hyaline zones are not laid down all around the otolith (Fig. 6). This is the main source of the high proportion of Russian readings which differ by more than three years from the best age. The probable cause of this error is the practice of always reading the age along the same line towards the wide end of the otolith.

Fig. 6. Cod otolith K10 (60 cm, caught August 1962) illustrating the discontinuity in the outermost zones towards the blunt tip.

4. Unreadable otoliths. In most otoliths in the exchange samples, the hyaline and opaque zones form a pattern which can reasonably be interpreted, but others - like H7 (Fig. 7) - show what can only be described as a conglomération of rings which do not fall into any recognizable pattern at all. The best interpretation of these is probably "?" or "unreadable" and it is surprising that in all the exchange series few readers described any otoliths as unreadable. In Jensen's notation (1963), these are defined as "poor" and the definition includes the phrase "...or where the age is merely estimated". Often these 'estimations' must have no basis other than the length of the fish, but length is not a valid criterion of age, and the inclusion of such 'ages' in data for age/length keys may cause considerable errors.

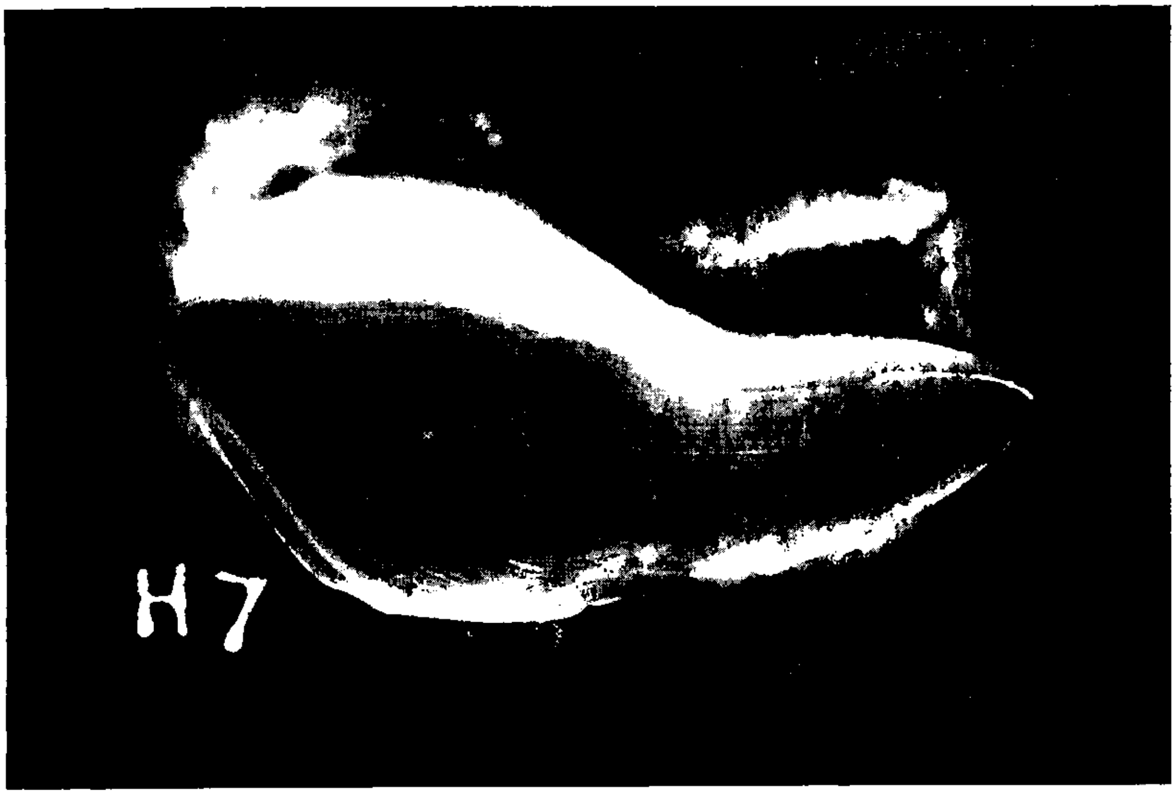

Fig. 7. Cod otolith H7 (60 cm, caught August 1960). Ages from 6 to 11 years were given. Any age is a guess and the best interpretation is "unreadable".

Conclusions and Recommendations

The 1963-67 exchange results show that there is a considerable measure of agreement amongst the otolith readers from the participating countries, but there are also some disagreements which might be lessened by a meeting of practising otolith readers. If such a meeting is practicable, it should perhaps be held before any further otolith exchanges are started.

The recommendations of the 1962 Workshop are still important, although some of the required material and data may have been collected by other laboratories since the recommendations were published (ICNAF, 1963*b*).

The problem of interpreting the central zones can only be solved by large collections of otoliths from small fish - presumed to be 0-, I- and II-group - taken at all seasons of the year. Studies on the feeding habits and seasons of these fish are also required. The otolith zones are presumed to be closely correlated with growth and feeding, so the data should be collected to prove or disprove this. Laboratory experiments may also help in studies of otolith structure. The writer recommends that the collection of these data should be continued.

Other recommendations are that:

1. Otolith readers should be reminded that the length of a fish is very rarely a valid criterion in determining its age.

2. Otolith readers should be encouraged to use a category "unreadable" instead of guessing the age of some poor otoliths.

3. Unless evidence to the contrary is, or becomes, available, the type of first hyaline zone illustrated in Fig. 3 should be counted as the first annual zone whenever it occurs.

4. Likewise the type of zone counted as the second annual zone in Fig. 4 should be counted until proved otherwise.

5. All published validation studies should include annotated photographs of the otoliths or whatever other structures are used for age determination.

Acknowledgements

The writer wishes to thank all those who have taken part in this otolith photograph exchange scheme for their cooperation.

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1. Comparative fishing by research vessels *A.T.Cameron* and *Walther Herwig*[1]

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Introduction

Through research programs submitted to and distributed by ICNAF prior to the 1967 Annual Meeting, and personal contact at this Meeting, the authors found that the R/V *A.T.Cameron* and *Walther Herwig* would be present off southern Labrador (Div.2J) at approximately the same time during the autumn of 1967. Preliminary plans for comparative fishing were made, and further details arranged through correspondence. It was found possible to overlap the cruise schedules by about 3 days, and the ships were in company, with the authors on board, from 20-22 October. Operations were hindered by bad weather, but 6 stations were fished together. Also, both ships occupied a series of hydrographic stations across Hamilton Inlet Bank, but at different times.

Ships, Gear and Methods

The two vessels are very different in size, fish by different methods (side versus stern), use different sized nets and fish at different speeds. Fuller details are listed in Table 1.

Table 1. Characteristics of vessels and gear

		A.T.Cameron	*Walther Herwig*
Ship:	Length overall	177 ft (54 m)	273 ft (83 m)
	Displacement (gross tons)	750	1,987
	Horsepower	1,000	2,000
	Type fishing	Side	Stern
	Speed of tow	3.5 knots	4.5 knots
Gear:	Headrope length	79 ft (24.1 m)	102 ft (31.2 m)
	Footrope length	100 ft (30.5 m)	140 ft (42.7 m)
	Rollers	Rubber, 21 in	Wood + iron, 21 in
	Net material	Courlene (polypropylene)	Perlon (polyamide)
	Net mesh sizes	5 - 3 1/4 in (127-83 mm)	5 1/2 - 4 3/8 in (140-110 mm)
	Codend material	Double Nylon (polyamide)	Double Perlon
	Codend mesh size	3 1/4 in (83 mm)	4 3/8 in (110 mm)
	Codend liner	Nylon 1 1/8 in (29 mm)	Perlon 1 1/4 in (32 mm)

[1] submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/96

At each station the ships fished a few hundred meters apart on parallel courses. Because of its greater towing speed, the *Walther Herwig* began each tow a short distance behind the *A.T.Cameron*, and finished a short distance ahead. All tows were of 30-min duration. Direction of tow was chosen so as to minimize the depth range for each tow.

Length measurements were made on all individuals of the major species in the catches except for the redfish catches of stations 5 and 6 (Table 2). Random samples were measured by both vessels at station 5, and by the *Walther Herwig* at station 6. These were adjusted to total catch before comparison. Measurements on the *A.T.Cameron* were of fork length to the nearest cm, on the *Walther Herwig* total length to the cm below. No adjustments were made to these original measurements. However, it may be noted that the differences tend to cancel each other since total lengths were measured to the cm below, but fork lengths to the nearest cm.

Catch comparisons

Positions and depths fished, and numbers and weights of the major species taken by each vessel are listed in Table 2. Cod, plaice and redfish only were sufficiently plentiful to give meaningful comparisons. Presence or absence in the catches of these and other species is noted in Table 3.

No comparison was possible for station 1 because of fouled gear by the *Walther Herwig*. In spite of this, it is curious that 20.5 kg (263 specimens) of the crab *Chionoecetes opilio* were taken at this station by the *Walther Herwig*, while none were captured by the *A.T.Cameron*.

As might be expected, the *Walther Herwig* consistently caught more of the major species, both by weight and numbers, than did the *A.T.Cameron*. Individual catch ratios were extremely variable, but on the average the *Walther Herwig* caught more than 4 times as much cod, about 1.5 times as much plaice, and between 1.25 and 1.5 times as much redfish.

Of greater interest are comparisons of average sizes caught. Average weights for each station are listed in Table 2, average lengths in Table 4, and length distributions plotted in Fig. 1. Average weights of fish caught were very similar except for the small plaice catches of stations 2 and 6. Length distributions (Fig. 1) were generally very similar, in spite of some small catches. Statistical comparison of average lengths (Table 4) resulted in significant differences at the .01 level in 2 out of 9 comparisons, these being the small plaice catches of station 2 and the large redfish catches of station 5. In the first instance, the difference was caused by a few large fish in the *A.T.Cameron's* catch; in the second instance, by a secondary peak in the *Walther Herwig's* catch (Fig. 1).

Hydrography

A line of stations from Seal Islands northeast across Hamilton Inlet Bank was occupied by the *Walther Herwig* on 19-20 October and by the *A.T.Cameron*

Table 2. Comparison of catches by *A.T.Cameron* and *Walther Herwig*. W = weight (kg), N = number, AW = average weight. Position and depths given are those recorded independently by both vessels. Depths ranges fished at each station do not extend more than ± 10 m from the given depths.

Station	Depth (m)	Position		Cod		Plaice		Redfish		Total Catch all Species	
				ATC	WH	ATC	WH	ATC	WH	ATC	WH
2	230	53°26'N 54°38'W	W	34	574	22.7	12.0	0	0	135	709
			N	25	449	35	40				
			AW	1.36	1.28	0.65	0.30				
3	205	54°01'N 53°36'W	W	77	170	81.6	131.0	0	0	190	394
			N	81	229	133	233				
			AW	0.95	0.74	0.61	0.56				
4	270	54°02'N 53°12'W	W	57	83	18.1	22.0	254	544	345	707
			N	89	125	33	41	311	822		
			AW	0.64	0.66	0.55	0.54	0.82	0.66		
5	310	54°00'N 53°03'W	W	0	3.6	3.6	11.8	1151	1223	1191	1352
			N		7	9	38	2578	2684		
			AW		0.51	0.40	0.31	0.45	0.46		
6	440	53°59'N 52°54'W	W	0	0	0.5	1.5	290	570	333	627
			N			2	3	364	778		
			AW			0.25	0.40	0.80	0.73		
Total Weight				168	830.6	126.5	178.3	1695	2337	2194	3789
Ratio WH/ATC				4.94		1.41		1.38		1.73	
Total Number				195	810	212	355	3253	4284	-	-
Ratio WH/ATC				4.15		1.67		1.32		-	

Table 3. Fish species present in each catch. Presence of the species is indicated by + for *Walther Herwig* and 0 for *A.T.Cameron*.

Species	comparative catches					
	1	2	3	4	5	6
Cod, *Gadus morhua*	⊕	⊕	⊕	⊕	+	
Redfish, *Sebastes* sp.				⊕	⊕	⊕
Plaice, *Hippoglossoides platessoides*	⊕	⊕	⊕	⊕	⊕	⊕
Greenland halibut, *Reinhardtius hippoglossoides*	0	⊕	⊕	⊕	⊕	⊕
Witch flounder, *Glyptocephalus cynoglossus*	⊕		⊕			
Striped wolffish, *Anarhichas lupus*	0	⊕	⊕	0	⊕	
Spotted wolffish, *Anarhichas minor*		⊕	+	⊕	⊕	
Broadhead wolffish, *Anarhichas denticulatus*		⊕	⊕	⊕	⊕	⊕
Roughhead grenadier, *Macrourus berglax*	⊕	⊕	⊕	⊕	⊕	⊕
Common grenadier, *Nezumia bairdii*						⊕
Roundnose grenadier, *Coryphaenoides rupestris*						⊕
Eel pouts, *Lycodes reticulatus* and *vahlii*	⊕	⊕	+	⊕	⊕	
Cusk, *Brosme brosme*						0
Thorny skate, *Raja radiata*	⊕	⊕	⊕	+		
Spinytail skate, *Breviraja spinicauda*					+	
Arctic sculpin, *Cottunculus microps*	+					
Hookeared sculpin, *Artediellus* sp.		⊕				
Capelin, *Mallotus villosus*			+			
Argentine, *Argentina silus*						+
Sea snail, *Liparis* sp.		+				
Black dogfish, *Centroscyllium fabricii*						⊕
Scaled lancet fish, *Paralepis* sp.	0					
Common alligator fish, *Aspidophoroides monopterygius*		0				
Lantern fish						0

on 26-27 October. Both vessels took temperatures at the following depths (meters) where these existed at the stations: 0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 600, 800, 1,000. Temperature and salinity sections are shown in Fig. 2 and 3. The station numbers and positions shown in the figures correspond to each other as follows:

W.H.	-	-	397	396	395	392	391	390
A.T.C.	51	52	53	53A	54	55	55A	56

A comparison of the temperature conditions over the southern part of Hamilton Inlet Bank, as observed by both vessels one week apart, shows that the temperature distribution at the eastern slope of the bank remained very much the same with bottom temperatures of about 1°C in 200-250 m increasing to over 4°C in 300-350 m. The core of cold Labrador water over the shallower part of the bank, with minimum temperatures below 0°C, was of greater volume during the first series of observations. The difference in depths at corresponding stations 397 (W.H.) and 53 (A.T.C.) was due to irregular depth contours within short distances in this part of the bank.

Table 4. Average lengths of fish from largest catches, with statistical comparisons. An asterisk (*) indicates a significant difference at the .01 level.

Species	Station		Number	Mean Length (cm)	Standard Deviation	Standard Error	t
Cod	2	ATC	25	48.88	10.94	2.19	.01
		WH	449	48.90	10.22	0.48	
	3	ATC	81	43.22	9.53	1.06	2.07
		WH	229	41.09	7.29	0.48	
	4	ATC	89	40.10	6.38	0.68	0.96
		WH	125	39.16	7.44	0.66	
Plaice	2	ATC	35	35.57	8.88	1.50	3.18*
		WH	40	30.05	5.80	0.92	
	3	ATC	133	36.92	8.67	0.75	0.24
		WH	233	37.14	8.30	0.54	
	4	ATC	33	36.70	6.91	1.20	0.38
		WH	41	36.07	6.97	1.09	
Redfish	4	ATC	311	37.22	5.75	0.32	2.13
		WH	822	36.40	5.80	0.20	
	5	ATC	2,578	30.19	4.25	0.08	3.94*
		WH	2,685	30.69	4.91	0.10	
	6	ATC	364	37.25	3.96	0.21	2.21
		WH	778	36.63	4.61	0.16	

The salinity distribution was determined by *Walther Herwig* only and it corresponds to the general pattern observed over the whole Labrador Shelf by three or more hydrographic sections taken by *Walther Herwig* in Div.2H and 2G since 14 October 1967. These are published separately in the German Research Report for 1967 (ICNAF Res.Doc.68/8, Part II, and *Redbook* 1968, Part II).

Conclusion

The most important point to be noted from these comparisons is that two ships of widely differing characteristics, with different sized nets and different towing speeds, but with codend liners of equal mesh size, produced very similar size distributions in the catches, although the amount of comparative hauls as well as sometimes the catches were rather small. This was so in spite also of different methods of fish measurement, suggesting that the above factors do not lead to appreciable differences in estimating size composition.

Differences which do appear *in Sampling Yearbooks* between months and areas thus probably represent real temporal and spatial variations within the stocks, provided that selection properties of codend meshes are the same.

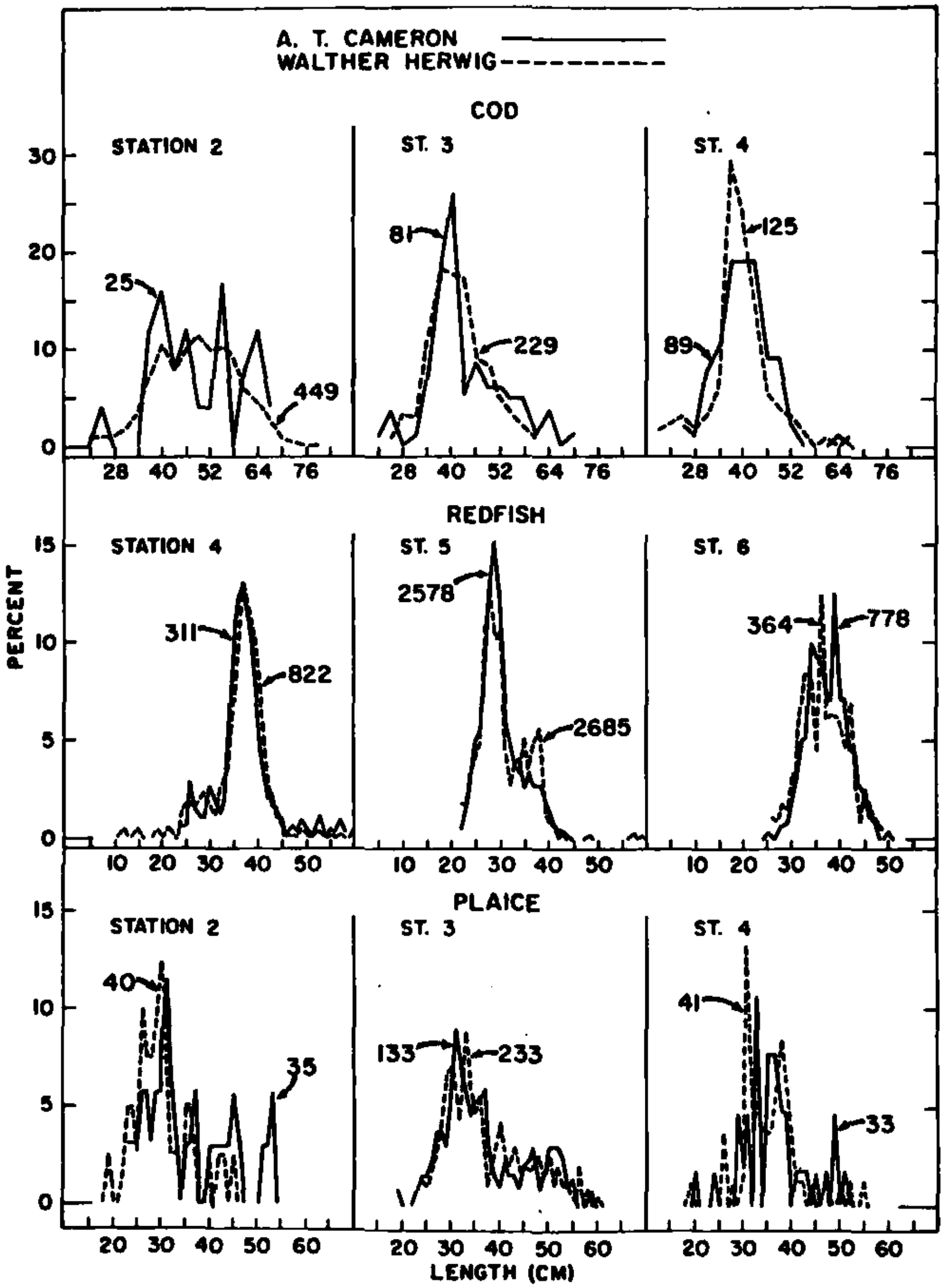

Fig. 1. Length distributions from largest catches of major species.

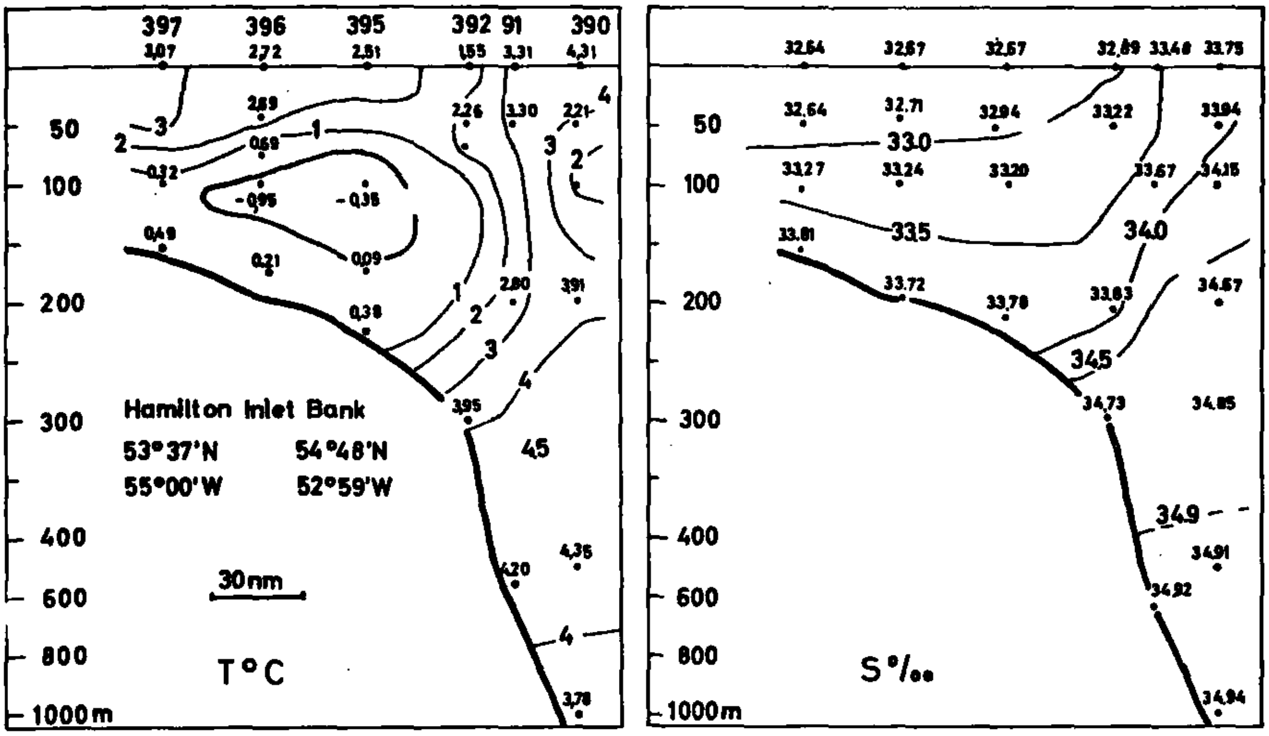

Fig. 2. Temperature and salinity distribution over Hamilton Inlet Bank compiled from *Walther Herwig* data, 19-20 October 1967.

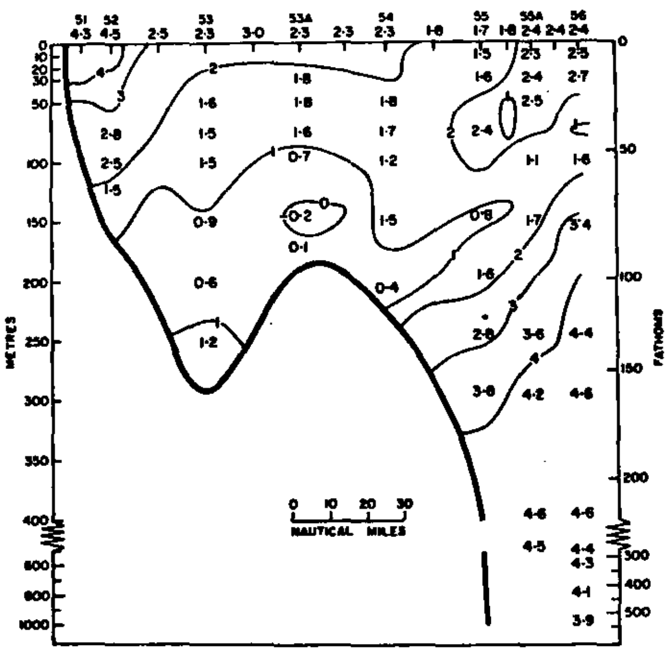

Fig. 3. Temperature distribution over Hamilton Inlet Bank compiled from *A.T.Cameron* data, 26-27 October 1967.

1. Summary of statistics on discards (whole fish returned to the sea), 1966[1]

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At its 1968 meetings, the Standing Committee on Research and Statistics adopted the following recommendation of the Subcommittee on Statistics and Sampling:

> "that the document arising from ICNAF Statistical Form 4 submissions (Res.Doc.68/21), insofar as it covers discards, should be published in Part III of the ICNAF *Redbook*" (*Redbook* 1968, Pt.I, p.71).

Discard data for the year 1966 were submitted by Canada (M), Canada (N), France (M), Fed. Rep. Germany, Poland, Portugal, Spain, UK and USA. Denmark (G) reported no information available on discards for 1966. USSR reported in 1964 that "the Soviet fishing vessels do not carry on any discard". Denmark (F), France (St.P), Iceland, and Norway did not report their data. Italy did not fish in the Convention Area in 1966.

In the following table, the percent discard is calculated from the discards (weight in metric tons of whole fish returned to the sea) and the gross catch (weight in metric tons of whole fish taken from the sea).

In order to provide a more complete assessment of the amount of discarded fish, the table presents total amounts of discard and gross catch as well as the total nominal catch (weight in metric tons of fish landed including the whole fish processed as fish meal at sea) for each subarea.

Abbreviations and Symbols Used

Species:	Had	-	haddock
	Red	-	redfish
	Flo	-	flounders
	Pla or (p)	-	American plaice
	Wit or (w)	-	witch
	Yel or (y)	-	yellowtail
	Gro	-	groundfish
	Pol	-	pollock
	Her	-	herring
	Sha	-	sharks
	Mix	-	mixed
Gear:	OT	-	otter trawl
	PT	-	pair trawl
	DS	-	Danish seine

(continued)

[1]Submitted to the 1968 Annual Meeting of ICNAF in ICNAF Res.Doc.68/21

Abbreviations and Symbols Used (cont'd)

Tonnage Class:	1	-	0- 50 GRT
	1b	-	26- 50 GRT
	2	-	51- 150 GRT
	3	-	151- 500 GRT
	4	-	501- 900 GRT
	5	-	901-1800 GRT
	6		over 1800 GRT
Country:	Can (M)	-	Canada (Maritimes and Quebec)
	Can (N)	-	Canada (Newfoundland)
	Fr (M)	-	France (Metropolitan)
	Ger	-	Germany
	Pol	-	Poland
	Por	-	Portugal
	Spa	-	Spain
	UK	-	United Kingdom
	USA	-	United States of America
Source of information:			
	Log	-	logbook
	Int	-	dockside interview
	Rep	-	current reports
Symbols:	...	-	not available or not reported
	-	-	magnitude known to be nil or zero
	ø	-	magnitude known to be more than zero but less than half the unit

Summary Table of Discards, 1966.

Div	Main Species Sought	Gear and Tonnage Class	Country	COD Discard in Tons	COD Gross Catch in Tons	COD Rate of Discard (%)	HADDOCK Discard in Tons	HADDOCK Gross Catch in Tons	HADDOCK Rate of Discard (%)	REDFISH Discard in Tons	REDFISH Gross Catch in Tons	REDFISH Rate of Discard (%)	FLOUNDERS Discard in Tons	FLOUNDERS Gross Catch in Tons	FLOUNDERS Rate of Discard (%)	MIXED Discard in Tons	MIXED Principal Species	MIXED Gross Catch in Tons	MIXED Rate of Discard (%)	Source of Information	Sampling Rate in %
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1B	Cod	OT 5	Fr(M)	661	31558	2				3	3	100	ϕ	ϕ	100					Log	100
	Cod	OT 4,5,6	Ger	155	16518	1				ϕ	192	ϕ				ϕ		353	ϕ	Rep	100
	Cod	OT 6	Pol	20	488	4														Int	33
	Cod	OT 6	Por													5		5	100	Log	100
	Cod	OT 5	Por	2	840	ϕ										2		2	100	Log	100
	Cod	PT 3	Spa	ϕ	887	ϕ										24		24	100	Log	72
1C	Cod	OT 5	Fr(M)	222	5831	4				2	2	100	ϕ	ϕ	100					Log	100
	Cod	OT 4,5,6	Ger	258	20660	1				25	2885	1				24		411	6	Rep	100
	Cod	OT 5	Por	1	272	ϕ										2		2	100	Log	100
	Cod	PT 3	Spa													10		10	100	Log	72
1D	Cod	OT 5	Fr(M)	38	2910	1				16	16	100	ϕ	ϕ	100					Log	100
	Cod	OT 4,5,6	Ger	376	24136	2				13	2961	ϕ				58		648	10	Rep	100
	Cod	PT 3	Spa													11		11	100	Log	72
1E	Cod	OT 5	Fr(M)	41	2033	2				3	3	100	ϕ	ϕ	100					Log	100
	Cod	OT 4,5,6	Ger	39	11566	ϕ				15	2670	1				29		419	7	Rep	100
	Cod	OT 5	Por													1		1	100	Log	100
	Cod	OT 5	Spa	1	44	2										1		1	100	Log	60
1F	Cod	OT 5	Fr(M)	2	41	5														Log	100
	Cod	OT 4,5,6	Ger	175	10347	2				33	5828	1				64		467	14	Rep	100
	Cod	OT 5	Por													1		1	100	Log	100
1B-1F	Mix	OT 4,5	UK													1298	Cod	20624	6	Int	7
Total[1]				1991	128131	2				110	14560	1	ϕ	ϕ	100	1530		22979	7		
Subarea 1. Total Nominal catch					366126						16758			2788				...			

[1] For gear and tonnage classes reporting discard data

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
2G	Cod	OT 5	Fr(M)	1	39	2														Log	100
	Cod	OT 4,5,6	Ger	40	4700	1				∅	153	∅				8		72	11	Rep	100
2H	Cod	OT 5	Fr(M)	132	5902	2				11	11	100	∅	∅	100					Log	100
	Cod	OT 4,5,6	Ger	200	22550	1				∅	1101	∅				39		403	10	Rep	100
	Cod	OT 6	Pol	400	12284	3				20	494	4	2	261	1					Int	33
	Cod	OT 5	Por	108	6723	2										38		38	100	Log	100
	Cod	OT 5	Spa	22	4622	∅										76		76	100	Log	53
2J	Cod	OT 5	Fr(M)	858	26253	3				64	64	100	19	19	100					Log	100
	Cod	OT 4,5,6	Ger	324	36719	1				32	1385	2				63		566	11	Rep	100
	Cod	OT 6	Pol	500	18366	3				10	689	1	10	639	2					Int	33
	Cod	OT 6	Por	55	3066	2										50		50	100	Log	100
	Cod	OT 5	Por	443	33887	1										174		174	100	Log	100
	Cod	OT 5	Spa	506	43795	1										968		968	100	Log	57
	Cod	PT 3	Spa													10		10	100	Log	72
2G-2J	Mix	OT 4,5	UK													1664	Cod	11241	15	Int	7
Total[1]				3589	218906	2				137	3897	4	31	919	3	3090		13598	22		
Subarea 2. Total Nominal Catch					337877						14010					3237		...			
3K	Cod	OT 5	Fr(M)	268	17917	2				163	171	96	∅	∅	100					Log	100
	Cod	OT 4,5,6	Ger	5	2399	∅				∅	215	∅				2		54	4	Rep	100
	Cod	OT 6	Por	198	1329	15										50		50	100	Log	100
	Cod	OT 5	Por	64	11397	1										59		59	100	Log	100
	Cod	OT 5	Spa	72	9376	1										293		293	100	Log	55
	Cod	PT 3	Spa													1		1	100	Log	72
	Red	OT 6	Pol	50	4504	1				200	10690	2	10	2526	∅					Int	33
3L	Cod	OT 4	Can(N)	∅	388	∅							(p) ∅	193	∅					Log	20
	Cod	OT 3	Can(N)	21	3238	1							(p)54	1462	4					Log	19
	Cod	OT 5	Fr(M)	464	22167	2	38	∅	99	116	122	95	2	2	100	114		114	100	Log	100
	Cod	OT 4,5,6	Ger	11	6314	∅				∅	143	∅				4		168	2	Rep	100
	Cod	OT 6	Por	9	4543	∅										92		92	100	Log	100
	Cod	OT 5	Por	167	33799	∅										353		353	100	Log	100
	Cod	OT 5	Spa	162	20215	1										721		721	100	Log	59
	Cod	PT 3	Spa	10	12646	∅	12	523	2							160		160	100	Log	72
	Pla	OT 4	Can(N)	∅	995	∅							(p) ∅	3184	∅					Log	33
	Pla	OT 3	Can(N)	38	1851	2							(p)268	7053	4					Log	19
	Gro	OT 3	Can(M)										193	4580	4					Log	2

[1]For gear and tonnage classes reporting discard data

1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3M	Cod	OT	5	Fr(M)	7	4089	ø				150	150	100								Log	100
	Cod	OT	4,5,6	Ger	ø	195	ø				ø	11	...								Rep	100
	Cod	OT	5	Por	17	439	4										52		52	100	Log	100
	Cod	OT	5	Spa	45	4313	1										158		158	100	Log	68
3N	Cod	OT	3	Can(N)	17	1029	2	ø	73	...				(p)ø	572	ø					Log	12
	Cod	OT	5	Fr(M)	20	611	3				9	9	100								Log	100
	Cod	OT	5	Por	6	2617	ø										16		16	100	Log	100
	Cod	OT	5	Spa	9	2745	ø										120		120	100	Log	69
	Cod	PT	3	Spa	70	29307	ø	36	704	5							696		696	100	Log	72
	Had	OT	3	Can(N)				ø	115	ø											Log	30
	Red	OT	6	Pol	5	618	1				30	2506	1								Int	33
	Pla	OT	4	Can(N)	ø	1056	ø				ø	96	ø	(p)ø	6989	ø					Log	22
	Pla	OT	3	Can(N)	23	1714	1							(p)944	16670	6					Log	18
	Wit	OT	3	Can(N)	ø	21	...	ø	22	...				(p)29	140	21					Log	32
	Yel	OT	3	Can(N)	ø	73	...							(p)(y)ø	1353	ø					Log	13
	Gro	OT	3	Can(M)										840	8543	10					Log	9
3O	Cod	OT	4	Can(N)	ø	92	ø	ø	8	...											Log	100
	Cod	OT	3	Can(N)	ø	210	ø	ø	77	...				(p)ø	78	...					Log	11
	Cod	OT	5	Fr(M)	4	163	2														Log	100
	Cod	OT	5	Spa	8	213	4										20		20	100	Log	59
	Cod	PT	3	Spa	113	20468	1	28	406	7							550		550	100	Log	72
	Red	OT	6	Pol							5	457	1								Int	33
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	Wit	OT	3	Can(N)	ø	140	ø	ø	76	...				ø	1191	ø					Log	3
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	Cod	PT	3	Spa													28		28	100	Log	72
	Red	OT	3	Can(N)	ø	168	ø				ø	3465	ø								Log	11
3Ps	Cod	OT	3	Can(N)	69	4299	2	ø	237	ø	2	491	ø	ø	358	ø					Log	7
	Cod	OT	5	Fr(M)	68	4337	2	3	5	60	194	194	100	1	1	100					Log	100
	Cod	OT	5	Por	6	525	1										2		2	100	Log	100
	Cod	OT	5	Spa	11	1298	1										19		19	100	Log	85

1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3Ps	Cod	PT	3	Spa	115	22506	1	49	566	9							320		320	100	Log	72
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	Red	OT	1,2,3	USA	1	1	100														Int	...
	Pla	OT	3	Can(N)	ø	83	ø				ø	39	...	(p)2	437	ø					Log	32
	Wit	OT	3	Can(N)	ø	16	...	ø	24	...	ø	25	...	(w)54	131	41					Log	33
Total[1]					2213	261817	1	184	2959	6	1007	27896	4	3664	59894	6	3837		4053	95		
Subarea 3, Total Nominal Catch						498665			9854			79108					111101		...			
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	Cod	OT	3	Can(N)	46	4528	1	ø	112	ø	ø	846	ø	ø	137	ø					Log	12
	Cod	OT	5	Fr(M)	408	10051	4	27	27	100	72	72	100	16	16	100					Log	100
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	Red	OT	3	Can(N)	ø	320	ø				ø	12143	ø								Log	14
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	Red	OT	2	Can(M)							2299	15214	15								Log	11
	Red	OT	1b	Can(M)							432	4099	11								Log	7
	Red	OT	3	Can(N)							ø	824	ø								Log	31
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	Cod	OT	5	Fr(M)	47	1056	5	21	21	100	2	2	100	60	60	100					Log	100
	Red	OT	3	Can(M)							504	1677	30								Log	2
	Red	OT	2	Can(M)							258	4230	6								Log	6
	Red	OT	1b	Can(M)							511	2284	22								Log	9
	Gro	OT	3	Can(M)	122	2468	5														Log	15
	Gro	OT	3	Can(M)										180	1096	16					Log	6
	Gro	OT	1b	Can(M)	334	9888	3														Log	1
	Gro	OT	1b	Can(M)										1422	3854	37					Log	8
	Gro	DS	2	Can(M)										585	969	60					Log	1
	Gro	DS	1b	Can(M)	130	2330	6														Log	4
	Gro	DS	1b	Can(M)										665	2681	25					Log	7

[1]For gear and tonnage classes reporting discard data

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
4Vn	Cod	OT 4	Can(N)	0	517	0														Log	12
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	Cod	OT 5	Por	5	143	3										1		1	100	Log	100
	Cod	PT 3	Spa	47	2252	2										72		72	100	Log	72
	Red	OT 3	Can(M)							70	3131	2								Log	2
	Red	OT 3	Can(N)							0	1750	0								Log	22
	Wit	OT 3	Can(N)							0	30	...	0	113	0					Log	13
	Gro	OT 3	Can(M)	141	6863	2														Log	8
	Gro	OT 3	Can(M)										306	2556	12					Log	3
	Gro	OT 1b	Can(M)	10	456	2														Log	10
	Gro	OT 1b	Can(M)										5	169	3					Log	1
	Gro	DS 1b	Can(M)										1037	1739	60					Log	1
4Vs	Cod	OT 4	Can(N)	0	276	0	0	3	...	0	16	...	0	9	...					Log	6
	Cod	OT 3	Can(N)	0	710	0														Log	8
	Cod	OT 5	Fr(M)	74	1486	5				9	9	100								Log	100
	Cod	OT 5	Spa	0	19	...										8		8	100	Log	100
	Cod	PT 3	Spa	49	18951	0	49	984	5							464		464	100	Log	72
	Red	OT 3	Can(N)							0	612	0								Log	21
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	Gro	OT 3	Can(M)				311	7369	4											Log	3
	Gro	OT 3	Can(M)										195	907	21					Log	9
	Gro	OT 3	Can(M)													328	Pol	5086	6	Log	1
	Gro	DS 1b	Can(M)										198	662	30					Log	1
4X	Cod	PT 3	Spa	4	807	0	2	145	1							22		22	100	Log	72
	Had	OT 2,3	USA				21	1722	1											Int	67
	Red	OT 1,2,3	USA													64	Her	64	100	Int	33

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
4X	Gro	OT 3	Can(M)	427	7622	6														Log	1
	Gro	OT 3	Can(M)				5014	12881	39											Log	1
Total[1]				3606	124027	3	5589	26674	21	5126	56110	9	5600	24934	22	1847		6605	28		
Subarea 4, Total Nominal Catch					215254			66092			106051			55036				...			
5Y	Red	OT 1,2,3	USA													17	Sha	17	100	Int	33
	Gro	OT 3	Can(M)	3	93	3														Log	10
	Gro	OT 3	Can(M)				2	392	0											Log	48
5Z	Cod	PT 3	Spa	1	8376	0	90	1201	9							111		111	100	Log	72
	Had	OT 2,3	USA				27	38479	0											Int	67
	Flo	OT 1,2	USA										(y)6968	29740	23					Int	3
	Her	OT 6	Pol	3	272	1										100	Her	14573	1	Int	33
	Gro	OT 3	Can(M)	1242	13129	9														Log	1
	Gro	OT 3	Can(M)				1801	17737	10											Log	2
Total[1]				1249	21870	6	1920	57809	3				6968	29740	23	228		14701	2		
Subarea 5, Total Nominal Catch					57255			126978						53751				...			

[1]For gear and tonnage classes reporting discard data

1. Temperatures and salinities, 1967 at Station 27 and in the St. John's-Flemish Cap section[1]

by Wilfred Templeman
Fisheries Research Board of Canada
St. John's, Newfoundland, Canada

At Station 27 near St. John's (Fig. 1), late winter, early spring, and summer deep-water temperatures in 1967 were considerably lower than in 1966, a little lower than in 1963 and 1965, close to but on the average a little lower than those of 1964, and lower than the average for 1950-62 (Templeman, 1965).

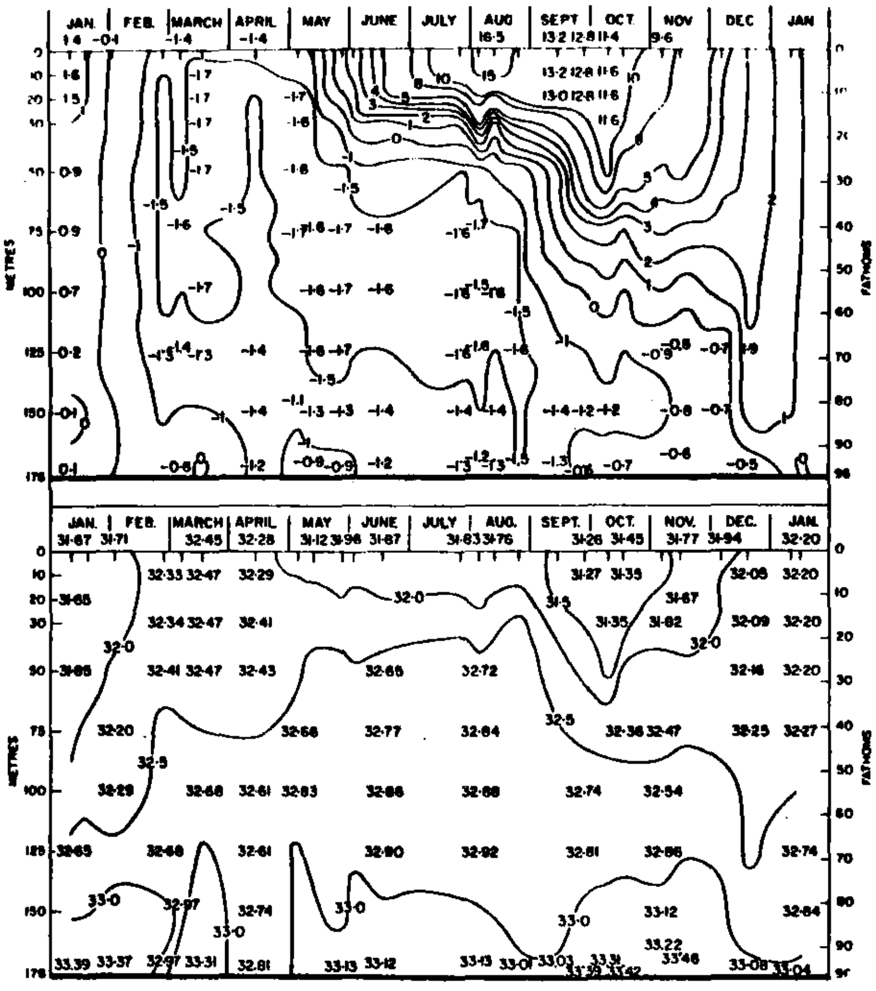

Fig. 1. Above, temperature (°C) and below, salinity ‰ from surface to bottom at Station 27 (see Fig. 2 insert), 2 nautical miles off Cape Spear near St. John's, January 1967 to January 1968.

[1]Submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/3

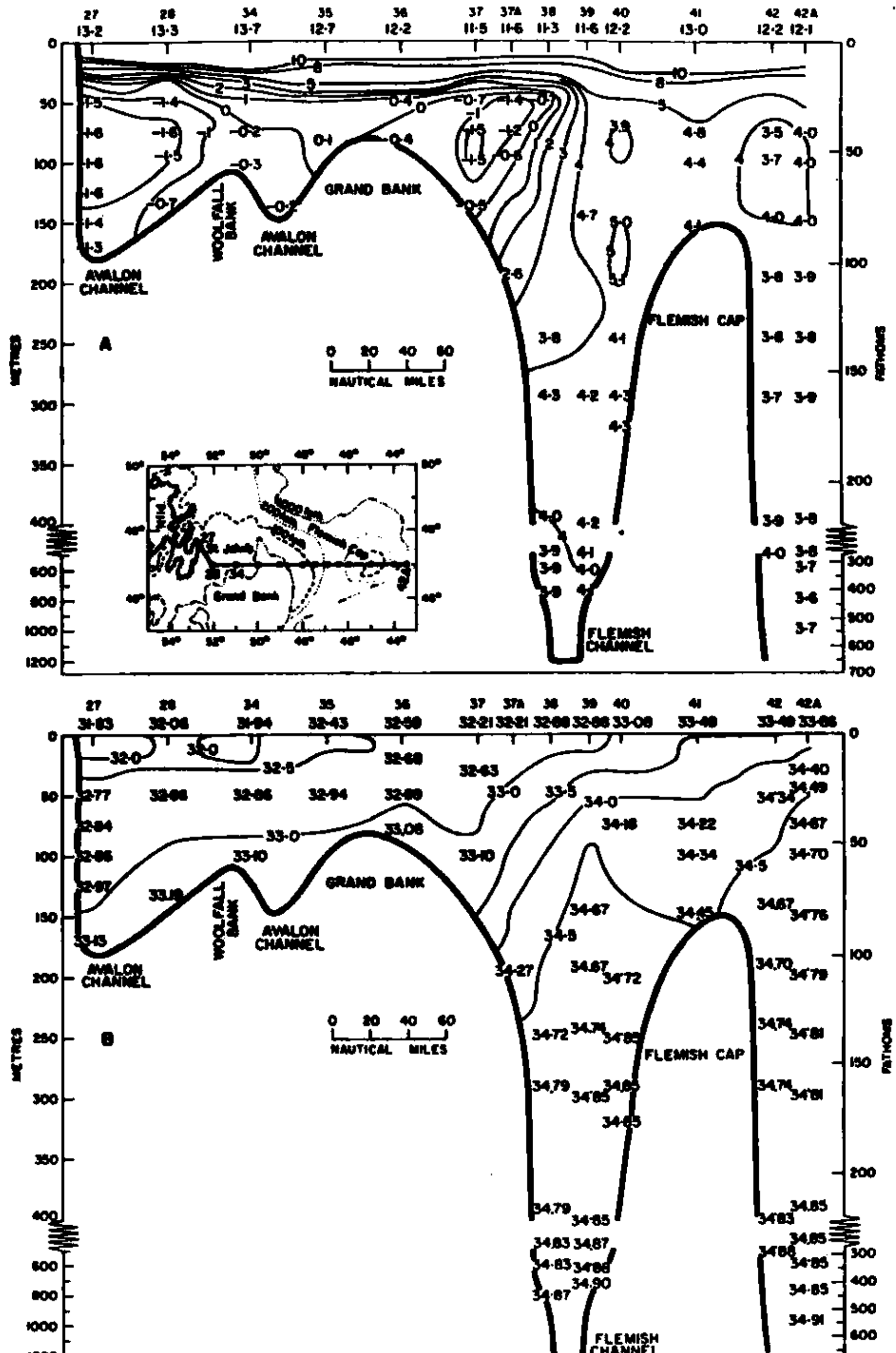

Fig. 2. Above, temperature (°C) and below, salinity ‰ sections, St. John's-Grand Bank-Flemish Cap, 25-27 July 1967.

Surface temperatures from August to November were higher than usual and well above the 1950-62 average. The salinity picture was not much different from those of 1965 and 1966.

Because of shortage in vessel time, only one (St. John's to Flemish Cap) of the 6 standard hydrographic sections across the Labrador Current was occupied.

In this section, taken on 25-27 July (Fig. 2), the temperatures of the colder cores of the Labrador Current were considerably lower than in 1966 and bottom temperatures in the Avalon Channel and over the surface of the Grand Bank were lower also.

Surface temperatures in 1967 were higher than the averages for 1951-65, though not as high as the highest surface temperatures for this period. In the eastern part of the section, surface temperatures were a little lower, and over the Avalon Channel they were generally approximately the same as in 1966.

Although the temperatures of the colder water cores of the Labrador Current were below the 1951-65 averages and contained temperatures as low as any obtained during this period, the temperatures in Flemish Channel and on the seaward face of Flemish Cap were higher than the 1951-65 averages and were approximately as high as the highest temperatures of this period. Those in Flemish Channel, however, were only slightly higher than those of 1966. In 1966 the stations seaward of Flemish Cap were not occupied.

Bottom salinities in the Avalon Channel were a little lower than in 1965 or 1966 but otherwise the salinity picture did not change very much.

Acknowledgements

I am grateful to the various scientists and technicians of the St. John's Station who have taken the various hydrographic observations and especially to Mr G.H.Winters who, as scientist-in-charge of the *A.T.Cameron* cruise, carried out the Flemish Cap section and to Mr A.G.Kelland, the technician most closely associated with hydrographic work at the St. John's Station.

Reference

Templeman, W., 1965. Anomalies of sea temperature at Station 27 off Cape Spear and of air temperature at Torbay-St. John's. *Spec. Publ. int. Comm. Northw. Atlant. Fish.*, No.6, p.795-806.

2. Hydrological conditions in the Labrador and Newfoundland areas in 1967[1]

by V.V.Burmakin
PINRO, Murmansk, USSR

Introduction

In 1967 oceanographic observations were carried out on board R/V *Sevastopol*, *Novorossiisk*, *Kreml*, *Rossiya* and *Volgograd* in ICNAF Subareas 1, 2 and 3. The first two ships conducted investigations on the distribution of temperature, salinity, oxygen and biogenic elements on standard hydrological sections (Fig. 1) and at trawling stations. Scouting vessels made observations from time to time.

Table 1 shows cruises carried out in 1967.

Table 1. Oceanographic cruises and observations carried out in 1967.

Ser. No	Cruise No	Vessel	Date of Observations	Area of Investigations	Sections	Kind of Observations
1	-	*Kreml*	Dec 1966-Feb 1967	Flemish Cap Bank, Southern Grand Bank, South Labrador	6A 2A	t°, s‰, O_2
2	8	*Rossiya*	Dec 1966-Apr 1967	South and Central Labrador	8A	t°, s‰, O_2, P, N
3	21	*Novorossiisk*	Jan-May 1967	Labrador, North Newfoundland Bank, Iceland	14-15A 8A, 7A	t°, s‰, O_2, P, N
4	26	*Sevastopol*	Feb-May 1967	North Newfoundland and Grand Bank, Cabot Strait	7A,6A,4A 3A,2A,1A 1A up to 45°	t°, s‰, O_2, P, N
5	-	*Kreml*	30 Mar-18 May 1967	North Newfoundland and Grand Bank	-	t°, s‰
6	-	*Volgograd*	17 July-18 Oct 1967	Iceland, West Greenland, Labrador and Grand Bank	10A 8A	t°, s‰
7	22	*Novorossiisk*	12 Aug-1 Dec 1967	Iceland, Davis Strait, Labrador, North Newfoundland Bank	14AD 14-15A 8A,7A Survey of Davis Strait	t°, s‰, O_2, P, N

[1] submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/37

Water Temperature Fluctuations of the Labrador Current

Burmakin (1967) showed that, in January 1967 on Section 8A across the Hamilton Bank (Fig. 1), the average temperature in the 0-200 m layer between 54°44'N and 54°57'W was 1.30°C, *i.e.* 0.75°C higher than it was observed in the same month in 1964 but 0.89°C lower compared to 1966.

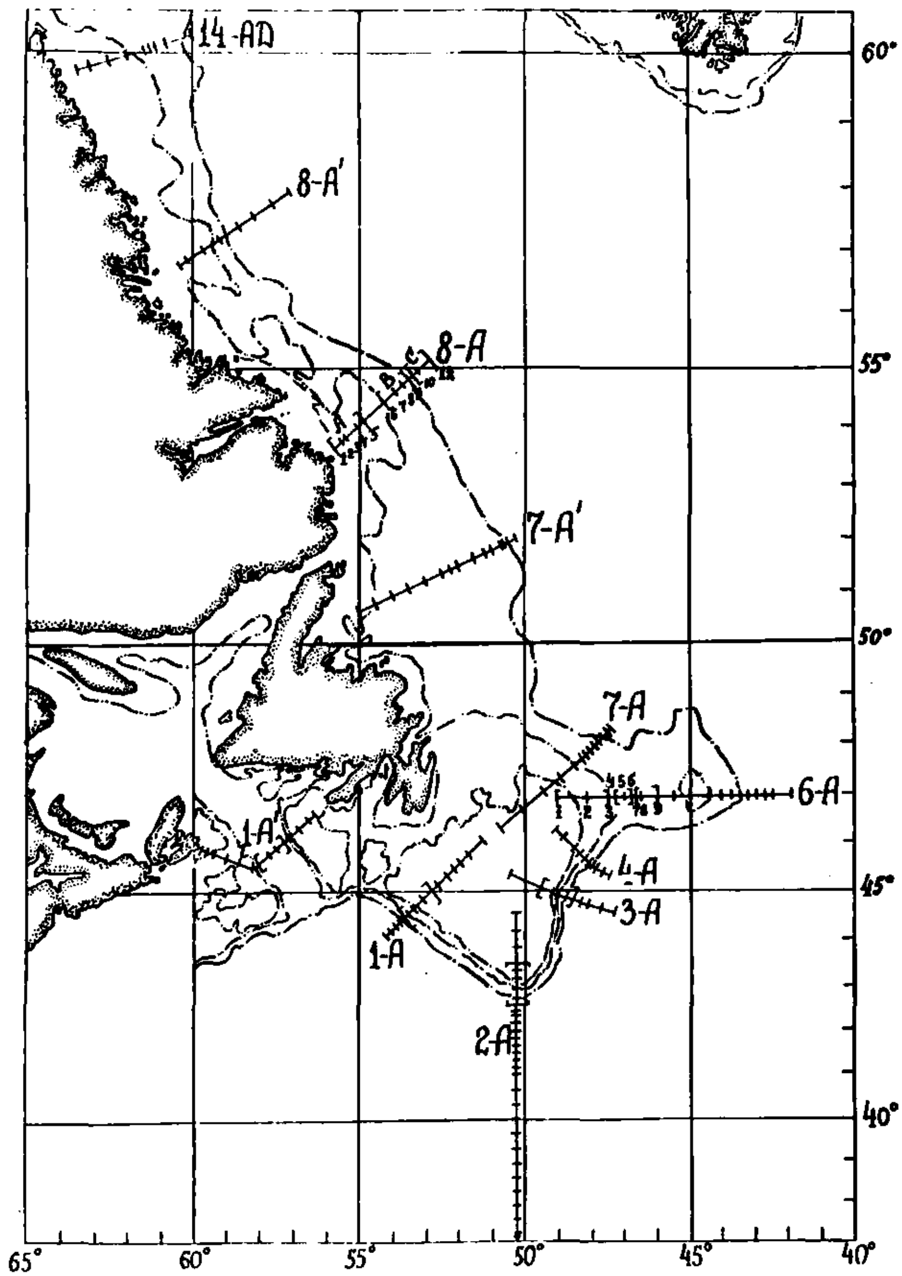

Fig. 1. Location of standard hydrological sections in the Labrador and Newfoundland areas.

In February 1967, inner waters of the Labrador Shelf were also colder than at the same time in the previous year. However the temperature of the warm part of the Labrador Current was considerably higher in 1967 than in 1966 (Table 2, Fig. 1). As the table shows, warm waters of the Labrador Current can enter its cold part and as a result late in February a sharp heating occurred, especially in the near-bottom layers of Hamilton Bank.

Table 2. Average temperature (°C) at four stations of Section 8A

Depth (m)	Date	No of Station 6	7	8	9
0-50	10 Feb 1966	0.20	-1.68	0.24	-0.32
	10 Feb 1967	-0.91	-1.55	-0.64	2.92
	26 Feb 1967	-1.49	-0.95	0.94	2.53
0-200	10 Feb 1967	-1.48	0.47	2.10	1.48
	10 Feb 1967	-1.64	0.13	1.54	3.66
	26 Feb 1967	-0.50	1.28	2.06	3.46

In March, observations were carried out on Sections 6A and 2A.

Earlier, a comparison between average temperatures and the standard (Burmakin, 1967) showed that in March 1967 the temperature in the 0-200 m layer was below the standard (-0.23°C) in the cold part of the Labrador Current (Stations 1-3, Fig. 1) and it was 0.19°C and 0.06°C above the standard (Stations 4-6 and 7-9 respectively) in warm mixed waters.

Thus, in the Labrador and Newfoundland areas, the water temperature of the main (cold) branch of the Labrador Current was below the standard of 1960-1967 and 1966 and in warm mixed waters it was higher than this standard in winter and spring 1967. Therefore, the strengthening of both the cold and warm components of the Labrador Current occurred simultaneously.

No observations were carried out in summer. In autumn, investigations were conducted in September, October and November, mainly in the Labrador and North Newfoundland bank areas.

We had the possibility to compare data on water temperatures on Section 8A carried out in September 1967 with temperatures taken in the same month in 1964 (Table 3, Fig. 1). As is evident from the table, the surface (0-50 m) layer was warmed to a greater extent in 1967 than in 1964, and this affected the temperature of the active layer (0-200 m). On the other hand, the cold part (AB) of the waters (that were affected by the heating insignificantly) in the 50-200 m layer was warmer (approximately by 1°C) and the warm part (C) was colder (by 0.4°C) in 1967 compared to 1964. In September 1967 in the near-bottom layers (200-500 m), the temperature was also 0.2-0.5°C higher than in September 1964.

Table 3. Average temperature (°C) on Section 8A in coastal (A), main (B) and warm (C) streams of the Labrador Current in September 1964 and 1967.

Depth (m)	Date	Parts of the Section A	B	C	AB	ABC
0-50	4 Sept 1964	2.65	1.75	4.92	2.33	2.49
	11 Sept 1967	4.53	3.24	6.32	3.75	3.90
0-200	4 Sept 1964	0.28	0.33	4.00	0.27	0.50
	11 Sept 1967	1.34	1.59	4.08	1.18	1.35
50-200	4 Sept 1964	-0.78	-0.13	3.70	-0.46	0.39
	11 Sept 1967	0.48	1.05	3.34	0.53	0.70
200-500	4 Sept 1964	-	1.24	4.12	-	-
	11 Sept 1967	-	1.71	4.30	-	-

In October and November 1967, temperatures observed on Section 8A are similar to those in 1958, 1962, 1964, 1965 and 1966 (Table 4).

These data show that in October 1967 waters in the coastal branch of the Labrador Current were very warm (the average anomaly is +0.5) and those in the main branch were colder than in 1962 and 1966 but warmer compared to 1964 (the average anomaly -0.4). Consequently, the water temperature of the Labrador Current (AB) was insignificantly (+0.1°C) higher than the standard of 1962-67; in the warm stream (C), the temperature was lower than in 1962, 1964 and 1966. In November 1967, the warming occurred: near-bottom warm waters moved on the slope to the inner part of the Labrador Shelf and as a result their temperature increased by 2-3°C compared to that observed in October and reached 3-4°C. Similar warming was observed from January to February 1967 (see above) and also since October to November 1962 (Table 4). If we consider that temperature maxima in near-bottom layers off Greenland are always observed in February and November (see the data collected on the Godthaab station in papers by Hermann, *ICES Ann. Biol.* for 1947-66), then one can assume that these warmings are due to one general reason, namely to the temperature maximum in August in the Gulf Stream system in middle latitudes in the area occupied by the weather ship DELTA. In November 1967, in near-bottom layers (200-500 m), the temperature was 0.1°C higher than that in 1958 but almost 1°C lower compared to 1962 and 1965.

Table 4. Average temperatures (°C) in the 0-200 m layer in the coastal (A), main (B) and warm (C) streams of the Labrador Current in October and November 1958-1967.

Date	Streams A	B	C	AB	ABC	Date	Streams A	B	AB
16 Oct 1962	0.62	1.76	4.61	1.08	1.89	24 Nov 1958	1.15	1.34	1.25
24 Oct 1964	0.05	0.41	4.23	0.17	1.07	26 Nov 1962	1.70	3.60	2.20
16 Oct 1966	0.93	2.27	5.25	1.46	2.40	13 Nov 1965	0.80	2.11	1.38
21 Oct 1967	1.07	1.12	4.22	1.10	1.71	11 Nov 1967	1.42	1.22	1.28

Horizontal Distribution of Near-Bottom Temperatures in Winter 1964-67

Figure 2 A,B,C,D shows charts of the horizontal distribution of near-bottom temperatures off Labrador and on the Grand Bank in winter 1964-67. These charts are drawn from observations carried out in cruises while determining the abundance of young fish from on board the R/V *Sevastopol*, *Pobyeda* and *Novorossiisk* on standard hydrological sections and trawling stations. As shown, the greatest occurrence of cold waters with a negative temperature of the Labrador Current eastwards and southwards of the Grand Bank was found in winter 1964 and 1965; in 1967, it was not so great, and in winter 1966, it became very warm and no negative temperatures were observed off South Labrador and on the Grand Bank. Warm waters intensively invaded the slopes of the Labrador Shelf and Grand Bank in 1965 and 1967.

These observations as well as mean water temperatures confirm that it was colder in winter 1967 than in 1966, but it was warmer compared to the winter 1964 and 1965.

Location of the Polar Front in the Southern Grand Bank in May 1956-59, 1961-62 and 1967

It is well known that, to the south of the Grand Bank, the Gulf Stream is observed within 42-43°N. An attempt was made to track the position of the 5°C isotherm in Section 2A in May 1956-59, 1961-62 and 1967 (Fig. 3). Figure 3 indicates that in May 1958 and 1967, the Gulf Stream was very close to the "tail" of the Grand Bank. It is known that 1958 was a warm hydrological year; 1967 was not so warm as 1958 owing to the fact that the northern boundary of the Gulf Stream was found more to the south.

Temperature Distribution off Labrador and North Newfoundland Bank in Autum 1967

From observations carried out in October-November 1967 on board R/V *Novorossiisk*, diagrams were constructed of the vertical distribution of water temperature on the following sections: 14AD across the North Labrador Shelf, 8A' across the Central Labrador Shelf, 8A across the Hamilton Bank and 7A across the North Newfoundland Bank (Fig. 4 A,B,C,D).

As is evident from Fig. 4, in autum 1967, almost no negative temperatures were registered over the whole area of the Labrador Shelf and North Newfoundland Bank.

In autumn 1962, it was also warm in the Labrador Shelf area. Observations by Ramster (1964) showed that in November-December 1962, as well as in November 1967, waters with a negative temperature were not met cff Labrador.

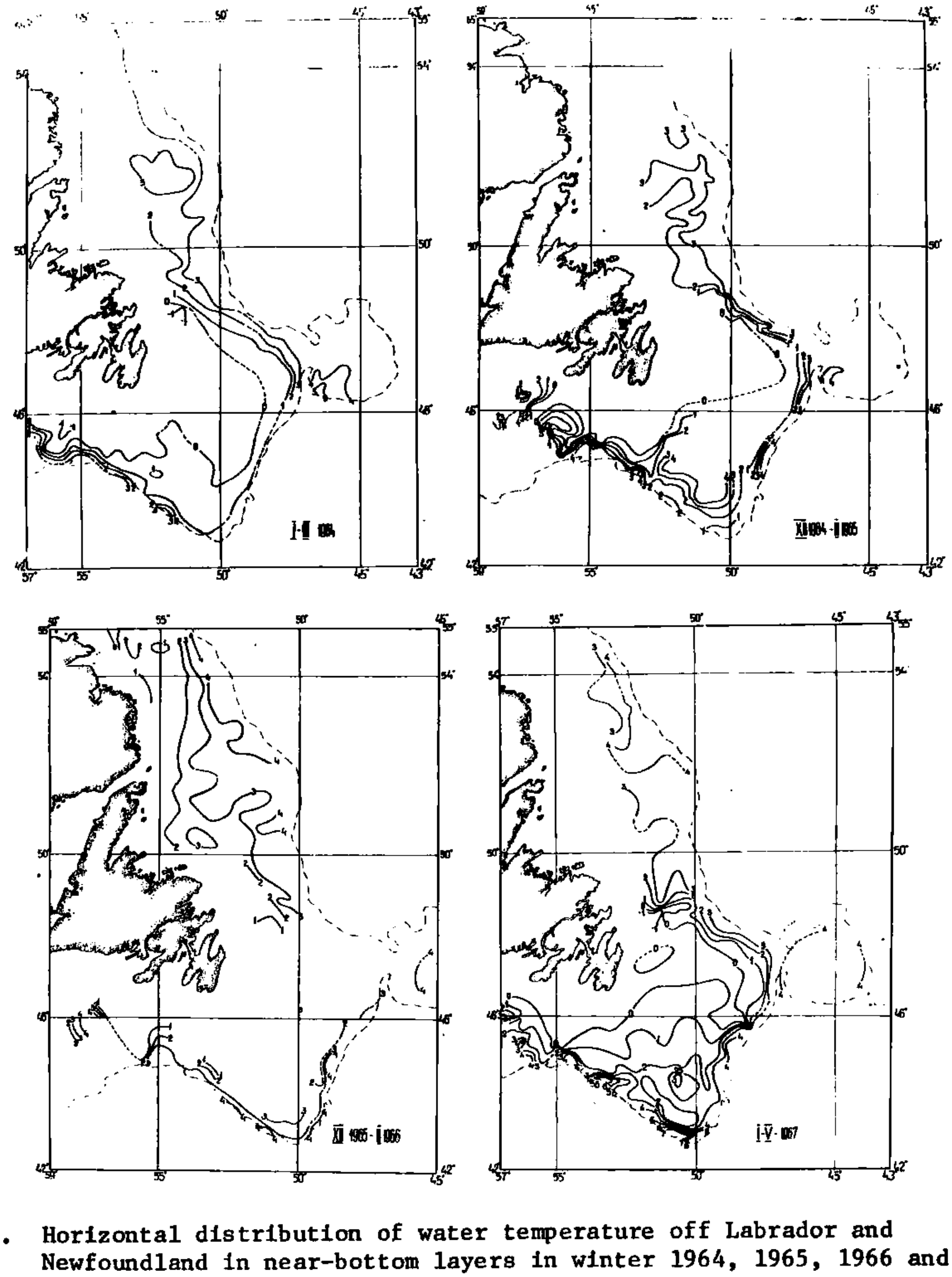

Fig. 2. Horizontal distribution of water temperature off Labrador and Newfoundland in near-bottom layers in winter 1964, 1965, 1966 and 1967.

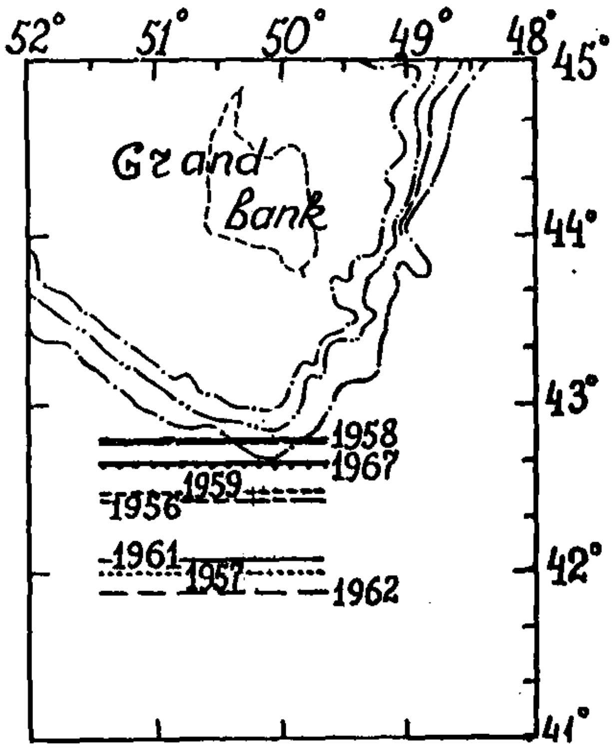

Fig. 3. Position of the 5°C isotherm in the southern Grand Bank (Section 2A) in May 1956-59, 1961-62 and 1967.

Summary

1. Near Labrador and Newfoundland it was colder in winter and spring 1967 than in the previous year, but it was warmer than in 1964. The strengthening of both the warm and cold components of the Labrador Current took place simultaneously. In September 1967, the temperature was about 1°C higher than in 1964. In October and November, it was colder than in 1965 and 1966 but it was warmer compared to 1962 and 1964.

On the whole, the thermal conditions in 1967, as in the previous two years, remained above the long-term standard; however, a cooling tendency was observed compared with 1965 and especially since 1966.

2. In the area of Labrador-North Newfoundland Bank, two temperature maxima were recorded: one in February and the other in November 1967.

3. Conclusions drawn by Ramster (1962) that in November waters with a negative temperature were not met in the Labrador and North Newfoundland Bank areas were corroborated.

References

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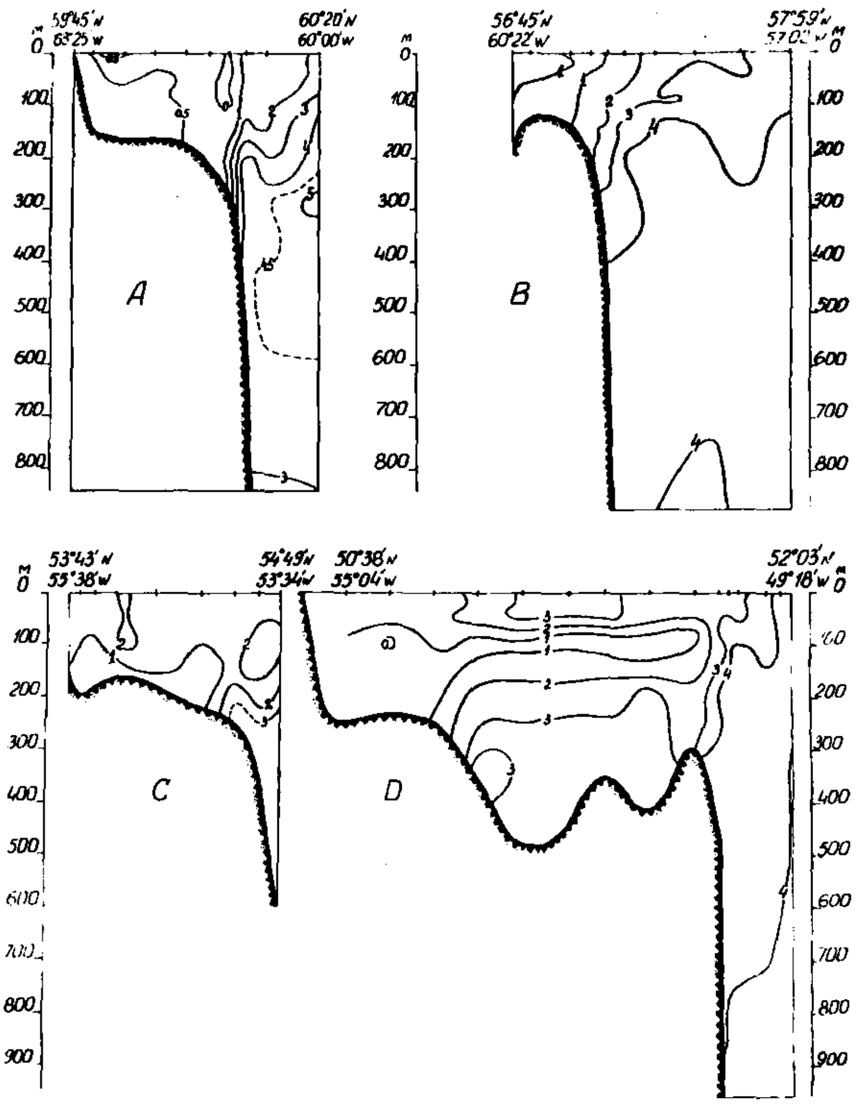

Fig. 4. Vertical distribution of water temperature on sections: 14AD across the North Newfoundland Shelf (A), 8A' across the Central Labrador Shelf (B), 8A across the Hamilton Bank (C) and 7A across the North Newfoundland Bank (D) in October-November 1967.

3. Recent trends in subsurface temperatures in the Gulf of Maine and contiguous waters[1]

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Abstract

A comparison was made of 1955-60 and 1961-66 monthly mean 200 m temperatures in eight one-degree quadrangle areas in the Gulf of Maine and along the Continental Slope between Nova Scotia and Long Island. Temperatures were appreciably colder in all areas during the latter period. The subsurface temperature trends paralleled trends in surface temperatures previously documented. The distribution of temperature at 200 m along the edge of the Continental Shelf during March, May-June, and September 1965 and 1966 and the distribution of temperature, salinity and dissolved oxygen on sections made across the Continental Shelf in September 1954, 1965, and 1966 showed that the cooling and warming trends are associated with changes in the composition of the subsurface water. Cold years occur when slope water is displaced or modified by coastal water of Labrador origin. Warm years occur when slope water borders upon the 200 m isobath and its constituent ratio of coastal to Central Atlantic water is low.

[1] Abstract of Res.Doc.68/39 presented to the 1968 Annual Meeting. Complete text to be published in the Journal of the Fisheries Research Board of Canada.

1. Field identification of synthetic fibres used in fish nets[1]

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Characteristics used:

General appearance -

Continuous filament - the twine or cordage has a smooth surface; each filament runs the full length of the piece.

Coarse - individual filaments easily seen.

Fine - individual filaments distinguished only by close inspection or by unravelling the material.

Discontinuous (staple) fibre - the twine or cordage has a dull, rough surface, with fibre loops and ends protruding; individual fibres are usually less than 4 in long.

Note: All these filaments or fibre types are used in laid (twisted) and in braided (plaited) materials, so that material construction is no indication of fibre type.

Burning properties -

The flame of a match is gradually brought toward a cut end of the material until the fibres ignite, and the following properties are noted:

(a) whether or not the fibres shrink from the flame, and the colour, shape and consistency of any bead that forms on the end of the material (this bead is hot and can cause a burn);

(b) how easily the fibres ignite, and whether or not they stop burning when the match is removed;

(c) the colour of the flame and of any smoke from the burning material;

(d) the colour and odour of the smoke formed immediately after the burning material is extinguished (if the fibres do not stop burning when the match is removed, the flame is blown out).

[1] Submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/94

Note: The presence of treating agents (*e.g.* tars) or other foreign matter can modify the burning characteristics.

The above-noted properties identify each type of fibre as follows:

1. Coarse continuous filament (*e.g.* polyethylene)

   a. Polyethylene - shrinks from flame, bead smooth and similar colour to twine, fairly easy to ignite, burns alone giving a blue flame with yellow tip and no smoke, extinguishes to give grey smoke and "paraffin candle" smell. Check test: floats on water.

   b. Polypropylene - same as polyethylene except "bearing grease" smell when extinguished.

   c. Saran - shrinks from flame, fairly difficult to ignite, bright yellow flame with orange tip and green edges and bottom, some "spurting", self-extinguishing with puff of blue smoke and "hyacinth" odour, leaving crisp black bead. Check test: heaviest synthetic fibre in water.

   d. Nylon - coarse filament is not usually found in trawls but is sometimes used in gill nets. See 2.a. for test.

2. Fine continuous filament (*e.g.* most nylons)

   a. Nylon - shrinks from flame, forms brown bead with some froth, fairly difficult to ignite, blue flame with bright yellow tip and orange edges, sometimes burns alone but without smoke, extinguishes with blue-grey smoke, and "celery" smell.

   b. Polyester - shrinks from flame faster than nylon, forms brown bead with grey smoke but without froth, fairly difficult to ignite, bursts into bright yellow flame with orange tip and black smoke, sometimes burns alone, extinguishes with blue-grey smoke and "burning paper" smell.

   c. Polypropylene - shrinks from flame like nylon, forms light grey bead, fairly easy to ignite, burns alone with blue flame with yellow tip but without froth or smoke, extinguishes to give light grey smoke and "bearing grease" smell. Check test: floats on water even when thoroughly soaked.

   d. PVC (low strength) - shrinks from flame, forms irregular bead, fairly difficult to ignite, burns with bright yellow flame with orange tip and green base and with thick blue-black smoke and spurting, self-extinguishing with blue-grey smoke and "melting solder" smell, leaves charred black bead.

e. Rayon (low strength) - burns without shrinking or bead formation, ignites readily to orange-yellow flame, must be extinguished giving wisps of blue smoke and "burnt paper" odour.

f. Acetate (low strength) - forms bead, ignites readily and burns quickly and alone with yellow flame with mauve or blue base but without smoke, extinguishes to give wisps of blue smoke and a "vinegar" odour.

g. Vinylal - see 3.d. for burning test results.

h. Glass fibre - does not burn, but can melt in hot flame.

3. Discontinuous fibres (general appearance similar to cotton)

a. Staple (or spun) nylon - see 2.a. for burning test results

b. Staple (or spun) polyester - see 2.b. for burning test results

c. Staple (or spun) polypropylene - see 2.c. for burning test results

d. Vinylal - shrinks from flame, forms white bead, ignites readily and burns quickly with yellow flame with blue base but no smoke, extinguishes with grey smoke and "burned cloth" odour leaving a yellow-brown bead.

4. Textured and combination twines - smoother than 3. but rougher than 2.

a. Textured nylon (Taslan, Goldspun) - see 2.a. for burning test results.

b. Combination nylon (fine continuous filament yarns and staple fibre yarns laid together) - untwist the twine and test the continuous filament yarns and staple fibre yarns separately with results as per 2.a.

c. Nyak (fine continuous filament nylon and staple acetate yarns laid together) - proceed as in 4.b., with results for the continuous filament yarns as per 2.a. and those for the staple fibre yarns as per 2.f.

d. Marlon (fine continuous filament nylon and staple vinylal yarns laid together) - proceed as in 4.b., with results for the continuous filament yarns as per 2.a. and those for the staple fibre yarns as per 3.d.

Classification of Trade Names of Fibres Used in Fish Nets

Generic name (ISO/TC38)	Common trade names
Polyamide (nylon)	Amilan, Anzalon, Goldspun, Grilon, Kapron, Perlon
Polyester	Dacron, Terylene, Tetoron
Polyethylene	Courlene (X3), DLP 21, Drylene, Nymplex, Polythene
Polypropylene	Courlene PY, DLP 61, Propylon, Pylen, Ulstron
Polyvinyl chloride	Envilon, Kurehalon S, PVC, Teviron, Vinyon
Polyvinylidene chloride	Kurehalon, Saran
Vinylal (polyvinyl alcohol)	Cremona, Kuralon, Manryo, Mewlon, PVA (also stands for polyvinyl acetate), Vinal, Vinylon
Combination twines	Kyokurin (nylon and saran) Livlon (nylon and saran) Marlon (nylon and vinylal) Nyak (nylon and acetate) Polytex (polyethylene and PVC) Ryolon (polyester and PVC)

1. Observations on herring caught on Georges Bank[1]

by F. Chrzan and B. Draganik
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Catches

Polish herring catches made on Georges Bank by stern trawlers began in 1965 and amounted to 1,447 tons. In 1966, the catch increased tenfold to 14,473 tons. Still larger quantitites were landed in 1967, namely 37,677 tons. This increase was caused both by the demand for herring in the Polish market and by the decrease in herring catches in the North Sea. For these reasons, some of the side trawlers, which had operated until 1967 in the North Sea, were re-directed to herring fishing on Georges Bank and landed 26,798 tons of herring, while the stern trawlers landed only 10,849 tons.

Thus, the increase in herring catches was related to the increase in fishing effort. This fishing effort, expressed as the number of catch-hours per chosen standard vessel (factory trawler) amounted to 3,421 hours in 1966 and to 11,995 hours in 1967. These figures show that herring landings were disproportionate to the increase of fishing effort and the catch-per-unit effort dropped from 4.1 tons per hour to 3.1 tons per hour.

The best fishing yield was noted for motor side trawlers, operating with bottom trawls. These vessels obtained 2.5-4.0 tons of herring - average 2.75 tons per 1 hour trawling. The best fishing results were obtained in the period from 18 September to 5 October on the fishing ground bounded by 41°55'-42°10'N and 67°30'W. Catches consisted of herring with running gonads. The great concentration of fish here is evidenced by the yield of stern trawlers, which, from 1-5 October, landed, on the average, up to 12.25 tons per 1 hour trawling.

Material

Herring sampling was performed mainly aboard the commercial S/T *Aries* from 26 August to 8 October 1967 and, additionally, aboard R/V *Wieczno* from 2 to 4 November 1967. A total of 10,200 measurements and 2,006 otoliths were taken from fish in the commercial catches and 1,674 measurements and 200 otoliths from fish aboard the research vessel. Lengths were measured in half cm. For herring from which otoliths were taken, sexual maturity and stomach content were also determined.

Age Reading

Ageing was considered to be highly accurate and included the technical experience of various other researchers. Having in view, however, some

[1] Submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/53

differences in the earlier results of age readings among the experts from Canada, United States and Poland, a revised method of interpretation of otolith zones is presented in this paper. To illustrate the method better, drawings rather than photographs of the opaque and hyaline zones of otoliths are shown in Fig. 1.

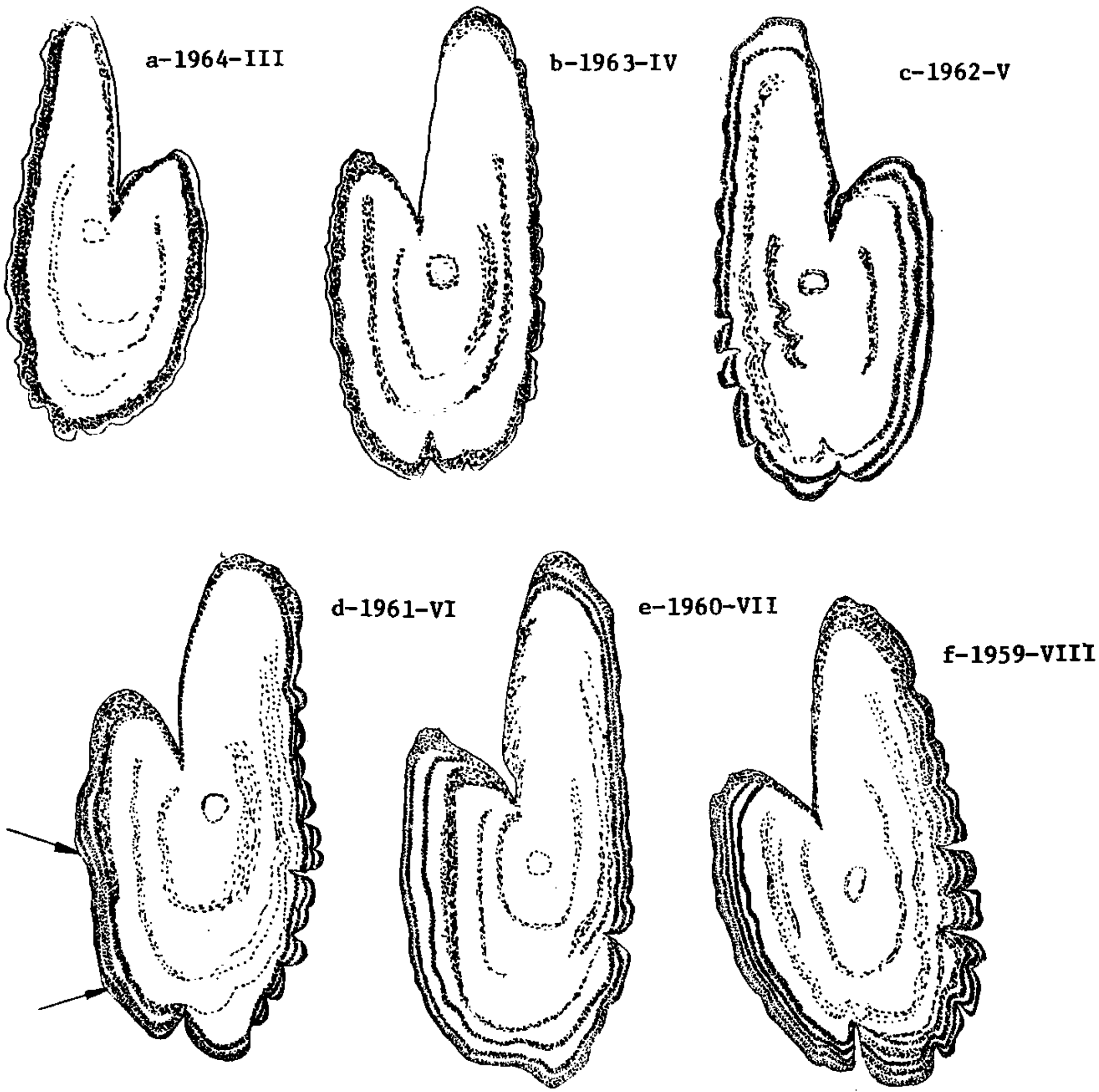

Fig. 1. Otoliths of herring of different year-classes and age-groups. The arrows show the opaque places.

Materials were collected from August to November when the annual life cycle is being completed. In Fig. 1a, two hyaline zones are seen, one less and one more distinct, and a dimly outlined nucleus. Since the fish is born in the autumn, it may be assumed that the nucleus corresponds to the first winter zone. The winter zones of the otolith in Fig. 1a are sufficiently clear and, with the nucleus, allow determination of the age of the fish with some accuracy as completing its third year of life and it may be classified as age-group III.

In former investigations (Draganik and Zukowski, 1967), the number of distinct hyaline zones was taken as the basis for determining the particular age-group and the nucleus was disregarded, thus reducing the age-group by one year. Still, the year-class was determined correctly, because counting was started from the outside of the otolith toward its centre and the hyaline zones correspond to each consecutive winter period, while the starting point of the nucleus was taken to be the year the fish was born.

It is well known that the opaque zones in the otoliths of herring of different size and age are formed in different months of the period from spring to autumn. In young herring, one to three years old, this zone begins to form in the spring months and, in older herring, from June to October. This is similar to the process of formation of opaque zones in the cod otolith, which is described by May (1967).

The drawings in Fig. 1 give approximately the same picture of the zones of an otolith as might be seen through a binocular microscope. According to the usual method, the basis for determination of an age-group was the final stage of increase of the hyaline zone. This point is marked by the formation of the next opaque zone. A survey of photographs of otoliths showed that, with the increase in the number of hyaline zones, the last opaque zone at the edge of the otolith becomes less and less distinguishable. This phenomenon may be attributed, among other factors, to the age of the fish, *i.e.*, the older the fish the more retarded is the formation of opaque zones in their otoliths. In the case of the otolith in Fig. 1d, the opaque zone is distinguishable only at two spots, which in the drawing are marked by arrows. In still older fish as in Fig. 1e and 1f, the opaque zone at the edge of the otolith is not distinguishable at all. The question, then, arose: how to determine the age of these fish? An acceptable solution was to read the age of such fish, when they were caught in the summer or autumn, as if the outer opaque zone were already formed.

Figure 2 shows the shift in length composition of the 1960 year-class to the right for the successive years 1965, 1966 and 1967. The 1960 year-class was predominant through these years. The modal lengths of this year-class followed the shift in length composition. Length measurements in the catches showed that the most abundant fish were those of the following lengths: in 1965 - 29.0 cm, 1966 - 30.5 cm and 1967 - 31.5 cm, and in Fig. 2 the mean lengths of the 1960 year-class were: 29.0 cm, 30.5 cm and 31.7 cm. There is, therefore, a close correlation between the occurrence of a very abundant year-class (1960) and the changes in length composition of the exploited fish stock. The participation of such an abundant year-class in the fishery was in a sense a natural tag. Since the results obtained from otolith reading are in conformity with

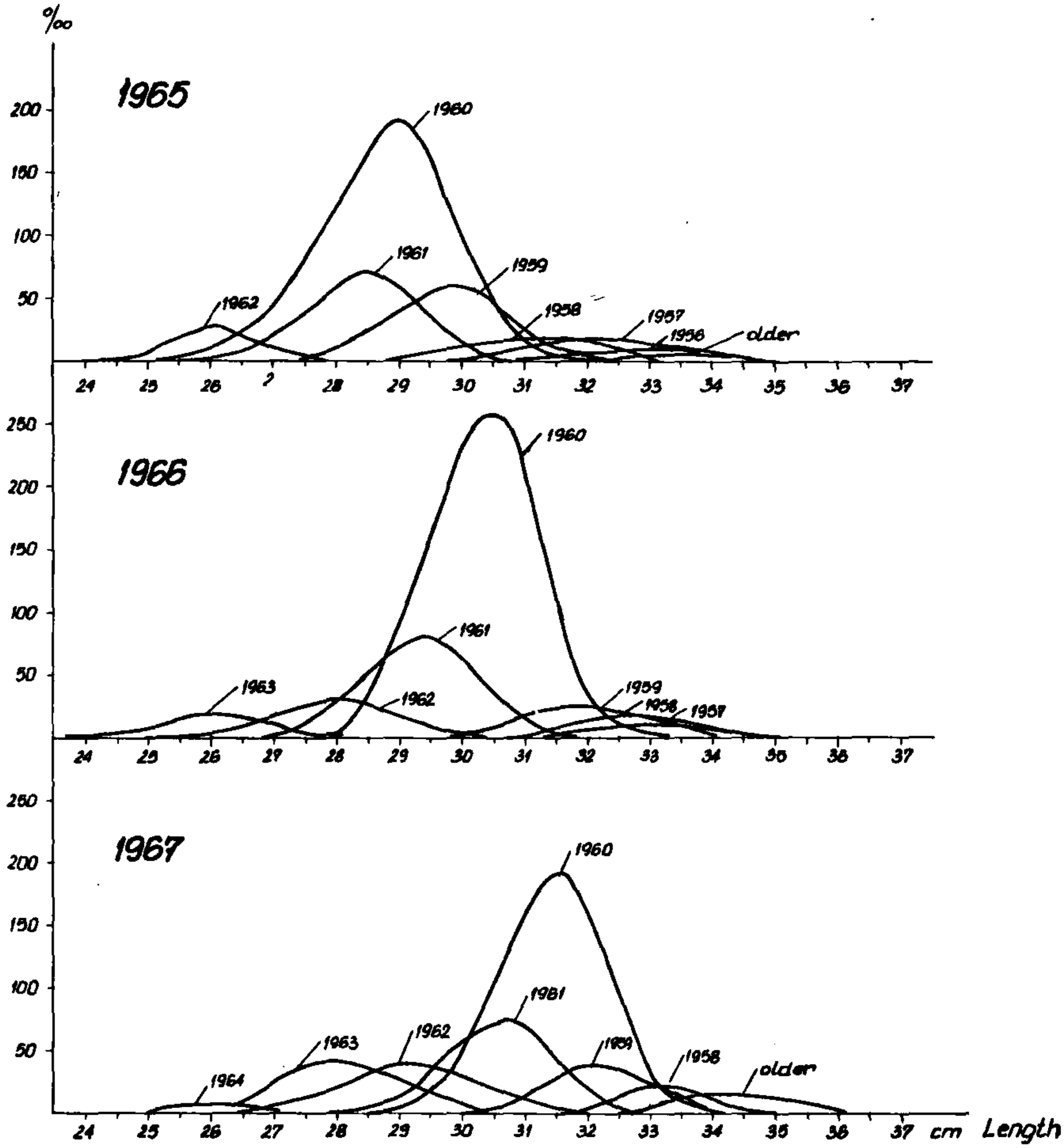

Fig. 2. Length frequencies of the year-classes of herring in the 1965, 1966 and 1967 catches.

the results obtained from herring measurements in the catches, the interpretation of otolith reading presented seems justified. Some mistakes in age reading are unavoidable and may be due to otolith structure and observational technique.

Length and Age

The length composition of herring caught in Georges Bank in 1967 is given in Fig. 3. Length ranged from 25 to 37 cm. The curve is unimodal, as are the curves of length-classes in the years 1965 and 1966. In 1967, most of the herring were of the 29 to 33 cm length-class with a modal length of 31.5 cm. These fish were caught in August, September and October 1967.

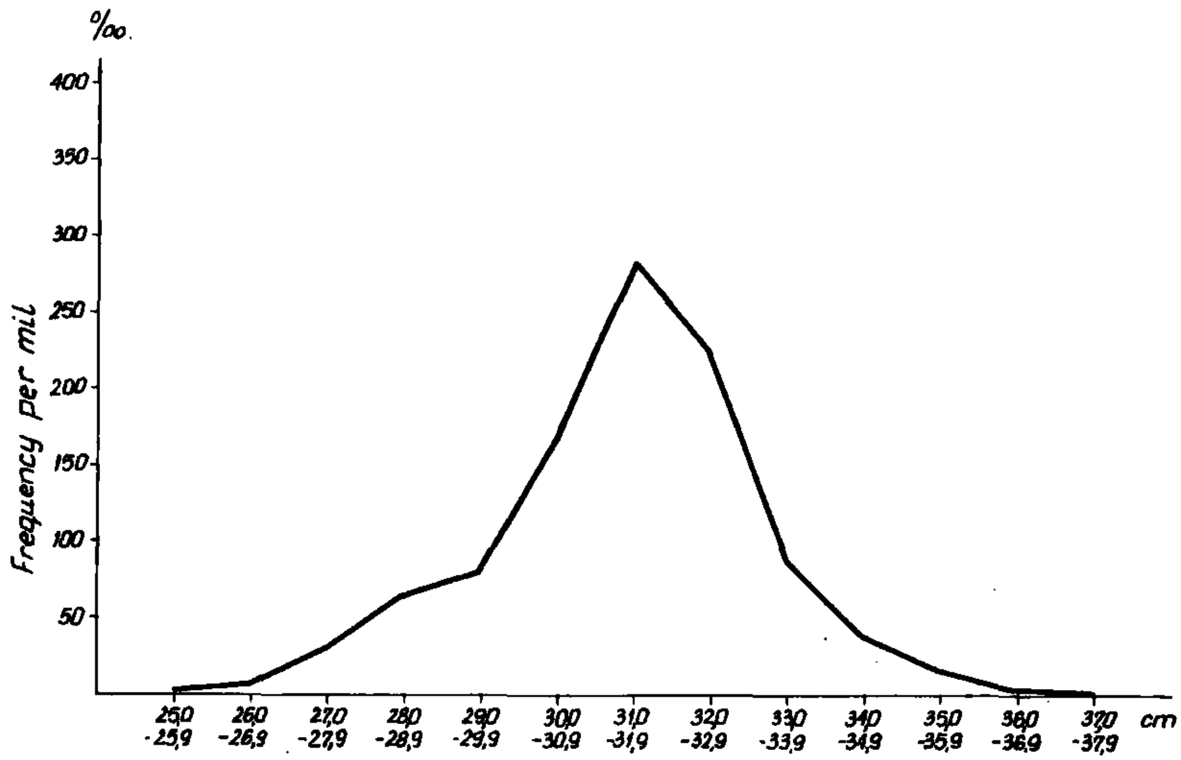

Fig. 3. Length composition of herring caught on Georges Bank in 1967.

Age readings, performed in the manner described above, give the age composition of herring caught by Polish fishing vessels in 1967 (Fig. 4). The 1960 year-class is dominant followed by the 1961 year-class. Worthy of attention is the 1963 year-class, which was equal in abundance to the 1962 year-class. Since the 1963 year-class is younger, it may be more abundant in future catches.

Previous investigations (Draganik and Zukowski, 1967) show that the participation of the 1960 year-class decreased by about 10 percent, whereas the reduction of this year-class due to natural and fishing mortality amounted to 65 percent (Noskov and Zinkevich, 1967). Therefore the total herring stock has been reduced considerably during the last two years.

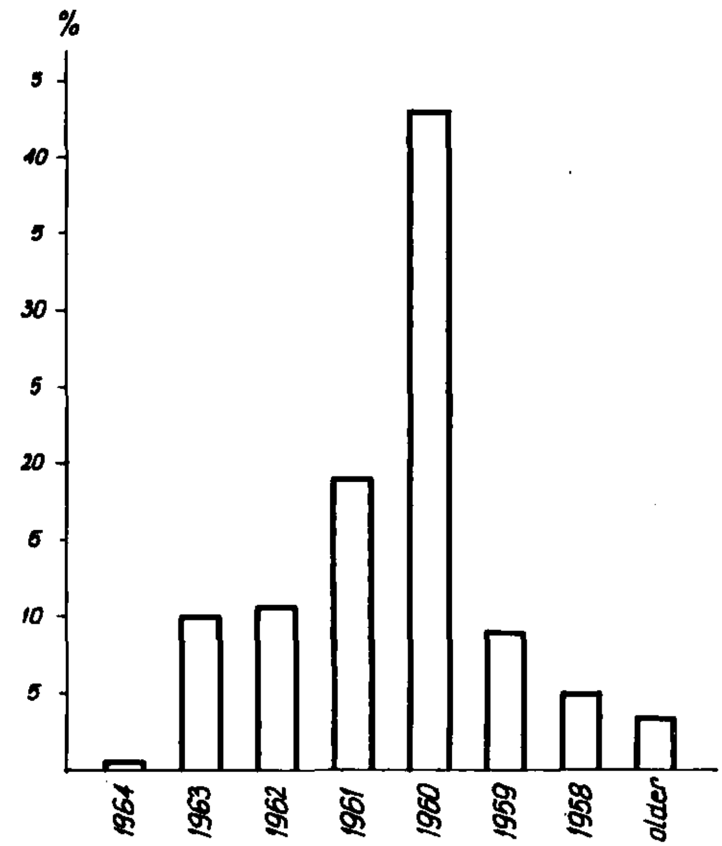

Fig. 4. Age composition of herring caught in 1967.

Rate of growth

The rate of growth of herring investigated in 1967 was determined from the mean lengths of age-groups. These data were used for calculation of parameters of the von Bertalanffy formula. They were as follows:

$L\infty$ - 37.3 cm
K - 0.195
t_o - -2.7

On the basis of these parameters mean lengths of fish in particular age-groups were calculated and a curve for the rate of growth in 1967 was plotted. Two other curves, prepared similarly by Draganik and Zukowski (1967) for growth in 1965 and 1966 were available. The three curves are given in Fig. 5. Comparison of these curves shows that the rate of growth was very similar in each of the last three years.

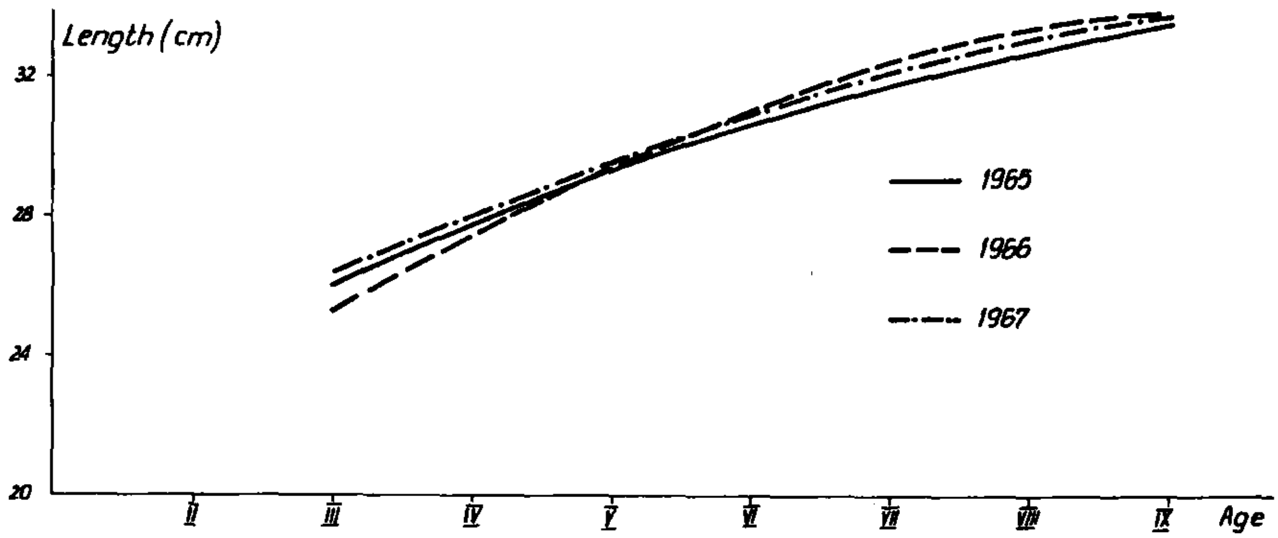

Fig. 5. Growth rate of herring.

Length/weight relationship

To establish the relationship between length and weight of herring in different biological states, fish were measured and weighed as soon as they were brought on deck. A total of 1,000 specimens were weighed, of which 400 were in full, 400 in running and 200 in spent stages of maturity. The length (L) and weight (W) relationship of these three groups were:

$$\text{For full herring } \log W = \bar{3}.3860 + 3.378 \log L;$$
$$\text{For running herring } \log W = \bar{3}.8401 + 3.055 \log L;$$
$$\text{For spent herring } \log W = \bar{2}.0162 + 2.899 \log L.$$

Graphic representation of the above equation is given in Fig. 6.

As expected the ratio of weight to length was the highest for full herring and lowest for spent herring. The coefficient of condition, calculated from the above data according to Fulton's formula, was as follows: for the most representative length-group (31.5 cm, full herring), K = 0.895; for running herring, K = 0.835, and for spent herring, K = 0.736.

Other observations

Observations were made on the gonads and feeding. The herring population studied is considered a spawning stock. Only in the August catches were some spring spawners (5 percent) found. Later no spring spawners were found in the catches.

In August, male gonads of the summer-autumn spawning stock were in Stage V of maturity and female gonads were in Stage IV. At the beginning of September, the development of gonads reached a common stage in both sexes and from the middle of September most of the herring had running gonads.

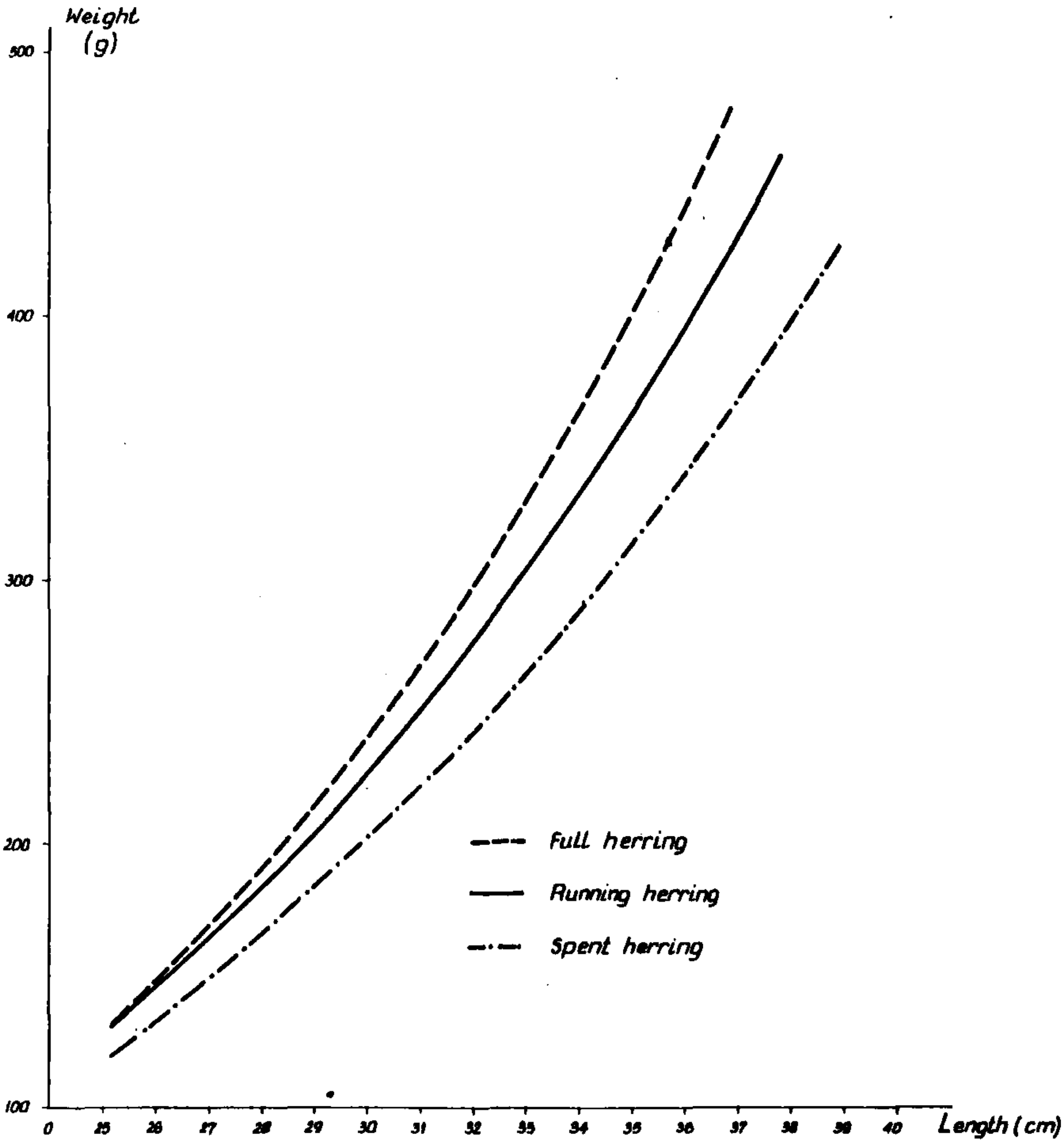

Fig. 6. Relation between length and weight of herring in different stages of maturity.

Observations on the stomach content showed that, in August and later, the stomachs of most fish were empty. In some hauls, however, a number of fish were found with stomachs filled with food. As a rule, all herring had empty stomachs at the peak of their spawning period.

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2. Recent changes in size composition of Canadian Atlantic swordfish catches[1]

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History of Landings

Swordfish (*Xiphias gladius* L.) have been harpooned off the Canadian coast as part of a regular summer fishery since the early years of this century. Prior to 1930, however, the landings seldom exceeded 500 metric tons. Between then and 1962, they were higher and for a brief period in the late 1950's exceeded 2,000 tons, reaching a high of 4,000 tons in 1959.

A major change in the fishery occurred in the late summer of 1962 with the introduction of surface longlining. The new method greatly increased the catch per day and the size range of fish taken. It allowed a substantial increase in the area fished and the length of the season, and was rapidly adopted by practically all units. The effectiveness of the method resulted in a dramatic increase in landings, which exceeded 7,400 metric tons in 1963, decreased only slightly in 1964, but fell in 1965 to 4,600 tons, and have remained near that level since then. Some harpooning is still being carried on as a supplementary method during the summer months, particularly by the smaller vessels.

Size Composition

Catches have been sampled regularly for weight either at sea or on landing. Harpooned swordfish usually average about 150 kg, while the average size of longlined fish, although varying considerably, is below that value. The combined size distribution of fish taken by both methods, calculated from individual samples, shows that there has been a steady decline in average size (Fig. 1). Size data from a considerably larger proportion of the total catch are available in the form of number of fish and total weight taken per fishing vessel trip. Average fish weight, using this information emphasizes the decline, and suggests that the values from detailed samples were low in 1959 and 1964, but high in 1967. The average weights and sample sizes are compared in Table 1.

Factors Affecting Size Composition

The decrease in average size from 90.7 to 51.7 kg (dressed weight) (Table 1) is probably due to several factors, all associated with the introduction of longlining; changes in sex ratio and size of fish available to the fishery; expansion of fishing area; length of season; and, increased fishing intensity.

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[1]submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/69

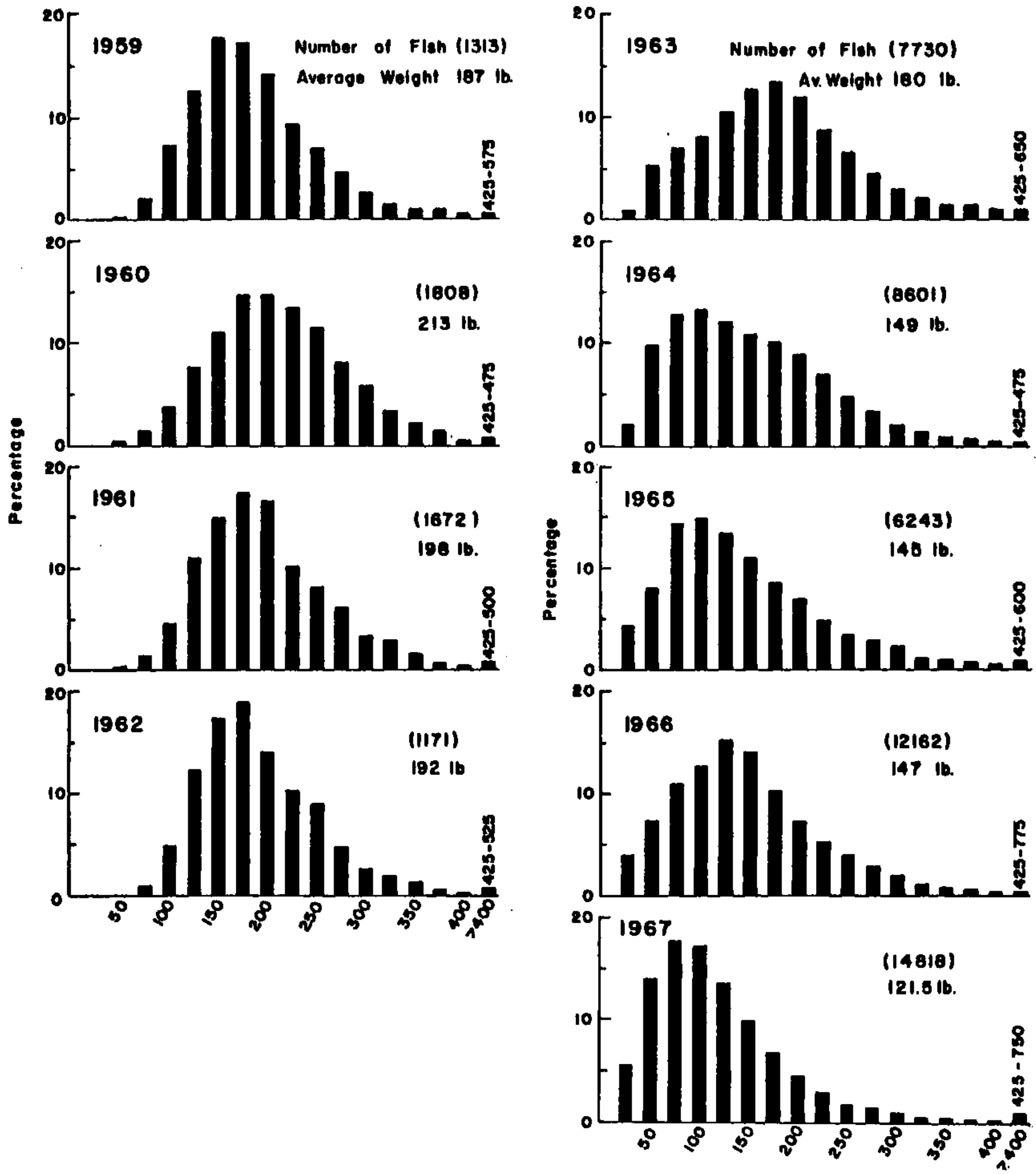

Fig. 1. Size composition of swordfish samples, 1959-67. Weight, Pounds (25 lb = 11.34 kg).

Table 1. Average size of swordfish (dressed weight kg x 1.32 to round) in various years, calculated by two methods (individual weights and vessel trip totals of weight and number) with the proportion of the total annual catch included in each estimate.

Year	Individual Weights		Trip Total Weights	
	Avg Wt	% Annual Landings	Avg Wt	% Annual Landings
1959	84.8 kg	3.7	90.7	8.7
1960	96.6	9.9	97.8	49.2
1961	89.8	10.3	91.6	38.7
1962*	87.1	6.4	89.4	35.3
1963	81.6	11.2	77.6	34.4
1964	67.6	10.0	70.8	41.7
1965	65.8	11.5	64.9	61.6
1966	66.7	12.1	61.7	58.6
1967	55.3	22.3	51.7	59.5

*Longlining began late in 1962

Sex Ratio and Fish Size

Harpooned fish are exclusively female and are usually large, with few fish under 65 kg. In contrast, longline catches include both males, which seldom attain 150 kg, and smaller females, with fish smaller than 10 kg being not unusual. Size compositions of catches by the two methods are compared in Fig.2.

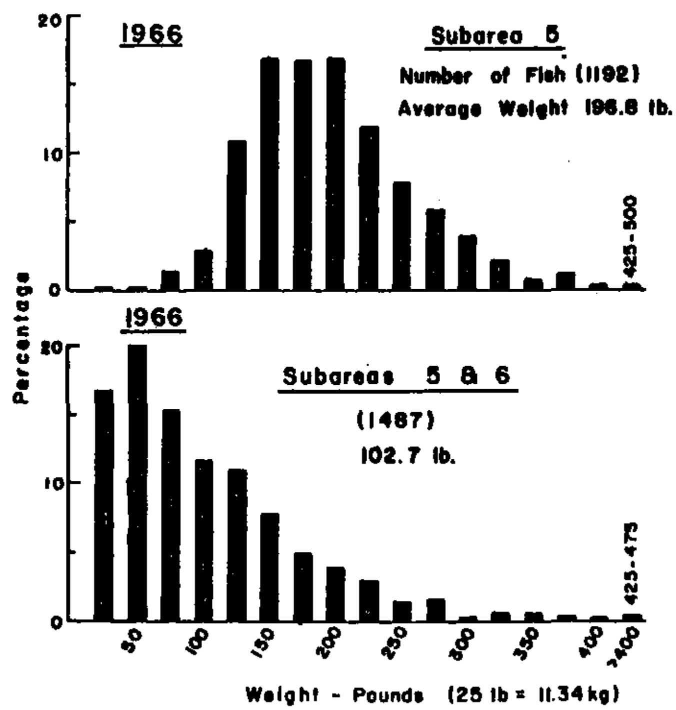

Fig. 2. Differences in size composition of swordfish caught in the same area by harpooning (upper) and longlining (lower).

Area and Season

Longlining is carried out over a much wider area than harpooning, and for a longer season. The latter method is limited to an area near the edge of the Continental Shelf and significant landings are made only between the middle of June and the end of September. Since the introduction of longlining, a year-round fishery has developed in an area bounded by the Gulf Stream and the edge of the Continental Shelf between Cape Hatteras and the Flemish Cap. Sampling shows considerable between-area and between-season variation in average size of longlined swordfish. Figure 3 illustrates the different size compositions of catches from the vicinities of the Grand Banks (Subarea 3) and Georges Bank (Subareas 5 and 6). Expansion of the longline fishery into previously unfished areas, yielding fish of small average size, has also contributed to the gradual decrease in the annual average size. The area south of the Grand Banks is one example of a newly fished area, and the landings from there have contributed to a reduction of 15 kg (87-72 kg) in the average size of fish from Subarea 3 in 1965 and 1966.

Variation in the average size is also seen within some localities at different seasons. Thus, relatively large numbers of fish, under 30 kg, are taken in Subareas 5 and 6 during September and October when compared to landings from the same areas earlier in the year.

Changes in the overall average for a year can also be caused by variation in the proportions of the total landings from different areas, or by unusually successful fishing from one area. Thus, in 1967, there were substantial increases in the landings from the area south of the Grand Banks referred to above and from the area off Cape Hatteras, both areas of smaller fish. This appears to be the major cause for the sharp decrease in the average size between 1966 and 1967 (Fig. 1).

Effect of Fishery

The increased fishing effort may have reduced the average size as might be expected when pressure on a partially exploited stock is increased. However, the size composition of the longlined catches does not suggest this as there are no apparent changes in the composition from any particular area at a particular season. Moreover, the average size of the harpooned catches has not changed appreciably. This latter may, however, be due to the behaviour of the fish as only females of a certain minimum size are generally available to the harpoon fishery.

Summary and Conclusions

Various effects ascribable to the introduction of longlining are examined, and the observed reduction of the average size of fish is attributed to the more heterogeneous size composition encountered in the longline fishery, rather than to significant effects of fishing intensity.

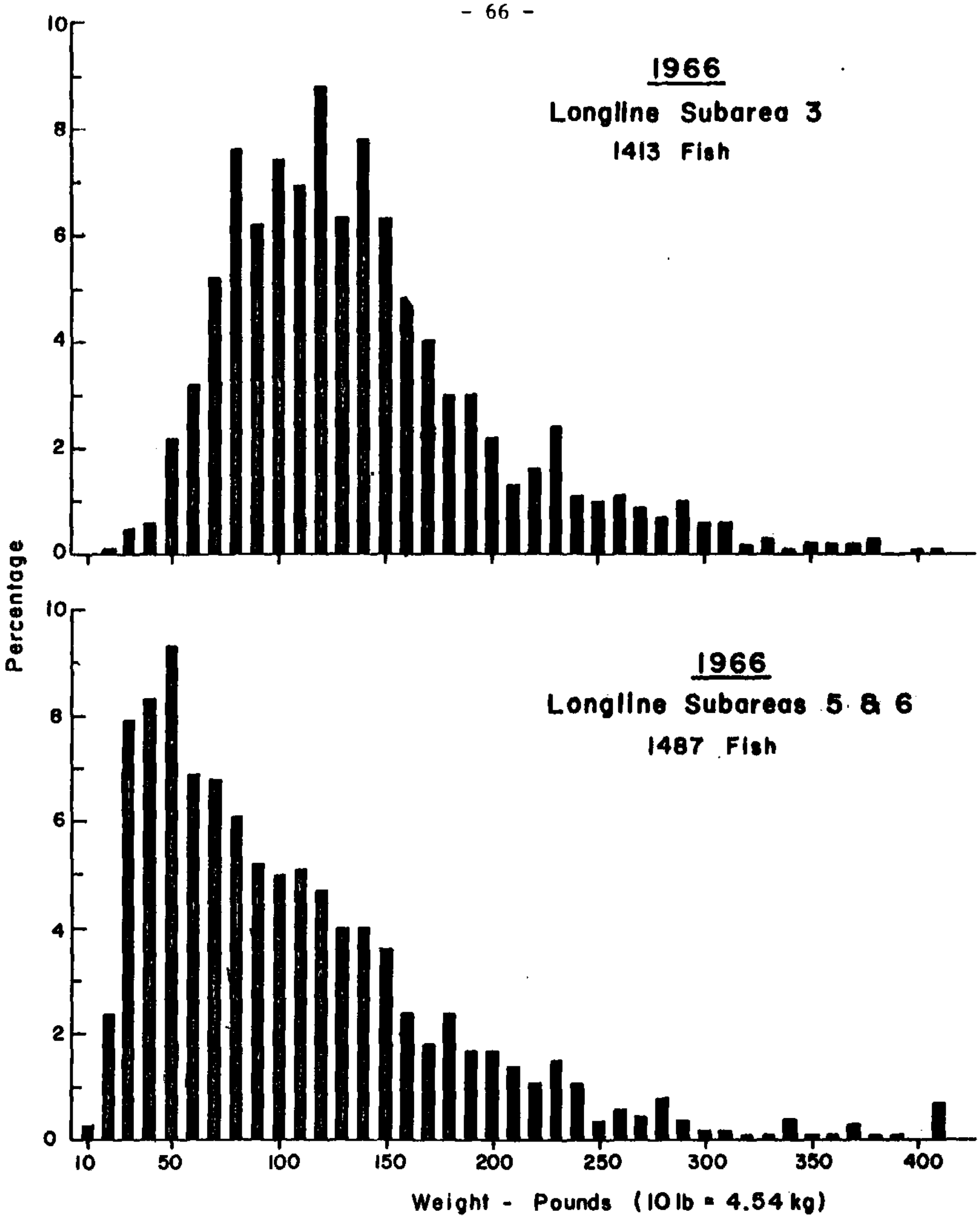

Fig. 3. Size composition of swordfish landings from two different areas by the same fishery method.

3. The Newfoundland herring fishery and its implications concerning the resource[1]

by A.S.Hourston
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Although Newfoundlanders have probably fished for herring in their inshore waters since the establishment of the first settlements on the island, it was not until 1856 that any continuing record of catch became available. Annual exports of herring products are given in the Journals of the House of Assembly, Newfoundland, for the years 1856 to 1932. Annual exports by product weight are given in the Economic Bulletins of the Newfoundland Government, Department of Natural Resources, for the years 1936 to 1948. Records of local food consumption and of bait sold directly to cod fishing boats (which involved large quantities of herring prior to the decline in the banking fleets in the early 1900's) are not available for this period. Since 1952, the Markets and Economics Branch of the Canadian Department of Fisheries has provided records of actual landings (as well as products) with detailed breakdowns by area and month of landing since 1956.

Prior to the development of a mobile purse seine fishery in 1965, area of landing probably coincided closely with area of capture. With the advent of the seine fishery, however, catches were transported considerable distances to processing plants and in 1967, appreciable quantities of Newfoundland-caught herring were landed at processing plants outside the province. Thus, landings no longer accurately reflected catches in areas along the coast or in the province as a whole. The collection and reporting of seine catches by area and date of capture was therefore undertaken by the St. John's Biological Station beginning in 1965.

Long-term trends in annual landings

Annual landings by form of utilization (food, bait or reduction) have fluctuated considerably over the history of the fishery (Fig. 1). In general, landings appear to reflect demand for the product rather than the abundance of the resource. The immediate, extensive and sustained response of landings to a heavy demand for food during and just after World Wars I and II suggests that only in such periods of high demand has the resource been exploited to an extent approaching its potential yield.

Landings have shown a similar response to the recent introduction in Newfoundland of a major industry for the reduction of herring into meal and oil. While landings processed for food and bait have remained fairly constant since 1956 at 5,600 to 8,700 metric tons (Fig. 1), following the introduction of the reduction fishery in 1965, total landings rose to 28,000 tons in 1966 and over 90,000 tons in 1967.

[1]Submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/49

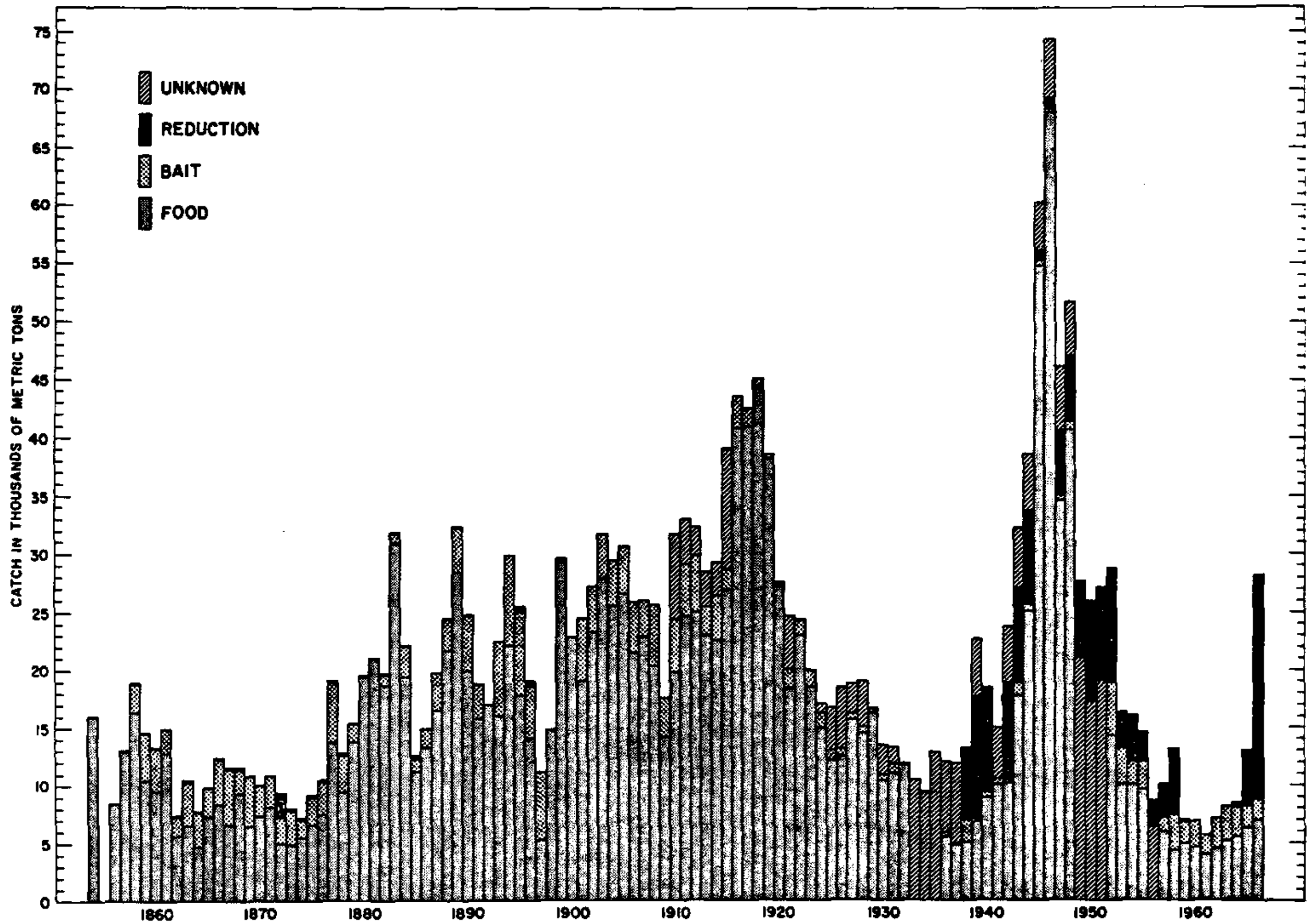

Fig. 1. Annual herring landings in Newfoundland and their form of utilization. "Unknown" represents surplus of total catch over that accounted for in product records when shown above reduction catch and combined food and bait catch when shown below reduction catch.

Since the purse seine fishery supporting the reduction industry is a winter fishery extending over two calendar years, the recent increase in catch over the past three fishing seasons is even more dramatic (Fig. 2) than indicated by annual landings (Fig. 1). The increase in catch in the 1966-67 season over that in 1965-66 represents a larger increase proportionately (200 percent) and in quantity (47,000 tons) than between any two calendar years on record.

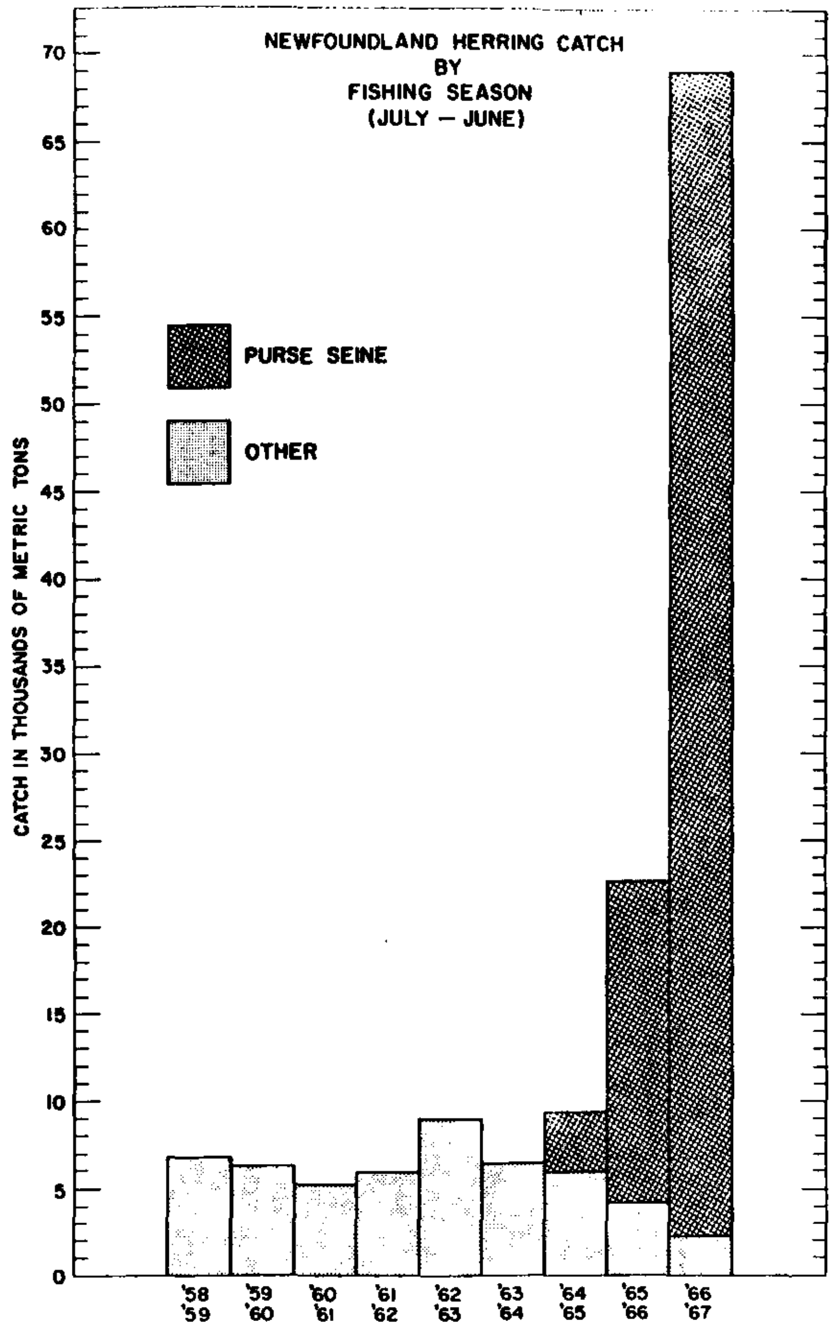

Fig. 2. Newfoundland herring landings by fishing season (July to June).

Table 1. Herring catches (metric tons) in Newfoundland coastal waters by region and fishing season (July to June) since 1953-54.

SEASON (July to June)	3K Northeast coast	3L St. Mary's Bay	3L Other	3L Total	3Ps Placentia Bay	3Ps Fortune Bay	3Ps Hermitage Bay	3Ps Ramea	3Ps Total	3Pn La Poile	3Pn Port aux Basques	3Pn Total	4R St. Georges Bay	4R Bay of Islands	4R Bonne Bay	4R Other	4R Total
1953-54[a]	105.4	-	550.4	550.4	1827.4	3350.5	←		- 746.3		→	-	-	11534.7	-	-	11534.7
1954-55[a]	172.7	53.9	1178.1	1232.0	1685.7	1606.6	←		- 900.6		→	-	-	7258.2	-	-	7258.2
1955-56[a]	103.8	89.0	2114.2	2203.2	1047.6	552.9	←		- 208.9		→	-	-	2687.8	-	-	2687.8
1956-57[a]	439.4	182.2	835.5	1017.7	678.3	97.3	←		- 50.6		→	-	-	2671.9	-	-	2671.9
1957-58	1245.5	221.6	3451.1	3672.7	1952.8	20.9	←		- 59.8		→	-	5.6	11455.7	108.0[b]	32.4	11601.7
1958-59	448.6	389.4	1763.2	2152.6	1736.9	68.1	145.5	3.7	1954.2	-	67.6	67.6	56.3	2053.3	20.9	15.6	2146.1
1959-60	419.5	492.0	1639.6	2131.6	2718.8	44.0	75.5	16.9	2855.2	-	28.7	28.7	127.9	2426.9	75.8	163.8	2794.4
1960-61	474.9	603.0	1124.6	1727.6	1624.9	45.4	139.6	12.5	1822.4	-	27.9	27.9	78.0	112.0	1014.4	36.7	1241.1
1961-62	535.0	531.6	943.4	1475.0	2283.0	91.4	27.9	37.9	2440.2	14.2	22.9	37.1	103.4	88.5	1278.8	45.5	1516.2
1962-63	805.5	360.2	1506.3	1866.5	3669.1	63.8	120.7	57.8	3912.3	1.7	25.9	27.6	207.7	142.8	2076.7	57.8	2485.0
1963-64	523.3	279.6	787.1	1066.7	1066.2	155.4	501.0	70.0	1792.6	90.1	59.2	149.3	200.2	128.8	2653.5	44.3	3026.8
1964-65	237.8	258.5	470.9	729.4	1097.8	761.2	224.7	1588.0	3671.7	.3	442.6	442.9	213.7	158.5	4024.0	14.6	4410.8
1965-66	372.5	1028.0	664.3	1692.3	2068.1	334.4	4589.8	8046.3	15038.6	-	2258.6	2258.6	209.1	104.1	3650.5	53.5	4017.2
1966-67[c]	315.7	1323.0	223.2	1546.2	230.3	5510.7	18419.5	22321.6	46482.1	6332.5	5861.7	12194.2	1645.5	13.9	7925.6	28.8	9613.8

[a]Excludes fish whose area of capture was not known (2,156.9 tons in 1953-54, 1,908.1 tons in 1954-55, 1,232.2 tons in 1955-56 and 220.3 tons in 1956-57).

[b]Includes some fish from other regions of Div.4R.

[c]Excludes catches by gears other than purse seine for the period January to June 1967.

Regional and seasonal trends

Herring are caught on virtually the entire coast of the island of Newfoundland. However, during the present century at least, most of the catch has been taken by a few, localized fisheries operating on the south and west coasts of the island in the winter and spring (Table 1).

For the century preceding the mid 1900's, the Newfoundland herring fishery was located chiefly in the Bay of Islands on the west coast (Tibbo, 1956). However, in the early 1950's, herring failed to appear on the traditional Bay of Islands fishing grounds. Landings in this area (Div.4R) continued at a respectable level as the fishermen shifted their efforts first southward to the Port au Port area and then northward to Bonne Bay (Fig. 3). Since 1959, almost all of the catch from Div.4R has been taken in the Bonne Bay region (Table 1).

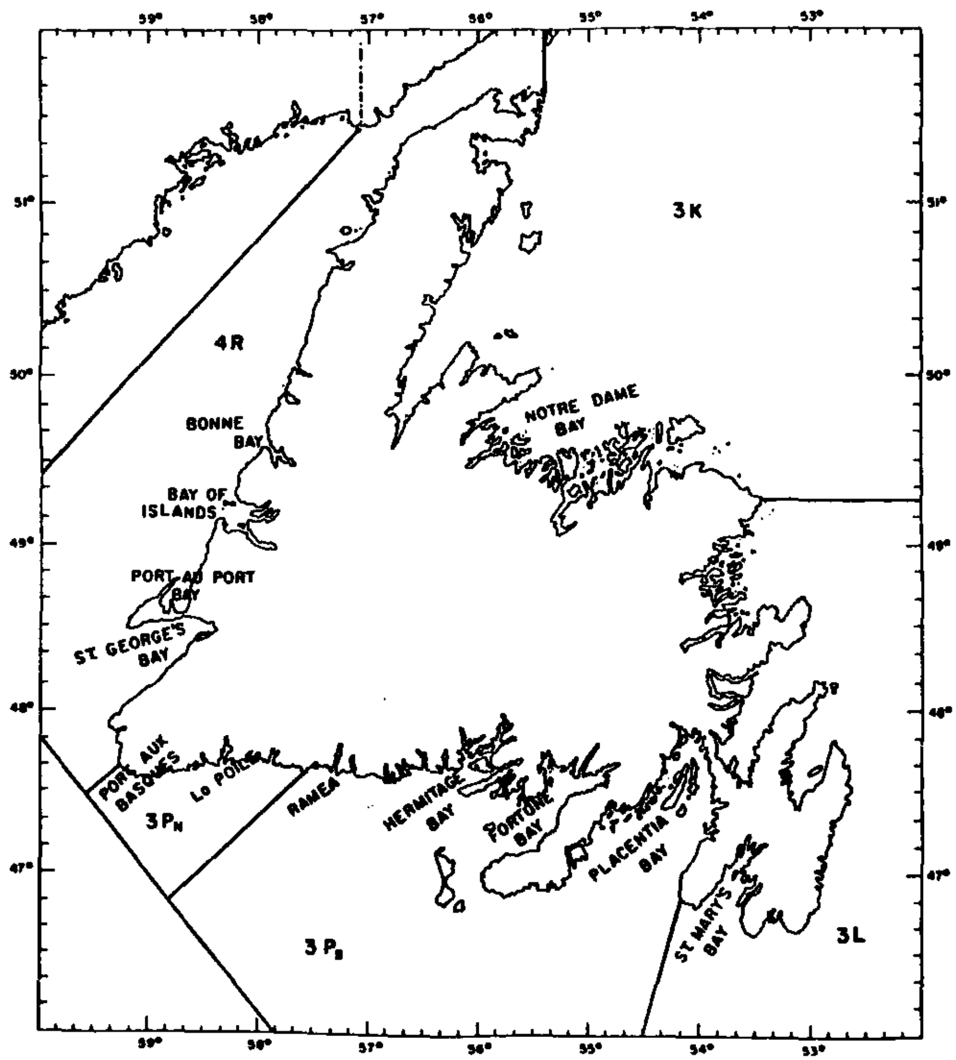

Fig. 3. Map of Newfoundland showing divisions and regions discussed.

During World War I and the preceding years, the high demands for herring as food supported extensive, but smaller fisheries in Fortune Bay and Placentia Bay on the south coast (Fig. 3) and in Notre Dame Bay on the northeast coast (Tibbo, 1956). During and after World War II, the main cathces outside the Bay of Islands area were taken in Fortune Bay on the south coast (Tibbo, 1957).

The recent upsurge in catch is accounted for by the development of a winter seine fishery along the western part of the south coast, mainly between Hermitage Bay and Port aux Basques (Table 1). This region, which had contributed only token amounts to the catch in the preceding years, became the major fishing area in 1965-66 (Table 1). As catches on southwest coast dropped towards the end of the 1965-66 season, some seiners moved eastward to St. Mary's Bay to finish the season. In 1966-67, others finished the season in Fortune Bay. This has resulted in a sharp increase in landings in these bays, but the amounts of fish involved have been small compared to catches on the southwest coast (Table 1).

The seasonal distribution of the catch has directly reflected the waxing and waning of the regional fisheries. The Bonne Bay fishery extends from mid-November to mid-January. The Fortune Bay and Placentia Bay fisheries usually take place in April and/or May but start as early as late February in some years. Consequently, during the 1950's and early 1960's, the catch peaked between November to January and again in April or May. With the advent of the south coast seine fishery in 1966, which extends mainly from late November to late April, the seasonal catch pattern changed into a broad "hump" of six months of good catches (November to April) followed by a six month "trough" of rather low catches (May to October).

The regional and seasonal distribution of the catch suggests that the Newfoundland herring fishery operates mainly on bodies of herring that migrate onshore in a broad wave in the late fall and migrate offshore again in the spring. The differences between various regions in the timing of the inshore and offshore migrations (as reflected in the catches) and the gaps between centres of concentration along the coast suggests the presence of several stocks, some of which were not evident a decade ago (Tibbo, 1956). However, these differences are not great enough to preclude some intermingling of stocks during their migrations. The virtual disappearance of herring from the Bay of Islands area in the 1950's, after supporting a major fishery for over a century, and the sudden development of a major fishery on the western portion of the south coast in the late 1960's would indicate wide fluctuations in the survival of individual stocks. Fall spawning (spent) fish, which were absent from the Bay of Islands catches in the 1940's (Tibbo, 1956, 1957), have been prominent in the recent catches off the southwest coast (Humphreys, 1966) suggesting one source of differences in survival between the two groups of fish.

Samples of herring collected from commercial catches in the major fishing areas since 1965 are currently being analyzed for differences in age composition, growth, maturity and vertebral numbers to check, clarify and quantitatively assess these indications from the fishery.

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1. Observations on the catching efficiencies of two zooplankton samplers[1]

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Comparisons were made of the catching efficiencies of the Gulf III and paired Brown-McGowan type zooplankton samplers, as part of a cooperative investigation of plankton sampling methods initiated between the US and USSR in autumn 1967. The paired samplers were modified by Arthur Posgay and Robert Marak of the Bureau of Commercial Fisheries Biological Laboratory, Woods Hole. They were scaled down to a mouth diameter of 20.3 cm, fitted with a 29 cm long tube of polyvinylchloride tapered to a 7° angle at the mouth, and designated by Posgay and Marak as the BCF Bongo .03 sampler.

A series of 10 tows was made in coastal waters off Boothbay Harbour, Maine, in November 1967. The samplers were hauled simultaneously in a step-oblique tow of 30 minutes - 10 minutes each at 20 m, 10 m, and the surface - during daylight on two consecutive days. The nets were on the same wire; the Bongo samplers were positioned about 25 cm above the Gulf III sampler (Fig. 1). Each of the samplers had mouth diameters of 20.3 cm, and were fitted with nets of 0.36 mesh apertures. The netting was metal in the Gulf III sampler, and nylon in the Bongo samplers. The amount of water strained was determined from a calibrated flow meter mounted in the mouth of one of the Bongo nets, and on the tail section of the Gulf III sampler. Each tow covered approximately 5.6 km and filtered about 165 m^3 of water. The towing speed was 308 cm/sec (6 knots). Volumes of samples were measured in the laboratory by the mercury immersion method. Ctenophores, large coelenterate remains (>2 cm long) and all fish larvae were excluded. Zooplankton samples were divided into aliquots ranging from an eighth to a sixty-fourth, depending on the mass of the samples, and sorted into major taxonomic groups. Copepods were identified to species, and numbers of copepods and other zooplankters per 100 m^3 of water were calculated.

Zooplankton Volumes

Volumes were examined for differences between the samplers with the Mann-Whitney U test. No significant differences were found between volumes of the port and starboard Bongo nets. But in each set, the volumes of the Bongo nets were significantly higher than the Gulf III volumes (Table 1).

Group and Species Comparisons

Copepods were the dominant zooplankters in the samples. Their contribution to the total zooplankton ranged from 97 to 63 percent. Ten other groups (taxa) were in the samples, but only four constituted greater than 1 percent of the zooplankton - chaetognaths, cladocerans, crustacean nauplii, and medusae. The abundance of these groups, expressed as numbers per 100 m^3 of

[1] submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/34

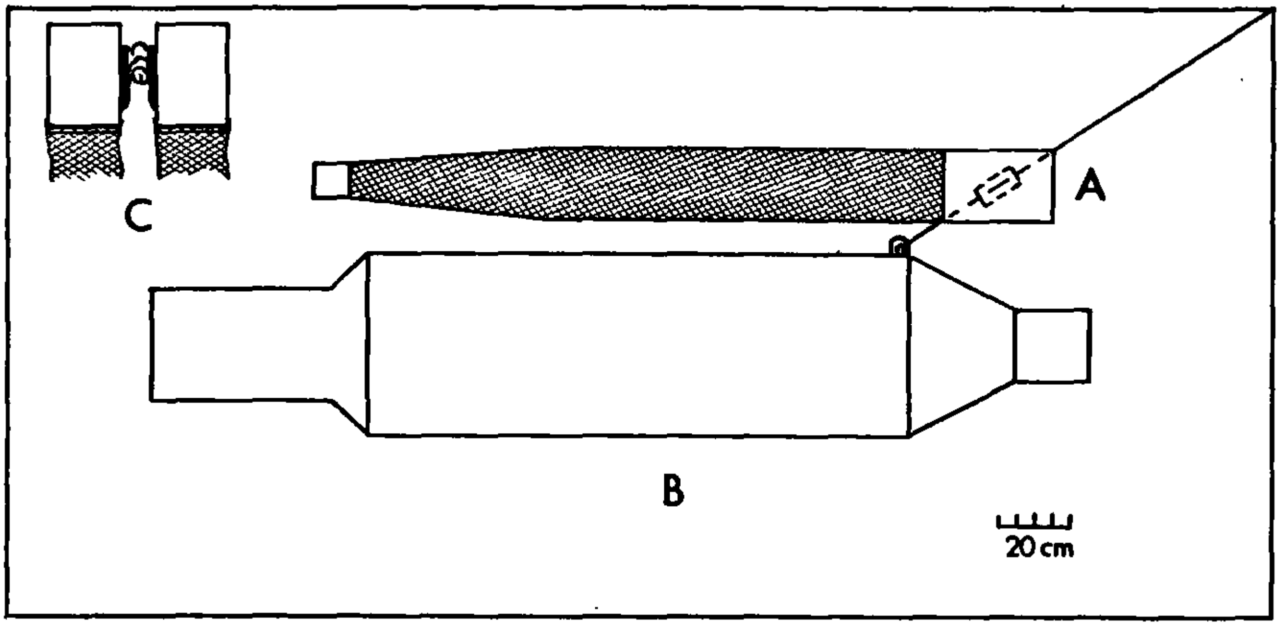

Fig. 1. Position of the Bongo (A) and Gulf III (B) samplers on the towing wire. (C) Top view of the Bongo samplers; a wire swivel clamp is positioned between the two nets.

Table 1. Sample volumes (cc/100 m^3 of water) for each of the 10 simultaneous tows made with the Bongo and Gulf III samplers. (Mann Whitney U and probability values are listed for each comparison).

	Sampler		Sampler		Sampler		Water strained(m^3)	
Tow	Port	Starboard	Port	Gulf III	Starboard	Gulf III	Bongo	Gulf III
1	1.39	1.85	1.39	0.97	1.85	0.97	169.03	159.26
2	1.22	1.37	1.22	0.83	1.37	0.83	169.95	174.34
3	1.67	1.98	1.67	0.63	1.98	0.63	167.90	158.88
4	1.20	1.60	1.20	0.42	1.60	0.42	164.21	157.92
5	1.75	1.73	1.75	1.17	1.73	1.17	162.10	118.08
6	1.67	1.92	1.67	0.09	1.92	0.09	163.68	143.14
7	1.74	1.68	1.74	0.62	1.68	0.62	166.32	134.88
8	2.07	1.97	2.07	0.59	1.97	0.59	165.92	139.10
9	1.68	1.86	1.68	0.80	1.86	0.80	165.13	145.06
10	2.17	2.38	2.17	1.26	2.38	1.26	166.52	152.26
	U value 34		U value 2		U value 0			
	P value > 0.05		P value < 0.001		P value < 0.001			

water strained per tow for each of the samplers, is shown in Table 2. Catches of each of the groups collected in the Bongo nets were compared with the Mann-Whitney U test; the differences in the catches of the Bongo nets were not significantly different. The mean number of each group in the Bongo samples was compared with the simultaneous catches made in the Gulf III. Differences in the catches of copepods (the predominant zooplankters), chaetognaths, and cladocerans were significant; numbers in the Bongo nets were consistently higher. Catches of the remaining groups, medusae and crustacean nauplii, were not significantly different (Table 2).

Table 2. Catches of the dominant zooplankton groups per 100 m^3 of water made with the Bongo (B) and Gulf III samplers. (Mann Whitney U and probability values are listed for each comparison.

		Sampler			
Group	Tow	Port (B)	Starboard (B)	Mean (B)	Gulf III
Copepods	1	17,417	12,938	14,928[1]	1,612
	2	21,051	7,607	14,325	1,501
	3	10,025	18,868	14,447	1,249
	4	14,654	14,615	14,635	2,275
	5	11,627	17,846	14,737	2,419
	6	12,551	14,428	13,490	1,777
	7	19,048	21,279	20,164	1,542
	8	8,409	12,960	10,685	2,030
	9	13,333	14,185	13,759	1,131
	10	7,418	19,409	13,445	1,687
	U value	37		0	
	P value	>0.05		<0.001	
Chaetognatha	1	379	757	568	686
	2	640	377	509	463
	3	1,010	1,372	1,191	312
	4	1,247	1,189	1,218	846
	5	217	217	217	108
	6	508	626	567	101
	7	577	596	587	101
	8	540	559	550	98
	9	736	911	824	55
	10	788	1,326	1,057	144
	U value	40.5		15	
	P value	>0.05		<0.01	
Cladocera	1	265	95	180	65
	2	132	19	76	37
	3	76	229	153	191
	4	429	175	302	208
	5	316	237	277	122
	6	254	430	342	235
	7	481	770	626	332
	8	193	463	328	247
	9	446	407	427	171
	10	384	442	413	278
	U value	49		25	
	P value	>0.05		<0.05	

[1]to nearest whole number

Table 2 (continued)

Group	Tow	Port (B)	Starboard (B)	Mean (B)	Gulf III
		Sampler			
Crustacean nauplii	1	38	-	19	30
	2	19	19	19	-
	3	-	38	19	30
	4	-	-	-	71
	5	-	39	20	34
	6	-	39	20	11
	7	38	19	29	12
	8	39	19	29	52
	9	39	39	39	28
	10	96	58	77	16
	U value	43.5		48.5	
	P value	>0.05		>0.05	
Medusae	1	-	-	-	20
	2	-	14	7	14
	3	38	76	57	30
	4	-	19	10	132
	5	39	20	29	41
	6	156	196	176	50
	7	173	96	135	42
	8	19	116	68	46
	9	78	233	156	22
	10	288	192	240	58
	U value	59		41	
	P value	>0.05		>0.05	

The samples included 16 copepod species. Of this number, four constituted approximately 95 percent of the total - *Temora longicornis, Acartia longiremis. A. clausi,* and *Pseudocalanus minutus*. Catches of the samplers were compared for differences with the Mann-Whitney U test; the collections of *Acartia longiremis* and *A. clausi* were combined to represent *Acartia* species, because of the low numbers of *A. clausi* in the samples. No significant differences were found between the catches of the port and starboard Bongo nets. Mean numbers per tow of *T. longicornis, Acartia* sp. and *P. minutus* in the Bongo samplers were compared with simultaneous catches of these species in the Gulf III sampler, and for each species the differences were significant (Table 3); catches in the Bongo nets were higher in each set.

At present we have no satisfactory explanation for the differences observed between samplers either in volumes or among the predominant taxa and species. The differences may be related to the variation in the towing characteristics of the samplers. The Bongo nets are set in a swivel yoke and present a full mouth diameter to each level sampled during the haulback. The Gulf III does not swivel and may be straining on a different angle during haulback, a difference that could be important where zooplankters are concentrated at different levels in the water column. Although the ratio of mouth opening to filtering area of the Bongo samplers (1:14) was greater than in the Gulf III (1:9.5), the average difference in the amount of water strained per tow was only 18 m^3 greater. This value is not large enough to account for the greater number (*ca.* 9 times) of copepods, the predominant zooplankters, in the Bongo sampler. It is possible that the flexible nylon netting of the Bongo samplers is reduced in aperture size in the lower portion of the net during the tow, thereby retaining greater numbers of the abundant smaller copepods, *T. longicornis* (1.3 mm, mean length), *Acartia* (1.2 mm, mean length) and *P. minutus* (1.5 mm, mean length).

Table 3. Catches of the dominant copepod species per 100 m^3 of water made with the Bongo (B) and Gulf III samplers. (Mann Whitney U and probability values are listed for each comparison.

		Sampler			
Species	Tow	Port (B)	Starboard (B)	Mean (B)	Gulf III
Temora					
longicornis	1	5,414	4,922	5,183	1,160
	2	5,573	2,391	3,982	835
	3	2,897	6,404	4,651	549
	4	3,936	4,443	4,190	892
	5	5,310	7,778	6,544	1,728
	6	5,239	5,904	5,572	1,012
	7	8,235	7,888	8,162	961
	8	3,375	5,439	4,407	1,087
	9	4,535	4,457	4,496	618
	10	2,652	6,149	4,351	1,009
	U value		33		0
	P value		0.05		0.001
Acartia	1	9,655	6,096	7,876	282
	2	12,380	4,576	8,478	445
	3	5,756	10,368	8,062	458
	4	8,730	8,370	8,550	856
	5	5,409	8,647	7,028	414
	6	6,178	7,781	6,980	570
	7	9,082	11,428	1,026	398
	8	4,417	6,403	5,410	661
	9	7,170	8,023	7,597	260
	10	3,536	10,723	7,130	373
	U value		38		0
	P value		0.05		0.001
Pseudocalanus					
minutus	1	1,515	909	1,212	10
	2	2,222	377	1,300	32
	3	839	1,258	2,348	15
	4	1,130	974	1,052	51
	5	533	711	622	34
	6	626	196	411	11
	7	1,039	1,000	1,020	24
	8	289	463	376	40
	9	814	659	737	22
	10	594	1,422	1,009	26
	U value		44		0
	P value		0.05		0.001

From our comparisons, it appears that for our present studies of herring ecology the Bongo nets collect more of the forage utilized by herring, and may provide a better estimate of prey distribution and abundance than the Gulf III sampler. Comparisons of the catching efficiencies of the two samplers will be continued during each of the seasons in 1968 for a measure of the effects of seasonal changes in zooplankton composition between the two samplers.

The BCF Bongo .03 sampler used in the study was kindly made available by Robert Marak and Arthur Posgay, Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, whose cooperation is greatly appreciated.

1. Report on recaptures in Greenland waters of salmon tagged in rivers in America and Europe, and of recaptures from tagging experiments in Greenland[1]

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The purpose of this paper is to give a survey of all recaptures of salmon in Greenland waters and the distribution of these. In the second part of this paper, there is a survey of the tagging experiments in Greenland and the recaptures from these.

Recaptures in 1967

Table 1 shows the recaptures in Greenland waters of salmon tagged in America and Europe.

Table 1. S = salmon tagged as smolts, A = salmon tagged as adult, E.G. = East Greenland.

Div	Canada		USA		Scotland		England		Sweden		Iceland	
	S	A	S	A	S	A	S	A	S	A	S	A
1A	-	-	-	-	-	-	-	-	-	-	-	-
1B	11	-	10	1	2	2	-	1	2	-	-	-
1C	25	1	9	2	6	-	3	-	1	-	1	-
1D	37	-	8	-	10	-	1	-	3	-	-	-
1E	23	-	4	1	3	1	1	-	-	-	-	-
1F	8	-	1	-	1	-	-	-	-	-	-	-
EG	-	-	-	-	-	-	-	-	-	-	-	-
1NK	1	-	2	-	1	1	-	-	-	-	-	-
Total	105	1	34	4	23	4	5	1	8	-	1	-

The total number of recaptures in 1967 was 186, of these 176 were tagged as smolts and 10 tagged as adult.

The recapture of a salmon tagged in Iceland is the first recapture from this country and a demonstration of the supposition that salmon from Iceland migrate to Greenland, too.

Recaptures from 1956-67

Tables 2-8 show the total number of recaptures in Greenland waters. The years in the tables are the year of recapture, not of tagging.

[1]Submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/65

Canada:

Table 2. Recaptures in Greenland of salmon tagged in Canada.

Div	1960		1961		1962		1963		1964		1965		1966		1967	
	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A
1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1B	-	-	-	1	-	-	2	2	1	-	1	-	30	-	11	-
1C	1	-	2	1	-	-	1	1	5	-	3	-	35	-	25	1
1D	-	-	-	-	-	-	-	-	1	-	1	-	30	-	37	-
1E	-	-	-	-	-	-	-	-	2	-	5	-	17	-	23	-
1F	-	-	-	-	-	-	-	-	2	-	2	-	8	-	8	-
EG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1NK	-	-	-	-	-	-	-	-	3	-	3	1	14	-	1	-
Total	1	-	2	2	-	-	3	3	14	-	15	1	134	-	105	1

There are 6 recaptures more from Canada. The years for the recaptures are unknown, but 3 of them were tagged in 1964, and the last 3 were tagged in 1965, all of them as smolts. The total number of recaptures from Canada are 287; of these 280 were tagged as smolts and 7 as adult salmon.

USA:

Table 3. Recaptures in Greenland of salmon tagged in USA.

Div	1963		1964		1965		1966		1967	
	S	A	S	A	S	A	S	A	S	A
1A	-	-	-	-	-	-	-	-	-	-
1B	-	-	-	1	-	-	-	-	10	1
1C	1	-	-	-	-	-	-	1	9	2
1D	-	-	-	-	-	-	-	-	8	-
1E	-	-	-	-	-	-	-	-	4	1
1F	-	-	-	-	-	-	-	1	1	-
EG	-	-	-	-	-	-	-	-	-	-
1NK	-	-	-	-	-	-	-	-	2	-
Total	1	-	-	1	-	-	-	2	34	4

The total number of recaptures of salmon tagged in USA is 42; of these 35 were tagged as smolts and 7 as adult.

Scotland:

Table 4. Recaptures in Greenland of salmon tagged in Scotland.

Div	1956		1962		1963		1964		1965		1966		1967	
	S	A	S	A	S	A	S	A	S	A	S	A	S	A
1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1B	-	-	-	-	-	-	2	-	1	1	1	3	2	2
1C	-	1	2	-	-	-	7	-	1	-	1	1	6	-
1D	-	-	-	-	-	1	-	-	-	-	1	-	10	-
1E	-	-	-	-	1	-	-	-	2	-	3	-	3	1
1F	-	-	-	-	-	-	2	-	1	-	1	-	1	-
EG	-	-	-	-	-	-	-	-	-	-	1	-	-	-
1NK	-	-	-	-	-	-	-	-	-	-	1	-	1	1
Total	-	1	2	-	1	1	11	-	5	1	9	4	23	4

The total number of recaptures in Greenland waters of salmon tagged in Scotland is 62; 51 of these were tagged as smolts and 11 were tagged as adult salmon.

England:

Table 5. Recaptures in Greenland of salmon tagged in England.

Div	1961		1962		1963		1964		1965		1966		1967	
	S	A	S	A	S	A	S	A	S	A	S	A	S	A
1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1B	-	-	-	-	-	-	-	-	1	-	-	-	-	1
1C	2	-	2	-	2	-	7	2	6	-	1	-	3	-
1D	-	-	-	-	-	1	-	-	-	-	2	-	1	-
1E	-	-	-	-	-	-	-	-	2	1	1	1	1	-
1F	-	-	-	-	-	-	1	-	-	-	1	-	-	-
EG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1NK	-	-	-	-	-	-	1	-	2	-	7	-	-	-
Total	2	-	2	-	2	1	9	2	11	1	12	1	5	1

The total number of recaptures in Greenland waters of salmon tagged in England is 49; of these, 43 were tagged as smolts and 6 as adult salmon.

Ireland:

Table 6. Recaptures in Greenland of salmon tagged in Ireland.

Div	1964		1965		1966		1967	
	S	A	S	A	S	A	S	A
1A	-	-	-	-	-	-	-	-
1B	-	-	-	1	-	-	-	-
1C	-	3	-	-	-	-	-	-
1D	-	-	-	-	-	-	-	-
1E	-	-	-	1	-	1	-	-
1F	-	1	-	-	-	-	-	-
EG	-	-	-	-	-	-	-	-
1NK	-	-	-	-	-	-	-	-
Total	-	4	-	2	-	1	-	-

The number of recaptures from Ireland is 7 and all were tagged as adult salmon.

Sweden:

Table 7. Recaptures in Greenland of salmon tagged in Sweden.

Div	1961		1962		1963		1964		1965		1966		1967	
	S	A	S	A	S	A	S	A	S	A	S	A	S	A
1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1B	-	-	-	-	-	-	-	-	-	-	-	-	2	-
1C	1	-	1	-	-	-	-	-	-	-	-	-	1	-
1D	-	-	-	-	-	-	-	-	-	-	-	-	3	-
1E	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1F	-	-	-	-	-	-	-	-	-	-	-	-	2	-
EG	-	-	-	-	-	-	-	-	1	-	-	-	-	-
1NK	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Total	1	-	1	-	1	-	-	-	1	-	-	-	8	-

The total number of recaptures from Sweden amounts to 12, all tagged as smolts; of these, 2 were tagged in Luleaa in the northern part of Sweden.

Table 8. Recaptures in Greenland of salmon tagged in various countries.

Year	Canada		USA		Scotland		England		Ireland		Sweden		Iceland	
	S	A	S	A	S	A	S	A	S	A	S	A	S	A
1956	-	-	-	-	-	1	-	-	-	-	-	-	-	-
1960	1	-	-	-	-	-	-	-	-	-	-	-	-	-
1961	2	2	-	-	-	-	2	-	-	-	1	-	-	-
1962	-	-	-	-	2	-	2	-	-	-	1	-	-	-
1963	3	3	1	-	1	1	2	1	-	-	1	-	-	-
1964	14	-	-	1	11	-	9	2	-	4	-	-	-	-
1965	15	1	-	-	5	1	11	1	-	2	1	-	-	-
1966	134	-	-	2	9	4	12	1	-	1	-	-	-	-
1967	105	1	34	4	23	4	5	1	-	-	8	-	1	-
INK	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	280	7	35	7	51	11	43	6	-	7	12	-	1	-

Table 8 gives the total number of recaptures in Greenland waters of salmon tagged in various countries. The total number is 460, of these were 422 tagged as smolts, and 38 tagged as adult salmon.

Distribution of the recaptures

It is very difficult to find any regularity in the distribution of the recaptures, and unfortunately the number of recaptures from salmon tagged in Europe is much smaller than the number of salmon tagged in North America. There are many reasons: the difference in the number of fish tagged, migration to other areas, and proportion between salmon and grilse. If just the various countries would use the same type of smolt tag, it would be easier to compare recaptures from different areas.

Table 9 shows the frequency of recaptures in 1966 and 1967 of salmon tagged as smolts in North America and Europe.

Table 9. The frequency is expressed in %, recaptures per % number of salmon caught. (= $\frac{n \cdot C}{N \cdot c}$, where N = total number of recaptures per year and tagging area (N. America and Europe resp.), n = number of recaptures per year, tagging area and division, C = total catch (in number) per year, c = catch (in number) per year and division).

Div	1966		1967	
	N. America	Europe	N. America	Europe
1B	1.64	0.55	1.16	0.82
1C	1.13	0.65	0.88	1.06
1D	1.42	1.42	1.79	2.06
1E	0.47	1.10	0.69	0.38
1F	0.68	1.70	0.69	0.86
Number	120	12	134	36

The frequency of salmon from North America is higher in Div.1B than the frequency of salmon from Europe; in Div.1F it is opposite. For both categories of salmon in Div.1D, the frequency is very high; this might be caused by the fact that the laboratory of Greenland Fisheries Investigations is placed in Godthaab, Div.1D.

An explanation of the higher frequency of European recaptures in Div. 1F might be that the salmon from North America and Europe migrate to West Greenland by two different routes. The European salmon probably migrates along the Irminger Current to East Greenland and around Cape Farewell to West Greenland. There are two recaptures of salmon tagged in Europe, one in Scotland 1966 and one in Sweden 1965 from Angmagssalik (65°50'N-37°00'W). About the route of migration from North America to West Greenland, it is, however, natural to presume that salmon arrive at the shore of West Greenland direct from North America and not via East Greenland. Therefore the concentration of salmon from Europe should be bigger in Div.1F than the concentration of salmon from North America.

Recaptures from the Tagging Experiments in Greenland Waters

Tagging Experiments 1965

The total number of salmon tagged was 223, and 3 of these salmon were recaptured. Two of them were locally recaptured and these salmon had spent 3 and 26 days respectively in the sea after the tagging. The third recapture was taken in Canada; it was Reg.0071-DA-4.

Tag No.0071-DA 4.	Details of Tagging	Details of Recapture
Date:	29 September 1965	June 1966
Place:	Praestefjord	Grand Bruit, Burgeo-LaPoile District
Length:	57-60 cm	-
Weight:	-	about 7 lb
Sex:	Female	-
Age:	4.1+	-

Tagging Experiment 1966

The total number of salmon tagged was 728. There were 28 local recaptures; of these 24 had spent between 1 and 8 days in the sea after the release; the last four had spent from 10 to 50 days in the sea after the tagging. Two of the recaptures were caught near Fiskenaesset, which is about 50 miles south of Godthaab, where tagging was carried out. Four salmon were caught in their native rivers, 3 in Scotland and 1 in Canada.

Tag No.0809-DA 4	Details of Tagging	Details of Recapture
Date:	14 October 1966	18 March 1967
Place:	Praestefjord	Net and Coble fishery at Horncliffe, River Tweed
Length:	64 cm (fork length)	68.5 cm (fork length)
Weight:	-	3.1 kg
Sex:	-	-
Age:	3.1+	3.2
Remarks:	-	Good condition

Tag No.0957-DA 4		
Date:	27 October 1966	Set net, Lower Newcastle in the upper part of the Miramichi estuary
Place:	Praestefjord	
Length:	69 cm (fork length)	28" (to tip of relaxed tail)
Weight:	-	9 lb
Sex:	Female	-
Age:	3.1+	3.2

Tag No.0936-DA 4		
Date:	26 October 1966	7 July 1967
Place:	Praestefjord	Net and coble fishery at Yarrow, River Tweed
Length:	69.5 cm (fork length)	74.0 cm (fork length)
Weight:	-	4.3 kg
Sex:	Female	Female
Age:	2.1+	2.2+
Remarks:	-	Slight tag wound, net burns visible but slight. General appearance of fish good.

Tag No.0403-DA 4		
Date:	30 September 1966	11 October 1967
Place:	Praestefjord	R. Livet, a tributary of the River Avon, which is itself a tributary of the River Spey
Length:	70-74 cm	80-85 cm
Weight:	-	4.55 kg
Sex:	Male	Male (partly spent)
Age:	2.1+	2.2+ (6° of erosion on scales)
Remarks:	-	General appearance good, no signs of net marks or fungus. The tag had been carried about an inch up the fin rays of the dorsal fin during growth.

Tagging Experiment 1967

The total number of salmon tagged in the autumn 1967 was 372. There were five locally recaptured, and all were caught less than 3 weeks after the tagging, and very near the tagging place. One recapture of a long migrated salmon has been reported from Ireland.

Tag No.1152-DA 4	Details of Tagging	Details of Recapture
Date:	3 November 1968	3 March
Place:	Praestefjord	River Slaney on the south east coast of Ireland
Length:	71-76 cm	-
Weight:	-	3.5 kg

1. Recent developments in the Georges Bank scallop fishery[1]

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History of the Fishery

Georges Bank supported a US scallop fishery for many years before the first appreciable Canadian landings from this area in 1956. Participation in the fishery by the Canadian offshore fleet continued to grow as the inshore grounds and the Nova Scotian banks were either fished out or closed to larger boats. Initially, effort was concentrated on the northeastern part of Georges Bank, catches increasing as the fleet became more familiar with the grounds, and as a greater part of their time was spent fishing on Georges. By 1957, Canadian landings had risen to 2 million pounds, one tenth of the total catch from the grounds.

By 1959, skippers and crew were becoming more efficient in shucking the catch and handling the gear. This may have been partly responsible for the steep rise in catch/day in 1959 (Fig. 1). However, that year also marked the first appearance of a new and dominant year-class into the fishery and catches containing 50 percent discards (below 3 3/4-4" shell length) were reported. The effect of this new year-class was felt the following year; extremely heavy catches gave rise to the practice of "deck loading". Dragging was restricted to 2 to 3 hours in early morning, afternoon, and evening, and the decks were piled high with unshucked scallops. After the deck was loaded, the boat was anchored, and all hands turned to shucking. This high figure for catch per day in 1960 would certainly have shown a further increase if dragging had continued for the normal 24 hours.

The success of the 1960 season resulted in a continued increase in fleet size, with bigger crews: as a result, shucking power was less of a limitation. In fact, although the record trip for a Canadian boat was made in April 1961 (M/V *Barbara Jo*: 62,570 lb for 10 days' fishing) boats had to drag continuously to maintain a high rate of catch. The main year-class contributing to the fishery was that which was recruited to the fishery the previous year. Pockets of this year-class still remained because of the practice of fishing out limited areas of high density before exploring for new beds.

In 1962, fleet size again increased steeply from 28 to 39 boats, and crew size diminished slightly as catch per boat fell off. This trend was continued the following year, when another 10 boats were added to the fleet. High landings were less frequent, and the fleet fished a much greater area of the Bank, including the southeastern part, another 4 to 6 hours steaming from Nova Scotian ports. This year the cull size fell to 3 1/2 inches, thus reducing the number of discards. No dominant year-class was in evidence.

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[1]submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/59

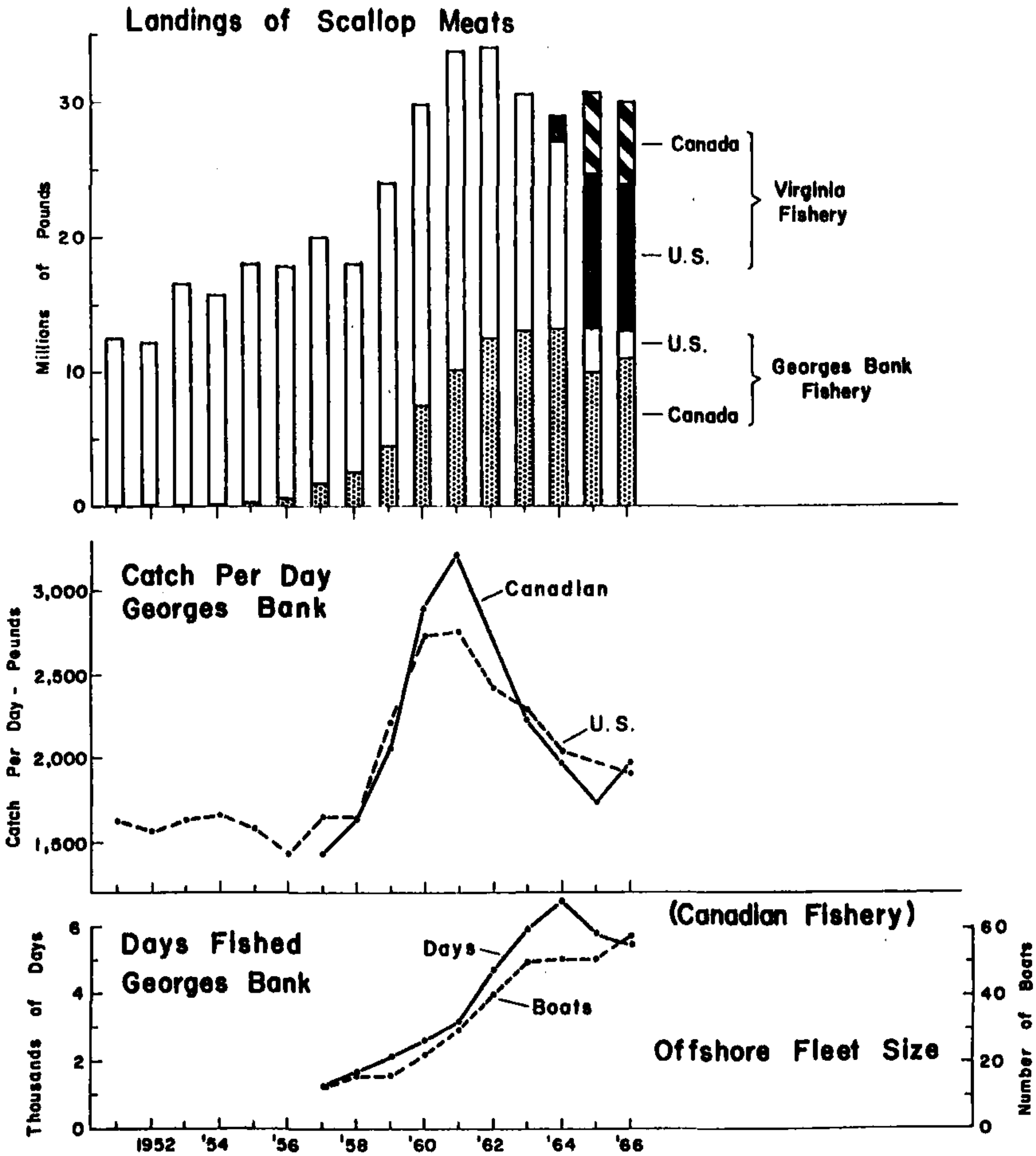

Fig. 1. Georges Bank and Virginia landings by the Canadian and US scallop fleets, 1951-66; with data on catch/day for Georges Bank (Canada and US), days fished on Georges Bank (Canada) and offshore fleet size (Canada).

In 1964, landings again increased slightly, at the expense of even greater effort in days fished and greater coverage of the Bank. For the first time, the fleet size remained constant. Although new boats still entered the fishery, equal numbers changed over to swordfish longlining. The cull size remained at 3 1/2 inches.

In 1965, the Virginia fishery, which yielded high catches to US scallopers the previous year, attracted many Canadian scallopers to make trips to the "Capes"; 38 percent of the Canadian offshore landings came from this area in 1965. In this year, Canadian landings from Georges Bank showed the first drop since entering this fishery in the early 1950's. Fishing effort on Georges Bank was still widely distributed.

By 1966, 17 million pounds of meats were landed by the Canadian offshore fleet, of which 56 percent came from the Virginia grounds. Catches of up to 3,100 pounds per day were made off the Capes in 1966, comparable with the peak catches on Georges Bank in 1960-61, and well above the daily landings from Georges over the same period.

Landing statistics

Scallops are not distributed evenly over Georges Bank but are concentrated in definite areas, some of which have a much better record of production than others. In order to study changes in scallop distribution and fishing effort, both US and Canadian fishery scientists pool data on catch statistics and break down landings from the joint fleets into unit areas. The unit areas are defined by a grid of horizontal and vertical lines at 10-minute intervals of latitude and longitude. This divides the Bank into approximately 175 units, 80 square miles in area, some part of each area lying within the 50-fathom line. Decca and Loran bearings from the log records of individual skippers are transposed into this system to give a record of individual production for each area on a yearly basis. This has been done for the Canadian fleet for four sample years (1957, 1960, 1963 and 1966) in Fig. 2, covering the main period of growth of the Canadian offshore scalloping operation. A progressive expansion of the area of operation is obvious from 1960 to 1963: this coincides with the period of decreasing scallop abundance and increasing fleet and crew size. Total landings and area of fishing operations have remained more or less constant since 1963, although still covering a smaller percentage of the Bank than the US fleet at this date (Fig. 2). The reduced effort of the US fleet on Georges Bank in recent years is quite evident however when the number of unit areas fished in 1963 and 1966 are compared.

Landings during the last 10 years by the combined US and Canadian fleets have been reported from 147 unit areas but only 40 of these have produced 80 percent of the total landings. The most consistently productive areas of the Bank have been the Great South Channel, the northern edge, the Northeastern Peak, and less consistently, the southeastern part (Bourne, 1964).

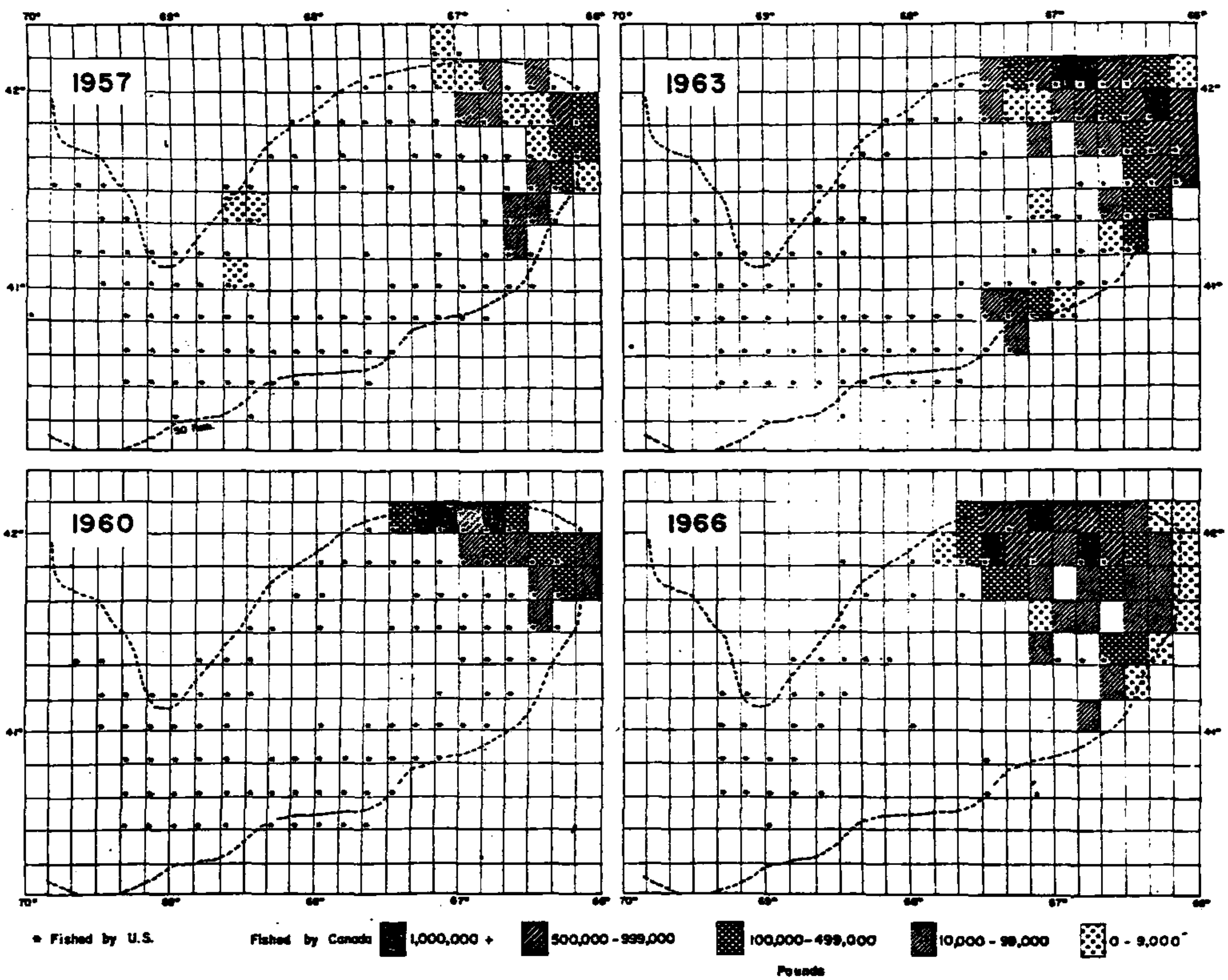

Fig. 2. Canadian scallop landings from Georges Bank for the sample years 1957, 1960, 1963 and 1966, showing numbers of 10-min unit areas fished and production of scallop meats. (Unit areas fished by the US fleet indicated by *).

Future trends

The spectacular rise in Canadian offshore scallop landings between 1958 and 1962 could not have been expected to have continued indefinitely. An eventual drop in landings was predicted by Bourne (1960) when catches were still rising. Although accurate predictions of scallop landings are impossible with our present knowledge of the biology of the scallop, earlier work on the long established Digby fishery (Dickie, 1955) suggests that scallop populations in the Bay of Fundy pass through cyclic fluctuations with peaks at approximately 10-year intervals. Further studies will be needed to establish whether Georges Bank scallops show similar fluctuations. The present trend toward a fleet of multi-purpose boats capable of exploiting more than one fishery seems encouraging. A more flexible response to changes in scallop abundance and market price will result, as well as the ability to change rapidly to a fishery for other species during their peaks of abundance.

Acknowledgments

We would like to express our gratitude to the field technicians who were largely responsible for the compiling and analysis of the data; in particular, Mr George Sullivan. Dr Neil Bourne, Fisheries Research Board, Biological Station, Nanaimo, B.C. made most of the field observations. Data from his Bulletin, "Scallops and the offshore fishery of the Maritimes" (No.145), was borrowed freely in compiling this report. We would also like to thank Mr J.A. Posgay, US Bureau of Commercial Fisheries, Woods Hole, Mass., for useful discussions on this subject.

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1. Comparative selectivity of trawl nets made of kapron and manila[1]

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Due to the fact that in the USSR trawl fishery conducted in the North Atlantic polyamide twine, *i.e.* kapron, is a main material used for manufacture of trawl webbing, a great number of experiments have been carried out during recent years with the aim of determining the selectivity of kapron trawl nets against those made of manila.

All the experiments were performed according to the same method worked out by ICES as a result of the joint experiment of 1959.

The comparative selectivity of trawl nets was studied in respect to cod and redfish separately. Systematization and treatment of experimental material were carried out in accordance with the recommendations of ICNAF and ICES.

Summarized results of experiments on determination of the comparative selectivity of kapron and manila trawl nets are shown in Tables 1-3.

For the sake of comparison, apart from data collected on board the USSR vessels from 1959 to the present time, the above tables contain also some data gathered by ICNAF from 1962 to 1966 (Res.Doc.67/75; *Redbook* 1967, Part III) as well as by ICES (*Cooperative Research Report* 2, 1964; *Cooperative Research Report* 3, 1965).

Since in trawl fishery for ground species single-braided materials practically are not used now, the tables show only those data which are pertinent to trawl nets made of double webbing.

The given tables lead to a conclusion that the mean value of the selection factor for double kapron trawl nets is 4.1 for cod, 3.6 for haddock and 3.1 for redfish. For double manila nets, the factor is 3.5, 3.1 and 2.6 respectively.

If the mean values of that factor for double manila trawl nets is taken as 1, then with the same mesh size the mean values of the selection factor for kapron nets will be 1.171 for cod, 1.161 for haddock, and 1.192 for redfish, and at an average it will be 1.176 higher than that for respective manila trawl nets.

Consequently, mesh sizes of kapron trawl nets equivalent to manila nets by selectivity will be determined by division of a mesh size of manila net by the conversion factor 1.176. Thus, the Convention mesh sizes will be:

[1]submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/58

Table 1. Summarized results of experiments on determination of comparative selectivity of trawl nets made of kapron and manila (for cod).

Experiment	Double manila No of hauls	Double manila mesh size (mm)	Double manila selection factor	Double polyamide No of hauls	Double polyamide mesh size (mm)	Double polyamide selection factor	Difference of factors (in %)	Notes
Tunets 1959 (joint experiment)	10	105	3.4	10	108	4.2	23	*Cooperative Research Report* 2,1964., Table 21, 26, 32, 33, 34
"	10	128	3.4					
Treska, 1959	-	-	-	10	98	4.4		
"	-	-	-	10	110	4.4		
"	-	-	-	20	90	4.3		
"	-	-	-	10	90	4.1		
Lot, 1959	-	-	-	10	108	4.3		
"	-	-	-	10	108	3.8		
Treska, 1960	10	125	3.8	10	103	4.2	10	
"		-	-	10	104	4.0		
Melitopol, 1960	10	106	3.7	10	93	4.0	8	
Lot, 1960	-	-	-	10	106	4.4		
Goncharov, 1962	5	141	3,4	10	108	4.1	21	*Cooperative Research Report* 3, 1965, Table ICNAF *Redbook* 1967. p.135
Kometa, 1963	-	-	-	5	105	4.0		
Vaigatch, 1964	-	-	-	26	95	4.1		
Lot, 1964	-	-	-	33	94	3.8		*Redbook* 1966, p.135, 138-141
Severnoe Sijanie, 1965	-	-	-	5	107	3.9		
"	-	-	-	5	102	4.0		
Mean value by ICES data	178	105-144	3.5	185	90 140	4.1	17.2	*Cooperative Research Report* 2, 1964, p.1
Mean value by ICNAF data perlon, kapron, stylon	97	98-130	3.5	23	60-125.4	3.7	5.7*	ICNAF *Redbook* 1967, Part III, p.103-104
Mean value by data from all countries			cp.3.5			cp.4.1	17.2	

*Hauls by nets with chafer are included

Table 2. Summarized results of experiments on determination of comparative selectivity of trawl nets made of kapron and manila (for haddock).

Experiment	Double manila			Double polyamide			Difference of factors (in %)	Notes
	No of hauls	mesh size (mm)	selection factor	No of hauls	mesh size (mm)	selection factor		
Tunets, 1959	5	106.0	3.2	6	103	3.8	18.8	
Treska, 1960	-	-	2.9	4	102	3.7	27.6	
Goncharov, 1963	-	-	3.0	8	98	3.6	20.0	
Mean values by ICES data								
a) Arctic	95	109-144	3.2	34	104-140	3.3	3.1	*Cooperative Research Report* 2, 1964
b) Faroes	39	82-106	2.9	-	-	-	-	
c) Iceland	51	67-178	3.2	-	-	-	-	
Mean values by data from joint experiment	112	98-141	3.3	12	89-126	3.5	6.1	*Cooperative Research Report* 3, 1965
Mean values by ICNAF data	179	67-118	3.2	16	113.4-127.3	3.5	9.4	*Redbook* 1967, Part III, ICNAF
Mean value by data from all countries	-	-	3.1	-	-	3.6	16.1	

Table 3. Summarized results of experiments on determination of comparative selectivity of trawl nets made of kapron and manila (for redfish).

Experiment	Double manila No of hauls	Double manila mesh size (mm)	Double manila selection factor	Double polyamide No of hauls	Double polyamide mesh size (mm)	Double polyamide selection factor	Difference of factors (in %)	Notes
USSR								
Sulin, 1961	8	116.0	2.7	-	-	-		
"	8	116.0	2.7	-	-	-		
"	6	119.8	2.9	-	-	-		
"	6	119.8	3.0	-	-	-		
"	6	130.3	2.9	-	-	-		
"	6	130.3	2.9	-	-	-		
Ogon, 1961	-	-	-	3	150.0	2.9		
Goncharov, 1962	5	92.0	2.5	5	116.0	3.3	32.0	
Kometa, 1963	-	-	-	8	103.0	2.7		
Canada								
Marinus, 1954-56	6	106.7	2.7	-	-	-	-	Templeman W.
"	4	99.1	2.7	-	-	-	-	Selection of
"	10	66.4	2.1	-	-	-	-	redfish, Joint
"	17	111.8	2.6	-	-	-	-	Sc. Meeting
"	39	111.8	2.5	-	-	-	-	S.21, Lisbon,19
Small-size trawler	10	114	2.2	-	-	-	-	McCracken, F.D.
"	10	114	2.4	-	-	-	-	Selection by
								large mesh cod-
								ends of flat-
								fish and redfish
USA								
Priscilla V	8	115	2.5	-	-	-	-	Clark, J.R.
"	3	99	2.4	-	-	-	-	Escapement of
"	4	69	2.3	-	-	-	-	redfish through
Albatross III	2	132	2.4	-	-	-	-	codends. Sum-
"	8	109	2.2	-	-	-	-	mary of United
"	4	80	2.2	-	-	-	-	States experiment,
"	3	82	2.6	-	-	-	-	J. Sc. Meeting
								S.29, Lisbon 1957

(continued)

Table 3 (continued)

Experiment	Double manila			Double polyamide			Difference of factors (in %)	Notes
	No of hauls	mesh size (mm)	selection factor	No of hauls	mesh size (mm)	selection factor		
Norway								
G.O.Sars, 1956-57	1	144	2.6	-	-	-		*ICNAF Spec.Publ.*5
"	1	144	3.1	-	-	-		
"	1	144	2.8	-	-	-		
Johan Hjort, 1960	1	132	3.0	-	-	-		*C.M.* 1960, N 89
"	1	132	2.9	-	-	-		
FRG								
Anton Dohrn, 1957-60	-	-	-	12	129	3.5		
"	-	-	-	11	129	3.3		
"	5	129	2.4	7	132	3.1	29.2	
Joint Experiment 1962								
Anton Dohrn	11	139	2.9	17	132	2.9		*Cooperative Research Report* 3, 1965
"	10	149	3.1	7	142	3.1		
Explorer	8	127	2.2	3	89	2.7	22.7	
"	3	132	2.8	-	-	-		
Goncharov	-	-	-	3	118	3.2		
Mean value by data from all countries			2.6			3.1	19.2	

a) for areas in the Northwest Atlantic, where at present 114 mm manila mesh size is adopted, for kapron - 114:1.176 = 97 mm;

b) for the Northeast Atlantic, where 120 mm inner manila mesh size is adopted, for kapron - 120 mm :1.176 = 102 mm and so on.

As has repeatedly been noted by many authors, fishing nets made of polyamide twines, of which kapron and nylon are typical representatives, possess maximum extensibility, which accordingly influences the selectivity of fishing gear made of them.

All other materials, including synthetic, exert less influence on the selectivity, but nevertheless this influence is considerable and cannot be ignored. For this reason, in accordance with the principle of the equivalent selectivity (established by the resolutions of ICNAF Annual Meetings), it is expedient to determine differentiated factors for conversion of mesh sizes equivalent by selectivity for all material used in fishing.

Application of the above method allows determination of mesh sizes for various materials on a scientific basis and would help to get a more precise idea of size composition of fish taken from stocks. Keeping in mind the present state of stocks of groundfish in the North Atlantic, the latter is of great practical importance.

2. Codend mesh selection studies of yellowtail flounder, *Limanda ferruginea* (Storer)[1]

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Introduction

The yellowtail flounder is the most important flatfish in the New England otter trawl fishery. United States landings in 1966 were 30,000 metric tons. Most of the catch comes from Div.5Z and from grounds just to the west of 5Z. The fish are caught on sandy bottoms in depths of 30 to 60 m. When vessels are fishing for yellowtail this species is the predominant food fish taken although at times small amounts of summer flounder and winter flounder also are caught. Non-food species taken, which are discarded by yellowtail draggers, consist largely of sculpins, spiny dogfish and red hake.

About 75 percent of the yellowtail are landed at New Bedford, Massachusetts. Most vessels fishing yellowtail from there are medium otter trawlers of 50 to 85 gross tons. The trawls used, for the most part, are fitted with single nylon codends of 114 mm mesh (internal, stretched measure). This mesh retains large numbers of yellowtail less than 340 g (about 35 cm), currently the minimum market size. The undersized yellowtail, which frequently are 50 percent of the catch by weight, are discarded overboard. My very limited information on survival of discarded fish, obtained by placing discards in tanks of running sea water aboard commercial trawlers, indicates that about 25 percent survive.

Yellowtail of discarded sizes are growing rapidly (Lux and Nichy, 1969) and available information indicates that natural mortality is relatively low (Lux, 1969). A savings of fish presumably would result if the discards could be effectively released by increasing codend mesh size. To obtain release information we therefore examined mesh selection for yellowtail aboard commercial otter trawlers in September 1967.

Methods

The work was done aboard two New Bedford otter trawlers. Pair tows were made during a part of the trip, using a codend of the mesh to be tested on one vessel and a lined codend or different size codend on the other. The catches from a series of tows were compared (large mesh versus liner) to obtain selection data. The liner was of 38 mm mesh nylon, which retained all sizes of yellowtail present on the grounds.

[1]Submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/91

Mesh measurements were made on wet, after use, codends with an ICES mesh gauge set at a tension of 4 kg. Two rows of meshes, from head end to purse ring end of the codend, were measured, and the mean of these measurements was taken to be the mean mesh size for the codend.

The vessels were diesel-powered medium side trawlers which normally fish for yellowtail. The *Catherine and Mary* was 56 gross tons, 19.8 m long and had 180 horsepower. The *Moonlight* was 71 gross tons, 23.8 m long and had 200 horsepower. Both vessels used a No 36 otter trawl with 127 mm mesh nylon twine in net parts forward of the codend. This is their standard gear. Aside from very minor variations, the nets were similarly rigged. Towing speed was the same for the two vessels. This was estimated by the captain of the *Moonlight* to be 2.5 to 3 knots, depending on current and wind conditions.

I assumed that the two vessels had equal fishing power, given the mild weather conditions prevailing during the experiments. For this trip, for equal amounts of effort, the comparative weighouts in metric tons of commercial fish caught were as follows: *Catherine and Mary:* yellowtail flounder, 12.76, summer flounder, 0.32; *Moonlight*: yellowtail flounder, 11.05, summer flounder, 0.31. Since the vessels fished within sight of each other during the trip, even when pair tows were not being made, they presumably were working on the same body of fish.

We compared two nylon codends, in pair tows, with the lined codend. One of these had a mesh opening of 129 mm and was of single, twisted twine 5 mm in diameter; the other had a mesh opening of 145 mm and was of single, braided twine 6 mm in diameter. In addition, we made a few pair tows with the 129 mm versus the 145 mm codend, and with the 129 mm versus a 116 mm codend. The 116 mm codend was one that normally was used for yellowtail fishing aboard the *Moonlight*. It was of single, braided nylon twine of 6 mm diameter.

Chafing gear was used only on the bottom of the codend, in the after part where the bag of fish dragged on the sea floor. It was the same on both vessels and consisted of 114 mm mesh nylon tied at the knots with short lengths of polypropylene twine which frayed out in use to form a protective mat. This chafing gear is the kind most used on New England trawlers, although bull hides continue to be used by some fishermen.

Total catches and length frequency distributions for each tow were estimated from samples. We obtained a sample of 2 or 3 one-bushel baskets of unculled yellowtail from each tow. These fish were measured to the nearest centimetre and separated into baskets of markets (kept catch) and discards, using the cull point length of 35 cm. This gave estimates of the length frequency distribution and the ratio, by volume, of the catch of markets to discards for the tow. The total amount of market yellowtail caught per tow, in bushels, was obtained from the crew who measure their catch by bushelling it. Using the above ratio and the total volume of markets in the tow, we calculated the total number of bushels of discards in the catch and added this to the bushels of market fish to get total catch.

We measured the actual volume of total discards in 5 tows and compared this with estimated values to obtain a measure of the error in the above technique. The actual and estimated percentages for these tows are given in Table 1. Some catches were underestimated and some overestimated. The average difference between estimated and actual catch was about 6 percent.

Table 1. Comparison of actual and estimated proportions of yellowtail discards in 5 tows.

Tow	% Discard Yellowtail		Total Catch
	Actual	Estimated	(Bushels)
1	58	67	26.0
2	65	60	23.0
3	62	50	26.0
4	62	65	10.5
5	69	65	24.5

Since towing time varied from 35 to 90 minutes and was usually not exactly the same for each of the vessels in a given pair tow, we adjusted catches to a one hour tow length. The length frequency distribution for the measured sample was applied to the estimated total number of yellowtail in the catch for each (one hour equivalent) tow, to obtain the length frequencies of the total catch per one hour tow. In each pair tow series, the length frequency data for all tows with the one codend were combined and compared with the equivalent data for the other codend. The percentage retention for each 2 cm interval was computed and selection curves, based on smoothed retention percentages, were constructed.

Results

Fourteen pair tows were made in four series (Table 2). All were made on yellowtail grounds 7 to 10 miles north and northwest of Nantucket Shoals lightship (40°33'N, 69°28'W). Water depth was 45 to 55 m.

Table 2. Number of tows and codend mesh sizes in each series of yellowtail mesh selection experiments.

Series	Number of Tows	Codend Mesh Size (mm)	
	(each vessel)	*Catherine and Mary*	*Moonlight*
1	6	129	38 liner
2	3	38 liner	145
3	2	129	145
4	3	129	116

The numbers of small and large yellowtail present on this ground were too few to provide precise selection information at the lower and upper ends of the selection curves. Also, the number of tows were rather inadequate to even out sampling errors to the extent desired. These factors should be kept in mind when interpreting the data.

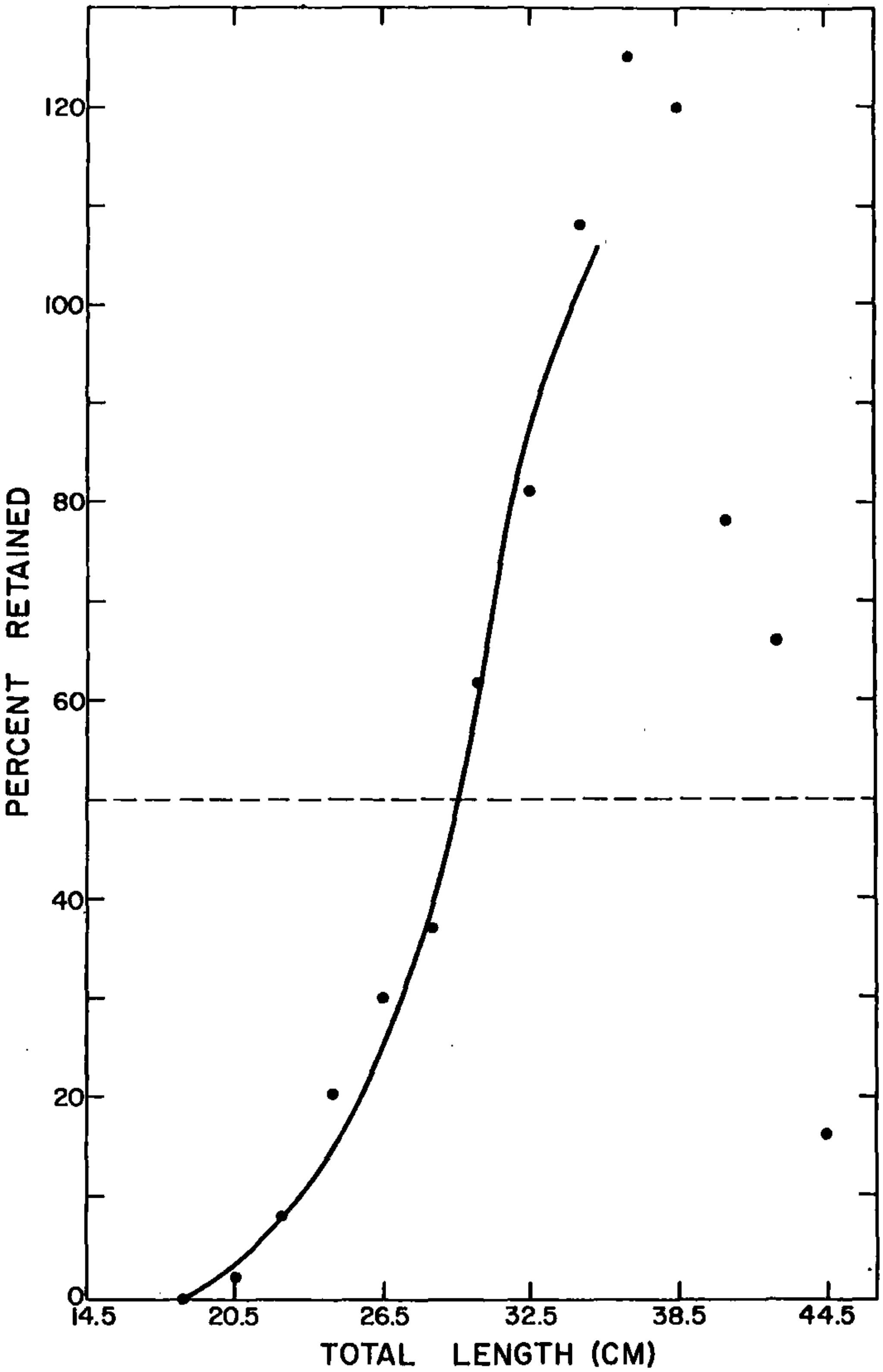

Fig. 1. Selection curve for yellowtail for a 129 mm nylon codend.

Series 1 (mesh size 129 mm)

Selection data for the 129 mm codend, based on 6 pair tows, are given in Table 3. Some market fish near the cull length (35 cm) were released. A selection curve, drawn by eye to the percentage retention points, is shown in Fig. 1. The 50 percent selection length of approximately 29.5 cm gives a selection factor of 2.29. The 25 percent to 75 percent selection range is approximately 5 cm.

Table 3. Estimated yellowtail length frequency distributions and percent retained for a 129 mm mesh codend compared with a lined codend (38 mm mesh) for 6 one-hour pair tows.

Length interval (cm)	Numbers caught		% retained[1]
	129 mm	38 mm	
14-15	0	2	
16-17	0	39	0
18-19	0	259	0
20-21	0	319	2
22-23	12	87	8
24-25	10	29	20
26-27	31	200	30
28-29	389	764	37
30-31	1,022	1,615	62
32-33	1,015	1,376	81
34-35	1,040	916	108
36-37	635	424	125
38-39	149	128	120
40-41	20	20	78
42-43	9	22	66
44-45	8	11	16
46-47	0	2	
Total	4,340	6,213	

[1]smoothed by 3's, using geometric means

The estimated yellowtail catches for the 129 mm mesh and the lined codend, for the 6 pair tows, are given in Table 4. The 129 mm mesh caught relatively more market yellowtail than the lined codend while releasing some of the undersize fish. The ratio of market to discard catch increased from 0.37 to 0.87.

Table 4. Comparison of yellowtail catch for the 129 mm mesh and the lined (38 mm) codend.

	Catch - bushels/hour	
Size Category	129 mm	38 mm
Market	3.9	2.5
Discard	4.5	6.8
Ratio, Market to Discard	0.87	0.37

Series 2 (mesh size 145 mm)

Selection data for the 145 mm mesh codend, based on 3 pair tows, are given in Table 5. A selection curve, drawn by eye to the percentage retention points, is shown in Fig. 2. The 50 percent selection length of approximately 34 cm gives a selection factor of 2.34. The 25 percent to 75 percent selection range is approximately 8.5 cm.

Table 5. Estimated yellowtail length frequency distributions and percent retained for a 145 mm mesh codend compared with a lined codend (38 mm mesh) for 3 one-hour pair tows.

Length interval (cm)	Numbers caught		% retained[1]
	145 mm	38 mm	
16-17	0	7	
18-19	0	124	4
20-21	49	313	8
22-23	21	149	16
24-25	11	56	18
26-27	63	299	23
28-29	361	1,277	28
30-31	827	2,282	35
32-33	748	1,786	41
34-35	528	1,124	50
36-37	239	362	93
38-39	141	54	111
40-41	34	42	139
42-43	9	7	
Total	3,031	7,882	

[1]smoothed by 3's, using geometric means

The 145 mm mesh showed less effective release of small fish than did the 129 mm gear (Fig. 1 and 2). In view of the low numbers of small fish present, this apparent anomaly probably resulted from sampling error.

The estimated yellowtail catches for the 145 mm mesh and the lined codend, for the 3 pair tows, are given in Table 6. The 145 mm mesh caught fewer of both market and discard fish than the lined codend. The ratio of market to discard catch increased from 0.45 to 0.56.

Table 6. Comparison of yellowtail catch for the 145 mm mesh and the lined (38 mm) codend.

Size category	Catch - bushels/hr	
	145 mm	38 mm
Market	3.6	7.6
Discard	6.5	16.7
Ratio, Market to Discard	0.56	0.45

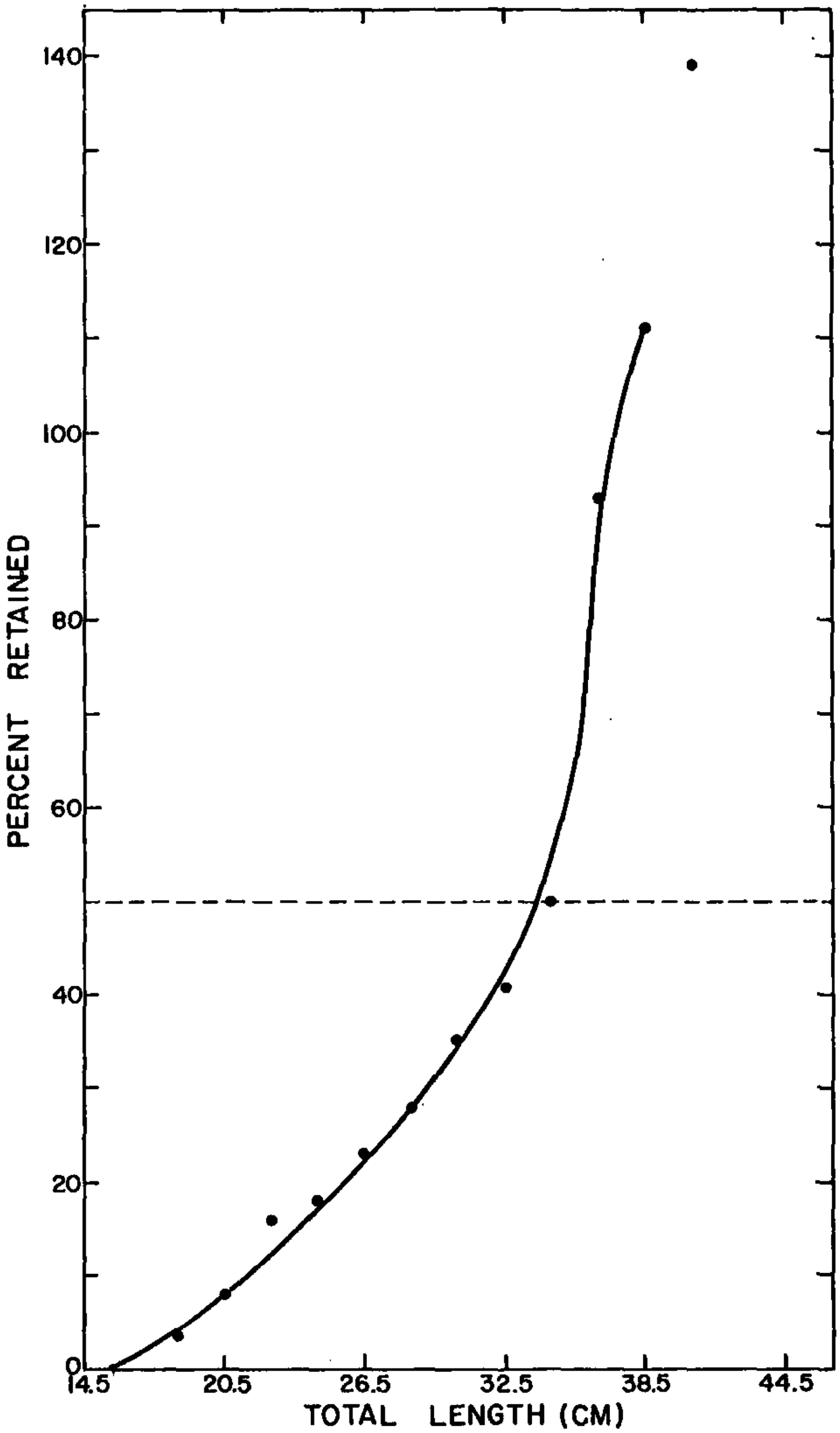

Fig. 2. Selection curve tor yellowtail for a 145 mm nylon codend.

Series 3 (mesh size 129 mm versus 145 mm)

Length distribution data for the 129 mm and 145 mm mesh codends, based on 2 pair tows, are given in Table 7. The 145 mm mesh showed more effective release of small fish in this series than it did in Series 2.

Table 7. Estimated yellowtail length frequency distribution and percent retained for a 129 mm mesh codend compared with a 145 mm mesh codend for 2 one-hour pair tows.

Length Interval (cm)	Numbers caught		% Caught
	145 mm	129 mm	by 145 mm
16-17	0	11	0
18-19	5	30	17
20-21	10	70	14
22-23	20	43	46
24-25	0	27	0
26-27	38	109	35
28-29	197	529	37
30-31	620	1,318	47
32-33	696	1,417	49
34-35	385	968	40
36-37	273	474	58
38-39	132	127	104
40-41	38	32	119
42-43	29	30	97
44-45	0	8	0
46-47	6	0	
Total	2,449	5,193	

The estimated yellowtail catches for these two codends are given in Table 8. The 129 mm mesh caught about twice the volume of both market and discard fish as the 145 mm did; hence both meshes had similar ratios of market to discard.

Table 8. Comparison of yellowtail catch for the 129 mm and 145 mm mesh codends

Size Category	Catch - bushels/hr	
	129 mm	145 mm
Market	11.0	5.3
Discard	17.0	8.0
Ratio, Market to Discard	0.65	0.66

Series 4 (mesh size 129 mm versus 116 mm)

Length distribution data for the 129 mm mesh codend and the 116 mm mesh codend (standard commercial gear on the vessel *Moonlight*), based on 3 pair tows, are given in Table 9. The 129 mm net released some numbers of market yellowtail at or just above the 35 cm cull point, but few larger ones were released. Substantial amounts of discards were released by the larger mesh.

Table 9. Estimated yellowtail length frequency distributions and percent retained for a 129 mm mesh codend compared with a 116 mm mesh codend for 3 one-hour pair tows.

Length Interval (cm)	Numbers caught		% caught
	129 mm	116 mm	by 129 mm
20-21	0	12	0
22-23	2	0	
24-25	0	5	0
26-27	10	23	43
28-29	50	204	24
30-31	121	528	23
32-33	247	893	28
34-35	316	830	38
36-37	307	397	77
38-39	95	134	71
40-41	22	30	73
42-43	3	0	
44-45	3	3	100
Total	1,176	3,059	

The estimated yellowtail catches for these two codends are given in Table 10. The 129 mm mesh caught, by volume, 81 percent as much market fish and 26 percent as much discards as did the 116 mm mesh. The ratio of market to discard was much higher with the 129 mm mesh, 2.12 versus 0.68

Table 10. Comparison of yellowtail catch for the 129 mm and 116 mm mesh codends

Size Category	Catch - bushels/hr	
	129 mm	116 mm
Market	3.4	4.2
Discard	1.6	6.2
Ratio, Market to Discard	2.12	0.68

References

Lux, F.E., 1969. Landings per unit of effort, age composition, and total mortality of yellowtail flounder, *Limanda ferruginea* (Storer), off New England. *Res. Bull. int. Comm. Northw. Atlant. Fish.*, No.6 (In Press).

Lux, F.E. and F.E.Nichy., 1969. Growth of yellowtail flounder, *Limanda ferruginea* (Storer) on three New England fishing grounds. *Res. Bull. int. Comm. Northw. Atlant. Fish.*, No.6 (In Press).

3. Some observations on the selectivity of trawl nets with the Polish-type topside chafer[1]

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During 1967 we have made some observations in Div.3L of the ICNAF Area with the purpose of comparing the selection characteristics of the top-side chafers used by the Portuguese trawlers and those of the Polish type described by Strzyzewski (1966).

The results obtained for cod showed us that the chafers employed in our vessels were not convenient and, for that reason, the National Advisory Commission for the Northwest Atlantic Fisheries proposed a new regulation, afterwards approved and published in the Official Diary, which prohibits, for stern trawlers, all the topside chafers except the Polish type, due to the fact that the selection factors are similar to those obtained without chafers, or are even bigger (Bohl, 1967).

Vessel: Stern trawler, 2,700 GT, 80.3 m length o.a. and 2,300 h.p.e.
Gear: Portuguese standard stern trawler bottom trawl
Date: 4-5 September 1967
Time: 0500-2015 hrs (local time)
Locality: Div.3L
Depth range: 215-265 m
Experimental method: covered codend
Codend - Material: Polyethylene, 4.5 mm Ø
Dimensions: 168 x 32 meshes
Braiding: Double twine (16 x 4 filaments each)
Twine construction: Twisted
Chafer - Material: Polyethylene, 4.5 mm Ø
Dimensions: 85 x 26 meshes
Braiding: Double twine (16 x 4 filaments each)
Twine construction: Twisted
Cover - Material: Polyethylene, 2.3 mm Ø
Dimensions: 500 x 242 meshes
Braiding: Single twine (16 x 4 filaments each)
Twine construction: Twisted
Mesh gauge: ICES, 4 kg pressure
Mesh sizes: Codend (mean ± s.e.) : 103.8 ± 0.82 mm
Range: 94-116 mm
No of measurements: 3 x 20
Chafer: 215 mm
Cover: 40 mm
Duration of hauls: 2-4 hr

[1]Submitted to the 1968 Annual Meeting of ICNAF as ICNAF Res.Doc.68/100

No of hauls: 6
Towing speed: 3.5-5.5 knots
Species: Cod
Retention length (50 percent) - 409 mm
Selection range (25-75 percent) - 81 mm
Selection factor: 3.95
No of fish (cod) in: Codend - 5,795
Cover - 3,299
Selection range - 3,620
Avg weight per haul - Codend - Cod: 1,322 kg
Redfish: 8 kg
Sole: 300 kg
Cover - Cod: 233 kg

The chafer, covering completely the upper part of the codend, has been attached mesh-to-mesh along the upper part, the selvedges and the second row of the codend. Some meshes of the chafer were also laced to the codend in order to maintain such a relative position that one mesh of the chafer covers four meshes of the codend.

As we can see from the figure, the selection range reveals quite a sharp selection (8 cm).

The calculated selection factor for cod (3.95) agrees with the previous observations made by other authors and, particularly with Bohl (1967), in being bigger than the value indicated by this author for the hauls without chafer.

References

Bohl, H., 1967. Selection experiments with a large-meshed topside chafer. *Int. Comm. Northw. Atlant. Fish., Redbook* 1967, Part III, p.82-89.

Strzyzewski, W., 1966. The effect of the use of chafing gear on selection factor. *Int. Comm. Northw. Atlant. Fish., Redbook* 1966, Part III, p.112-121.

PORTUGAL - 1967

Topside chafer (Polish type) - Selectivity