INTERNATIONAL COMMISSION

FOR THE

NORTHWEST ATLANTIC FISHERIES

ANNUAL PROCEEDINGS

Vol. 9

for the year

1958-59

Issued from the Headquarters of the Commission
Halifax, N. S., Canada
1959

ROLPH-CLARK-STONE, MARITIMES, LIMITED
HALIFAX, N. S.
DECEMBER, 1959

CONTENTS

FOREWORD

The Commission's publications have been established in two annual series since 1953; an "Annual Proceedings" and a "Statistical Bulletin." Since 1957 a third annual series the "Sampling Yearbook" has been added. Special papers from the Commission may be published separately.

The Annual Proceedings contains the Commission's reports for the year in question: Administrative Report, Report of the Annual Meeting, Summaries of Research by the participating countries, scientific papers especially prepared for Meetings; lists of scientists engaged in the various branches of the Commission's work, and of main laboratories concerned with this work, and lists of papers on research in the Convention Area within the scope of ICNAF.

The Statistical Bulletin deals with the fisheries statistics of the Convention Area, mainly those for the year in question, but also with statistics for former years collected and compiled by the Commission. The Statistical Bulletins Vol. 1-3 dealt with the more important groups of groundfish. The Statistical Bulletins from Vol. 4 (year 1954) also deal with the other fishes and with shellfish, however in a more summarized form.

The "Sampling Yearbook" includes in tabular form length measurements, age determinations and possibly other data relating to the stocks of commercial fish species, and collected by the member countries in ports or on board fishing vessels or research vessels. The "Sampling Yearbook" is issued annually (the first volume in 1958). Its distribution is restricted to directly interested institutions or persons.

The Special Publication No. 1: "Some Problems for Biological Fishery Survey and Techniques for their Solution. A Symposium held at Biarritz, France, March 1-10, 1956" was published in June 1958.

A list of the Commission's publications is found on the back of the cover.

Erik M. Poulsen,
Executive Secretary.

Halifax, 30 November, 1959

PART 1

Administrative Report for the Year ending 30 June 1959

BY THE EXECUTIVE SECRETARY, ERIK M. POULSEN

1. Officers during the Year.

Chairman of Commission—Mr. Klaus Sunnanå, Norway

Vice-Chairman of Commission — Mr. A. J. Suomela, U.S.A.

Chairman Panel 1: Capt. T. de Almeida, Portugal

,, Panel 2: Mr. A. Carusi, Italy

,, Panel 3: Dr. J. Ancellin, France

,, Panel 4: Mr. F. W. Sargent, U.S.A.

,, Panel 5: Mr. G. R. Clark, Canada

The above officers were elected at the 1957 Annual Meeting, and are serving for a period of two years.

Chairman of Standing Committee on Finance and Administration— Mr. A. J. Suomela, U.S.A.

Chairman of Standing Committee on Research and Statistics — Dr. M. Ruivo, Portugal

These two chairmen hold office for a period of one year.

2. Panel Memberships 1958-59.

Country	Panel No. 1	2	3	4	5	Total
Canada		+	+	+	+	4
Denmark	+					1
France	+	+	+	+		4
Germany	+					1
Iceland	+					1
Italy	+	+	+	+		4
Norway	+					1
Portugal	+	+	+	+		4
Spain	+	+	+	+		4
U.S.S.R.	+	+	+			3
United Kingdom	+		+			2
United States			+	+	+	3
TOTAL	10	6	8	6	2	32

3. Newsletters

Newsletters were distributed from headquarters in order to circulate information relevant to the Commission's activities and interests on 14 August, 15 December 1958, and 31 March 1959.

4. Commission's Publications.

The Annual Proceedings, Vol. 8, for the year 1957-58, was issued in October 1958 This volume is somewhat larger than the preceding ones, owing to the inclusion of a series of selected papers from the 1958 Annual Meeting.

The Statistical Bulletin, Vol. 7, for the year 1957, is in print.

The Sampling Yearbook, Vol. 2, for the year 1957 was published in June 1958. In spite of some contraction of certain tables it is a little larger than Vol. 1, owing to the increase in number of samples and the inclusion of two short papers on sampling.

Following a recommendation of the 1958 Annual Meeting a special issue (the "Red Book") of papers, relating to the work of the Standing Committee on Research and Statistics at that meeting, was prepared in the Secretariat and distributed within the Commission. The paper includes the Report of the Standing Committee on Research and Statistics with thirteen appendices, further a number of documents from the 1958 Annual Meeting relevant to that report, and finally "An Outline of Present Research and Long Range Needs in the Convention Area" prepared by that Committee at the 1956 Annual Meeting. A corresponding "Red Book" is being prepared also from the 1959 Annual Meeting.

The Commission has been informed by FAO that the preparation of the report on the Joint Workshop by FAO, ICES and ICNAF on Population Dynamics and Selectivity of Fishing Gear held in Lisbon, Portugal, in 1957 is well under way. The editing and printing of the report is being done by the FAO.

5. Co-operation with other International Organizations.

This co-operation by means of exchange of observers, reports, and publications has been continued along the same lines and with the same organizations as in recent years. A co-operation of a more special kind has been commenced with FAO with the purpose of ensuring a review as complete as possible of papers relevant to the fisheries and the researches in the NW Atlantic.

6. Co-operation with Non-member Countries.

Poland is considering an extension of her fisheries to include parts of the NW Atlantic and has expressed the wish to enter into co-operation with ICNAF. Observers from Poland attended the 1959 Annual Meeting.

Belgium and Cuba are known to have been fishing in the Convention Area in 1958, and the Secretariat has contacted the two countries in order to collect statistical data on their fisheries in the Convention Area.

The exchange of publications with fishery research institutions in a number of non-member countries was maintained and extended.

7. Research Programs.

Research programs for 1958 were forwarded from member countries to the Secretariat, in the period December 1957 to April 1958. They were distributed, together with a summary prepared in the Secretariat during the same months.

Particulars about the hydrographic research plans were forwarded by member countries through the Secretariat to the special committee appointed by ICES in connection with the planning of the work of the International Geophysical Year.

At the 1958 Annual Meeting a paper by Mr. J. Corlett, Lowestoft, England, was considered by the Research Committee in connection with the elaboration of a general Plankton Research Program for the ICNAF Area. The problem was further considered at the 1959 Annual Meeting also in the light of a survey by Dr. L. A. Walford of present information on plankton in the Convention Area. A complete program of environmental studies is now under preparation.

8. Summaries of Research.

Summaries of the researches by the various member countries in 1958 were received in the Secretariat, and distributed for the 1959 Annual Meeting. They are printed in this Proceedings together with a summary of subareas, prepared in the Secretariat (see Part 3).

9. Sampling.

Data from samples of fish taken both by commercial vessels and research vessels in 1957 have been forwarded by member countries to the Secretariat. After being edited and converted to the Commission's standard form they were published in the Sampling Yearbook, Vol. 2, together with some samples from previous years, not hitherto reported to the Commission.

10. Collection of Statistics.

The Commission's collecting of statistics and the compilation of the data in the Secretariat have been continued according to the Commission's requirements. In all cases the high standard of collecting statistics by member countries has been maintained and in several cases additional detail has been added to the statistical submissions.

The collection of data on the species, quantities and sizes of fish discarded at sea has lagged behind, but there are signs from the statistical reports of a few member countries that more attention is being paid to this fundamental question.

11. Cod Otolith Exchange Program.

Following a recommendation of the Committee on Research and Statistics a series of samples of cod otoliths was obtained from member scientists during the year. The otoliths were then sent out to a number of scientists who aged them and reported their age estimates to the Commission. These results and an analysis of them were reported to the 1959 Annual Meeting. Preliminary analysis shows that the variation in age reading from Subarea 1 otoliths is very low, that the variation is rather greater with Subarea 3 and 4 otoliths, and that in all areas the variation increases with the size (and age) of the cod.

12. Fisheries Regulations.

The collection of detailed information, from the member countries concerned, on the implementation of the trawl regulations is being continued. This is also the case with information on the measures taken by the countries concerned in order to make known to the fishermen the requirements of the mesh regulations, and with information on systems of inspections and on the results of inspections carried out. The material collected was considered by the Commission at the 1959 Annual Meeting, and it was decided that the collection of these data be continued.

13. Ninth Annual Meeting.

The Ninth Annual Meeting was convened in Montreal, Canada, in the week beginning 1 June 1959. In the week preceding (26-30 May) meetings of the Standing Committee on Research and Statistics and the Groups of Advisers to Panels were held.

14. Future Meetings.

Preparations for the meeting on Redfish to be held jointly by ICES and ICNAF in Charlottenlund, Denmark, 12-16 October 1959 are well under way conducted by the designated Chairman and Vice-Chairman of the Meeting: Dr. Lundbeck, Germany and Mr. Trout, England.

Together with FAO and ICES the Commission is cosponsoring the meeting on North Atlantic Fishery Statistics to be held in Edinburgh, Scotland, September, 1959. The Commission's Biologist/Statistician will participate in the meeting.

15. Other Matters.

In December 1958 meetings of the Groups of Advisers to Panels 4 and 5 were held in Boston; scientists working in Subarea 3 participated in the meetings. The Executive Secretary and the Biologist/Statistician attended the meetings. Work carried out through the year was reviewed and plans for future researches were elaborated. The results of these meetings are presented in 1959 Annual Meeting Document No. 3.

Following invitation the Executive Secretary and the Biologist/Statistician attended meetings in Ottawa in January, 1959 sponsored by the Fisheries Research Board of Canada.

At the Statutory Meeting of ICES, October 1958, Dir. G. Rollefsen, Norway, and the Executive Secretary, acted as observers for ICNAF. A report of the meeting by the Executive Secretary was prepared as Document No. 2 for the 1959 Annual Meeting. After the meeting the Executive Secretary considered and discussed with the General Secretary of ICES various matters relevant to the co-operation between the two organizations, especially concerning the collection and publication of statistical data, and the joint ICNAF/ICES redfish symposium.

On his travel to and from Copenhagen the Executive Secretary visited the following member countries: U.S.A., Norway, Germany, France, Italy, Spain and Portugal. In the various countries he met representatives from Governments and scientific research institutions. In Rome he also had discussion at the headquarters of FAO concerning the co-operation between FAO and ICNAF.

In the autumn of 1958 the Biologist/Statistician visited the St. Andrews and Woods Hole laboratories for consideration of various ICNAF matters with the scientists concerned. The considerations centered on the collection of statistics, the sampling and the exchange of cod otoliths.

A list of annotated papers relevant to the Commission's work was circulated on 9 February, 1959 (Serial No. 596).

The annual addition to the Guide to ICNAF Papers covering the period 1957-58 was circulated on 1 December, 1958 (Serial No. 583).

16. Financial Statements for the Fiscal Year ending 30 June, 1959.

The accounts of the Commission for the year ending 30 June, show an appropriation of $ Can. 50,000.00 and a total expenditure of $51,663.51.

The audit of the Commission's finances for the fiscal year ending 30 June, 1959, was made by the Auditor General's Office of the Government of Canada in July, 1959.

The report from the Auditor General's Office, of 31 July, 1959, says:

"Subject to the foregoing [final approval by the Commission of transfers made in June, 1959], in accordance with the requirements of Financial Regulation 11.2 of the Commission, I certify that:

(a) the financial statements are in accord with the books and records of the Commission; and

(b) in my opinion the financial transactions reflected in the statements have been in accordance with the rules and regulations, the budgetary provisions, and other applicable directions; and

(c) the monies on deposit have been verified by certificates received direct from the Commission's depositary.

Free access was given to all accounts and records and such additional information as was required was readily provided. The co-operation of the Executive Secretary and his staff is acknowledged with appreciation."

The following three financial statements were attached to the Auditor's report:

Statement I

Statement of budget appropriations, obligations incurred, and unobligated balances of appropriations for the year ended 30 June 1959

Purposes of Appropriations	Appropriated by Commission	Transfers	Amended Appropriations	Obligations Incurred	Unobligated Balance of Appropriations
Personal Services—					
Salaries	$26,300	-	$26,300.00	$26,300.00	—
Superannuation	2,100	-$40.37	2,059.63	2,059.63	—
Travelling	5,400	-425.62	4,974.38	4,974.38	—
Transportation of things	300	-44.81	255.19	255.19	—
Communication Services	1,000	-148.65	851.35	851.35	—
Rent and Utility Services	1,800	—	1,800.00	1,800.00	—
Other Contractual Services including printing	7,100	-45.65	7,054.35	7,054.35	—
Supplies and Materials	1,800	-42.18	1,757.82	1,757.82	—
Equipment	3,000	-28.20	2,971.80	2,971.80	—
Annual Meeting	1,200	+775.48	1,975.48	1,975.48	—
	50,000		50,000.00	50,000.00	—

Transfers subsequent to 1959 Annual Meeting are subject to approval by the Commission.

Statement 2
Statement of Income and Expenditure for the year ended 30 June, 1959.

Income:		
Members' contributions assessed—		
Canada	$ 5,789.69	
Denmark	1,823.82	
France	5,789.69	
Germany	1,909.08	
Iceland	1,823.82	
Italy	5,789.69	
Norway	1,823.82	
Portugal	5,789.69	
Spain	5,789.69	
Union of Soviet Socialist Republics	4,584.79	
United Kingdom	3,145.77	
United States	4,467.71	$ 48,527.26
Add—Contributions of Germany:		
1956-57 (1/2 year)	263.33	
1957-58	1,766.82	2,030.15
Miscellaneous income—bank interest		102.64
		50,660.05
Expenditure:		
Obligations incurred (Statement 1)	50,000.00	
Cost of printing 1957-58 reports in excess of budgetary provision	1,663.51	51,663.51
Obligations incurred in excess of income, carried to Deficit Account		1,003.46

Statement 3
Statement of Assets and Liabilities as at 30 June, 1959

Assets			Liabilities		
GENERAL FUND					
Cash at bank		$ 1,405.86	Accounts payable (printing)		$ 2,682.21
Contributions receivable:			Credits due to Member States:		
Italy:			General, from USSR's contribution re 1957-58	$ 2,218.22	
1956-57	$ 5,221.72				
1957-58	5,739.70		Canada, advance on 1959-60 contribution	4,000.00	6,218.22
1958-59	5,789.69	16,751.11			
			Due to Working Capital Fund		10,000.00
			Deficit Account:		
			Obligations incurred in excess of income (Statement 2)	1,003.46	
			Less—Surplus as at 30 June 1958	260.00	-743.46
		$ 18,156.97			$ 18,156.97

Statement of Assets and Liabilities as at 30 June, 1959

WORKING CAPITAL FUND			
Cash at bank	$ 92.31	Principal of Fund	$ 10,000.00
Contributions receivable:		Credits due to Member States:	
Italy: 1958-59	346.57	from USSR ratification	438.88
Due from General Fund	10,000.00		
	10,438.88		10,438.88

PART 2

Report of the Ninth Annual Meeting

1 - 6 June, 1959

BY THE CHAIRMAN — MR. KLAUS SUNNANÅ

1. Time and Place of Meeting.

The Ninth Annual Meeting of the Commission was convened in Montreal, Canada, on 1st June, 1959, and continued through to 6th June. The Annual Meeting was preceded, 26th to 30th May, by meetings of the Standing Committee on Research and Statistics and its various subcommittees, and by Groups of Advisers to Panels.

2. Participants (Appendix I)

Commissioners, most of them accompanied by advisers and experts, were present from the following member countries: Canada, Denmark, France, Federal Republic of Germany, Iceland, Norway, Portugal, Spain, Union of Soviet Socialist Republics, United Kingdom, and United States. Delegates from Italy were not present.

Observers were present from Poland, the Food and Agriculture Organization of the United Nations, International Council for the Exploration of the Sea, International Fisheries Convention of 1946, the International North Pacific Fisheries Commission, and the Great Lakes Fishery Commission.

3. Opening of the Meeting (Agenda item 1 Appendix II)

The opening session was convened at Queens Hotel, Montreal. Present were: the Minister of Fisheries for Canada, the Honourable Mr. MacLean; the Mayor of Montreal, His Worship the Honourable Senator Mr. S. Fournier; representatives from Canadian Fisheries Organizations and from the Consular Agencies of member countries. Also present were observers from Poland and from various International Fisheries Organizations and delegates from the member countries.

The Chairman opened the meeting, welcoming guests, observers and delegates. The Honourable Mr. MacLean welcomed the delegates and observers to Canada, and His Worship Mr. Fournier welcomed the meeting participants to the City of Montreal. The Commission's Chairman and Vice-Chairman expressed their thanks for the welcome extended to the Commission and the opening session was adjourned.

Immediately after the adjournment of the opening session the First Plenary was opened by the Chairman. Dr. C. E. Lucas was called upon by the Chairman to address the Plenary on the occasion of Dr. Å. V. Tåning's death. The Meeting stood for a few moments in silent memory of Dr. Tåning and as a tribute to his work.

4. The Agenda (Agenda item 2)

The agenda, circulated 60 days in advance of the Annual Meeting, was adopted.

5. Publicity for the Meeting (Agenda item 3)

The Chairman explained that the Canadian Department of Fisheries had kindly provided for information to the press by offering the assistance of Mr. Ronayne, Ottawa, and Mr. Gillespie, Halifax. A committee of the Chairman, the Vice-Chairman and the Chairman of the Committee on Research and Statistics was appointed to work with the press officers and approve the press releases.

6. Review of Panel Memberships (Agenda item 4)

There were no requests for new panel memberships. Following a revision in accordance with the Convention, Article IV, 2, panel memberships for 1959/60 were established as follows:

Panel	1	2	3	4	5	**Total**
Canada		+	+	+	+	4
Denmark	+					1
France	+	+	+	+		4
Germany	+					1
Iceland	+					1
Italy						0
Norway	+					1
Portugal	+	+	+	+		4
Spain	+	+	+	+		4
U.S.S.R.	+	+	+			3
U.K.	+		+			2
U.S.A.			+	+	+	3
TOTAL	9	5	7	5	2	28

7. **Report on Staff Matters and Auditor's Report** (Agenda items 5, 6 and 15)

The Auditor's Report for 1957/58 was accepted, and transfers made in the interval between the 1958 Annual Meeting and the end of the fiscal year were approved.

The Commission expressed its gratitude to the Auditor General of Canada for the services rendered. The Commission also, on the recommendation of the Committee on Finance and Administration, approved the Administrative Report and the financial statements for 1958/59 (up to 31st May, 1959) with transfers between sections and the inclusion of an over-expenditure of $110.40 in the 1959 billing, these latter subject to possible adjustment during the remainder of the fiscal year.

8. **Budget** (Agenda items 7, 8 and 15)

The Commission approved the recommendation of the Committee on Finance and Administration to appropriate $53,000.00 for the financial year 1959/60 for the following purposes:

1.	Personal services	
	(a) Salaries	$26,600.00
	(b) Superannuation	2,107.36
2.	Travelling	5,700.00
3.	Transportation of things	300.00
4.	Communication services	1,000.00
5.	Rent and utility services	1,800.00
6.	Other contractual services, including printing	8,800.00
7.	Supplies and materials	2,000.00
8.	Equipment	500.00
9.	Annual Meeting	4,192.64
	TOTAL	$53,000.00

It was noted that in section 'Travelling' are included $3,000 to meet the travelling expenses of 4-6 scientists to participate in a meeting in Europe in the first half of 1960 on assessment of the need for conservation measures in the ICNAF area.

The Commission noted that the Committee on Finance and Administration had adopted a budget estimate for the year 1960/61 of $53,000 for the following purposes:

1.	Personal services	
	(a) Salaries	$26,000.00
	(b) Superannuation	2,107.36
2.	Travelling	3,200.00
3.	Transportation of things	300.00
4.	Communication services	1,000.00
5.	Rent and utility services	2,400.00
6.	Other contractual services, including printing	12,600.00
7.	Supplies and materials	2,242.64
8.	Equipment	500.00
9.	Annual Meeting	2,050.00
	TOTAL	$53,000.00

9. **The Commission further adopted the following recommendations by the Committee on Finance and Administration:**

(a) That the date of billing be 1st July, 1959.

(b) That, as it appeared from information at hand no particular advantages to employees would result from the establishment of a Commission medical health plan, no further action on this matter be taken.

(c) That an invitation by Norway to hold the 1960 Annual Meeting in Bergen be accepted with gratitude, that the meeting be convened on Monday, 30th May, 1960, to be continued through the remainder of that week and to be preceded (in the week before) by meetings of the Committee on Research and Statistics and by Groups of Advisers, and by a demonstration of field tagging work.

(d) That an invitation by the United States to hold the 1961 Annual Meeting in

Washington, D.C. be accepted with gratitude, that the meeting be convened on Monday, 8th June, 1961, to continue through the remainder of that week.

(e) That the Commission's Chairman and the Executive Secretary nominate a Commissioner as official ICNAF observer at the 1959 Statutory Meeting of ICES, and that the Executive Secretary be a technical observer.

(f) That an invitation to participate in the International Oceanographic Congress in New York in September 1959 be declined with thanks.

(g) That, following a request of the South Pacific Permanent Commission on Exploitation and Conservation of the Resources of the Sea, an exchange of information and publications with that organization be established.

The Commission noted that Mr. MacKichan, Canada, had been elected Chairman of the Committee on Finance and Administration for the ensuing year.

10. In two **Special Meetings of Commissioners,** attended by the Chairman of the Committee on Research and Statistics, item 10 of the agenda and other matters relating to research work and to regulations of fisheries were considered, and it was agreed to request the Committee on Research and Statistics to ensure a continuation and extension of researches to assess the need for, and the possible advantages of, an extension of the trawl regulations to cover the whole of the Convention area, and of a possible uniform mesh-size.

11. **Implementation of Trawl Regulations and Results of Inspections** (Agenda item 9)

The Commission approved the report by an *ad hoc* Committee on "Annual Returns." The Committee had considered the data collected on the implementation of the trawl regulations by the various countries and found them satisfactory. The reports on the results of inspections had also been considered. The Committee found that these returns should be collected and reviewed annually by the Commission, which should also consider possible new data on implementation. The forms to be used in reporting results of inspections carried out were revised; it was stressed that countries should make use of the prescribed forms when reporting.

12. **Report of the Standing Committee on Research and Statistics** (Agenda items 13 and 14)

This Committee, with several *ad hoc* subcommittees, met during the period 26th May to 5th June.

The report commences by stressing the need for a continued study of the benefit of fisheries regulations already imposed or under consideration, stating the increasing pressure of the fisheries on the stocks of fish through the Convention area, and noting how dependent the stocks are on environmental conditions and climatic changes. The need for more research possibilities and for closer co-operation is urgent. The introductory remarks conclude with the statement that the effectiveness of the Committee's work suffered from the fact that all countries were not fully represented at the Annual Meeting by scientific advisers.

The report summarizes the results of the work of the Committee and its various subcommittees and makes recommendations under the following headings:

(1) **Statistics and Sampling:**

The necessity of providing adequate statistics and sampling data and of a prompt compilation and publishing of such data is stressed. An appendix to the report—endorsed by the Committee—gives a series of recommendations on the collection and submission of data on landings efforts and discards and for action to be taken concerning comparative fishing experiments and standardization of fishing efforts. Specifications for the way in which sampling data are to be reported by countries and published in the Sampling Yearbook are included. The appendix concludes by stressing the importance of the FAO/ICNAF/ICES meeting on statistics and noting certain special ICNAF problems to be dealt with in that meeting.

(2) **Statistical Areas:**

It was agreed that the smallest practical unit area should be used for the collection of statistics and recommended that:

1. The Secretariat canvass member countries to ascertain which small units they are now using for collecting statistics.
2. The United States review present knowledge on the division of stocks of the four principle species of fish in the Convention Area.
3. Action be deferred on divisions of 5Z until the above studies are completed.

(3) **Assessment of Mesh Regulations:**

After noting the series of initial benefits resulting from the existing trawl regulations (big decreases in discards, and increases of average size of fish landed) the difficulties in measuring the long-term benefits were examined. These arise mainly from an insufficient knowledge of growth and mortality. A number of recommendations dealing with further relevant researches were made.

(4) **Gear Selectivity:**

The progress in the studies of gear selection was good, but important gaps in knowledge remain. The following specific recommendations for priority research were made:

1. Chafing gear investigation, with particular reference to:
   (a) the effects of chafing gears of various widths;
   (b) the effect of chafing gears of various mesh sizes;
   (c) the development of improved types of chafing gear; and
   (d) the results of experiments with covers outside the chafing gear in comparison with results obtained by other means, such as by parallel or alternative hauls.
2. Further investigations of the selectivity of large-ring scallop gear.

(5) **Sea Scallops:**

It was noted that the data available do not yet permit a precise prediction of the amount of benefit that would result from any given increase in ring-size. Recommendations for additional research were made.

(6) **Halibut:**

The problems of the halibut fisheries were discussed, and recommendations were made:

1. A bibliography of papers and reports be assembled.
2. The tagging and collection of biological information be continued.
3. An otolith exchange program be started.
4. Information be collected on discard of both large and small halibut.

(7) **Research Requirements for Subarea 1:**

A southerly withdrawal of cod from the most northerly region and falling yields per unit of fishing effort had been observed. It was recommended that:

1. Environmental studies should be expanded during all practical seasons.
2. A panel of scientists should be appointed to review and advise on the status of the fisheries.
3. Research reports for East Greenland should continue to be submitted. They could include statistical data on the fishing.

(8) **Redfish Symposium:**

The arrangements for the meeting and for the publishing of papers were considered and it was recommended that edited papers and proceedings be printed.

(9) **Marking Symposium:**

It was agreed that the scope of the Symposium in Bergen, 1960, be restricted to the field work planned for the demonstration of techniques, papers and data to be discussed at the 1961 Annual Meeting. It was further agreed that the Proceedings of the Symposium be published by the Commission as a special publication.

(10) **Cod Otolith Exchange Program:**

The results showed a high degree of agreement between estimates by participating scientists but differences in interpretation occurred. Recommendations for the management of the program were made.

(11) **Environmental Studies:**

It was agreed that a comprehensive study of environmental conditions was needed as part of the basis for an adequate management of the commercial fisheries, and a series of recommendations dealing with the furthering of such studies were made.

(12) **Publications:**

A number of recommendations were made referring to the distribution and publication of papers and proceedings of meetings and including the establishment of an editorial board to determine—subject to the standing recommendations —publication of the Proceedings.

(13) **Fishery Assessment in Relation to Regulation Problems:**

In the meeting of Commissioners (vide item 10, page 12) the Research Committee was asked to consider the following three ways of extending regulation of the fisheries:

1. Minimum mesh sizes for the remaining subareas (1 and 2).
2. A uniform minimum mesh size for the whole Convention Area.
3. A uniform mesh size for the whole of the North Atlantic.
4. In addition to these priority tasks, to explore other conservation measures (size limits of fish, closed areas and closed seasons).

The Committee and a special *ad hoc* committee considered the request and the various ways of studying the problems related to it. It was agreed to recommend to the Commission that:

"the Commission request from member countries all information of the following kinds already tabulated but which has not already been supplied:

1. Information on subdivision and mingling of stocks.
2. Their representative growth rates and mortality rates.
3. Data on the length and age composition of the catches.
4. The gears used and fishing efforts being exerted on the stocks.
5. The selection factors for the fish (or length, girth and weight measurements).
6. Any information on the species and amounts and sizes of fish discarded in the different fisheries.
7. Any other information known to be relevant to this problem."

The information should be collected and compiled ready for use at the 1960 Annual Meeting.

It was further agreed that Groups of Advisers and scientists from various countries should prepare reports including the best estimates of the immediate and long-term effects of minimum mesh sizes between 4 and 6 inches. These reports should be available about five months before the 1960 Annual Meeting.

It was also recommended that:

"a group of 4 to 6 population scientists meet 2 to 3 months before the 1960 Annual Meeting to do the final processing and evaluation of the material at hand, these scientists to be nominated by the Chairman of the Research Committee."

The Committee agreed that a vital factor in ensuring observance of mesh regulations lies in the timely education of fishermen in the objectives of the regulations, and that a draft of a poster showing the manner in which mesh regulations benefit the fisheries be prepared for the 1960 meeting.

(14) **Other Business:**

The Committee asked the Secretariat to invite Dr. J. Phillips to attend the Redfish Symposium in Copenhagen in October 1959.

The Committee agreed that the Biologist-Statistician's European travel in connection with the statistical meeting in Edinburgh should be adjusted so that he could be in Denmark in time for the Redfish Symposium.

(15) **Special Meetings:**

Talks by Mr. R. Jackson, Executive Secretary of INPFC on the structure and operation of that Commission, by Dr. A. Needler on the salmon stocks of the North Pacific, by Mr. Corlett on "Environmental Studies and the Barents Sea Cod Fishery," and a film by Dr. Paul M. Hansen on fisheries researches in East Greenland were included in the Committee's evening sessions.

(16) Dr. Mario Ruivo was re-elected Chairman for the ensuing year.

The full report by the Research Committee and its various appendices including the recommendations were tabled before the Plenary, considered and adopted. The preceding is only a summary; the whole report will be published in the "Red Book" for the 1959 Annual Meeting.

13. Reports of Meetings of Panels 1 to 5 (Agenda item 16)

All the panels considered panel memberships which were revised for Panels 1 to 4 (see item 6, page 2). They further considered the status of their fisheries, the researches carried out and the planning of future work.

Panel 1 recommended to the Commission that:

> results of researches in East Greenland waters and statistical data on the fisheries there be included in the research reports by countries.

It was agreed to establish a group of scientific advisers to the Panel.

Dr. Jón Jónsson, Iceland, was elected Chairman for the two ensuing years.

Panel 2. Under the items of the agenda dealing with fisheries and researches, Germany and Iceland, not members of the Panel, reported on their considerable fisheries (for redfish) and researches in the subarea, and the Panel noted that both countries expected their fisheries in the subarea to continue and planned further researches. A report by the Group of Advisers was read. The Panel agreed that the Group of Advisers should meet again in the week preceding the 1960 Annual Meeting, and it urged all member countries to endeavour to make provision for their scientists to attend that meeting as well as other ICNAF research meetings.

Dr. J. J. Marti, U.S.S.R., was elected Chairman for the two ensuing years.

Panel 3. In connection with the consideration of the status of fisheries and of researches, observers from Germany and Iceland—not members of the Panel—reported on their fisheries (mainly redfish) and researches. A report by the Group of Advisers was read, and the Panel noted the Group's regret at the absence of scientists from some of the member countries. It was agreed that the Group of Advisers should meet again in the week preceding the 1960 Annual Meeting.

Captain Tavares de Almeida, Portugal, was elected Chairman for the two ensuing years.

Panel 4. Reports on two meetings by the Group of Advisers were read, and it was agreed that the Group should meet again in December 1959 and that the Commission should request FAO to make the services of Mr. S. Holt available for the meeting. Canada and the United States were prepared to take part in the mid-year meeting; France, Portugal and Spain were interested in participating and will do so if the necessary arrangements can be made.

Captain L. J. Audigou, France, was elected Chairman for the two ensuing years.

Panel 5. The report of meetings of the Group of Advisers was read. It was agreed that a mid-year meeting of the Group be held in December 1959, and that the Commission should invite, through the Director-General of FAO, Mr. S. Holt to attend the Group meeting. The

Panel especially considered problems in connection with the sea scallops fisheries, with the assessment of the mesh regulations and the application of the 10 per cent annual exemption.

Mr. T. A. Fulham, U.S.A., was elected Chairman for the two ensuing years.

The above-mentioned five panel reports were approved by the Commission in the final Plenary.

14. Election of Chairman and Vice-Chairman (Agenda item 18)

Mr. A. J. Suomela, U.S.A., was elected Chairman and Mr. G. R. Clark, Canada, Vice-Chairman of the Commission for the two ensuing years.

Mr. Suomela and Mr. Clark expressed their gratitude for the honour bestowed upon them.

15. Acknowledgements and Adjournment (Agenda items 17 and 19)

Mr. Suomela expressed the Commission's thanks to Mr. Sunnanå for the excellent way in which he had guided the Commission during his two years of chairmanship.

The observers for Poland, for FAO, for ICES, for the Permanent Commission of 1946, for the INPFC, and for the Great Lakes Fishery Commission thanked the Commission for the opportunity of attending the Meeting.

The Chairman thanked the observers for their attendance. He expressed the Commission's thanks to the Canadian Department of Fisheries for the excellent support rendered during the Meeting, to the City of Montreal, and to the Board of Trade for the reception given. He thanked the Secretariat—the permanent as well as the additional staff—for its excellent work, and concluded by offering his most sincere thanks to Commissioners, Experts and Advisers, whose united efforts had ensured the success of the Annual Meeting.

As there was no further business, the Ninth Annual Meeting was adjourned.

APPENDIX I

LIST OF PARTICIPANTS

CANADA:

Commissioners:

Mr. G. R. Clark, Deputy Minister, Department of Fisheries, Ottawa, Ontario.

Mr. J. H. MacKichan, General Manager, United Maritime Fishermen Ltd., Halifax, N. S.

Mr. S. W. Moores, W. and J. Moores Limited, Carbonear, Nfld.

Advisers:

Mr. L. E. Baker, Area Director of Fisheries, Halifax, N. S.

Mr. H. R. Bradley, Area Director of Fisheries, St. John's, Nfld.

Dr. L. M. Dickie, Fisheries Research Board of Canada, Biological Station, St. Andrew's N.B.

Dr. H. D. Fisher, Fisheries Research Board of Canada, Arctic Unit, 505 Pine Avenue W., Montreal, P.Q.

Mr. A. M. Fleming, Fisheries Research Board of Canada, Biological Station, St. John's, Nfld.

Dr. F. E. J. Fry, Dept. of Zoology, University of Toronto, Toronto 5, Ont.

Dr. W. J. K. Harkness, Chief, Div. of Fish and Wildlife, Dept. of Lands and Forests, Toronto 2, Ont.

Dr. J. L. Hart, Director, Fisheries Research Board of Canada, Biological Station, St. Andrews, N. B.

Mr. V. M. Hodder, Fisheries Research Board of Canada, Biological Station, St. John's, Nfld.

Dr. Y. Jean, Fisheries Research Board of Canada, Biological Station, St. Andrews, N. B.

Dr. J. L. Kask, Chairman, Fisheries Research Board of Canada, Ottawa, Ontario.

Mr. J. H. LeBreton, Robin, Jones and Whitman, Paspebiac, Que.

Dr. F. D. McCracken, Fisheries Research Board of Canada, Biological Station, St. Andrews, N. B.

Mr. P. K. McGrath, Job Bros. Ltd., St. John's, Nfld.

Dr. A. Marcotte, Director, Marine Biological Station, Grande Rivière, P.Q.

Dr. W. R. Martin, Fisheries Research Board of Canada, Biological Station, St. Andrews, N. B.

Dr. A. W. H. Needler, Director, Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C.

Mr. H. D. Pyke, National Sea Products, Lunenburg Sea Products Division, Lunenburg, N. S.

Mr. W. R. Ritcey, Ritcey Bros., Riverport, N. S.

Dr. W. M. Sprules, Department of Fisheries, Ottawa, Ontario.

Mr. H. J. Squires, Fisheries Research Board of Canada, Biological Station, St. John's, Nfld.

Dr. W. Templeman, Director, Fisheries Research Board of Canada, Biological Station, St. John's, Nfld.

Mr. E. B. Young, Department of Fisheries Ottawa, Ontario.

DENMARK:

Commissioners:

Mr. B. Dinesen, Departementschef, Ministry of Fisheries, Borgergade 16, Copenhagen K.

Mr. K. Djurhuus, Chairman Local Government, Thorshavn, Faroe Islands.

Dr. Paul M. Hansen, Chief, Greenland Fishery Research, Charlottenlund Slot, Copenhagen.

Advisers:

Mr. E. Jacobsen, Royal Danish Consulate General, 17 Battery Place, New York, U.S.A.

FRANCE:

Commissioners:

Mr. L. J. Audigou, Shipping Attaché, French Embassy, Washington, D.C., U.S.A.

Mr. Plusquellec, Administrateur en Chef de l'Inscription Maritime, Secrêtariat d'Etat a la Marine Marchande, Paris.

Advisers:

Mr. A. Dezeustre, Directeur d'Armement des Pêcheries de Bordeaux Bassens, Bordeaux.

Mr. E. G. Percier, Chef du Quartier de l'Inscription Maritime, St. Pierre et Miquelon.

GERMANY:

Commissioners:

Dr. B. Freyberg, Verband der Deutschen Hochseefischereien, Bremerhaven.

Dr. J. Lundbeck, Bundesforschungsanstalt für Fischerei, Institut für Seefischerei, Hamburg 36.

Dr. G. Meseck, Bundesministerium für Ernährung, Landwirtschaft und Forsten, Bonn, Duisdorf.

ICELAND:

Commissioner:

Dr. J. Jónsson, Atvinnudeild Háskólans Fiskideild, Borgartun 7, Reykjavik.

ITALY:

No notification of participation.

NORWAY:

Commissioners:

Mr. G. Rollefsen, Director, Institute of Marine Research, Directorate of Fisheries, Bergen.

Mr. K. Sunnanå, Director of Fisheries, Directorate of Fisheries, Bergen.

PORTUGAL:

Commissioners:

Captain T. de Almeida, Captain Portuguese Navy, Praça Duque da Terceira, 24, 1°, Lisbon.

Dr. Mario Ruivo, Instituto de Biologia Maritima, Cais do Sodré, Lisbon.

SPAIN:

Commissioner:

Sr. Carlos Fernández-Shaw, Consul of Spain, Spanish Consulate, Montreal, P.Q.

Advisers:

Captain J. L. Arambarri, Industry Adviser, Madrid.

Dr. O. Rodriguez M., Biólogo de la Direccion General de Pesca Maritima, Madrid.

UNION OF SOVIET SOCIALIST REPUBLICS:

Commissioners:

Mr. Ju. Ju. Marti, Deputy Manager, Central Institute of Fisheries and Oceanography, Moscow.

Mr. P. Sapanadze, General Manager, Trawler Fleet, Murmansk.

Advisers:

Dr. V. I. Travin, Polar Institute of Marine Fisheries and Oceanography, Murmansk.

Mr. O. Timinski, Central Institute of Fisheries and Oceanography, Moscow.

UNITED KINGDOM:

Commissioners:

Mr. A. J. Aglen, Fisheries Secretary, Scottish Home Department, St. Andrews House, Edinburgh, Scotland.

Dr. C. E. Lucas, Director, Marine Laboratory, Scottish Home Department, Victoria Road, Torry, Aberdeen, Scotland.

Mr. G. C. Trout, Fisheries Laboratory, Lowestoft, England.

Adviser:

Mr. John Corlett, Fisheries Laboratory, Lowestoft, England.

UNITED STATES:

Commissioners:

Mr. T. A. Fulham, Fulham Bros. Inc., 280 Northern Avenue, Boston 10, Mass.

Mr. F. W. Sargent, Director, Outdoor Recreation Resources Review Commission, Washington 25, D.C.

Mr. A. J. Suomela, Commissioner, Fish and Wildlife Service, Department of the Interior, Washington, D.C.

Advisers:

Mr. L. F. Brackett, Chief, Resource Management, USBCF, Gloucester, Mass.

Dr. H. W. Graham, Director, Biological Laboratory, USBCF, Woods Hole, Mass.

Dr. J. L. McHugh, Chief, Division of Biological Research, USBCF, Washington, D. C.

Dr. L. A. Walford, Director, Biological Laboratory, USBCF, Washington, D. C.

Assistant Advisers:

Mr. J. R. Clark, Chief, Haddock Investigations, Biological Laboratory, USBCF, Woods Hole, Mass.

Mr. H. H. Eckles, Chief, Branch of Marine Fisheries, Division of Biological Research, USBCF, Washington, D. C.

Mr. R. Kershaw, Manager, Gloucester Whiting Association, Fishermen's Wharf, Gloucester, Mass.

Mr. G. Kelly, Chief, Ocean Perch Investigations, Biological Laboratory, USBCF, Woods Hole, Mass.

Mr. R. T. Norris, Assistant Regional Director, USBCF, Gloucester, Mass.

Mr. J. A. Posgay, Chief, Sea Scallop Investigations, Biological Laboratory, USBCF, Woods Hole, Mass.

Mr. T. D. Rice, Executive Secretary, Massachusetts Fishery Association, Boston, Mass.

Mr. L. Rosen, Executive Vice-President, Irving Usen Trawling Co., Boston, Mass.

Mr. J. P. Wise, Chief, Cod Investigations, Biological Laboratory, USBCF, Woods Hole, Mass.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS:

Observer:

Mr. Sidney Holt, Fisheries Biology Branch, FAO, Rome, Italy.

GREAT LAKES FISHERIES COMMISSION:

Observer:

Mr. R. Saalfeld, Assistant Executive Secretary, Ann Arbor, Michigan, U.S.A.

INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA:

Observer:

Dr. Paul M. Hansen, Fisheries Biologist, Charlottenlund Slot, Copenhagen.

INTERNATIONAL FISHERIES CONVENTION 1946:

Observer:

Mr. A. J. Aglen, Fisheries Secretary, Scottish Home Department, St. Andrews House, Edinburgh, Scotland.

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION:

Observer:

Mr. R. I. Jackson, Executive Secretary, Vancouver, B. C., Canada.

POLAND:

Observer:

Mr. I. Maciejkowicz, Consul of Poland, Montreal, Canada.

PRESS:

Mr. G. Gillespie, Information Officer, Department of Fisheries, Halifax, N. S., Canada.

Mr. M. Ronayne, Assistant Director, Information and Educational Service, Department of Fisheries, Ottawa, Ont., Canada.

SECRETARIAT:

Dr. Erik M. Poulsen, Executive Secretary, ICNAF, Halifax.

Mr. Ronald S. Keir, Biologist-Statistician, ICNAF, Halifax.

Miss Theresa Devine, Secretary, ICNAF, Halifax.

Miss Joan C. Edwards, Clerk-Stenographer, ICNAF, Halifax.

CLERICAL ASSISTANTS:

Miss J. Gilchrist, Department of Fisheries, Ottawa.

Mr. J. Guennette, Department of Fisheries, Ottawa.

Miss E. LeFebevre, Department of Fisheries, Ottawa.

Miss L. Mahoney, Department of Fisheries, Ottawa.

APPENDIX II
AGENDA

1. Opening by the Chairman.
2. Adoption of Agenda.
3. Policy with regard to publicity for the Annual Meeting.
4. Review of panel memberships (vide Meeting Document No. 1).
5. Report on staff matters, with presentation of the Administrative Report 1958/59 and financial statements for 1958/59.
6. Presentation of Auditor's Report for the financial year 1957/58 (vide Annual Proc. Vol. 8, pp. 7-9), with approval of transfers made.
7. Consideration of budget estimate for 1959/60 (see App. 1 to Agenda for the meetings of the Committee on Finance and Administration).
8. Consideration of advance budget estimate for 1960/61 (see App. 2 to Agenda for the meetings of the Committee on Finance and Administration).
9. Information on implementation of trawl regulations, and consideration of "Annual Returns" showing inspections carried out. Further, the appointment of an *ad hoc* committee to consider the collected information (vide Chairman's Report, Item 10, 1958 Ann. Meet.—Ann. Proc. Vol. 8, p. 12).
10. Review of progress in and results of the studies of the effects of the various regulations of the fisheries in the Convention Area (by the Chairman of the Standing Committee on Research and Statistics).
11. Reports by ICNAF observers on meetings of other organizations during the preceding year.
12. Date and place of Annual Meeting, 1960.
13. Report on plans for the Redfish Workshop in Copenhagen, 1959.
14. Report on the meetings of the Standing Committee on Research and Statistics, June 1959.
15. Report on the meetings of the Standing Committee on Finance and Administration, June 1959.
16. Reports on meetings of Panels 1 to 5, June 1959.
17. Other business.
18. Election of Commission's Chairman and Vice-Chairman for the two ensuing years.
19. Adjournment.

PART 3
Summaries of Research 1958
A. Summaries by Countries
I. Canadian Research Report, 1958

A. SUBAREAS 2 AND 3 — BY W. TEMPLEMAN

The Fisheries Research Board of Canada Biological Station at St. John's has carried out in 1958 researches in Subareas 2 and 3 on cod, haddock, redfish, and American plaice. Hydrographic sections have been taken over the area from southern Labrador to the southern Grand Bank during the period July 27 to August 26.

Cod, *Gadus callarias* L. Age determinations were made from otoliths of 800 cod taken in the Labrador area (Subarea 2) in 1950 and 1951. About one quarter of the fish were from the inshore area and the remainder were taken offshore in depths of 100-200 fathoms. The age readings indicate that in the Labrador area best survival of cod from 1940 to 1947 probably occurred in 1942, 1945, and 1947. There was relatively moderate to good survival in 1944 and 1946. A fair number of old fish in the samples may be a reflection of low fishing intensity in the area at that time.

In 1958 the emphasis on better sampling of the inshore cod fishery was continued. Observations were continued throughout the fishery at Bonavista, which is one of the most important centres of the inshore fishery. With the inshore fishery in Newfoundland generally poor in 1958, only about 8,700,000 pounds of cod were landed at Bonavista, compared with 15,300,000 pounds in 1957. Of the 1958 total, 40% was landed from handlines, 26% from traps, 4% from linetrawls (longlines pulled by hand), and 30% from longlines. The 1957 landings were made up as follows: handlined, 50%; trapped, 24%; linetrawled, 2%; longlined, 24%.

To ensure a successful inshore fishery at Bonavista and on the east coast of Newfoundland, generally, it is apparently necessary for cod which come toward shore in the warmer, surface layer to be concentrated inshore and prevented, by cold water of the coastal portion of the Labrador Current, from descending too rapidly to depths beyond the range of the gears. This portion of the current exists in summer as a cold, intermediate layer below the warmer, surface water.

This cold layer, with temperatures below 0°C, was not as close to the surface in 1958 as in 1957. In addition, severe, early-summer storms mixed the inshore waters to such an extent that cod were able from early June to move much deeper than would be possible during a calm summer. The apparent lack of concentration of cod in depths within the fishable range of the usual inshore gears is reflected in the much lower catch per unit of effort of all gears generally throughout the season as compared with 1957. Also, the fishery with baited hooks was severely hampered by an extreme shortage of fresh bait.

In 1958 the landings from the longline fishery at Bonavista were 45% lower than in 1957. The longline catch per unit of effort, both offshore in the deep water and inshore in the shallower water, was much reduced as compared with 1957, and was lower than for any other year since the fishery began. It is apparent that unfavourably warm hydrographic conditions in 1958 had an adverse effect on the inshore longline fishery. In addition, the deep-water grounds are much more heavily exploited now. When the fishery began in 1952, the deep-water stocks of cod off Bonavista had not been fished previously, and until 1956 the Bonavista longliners were the only boats fishing the area. In 1956 a few large European trawlers began fishing in the area, and in 1957 and 1958 a much greater concentration of effort by a larger number of trawlers occurred. In addition, a fleet of longliners from the Faroe Islands and from Norway fished off Bonavista and in neighbouring deep-water areas in 1957 and 1958.

Length measurements have been obtained from cod landed by longliners since 1952 from the deep water below 100 fathoms off Bonavista and comparisons made of the yearly length distributions in summer. In 1952, the first year of commercial longlining, 30% by number of the cod landed were 81 cm and larger, and the average length was 76.0 cm. Each year that followed, the proportion of these larger fish in the catch was reduced and by the end of July 1958, their contribution to the catch was only 6%. The average size of the longline cod has been reduced by about 10 cm in the 1952-58 interval and the fish landed in 1957 and 1958 were mainly between 50 and 80 cm in length, with greatest numbers at 62 cm. In 1958 it is apparent that even these fish were caught by the Bonavista longliners in smaller numbers than in 1957.

Observations were conducted at Isle aux Morts on cod from the fishery on the western part of the south coast of Newfoundland. Small motor boats, motor dories, and longliners all using the same type of longlines fished 3 to 5 miles from shore in depths ranging from 50-80 fathoms. Sizes of fish caught ranged from just over 30 cm to about 130 cm, but during the fishery of March and April few cod larger than 80 cm were taken. By the middle of April there were indications of an increase in the numbers of large cod relative to the numbers of smaller ones as compared with early March, and in early July this change was obvious.

The age composition in March-April indicated a great range of ages from 4 to over 20 years of age, with fish from 5 to 11 years old making up the majority. In April the older age groups (beyond 8) were more abundant relative to the younger age groups than in March. It is apparent that in July the numbers of the older fish relative to the younger ones were even greater than in April.

The March-April samples were largely made up of fish of the stock which migrates into the Gulf in April-May, whereas the July sample would be composed of fish of the "resident" stock.

The change in size and age composition was reflected in a large decrease in the catch per unit of effort beginning in May. The reduced catch per unit of effort throughout summer was apparently because the resident stock was far less abundant than the migratory stock which mingled with it during winter and on which the success of the winter fishery depends.

Haddock, *Melanogrammus aeglefinus* (L.). In May the yearly otter-trawling surveys for haddock were carried out by the *Investigator II* on the southern half of the Grand Bank and on St. Pierre Bank. The Grand Bank survey was made nearly a month earlier in 1958 than in 1957, and bottom temperatures were on an average higher in 1958. As in 1957 the haddock had already spread northeastward from their winter quarters in the deeper water of the southwest slope to occupy much of the southern half of the bank and hence were not very abundant at any of the stations. In the area as a whole, haddock were not quite as abundant as they were in 1957. Indications are that, due to the more favourable temperature conditions in 1958, haddock spread over the bank earlier than usual. This is also reflected in the commercial landings for 1958, which decreased rapidly about a month sooner than in 1957.

The St. Pierre Bank survey for haddock was made about five weeks earlier than in 1957 and bottom temperatures over the bank were favourable for haddock. However, as in 1957, no significant quantities of any year-classes were obtained, indicating that there has been no significant survival of young haddock on this bank since the extremely abundant 1949 year-class which maintained the commercial fishery there during 1954-56.

From the catch length-frequencies and the age analysis of the samples from the Grand Bank haddock cruise in May, the most abundant group present in 1958 was the 1955 year-class with a mode at 30 cm, which will undoubtedly contribute significantly to the commercial fishery in 1959 and still more by 1960. This group accounted for more than 50% by number of the catches of the *Investigator II*. The once very abundant 1949 year-class has been relatively much reduced, accounting for less than 10% by number in the catches. The moderately abundant 1952 and 1953 year-classes with modes at 38 and 41 cm, which were important commercially in 1958, are on the decline and will be replaced in importance by the 1955 year-class. The 1956 year-class does not appear to have survived very well, and the same is true of the 1957 year-class.

In 1958 for the first half of the year the main fishery for haddock was concentrated in the southwestern Grand Bank area (Subdivision 3O) Most of the haddock landed from this fishery were from 33 to 50 cm in length with a modal group at 40 cm, made up mainly of fish from the 1952 and 1953 year-classes.

In the second half of 1958 a limited fishery for haddock occurred in the southeastern Grand Bank area. Haddock landed were from 30 to 50 cm in length with modal groups at 33 to 34 cm and at 41 cm. The 33 to 34 cm modal group represents the larger fish of the 1955 year-class which were retained, and the 41 cm group represents fish of the 1952 and 1953 year-classes.

It is obvious that for the next two or three years fish of the 1955 year-class will be important in maintaining the Grand Bank haddock fishery.

Redfish, *Sebastes marinus mentella* Travin and *Sebastes marinus marinus* (L.). Researches in 1958 indicated that the *marinus* type redfish could be more plentiful and have somewhat different habits than had previously been known for the area. The *Investigator II* in a half-hour drag east of Hamilton Inlet Bank on June 10 at 250-256 fathoms (460 m) caught 480 pounds of large *marinus* type redfish per hour's dragging and only 80 pounds of the *mentella* type. Almost all the *marinus* type females had larvae ready or nearly ready for extrusion. This capture of significant numbers of spawning *marinus* type redfish at a depth where usually only *mentella* type redfish exist is similar to that reported by Lundbeck in the German Research Report, 1957 (ICNAF Ann. Proc. Vol. 8) of spawning concentrations of *marinus* type redfish at 420-450 m off East Greenland.

In 1958 commercial redfish fishing began in Subarea 2 of ICNAF in an area off Hawke Harbour, Labrador, which was first fished by the *Investigator II* in September 1951. The part of this new commercial fishing area fished by Newfoundland trawlers is about 80 to 120 nautical miles south of the area east of Hamilton Inlet Bank which has been fished successfully for redfish by the *Investigator II* usually in August or September, from about 140 fathoms down to about 200 fathoms in each year from 1950 to 1953, and down to 300-400 fathoms in 1954, 1956, 1957, and 1958.

Redfish fishing in this new commercial area off Hawke Harbour has been very successful and has been participated in by Canadian, United States, Icelandic, German, Belgian, and Russian trawlers. The Newfoundland fishery occurred mainly between 150 and 180 fathoms (occasionally 125-200 fathoms) in late August 1958, and produced a catch of between 2 and 3 million pounds of redfish. These catches were all from Subdivision 2J, mainly between Lat. 52°45′ and 53°00′N and Long. 52°10′ and 52°40′W, and with good catches also about 40 nautical miles north of this area. The northern part of the Newfoundland fishing area was on the southeastern part of the Hamilton Inlet Bank area and the more southern fishery which was much greater was on the fringes of Hawke Channel, the below-200-fathom indentation in the continental shelf leading toward Hawke Bay.

Sampling of some of the commercial catches from the area has shown that fair numbers of *marinus* type fish occurred in the catches, and between August 25 and September 25, 1958, when 1% of a total catch of one and a half million pounds was examined, 11% by numbers were found to be *marinus* type fish. Since specimens of *marinus* were on the average more than twice as heavy as an average specimen of *mentella*, the *marinus* type was considerably more important by weight than by relative number.

The data from this sampling would indicate that *marinus* type fish are, in this area, relatively more abundant than we had formerly supposed and that on occasional trips, a very high percentage of a trawler's catch may be *marinus* type.

In a cruise of the research vessel *Marinus* from May 5-22, 1958, just east of Hermitage Bay, at the northern entrance to Connaigre Bay on the south coast of Newfoundland at 112-116 fathoms, 146 *marinus* type redfish were found in an hour's towing during which 4,500 pounds of redfish were caught. The remaining approximately 4,000 redfish were of the usual *mentella* type.

Also on the east side of Connaigre Bay just below the edge of the 100-fathom contour and at the same time of the year one dragger caught 7,000 pounds of redfish in a 2-hour drag and the captain said that over half of these (probably by weight) were of the *marinus* type. Another dragger also fishing in the same area reported over half its catch to be *marinus* type. These *marinus* type fish which are typically golden yellow in colour in this area, are on the average considerably larger than the *mentella* type, and are readily recognized by the trawler skippers.

Flemish Cap has continued to receive our attention since 1950, when large catches of redfish were obtained there by the *Investigator II*. The area has, as yet, been little exploited by Canadian vessels, although vessels of the USSR have caught many millions of pounds there since 1956.

During the fishing trials of the new research vessel of the Fisheries Research Board, the *A. T. Cameron*, the opportunity was taken to examine again the general pattern of the redfish distribution at various depths in the area on the north and northeast slope of Flemish Cap. A total of 15 sets was made in the area at depths between 112 and 410 fathoms. The *A. T. Cameron* appeared to fish well at all depths and good catches of redfish occurred to 300 fathoms. In greater depths, e.g. 400 fathoms, although redfish were scarce, the catches of other fish indicated that the trawl was still fishing efficiently.

As in previous trips to this area, *marinus* type redfish were abundant in the shallower water of 150 fathoms and in the two daytime sets when large catches were obtained, 78% and 66% (by number) of the redfish were *marinus* type. In two sets at 200 fathoms the combined data show only 1.6% of the catch to be *marinus* type fish and at 250 fathoms the number was further reduced to only 0.3%. At depths greater than 250 fathoms no *marinus* type fish were found.

In separating the *marinus* and *mentella* forms of redfish, only those which could be separated with complete confidence were typed and those in which any doubt existed were classed as "indefinite" or "doubtful" types. The indefinite-type fish occurred only in the shallow water (150 fathoms or less). This is mainly due to the fact that greater numbers of small fish occurred at these depths although the occasional larger fish which showed intermediate characters also occurred.

The largest catches occurred during the mid-day period in 150 fathoms where catches of 6,200 and 7,300 pounds per hour's dragging were obtained. These catches consisted mainly of large *marinus* type fish and this is reflected in the average weight per fish, which is, for these sets, approximately 2 pounds. At 200-300 fathoms, where very few or no *marinus* type fish were present, the catches declined to between 3,000 and 5,000 pounds per hour's dragging, but greater numbers of the smaller, deep-water, *mentella* type fish were taken. Below 300 fathoms, with the exception of a set which extended from 350-280 fathoms, catches declined and at 400 fathoms only 7 redfish were taken in a 40-minute drag.

A study was undertaken during 1958 of the differences between late-stage pre-extrusion larvae of *marinus* and *mentella* type female redfish obtained from selected areas around Newfoundland. The study has revealed a very interesting difference between the two types in so much as larvae from *mentella* type parents nearly always possessed one or more caudal melanophores, situated ventral to the vertebral column, posterior to and separated from the ventral row of body melanophores, whereas in larvae from *marinus* type parents these caudal melanophores were usually absent or if present, were in fewer numbers. The difference is a quantitative one and is useful for distinguishing populations of *marinus* and *mentella* type redfish and probably for deciding whether the so-called intermediate-type redfish are actually of *marinus* or of *mentella* type, or whether early stage larvae captured at sea are predominantly *mentella* or *marinus* type. It cannot, however, generally be used as an absolute diagnostic character in the type-identification of single redfish larvae.

American plaice, *Hippoglossoides platessoides* (Fabr.). Monthly sampling of American plaice from St. Mary's Bay has been continued. The same dominant year-classes were found as in 1957 and it appears that there is a strong survival of larvae in alternate years. Age determinations of commercial plaice from Subdivisions 3L and 3N show that plaice from the latter subdivision reach a larger size at a comparable age. From 3N the bulk of the commercial catch is of male fish aged 7 to 18 years and females of 7 to 25 years. From 3L the catch is of male fish aged 10 to 18 years and females of 10 to 24 years.

Hydrography. The customary six hydrographic sections were taken as usual in July and August. These sections extended from southern Labrador to the southern slope of the Grand Bank and across the banks and Labrador Current seaward to a depth of 500 metres at the seaward slope of the continental shelf. Once or twice each month temperatures and salinities were taken at a station 2 miles off Cape Spear, near St. John's, in 176 metres.

The hydrographic section off Seal Islands, Labrador, (Fig. 1) was taken August 4-5, 1958, and revealed that the unusually high temperatures (3.9 to 4.7°C) which were present in the deep water in 1957 had disappeared and that the temperatures of the deep water had reverted to a more normal 3.3 to 3.7°C. The inshore upper layer of water with temperatures higher than

0°C was very much deeper in 1958 than in 1957. The salinity of the deeper water was slightly lower in 1958 than in 1957.

In the section off Bonavista, also, as in the Labrador section, temperatures in the deep water were more normal; almost a degree lower than in 1957. As in the Labrador section, the upper, surface, cold (below 0°C) layer extended deeper than usual in 1958 whereas it was shallower than usual in 1957. This coincided with a relative failure of the inshore cod fishery on the east coast of Newfoundland in 1958 compared with the much more successful fishery of 1957. A core of water with temperatures below -1.5°C was present in 1958 but not in 1957.

In the St. John's-Grand Bank-Flemish Cap section, (Fig. 2), mainly along the 47° Latitude line, the bottom temperatures of the shallower parts of the Grand Bank were slightly above 0°C in 1958 whereas in 1957 they were below 0°C. There was also considerably less water below -1°C in the shoreward portion of this section in 1958 than in 1957.

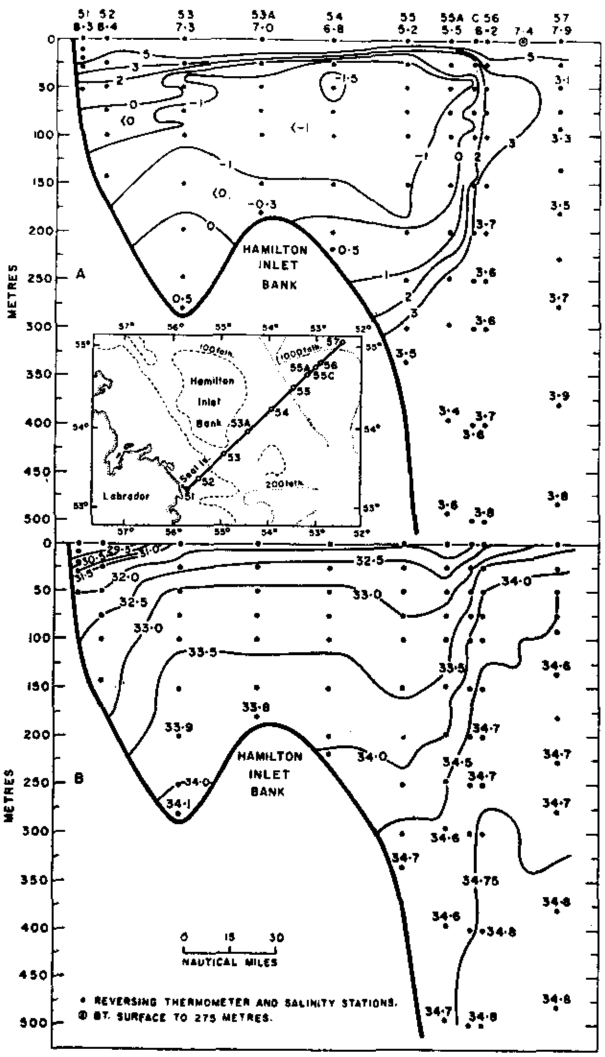


Fig. 1. Hydrographic section off Seal Islands, across Hamilton Inlet Bank, Labrador, August 4-5, 1958. A—Temperature °C; B—Salinity ‰.

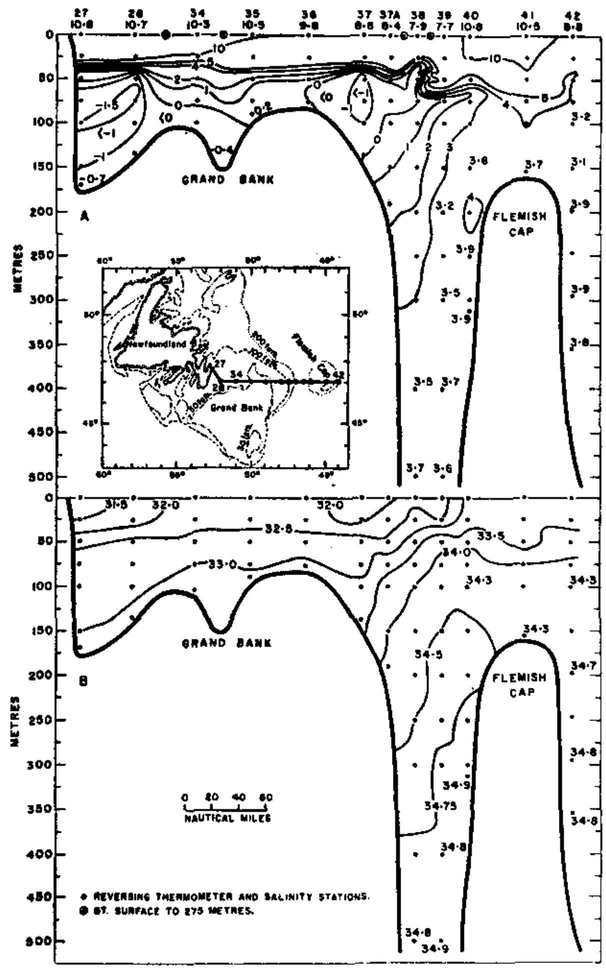


Fig. 2. Hydrographic section St. John's-Grand Bank-Flemish Cap, July 27-30, 1958. A—Temperature °C; B—Salinity ‰.

Seasonal cruises to the south and east of Newfoundland were carried out by the Atlantic Oceanographic Group, St. Andrews, N. B., in February and March and in October and November. These surveys covered a large area including the Laurentian Channel, the deep waters to the west, south, and the east of the Grand Bank, the Grand Bank, and the continental shelf east of Newfoundland as far north as the Bonavista section.

I. Canadian Research Report, 1958

B. SUBAREAS 4 AND 5 – BY W. R. MARTIN

Canadian research in Subarea 4 during 1958 was carried out by the Fisheries Research Board of Canada and the Quebec Department of Fisheries. The offshore species studied were haddock, *Melanogrammus aeglefinus* (L.), cod, *Gadus callarias* L., American plaice, *Hippoglossoides platessoides* (Fabr.), redfish, *Sebastes marinus* (L.), and sea scallop, *Placopecten magellanicus* (Gmelin). The research is described by species of groundfish under the following headings: tagging, surveys, statistics and sampling, discards at sea, and gear selection. Scallop observations in Subarea 5, and hydrographic research which is pertinent to ICNAF, are briefly summarized.

Tagging. The Biological Station, St. Andrews, N. B., continued its tagging program to obtain information on populations, growth, and mortalities.

Sixteen per cent of the 1,085 haddock tagged at the mouth of the Bay of Fundy in November-December 1957 were recovered by the end of 1958. Winter recaptures of Passamaquoddy Bay haddock were taken in large numbers from the Jeffrey's Ledge and South Channel regions of Subarea 5, and in small numbers from the Digby Neck and Browns areas of Subarea 4. Summer recaptures were mainly from the tagging area in Subarea 4. Although few haddock appear to cross the deep-water Fundian Channel separating Browns and Georges Banks, haddock do move seasonally from the northern Bay of Fundy area of Subdivision 4X to the New England shore of Subdivision 5Y.

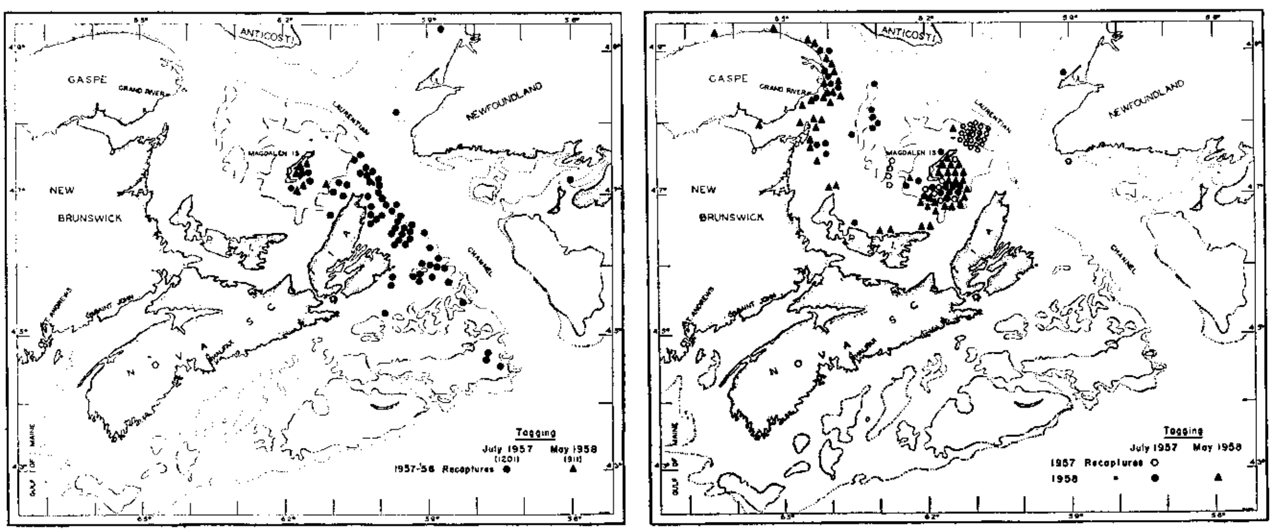


Fig. 1. Recaptures during 1957 and 1958 of cod tagged at the Magdalen Islands in Subdivision 4T, in July 1957 and May 1958. Left, recaptures from December to May; right, recaptures from June to November.

In 1957 and 1958 cod were tagged at the Magdalen Islands in order to study the relation of these cod to other populations in Subarea 4. Earlier cod taggings in the northern part of Subdivision 4T have shown few recaptures from the Magdalen Islands cod fishery. The distribution of recaptures is shown in Figure 1. Cod tagged in mid-summer 1957 were recaptured in the tagging area during the remainder of that summer, and outside the Gulf of St. Lawrence, along the 100-fathom contour, from January to April. In the spring recaptures were reported from the Magdalens area, and in summer months these cod had spread throughout Subdivision 4T with concentrations on the northern grounds off Bonaventure and Miscou Islands. Magdalens cod move northwest during spring months and southeast in the autumn. As noted in earlier taggings of cod and haddock in Subdivision 4T, few recaptures are reported from the other side of the deep-water Laurentian Channel, but they do move seasonally between Subdivisions 4T and 4V. In 1958 about one quarter of the winter returns were from French, Portuguese, and Spanish fishermen. All other returns were reported by Canadian fishermen.

Plaice were tagged in the northern part of Subdivision 4T in June and October 1958. A high percentage (27) of the 320 plaice tagged southeast of Shippegan Gully in June were recovered by the end of 1958. Most recaptures were taken from the tagging area, but some plaice moved offshore during the summer. Two fish, recaptured in September, had moved about 100 miles north, one to the Bay of Chaleur and the other to Bonaventure Island.

Surveys. In August 1958 the Sable Island-Emerald Bank area of Subdivision 4W was surveyed with the *Harengus*, and in May to November the northern part of Subdivision 4T was surveyed with the *J. J. Cowie* by the Biological Station, St. Andrews, N.B. The Marine Biological Station, Grand River, P.Q., extended the latter survey into the Bay of Chaleur in May to October. The survey programs are concerned with the seasonal distribution of haddock, cod, and plaice, and prediction of changes in the fishery.

The dominant species in the Subdivision 4W survey was haddock. In shoal water (10-20 fathoms) near Sable Island, large numbers of small haddock (mode 20 cm) were taken. In 20-45 fathoms the haddock were larger (mode 30 cm). At the edge of the bank, in 50-80 fathoms still larger haddock (mode 50 cm) were taken along with small haddock (mode 20 cm). These larger haddock (mode 50 cm) were more abundant on Emerald Bank (40-44 fathoms). A continuation of this program in winter and summer months will lead to prediction of the relative importance of new year-classes before they enter the fishery.

Young cod of the 1953 year-class were dominant in 1958 commercial landings from Subdivision 4T. As a result, the average size of cod in dragger landings dropped to 60 cm, the smallest mean size since 1947. Surveys in 1957 and 1958 have shown modal size groups at 22-25, 31-37, and 40-46 cm, representing 2, 3, and 4-year-old fish. The 1954 year-class appears to be above average abundance, and it is expected that it will replace that of 1953 as the dominant year-class in 1959 landings. As a result, no appreciable change from the small average size of cod landed in 1958 is anticipated in 1959.

The abundance of cod in the Bay of Chaleur increased from June to August with migration into the Bay, and decreased in October with the beginning of offshore migration. Mid-water line fishing in 1958 showed that some mature cod move off bottom in July and August. Euphausiacea appear to be more accessible to cod where they are concentrated at the thermocline.

Statistics and Sampling. Data on landings, abundance, and sizes of groundfish will be published in the "Statistical Bulletin" and the "Sampling Yearbook."

Canadian landings from Subarea 4 have increased substantially during post-war years with the adoption of more efficient fishing methods. Otter trawlers now take half the groundfish landings, including most of the redfish, flounders, and haddock, about half the cod, and a small fraction of the halibut and pollock. Cod landings continue at a high level, but with the increased landings of small-mouth species the cod catch is only about half the total groundfish catch.

With more intensive fishing, catch per unit effort and average size of most groundfish have decreased. Young, immature fish dominated haddock and cod landings in 1958. The 1952 year-class of haddock was dominant in Subdivision 4W. Various year-classes of cod, 1949 to 1955, were dominant in the landings from different populations of Subarea 4. In the Nova Scotia area, 1949 and 1952 year-classes dominated the spring catches of mature cod. Immature cod of the 1954 and 1955 year-classes were dominant for the remainder of the year. In the Gulf of St. Lawrence, the 1953 year-class replaced that of 1950 as the dominant year-class in cod landings.

Discards. The sizes and quantities of groundfish caught and discarded at sea vary with the sizes of fish available to the gear, the selective properties of the gear, and the sizes of fish acceptable for landing. During 1958, 16 trips on commercial otter trawlers were carried out by the Biological Station, St. Andrews, N. B., to assess discards of haddock and cod.

In 1951-52 on Nova Scotia Banks there were large numbers of haddock of about 30 cm in length; the codend mesh size was $2\frac{7}{8}$ inches; and the commercial cull for gutted haddock was between 40 and 45 cm. Under such conditions, 40 to 60% by weight of the haddock caught by otter trawlers were discarded at sea.

In 1958 small haddock were still numerous; the codend mesh size had increased to more than $4\frac{1}{2}$ inches as a result of ICNAF mesh regulation; and the commercial cull was lower, 40 cm for gutted haddock and 38 cm for those landed round. It was observed, on 6 commercial trawler trips, that only 3 to 7% of haddock were discarded, by weight, on 3 gutted-haddock trips. On trips where most haddock were landed as round fish, discards were only 2 to 4% by weight. For the small portion of these trips where haddock were gutted for landing, 33 to 37% by weight were discarded at sea. It appears that the large-mesh nets are releasing virtually all haddock below commercial size, and meshes larger than $4\frac{1}{2}$ inches, manila, or the equivalent with other twines, would release some marketable haddock. The advantage of a larger mesh size would depend on growth and survival of released haddock.

Ten summer trips on commercial draggers in Subdivision 4T provided data on discards of cod. Four trips were made on draggers using small-mesh (3-$4\frac{1}{4}$ inches) and 5 trips were on draggers using large-mesh ($4\frac{3}{4}$ inches) manila codends. These draggers fished mainly on Bonaventure Island grounds. A tenth trip was made in Chaleur Bay. The average discards on the small-mesh trips were 23% by number and 9% by weight. On the large-mesh trips average discards were 12% by number and 5% by weight. These results confirm those of 1957 in showing that $4\frac{3}{4}$-inch mesh codends reduce discards by about half.

Although it is believed that a still larger mesh size would be advantageous for Subarea 4 cod, initial losses might be too high to warrant premature action by ICNAF. Fishermen's cull appears to vary with the sizes of cod available to the fishery. In 1957 New Brunswick draggers culled cod at about 50 cm; but with smaller fish in 1958 catches, the 50% cull point dropped to about 46 cm. Selection factors for manila codends have been found to be variable for cod. In some experiments the selection factor has been 3.7, and in others (see below) only 3.3. Large-mesh nets are probably more efficient, but the amount is not adequately known. Finally, the growth and survival of released cod are poorly understood. All of these variables are being investigated.

Gear Selection. Various gear-selection studies were carried out in Subarea 4 during 1958. The Biological Station, St. Andrews, N. B., investigated the selectivity of a $5\frac{3}{4}$-inch mesh manila codend for cod, a 5- to $5\frac{1}{8}$-inch manila codend for haddock, a $4\frac{5}{16}$-inch mesh nylon codend for haddock, and the effect of chafing gear, as prescribed by ICNAF, on escapement of haddock. The Quebec Experimental Fishing Station, LaTabatière, P.Q., studied the selectivity of cotton and manila codend meshes for redfish, and the selectivity of 5-inch cotton meshes in traps for cod. The Marine Biological Station at Grand River, P.Q., studied selectivity of No. 14 and No. 17 Mustad hooks in line fishing for cod.

A selection factor of 3.3 was observed for a 5- to $5\frac{1}{8}$-inch mesh codend made of double, 75-yard, 4-ply manila twine, and fished for haddock.

A piece of chafing gear, 18 meshes long, attached 4 meshes ahead of the splitting strap and along the laceage to 3 meshes from the codline mesh, of $4\frac{7}{8}$-inch manila, and $1\frac{1}{2}$ times the width of the codend, did not have a measurable effect on the escapement of haddock from the same codend.

A higher selection factor, 3.9, was found for a $4\frac{5}{16}$-inch mesh codend made of double-strand, 85-yard, braided nylon twine, and fished for haddock. The experiment indicates that a 4-inch double nylon mesh is equivalent in selection to a $4\frac{1}{2}$-inch double manila mesh.

In all three experiments, a No. 36 Yankee manila trawl was towed by the M.V. *Harengus* on Sable Island and Emerald Banks in August and September 1958. A cover of $1\frac{1}{2}$-inch stretched-mesh Nyak was used to catch the fish which escaped through the codend meshes.

Another covered codend experiment was carried out in the summer of 1958 while fishing the M. V. *J. J. Cowie* for cod in the northern part of Subdivision 4T with a $\frac{3}{4}$ No. 35 Yankee cotton trawl. A selection factor of 3.3 was observed for a $5\frac{3}{4}$-inch mesh codend made of 75-yard, 4-ply manila twine. Higher selection factors had been observed earlier in double-manila, smaller-mesh experiments for cod.

Redfish selection experiments in Subdivision 4R gave the following selection factors: 2.4 for $3\frac{1}{2}$-inch mesh and 2.8 for $4\frac{3}{8}$-inch mesh single cotton codends; 2.2 for $3\frac{1}{4}$-inch mesh, and 2.5 for 5-inch mesh double-manila codends. These findings are consistent with earlier results for redfish.

The most frequent cotton mesh size in the back of codtraps is 4 inches. A preliminary experiment, using 3- and 5-inch meshes of single-cotton twine, gave a selection factor of 4.0. Further tests are needed.

There was little difference in the size composition of cod taken with No. 14 and No. 17 Mustad hooks on line trawl fished off Grand River, P.Q. Further work is required to compare the selectivity of these hooks with that of otter-trawl meshes.

Sea Scallop. Two sea trips to Georges Bank were made by the Biological Station, St. Andrews, N. B., on commercial scallop draggers in August and October 1958 to observe quantities and sizes of scallops discarded at sea. There were remarkable differences in the density and size distribution of scallops from bed to bed. The shucking facilities were saturated most of the time, and high catches resulted in high discards. Discards by number varied from 55 to 86%. The mean selection size varied from 95 to 100 mm shell height. Landings per boat appeared to be a measure of shucking power and sizes of scallops saved, rather than of scallop abundance. The present 3-inch ring size in scallop drags has a mean selection size of about 72 mm. The advantages and disadvantages of a larger ring size are being considered.

Hydrography. In July and August 1958 the Atlantic Oceanographic Group, St. Andrews, N. B., took part in the IGY "Deep Water Circulation" Project by occupying stations along a section between Bermuda and Baffin Bay and also stations from various points off the Canadian east coast to the IGY line. A section between Greenland and the Strait of Belle Isle was also occupied. During this cruise observations were made in Subareas 1, 2, 3, and 4; they included temperatures, salinities, dissolved oxygen, phosphate, silicate, and nitrite. Biological observations were made for the full extent of the cruise.

A survey of the central sector of the Scotian Shelf was made four times in 1958. This phase of the work is a contribution to the IGY project "Polar Front Survey — North Atlantic". The temperature and salinity distributions in the section off Halifax are given in Figure 2. In May, August, and October 1958 the intermediate temperature layer was less developed than during recent years. The bottom waters of the Scotian Gulf were colder than those observed in recent years in April, May and August. The bottom temperatures over Emerald Bank, between 6.0°C and 8.0°C, were within the limits of observations of temperature generally observed in those seasons.

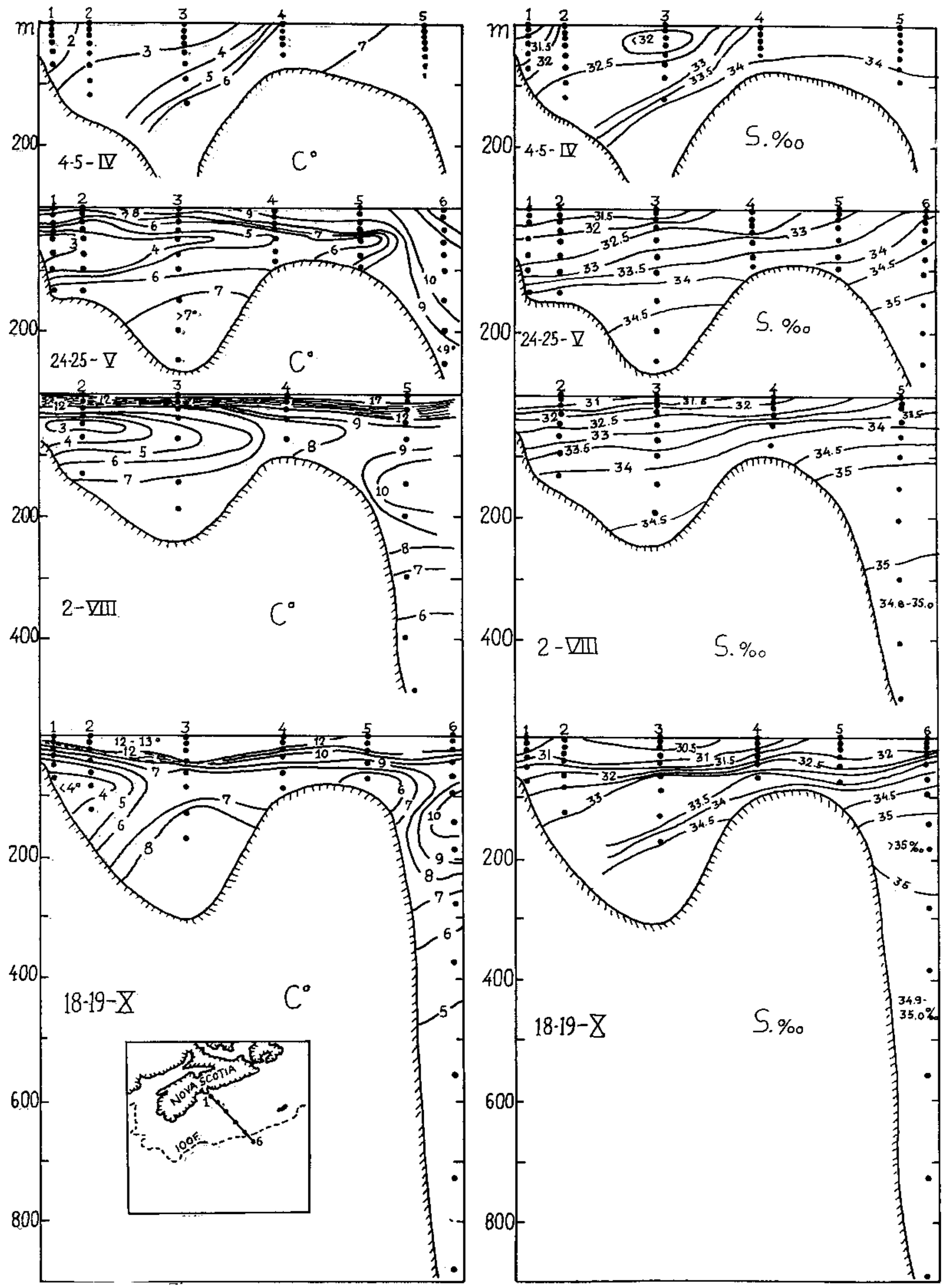


Fig. 2. Hydrographic sections off Halifax in 1958, 4-5 April, 24-25 May, 2 August and 18-19 October. Temperature °C. Salinity °/oo.

Analysis of volume transport through Cabot Strait for a series of 18 seasonal sections shows, on the average, the maximum outflow in the autumn, the maximum inflow in the winter. The net transport through Cabot Strait in the deep layers, of temperature greater than 1°C, indicates that the resultant flow for all seasons is generally directed into the Gulf. The maximum net transport occurs in the autumn-winter half of the year. The maximum speed of the current within the deep layers was computed to be 10 cm per second along the Cape Breton coast and 20 cm per second along the Newfoundland coast.

Analysis of surface water temperatures along the coast shows that the main feature of temperature variations from 1957 to 1958 was an increase at all stations during the first 6 months of the year and a general decrease during the second half of the year.

As in earlier years, the Marine Biological Station, Grand River, P.Q., carried out hydrographic observations in Chaleur Bay.

II. Danish Research Report, 1958

A. BIOLOGY — BY PAUL M. HANSEN

I. Cod, West Greenland.

1. Young Stages.

a. Occurrence of Cod Eggs.

In table 1 are presented the numbers of cod eggs caught in hauls of 30 minutes with 1 m stramin-net and 1 m nylon-net in the Godthåb Fjord area. The catches with nylon-net are given in brackets. Figure 1 shows the stations where the hauls were made. It is apparent that large quantities of eggs are taken in the spawning area proper (Stations 3, 4 and 5) in March and April; the numbers from the other stations are much smaller. The numbers of eggs taken in 1958 are somewhat higher than in the previous years.

b. Occurrence of Cod Fry.

The numbers of cod larvae (fry) caught with 1 m stramin-net in the Godthåb Fjord area are also shown in Table 1. The numbers of cod larvae caught by "Dana" in 30 minute hauls with a 2 m. stramin-net in July are presented in Figure 2 The numbers caught were very low in the fjord-area as well as over the banks. The greatest numbers were, as in 1956 and 1957, caught on the stations west of the banks.

The small quantities caught indicate that the 1958 year-class will be a poor one.

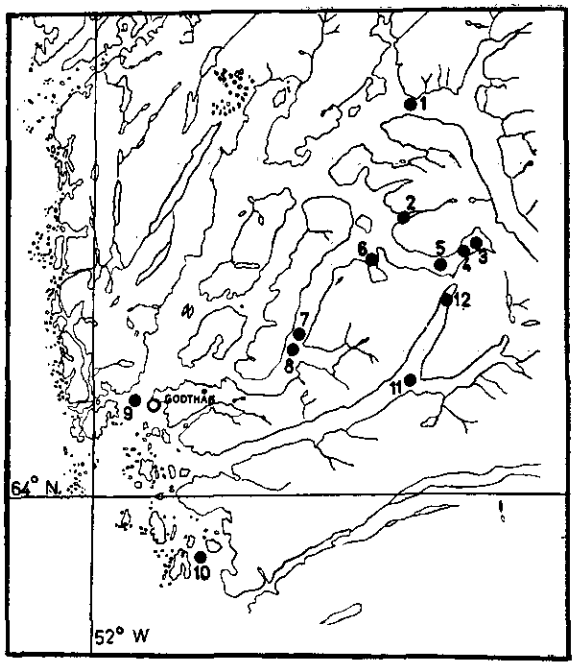


Fig. 1. The positions of the stations at which cod eggs were taken in 30 minutes hauls with the 1 m. stramin net and the 1 m. nylon net by "Adolf Jensen" and "Tornaq" with 100-50 m. wire out.

TABLE 1. Number of cod eggs and larvae taken per 30 minute hauls in the Godthåb Fjord area with 1 m stramin-net (nylon-net figures in brackets).

STATIONS		March	April		May		June	July
		15-31	1-15	15-30	1-15	15-31	15-30	1-15
3	Eggs	(3190)	(350000)	(105000)				
	Larvae							
4	Eggs	(4350)	(78400)	(148000)				
	Larvae							
5	Eggs	(11890)	3730 (3380)	125000 (115000)		5981 (8000)		0 (6)
	Larvae							5 (2)
6	Eggs	(27)						
	Larvae							
7	Eggs				150	1370		
	Larvae				1			
8	Eggs	9		84 (81)		147 (106)		0 (0)
	Larvae							1 (1)
9	Eggs	1 (0)		36 (52)	60 (81)			0 (2)
	Larvae							1 (8)
10	Eggs	0			10 (8)		8	(0)
	Larvae						14 (1)	(1)

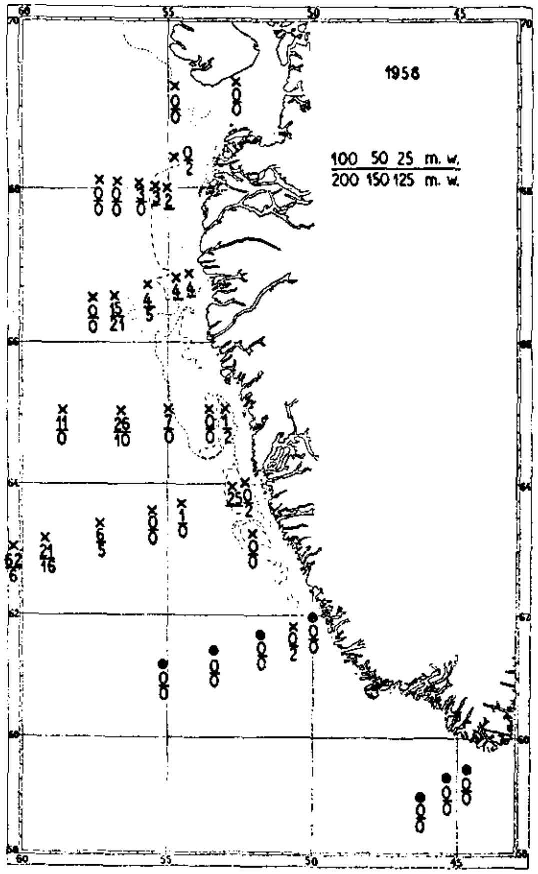


Fig. 2. Catches of cod larvae in 30 minutes hauls with the 2 m. stramin net taken by "Dana."

c. Occurrence of Small Cod of Age-Groups I, II and III.

Small cod were taken in rather low numbers in fine-meshed seines and in shrimp-trawl (see Table 2). The largest amounts were found in catches c and e, 1,989 and 995 respectively. The length frequencies are presented in Figure 3.

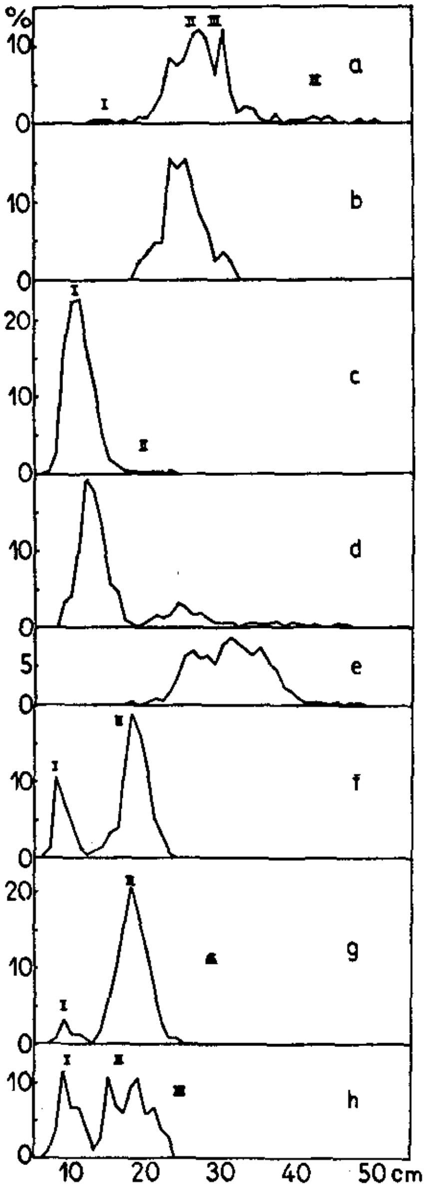


Fig. 3. Length frequencies of small cod, age-groups I, II, and III.

TABLE 2.

Sample	District	Date	Gear	Number of fish
a	Frederikshaab	11.6	seine	281 (ages determ.)
b	Frederikshaab	13.6	,,	84
c	Godthaab	5.7	,,	1989 (ages determ.)
d	Godthaab	23.7	,,	608
e	Holsteinsborg	15.6	,,	995
f	Godthaab	30.1	shrimp trawl	239 (ages determ.)
g	Godthaab	26.2	,, ,,	176 (ages determ.)
h	Godthaab	14.4	,, ,,	104 (ages determ.)

It is difficult to state, based on these catches, which year-classes can be expected to gain importance in the commercial fisheries in future years. However, there are reasons to assume that the 1957 year-class is rich, as large shoals of this year-class were observed in many places along the coast, where the bottom conditions did not permit the use of seines.

2. Commercial Sizes of Cod, Age and Length Composition[1])

a. Offshore Banks.

Age determinations were carried out on 1,135 cod from the banks: 879 were taken with handline from "Dana", end of July-beginning of August, 79 with longlines from "Adolf Jensen" on 6 May, 97 with handlines from "Sujumut" 4 September, and 80 with longlines from "Immanuel" 2 September. Figure 4 shows the age-composition in 6 of the 8 catches (the catches 7 and 8 are omitted in Figure 4, but included in Figure 5).

It is apparent that the 1953 year-class predominates very strongly (40-70%) in catches 1, 2, 3 and 7 (Subdivisions 1A, 1B and 1C). Three catches were made in 1D; in no. 4 the 1953 year-class predominates with a little more than 25%, in no. 5 the 1950 year-class, and in no. 6 the 1947 year-class (ca. 30%). Subdivision 1E is only represented by one sample (no. 8, longline, 2 Sept.); the 1947 year-class predominates with 58%.

These catches seem to indicate a strong improvement for the 1953 year-class, especially in 1B and 1C, whereas the 1950 and 1947 year-classes were greatly reduced. The two latter year-classes only predominated in the catches from 1D and 1E.

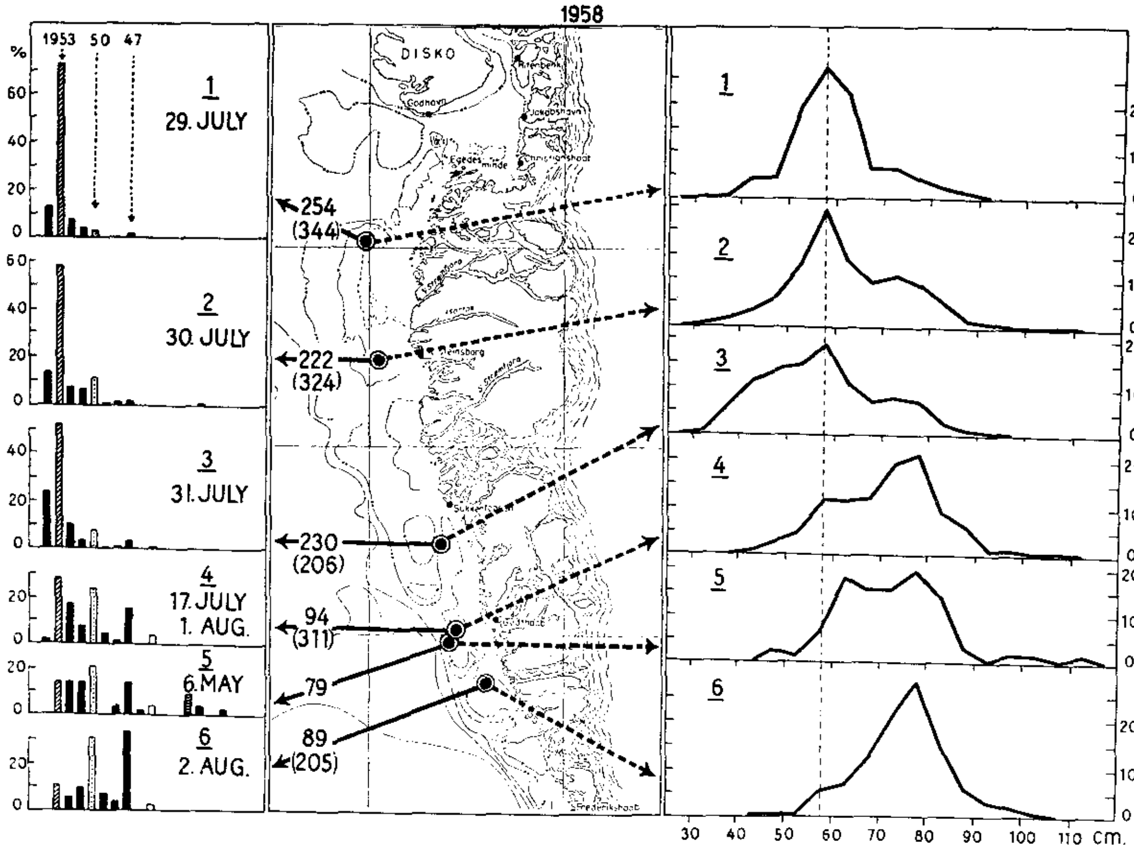


Fig. 4. **Percentage age distribution (left) and length measurements by 5 cm groups (right) of cod caught on the Greenland banks in 1958. The numbers of fish examined and of cod tagged (bracketed figures) are given for each station.**

[1]) The data will be presented in tabular form in the 1958 Sampling Yearbook.

The length distribution of the catches, shown in Figure 4 (right), are clearly conforming with the age composition. In the three northernmost catches mainly smaller cod are present; considerably larger cod are found in the more southerly catches, nos. 4, 5 and 6. The sample no. 6, with the strong 1947 year-class includes mainly big cod.

b. Inshore Waters and Fjords.

From the coastal region and from the fjords 3,764 cod were aged, 2,440 from 17 catches from Godthåb Fjord and the remainder 1,324 from eight catches from other areas. Age-composition and localities are shown in Figures 5 and 6.

These samples are distributed over the various subdivisions as follows: 1A-1, 1B-4, 1C-2, 1D-17, 1E-0, 1F-1.

Ten samples are shown on the map Figure 5 (nos. 7 and 8 of these, from the banks, have been considered in the preceding section). The samples from 1D, all from Godthåb Fjord and the coastal area nearest to the Fjord, are presented in Figure 6.

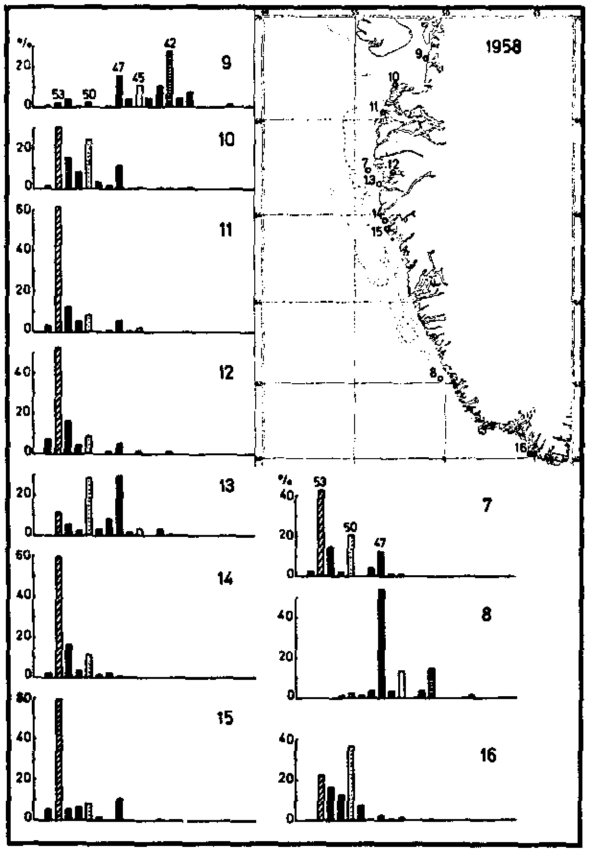


Fig. 5. **Percentage age distribution of cod caught in the coastal area of West Greenland in 1958 (No. 7 and 8 from the banks).**

Sample no. 9 is from Subdivision 1A. Here the stock of cod, as well as the fishery, had declined considerably, and was of hardly any importance in 1958. The 1942 year-class predominates in the sample in accordance with the fact that the old year-classes are the strongest in this northern region. The 1953 year-class is very strongly represented in the samples from the coastal areas, as was also the case for the samples from the banks. However, the 1947 year-class predominates in the Holsteinsborg Deep (no. 13) whereas the 1950 year-class is the strongest in no. 16 from Subdivision 1F. In the mouth of the Godthåb Fjord the 1953 year-class dominated, in the Fjord proper that of 1952. The spawning stock (April No. 3) shows as usual an even distribution of mainly older year-classes (1945 and 1947).

The samples are not so evenly distributed through the subdivisions as to afford a true picture of the age distribution for the whole of the West Greenland region. Thus there are no samples from the coastal area of 1E, and only one sample from 1F.

From the material available it appears that a reduction of the 1947 and 1950 year-classes occurred in the northern area, while the 1953 year-class improved considerably. This year-class will no doubt play an important role in the catches in 1959. In 1958 the 1953 year-class presented sizes between 55 and 60 cm and an average individual weight of ca. 2 kg. In 1959 it is expected to reach a mean length of 65 cm and a mean weight of ca. 3 kg.

II. Cod, East Greenland.

The research work in Angmagssalik district, started in 1957, was continued in 1958.

From 8-14 August large concentrations of cod were observed at Skjoldungen (63°N) on the bank as well as near the coast in a depth of 170 m. The cod were present below the layer of polar water which reached from 30-170 m. Good catches of cod were taken on 8 August on Skjoldungen Bank with longlines and handlines (Figure 7, nos. 5 and 6). These two types of gear were

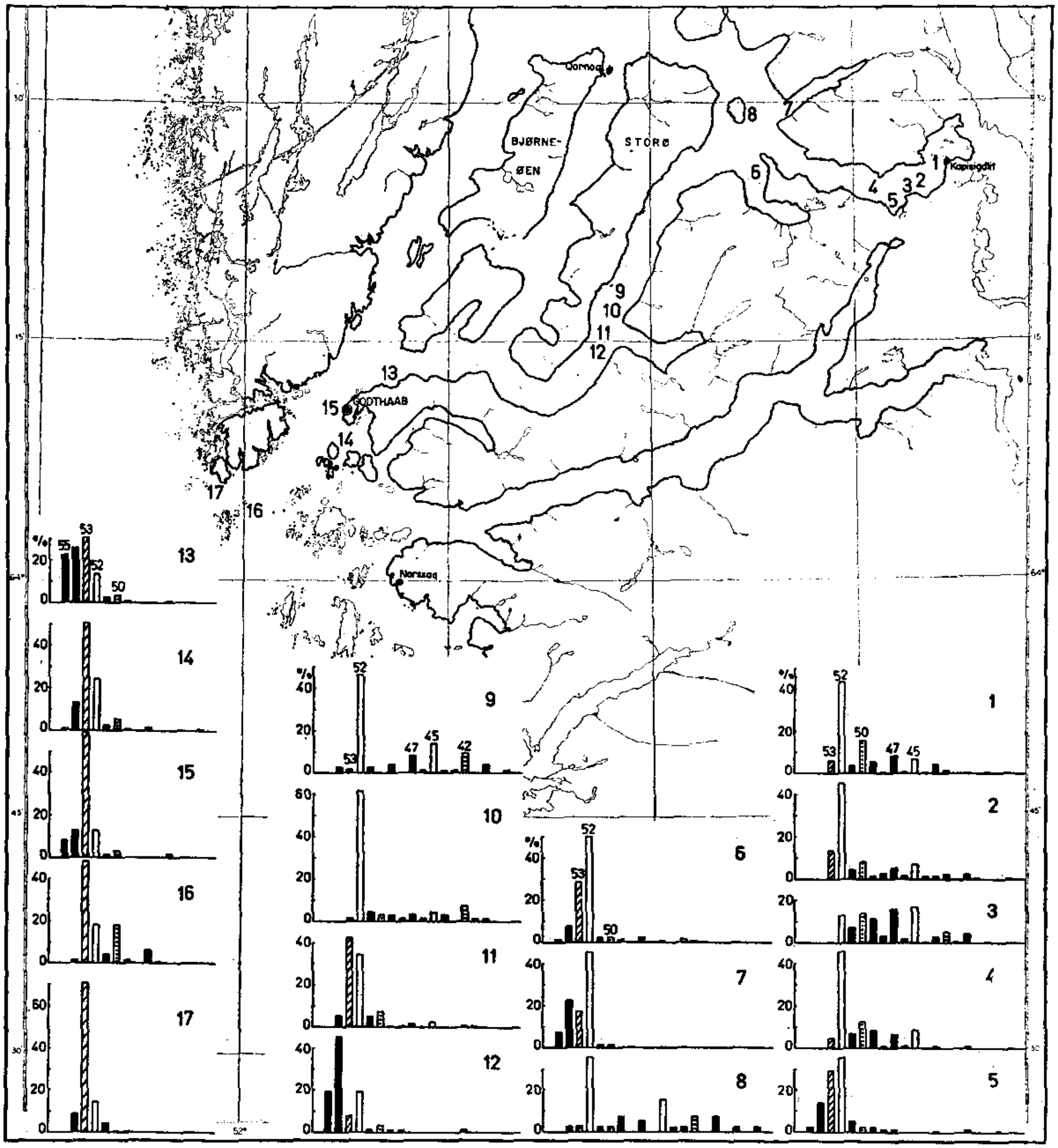


Fig. 6. Percentage age distribution of cod caught in the Godthaab Fjord area in 1958.

used in the same place and at the same depth, but the catches were completely different as to age-and size-distribution. The longline catches included the 1942, 1947 and 1950 year-classes in almost the same proportion (15-20%), while the 1950 year-class made up over 50% of the handline catch leaving only less than 5% for each of the year-classes older than 1948; the 1949 year-class came to 20%.

On 12 and 13 August two catches were made, one (no. 7) with longline from Skjoldungebank, and another (no. 8) with handline from the mouth of Skjoldungesund. Also these catches show that the longlines take cod of the large old 1942 and 1947 year-classes, the handlines mainly cod of the younger 1950 year-class (50%). The fact that the longlines used on the bank included ca. 5% of the 1950 year-class, which was so richly

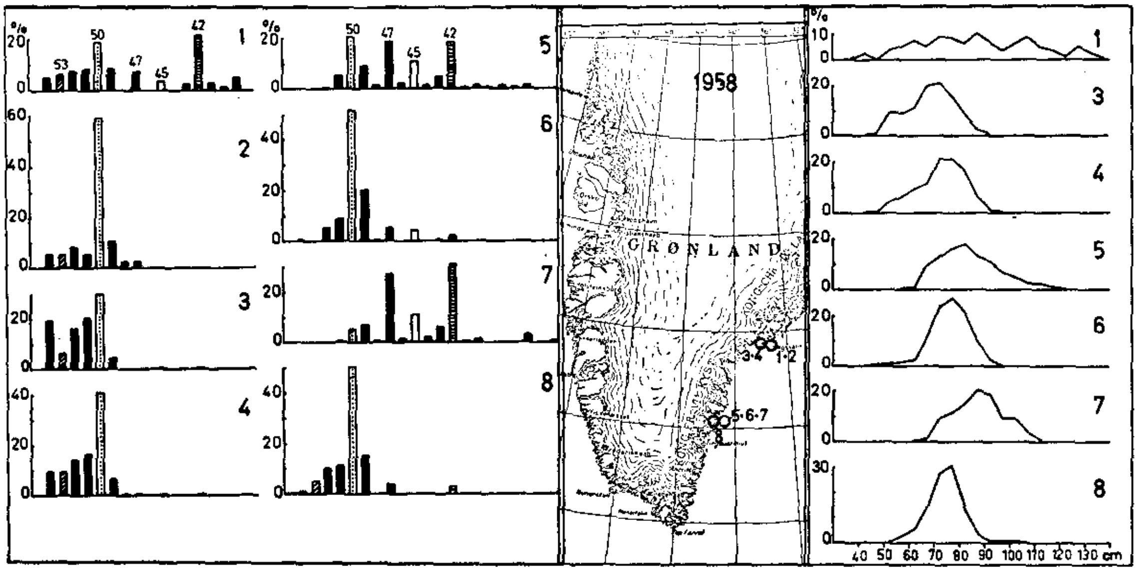


Fig. 7. Percentage age distribution (left) and length measurements by 5 cm. groups (right) of cod caught in Angmagssalik district, East Greenland 1958.

represented in inshore handline catches, may well be explained by a coastward migration of this year-class.

The samples from Angmagssalik Bank show the same differences in age composition between longline and handline catches. In sample no. 3 from the coastal area of Angmagssalik are many cod of the young year-classes, while the 1950 year-class constitutes 30%. In the Angmagssalik Fjord this year-class is more numerous (40%); it formed the basis for the fishery for cod which commenced here in 1958. Also at Angmagssalik there is a migration of cod into the fjord. Thus, in the beginning of September hardly any cod were observed on the bank and the longlines yielded almost exclusively halibut; at the same time cod occurred in large quantities in the fjord. Of a catch of 37 cod from handline fishing on the Angmagssalik Bank (22 August) 22 belonged to the 1950 year-class. These cod were exceptionally large with a mean length of 85.7 cm or 8-10 cm higher than the averages of the same year-class in other East Greenland samples. This fast growth indicates that the cod belong to the Icelandic stock. None of them were ripe. Obviously they are Icelandic cod which during their feeding-migrations have reached the East Greenland waters.

III. Cod, Age at First Maturity (Table 3).

The age of cod at first maturity was investigated by means of the otoliths and for the following regions: West Greenland Banks, coastal area north of 63°N (1A, 1B, 1C), the Godthåb Fjord, and the Angmagssalik district (East Greenland). Only cod of the old rich 1942, 1945 and 1957 year-classes were considered. Greater differences as to age at first maturity were not observed. The females become mature at a later age than the males.

IV. Cod, Tagging Experiments (Tables 4 and 5)

A total of 2,881 cod were tagged at West Greenland in 1958: 1,300 on the banks and 1,581 in fjords and coastal waters (of these 657 in the Godthåb Fjord). At East Greenland, Angmagssalik district, 1,015 were tagged.

From the West Greenland tagging experiments 788 recaptures were reported: 771 from West Greenland, 16 from Iceland, and 1 from East Greenland. The recapture from East Greenland was made by a German trawler near Angmagssalik on 7 March 1958. The cod had been tagged 7 December, 1954 in the inshore water of Subdivision 1F. The 16 recaptures from Iceland

TABLE 3. Age at first maturity of the 1942, 1945, and 1947 year-classes of Greenland cod in 1958.

1942 year-class					1945 year-class					1947 year-class				
age	no. ♂♂	%	no. ♀♀	%	age	no. ♂♂	%	no. ♀♀	%	age	no. ♂♂	%	no. ♀♀	%
Banks off the west-coast														
imm.	—	—	—	—	imm.	—	—	—	—	imm.	—	—	—	—
6	1	14.3	1	8.3	6	1	9.1	1	10.0	6	3	4.1	—	—
7	4	57.1	7	58.3	7	5	45.5	—	—	7	39	53.4	17	36.2
8	1	14.3	4	33.3	8	4	36.4	7	70.0	8	27	37.0	22	46.8
9	1	14.3	—	—	9	—	—	2	20.0	9	4	5.5	6	12.8
10	—	—	—	—	10	—	—	—	—	10	—	—	2	4.3
11	—	—	—	—	11	1	9.1	—	—	11	—	—	—	—
Total	7		12			11		10			73		47	
mean age		7.1		7.2			7.6		8.0			7.4		7.9
Coastal area north of 63°N.														
imm.	—	—	—	—	imm.	—	—	—	—	imm.	—	—	2	3.6
5	—	—	—	—	5	—	—	—	—	5	1	1.6	—	—
6	3	20.0	1	4.3	6	1	10.0	1	7.1	6	—	—	—	—
7	9	59.9	14	60.9	7	2	20.0	5	35.7	7	26	41.9	9	16.1
8	2	13.3	5	21.7	8	3	30.0	7	50.0	8	25	40.3	25	44.6
9	1	6.7	3	13.0	9	4	40.0	1	7.1	9	10	16.1	18	32.1
10	—	—	—	—	10	—	—	—	—	10	—	—	2	3.6
Total	15		23			10		14			62		56	
Mean age		7.1		7.4			8.0		7.6			7.7		8.2
Godthåb Fjord														
imm.	—	—	—	—	imm.	—	—	—	—	imm.	1	2.4	—	—
6	1	5.6	3	18.8	6	6	13.6	8	16.0	6	5	12.2	8	14.0
7	13	72.1	6	37.5	7	26	59.1	24	48.0	7	14	34.1	19	33.3
8	2	11.1	5	31.3	8	8	18.2	12	24.0	8	18	43.9	25	43.9
9	2	11.1	1	6.3	9	3	6.8	5	10.0	9	2	4.9	4	7.0
10	—	—	1	6.3	10	1	2.3	1	2.0	10	1	2.4	1	1.8
Total	18		16			44		50			41		57	
Mean age		7.3		7.4			7.3		7.3			7.5		7.5
East Coast														
imm.	—	—	—	—	imm.	1	5.3	1	3.2	imm.	1	2.1	3	6.1
6	4	13.3	2	2.7	6	3	15.8	1	3.2	6	2	4.3	—	—
7	13	43.3	33	43.9	7	7	36.8	8	25.8	7	16	34.0	14	28.6
8	10	33.3	31	41.2	8	4	21.1	8	25.8	8	19	40.4	18	36.7
9	3	10.0	5	6.7	9	2	10.5	4	12.9	9	8	17.0	10	20.4
10	—	—	2	2.7	10	1	5.3	7	22.6	10	1	2.1	4	8.2
11	—	—	2	2.7	11	1	5.3	2	6.5	11	—	—	—	—
Total	30		75			19		31			47		49	
Mean age		7.4		7.9			7.7		8.5			7.8		8.1

ABLE 4. **Marked Cod recaptured at Greenland (G.) and at Iceland (Ic.) in 1958, tabulated according to Age and Year of Liberation.**

ear-class	Age-group	1951		1952		1953		1954		1955		1956		1957		1958		Total		
		Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	%	Ic.
938	XX	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	0.2	—
940	XVIII	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	0.2	—
942	XVI	—	—	—	—	—	—	2	—	—	—	2	—	6	—	1	—	11	2.2	—
943	XV	—	—	—	—	1	—	1	—	—	—	—	—	1	—	—	—	3	0.6	—
945	XIII	—	—	—	—	—	—	4	1	1	—	—	—	9	1	—	—	14	2.8	2
946	XII	—	—	—	—	—	—	—	—	2	—	1	—	2	—	—	—	5	1.0	—
947	XI	—	—	2	—	1	—	11	—	10	—	28	—	42	—	10	—	104	20.9	—
948	X	—	—	—	—	—	—	—	—	1	—	2	—	3	—	1	—	7	1.4	—
949	IX	—	—	—	—	—	—	2	1+)	4	—	2	1	6	2	—	—	14	2.8	4+)
950	VIII	—	—	—	—	—	—	3	—	16	—	16	—	65	3	13	—	113	22.7	3
951	VII	—	—	—	—	—	—	—	—	1	—	1	—	26	1	3	—	31	6.2	1
952	VI	—	—	—	—	—	—	—	—	—	1	4	—	77	—	4	—	85	17.0	1
953	V	—	—	—	—	—	—	—	—	—	—	—	—	53	—	15	—	68	13.7	—
954	IV	—	—	—	—	—	—	—	—	—	—	2	—	28	—	3	—	33	6.6	—
955	III	—	—	—	—	—	—	—	—	—	—	—	—	7	—	1	—	8	1.6	—
??		2	—	—	—	4	—	20	3	19	1	58	2	125	—	45	—	273		6
otal Number		2	—	2	—	6	—	45	5+)	54	2	116	3	450	7	96	—	771		17+)

+) One cod recaptured at East Greenland.

had been tagged as follows in the subdivisions: 1B-1, 1C-3, 1D-8, 1E-1, and 1F-3

Otoliths of 509 recaptured cod were forwarded. Ca. 75% belonged to the 1950, 1947, 1952, and 1953 year-classes. The 1952 year-class accounts for 17% of the aged, recaptured cod, due to the large amount of tagging (over 2,000) in Godthåb Fjord in 1957 and 1958 when this year-class constituted a very large part of the stock. No less than 56 cod of this year-class were recaptured in 1958 in the Godthåb Fjord itself. In other West Greenland localities it was of no importance.

In Table 5 are presented numbers of recaptures reported by the various countries. As usual Portugal reported the highest numbers, about one half, while the Greenlanders reported about one third of the recaptures from Subarea 1.

From the tagging experiments at East Greenland in 1957 three recaptures were reported in 1958; one from East Greenland by a German trawler. The cod was tagged 16 September 1957 at Angmagssalik (65°35'N-37°35'W) and recaptured 22 September 1958, 66°50'N-35°45'W. Two other recaptures from Iceland off West Iceland 26 April, and off NW Iceland 15 June, 1958 are from the same experiment.

TABLE 5. Cod tagged at West Greenland in different years recaptured in 1958, by Countries.

	West Greenland	Iceland	East Greenland
Greenland	253	—	—
Faroe Islands	12	—	—
Norway	15	—	—
Iceland	25	9	—
United Kingdom	22	2	—
France	9	—	—
Germany	36	5	1
U.S.S.R.	2	—	—
Spain	13	—	—
Portugal	384	—	—
Total	771	16	1

V. Halibut.

1. Researches 1958.

Halibut were caught on the banks off Angmagssalik, East Greenland on longlines in the period 22 August to 8 September. Five hauls were made with a total of 4,800 cod-hooks and 2,600 halibut-hooks. The total catch from these hauls amounted to 144 halibut, 43 cod, 16 *Anarhichas minor* and 49 *A. denticulatus*, together with a few other fish of no commercial importance. Seventeen halibut were tagged with Petersen disks; from the rest, otoliths were taken for age-determinations. Halibut were always found in smaller quantities in the fjords.

Of 152 halibut, 75 were males and 77 females. The length distribution of the two sexes is shown by 10 cm groups in the following Figure 8.

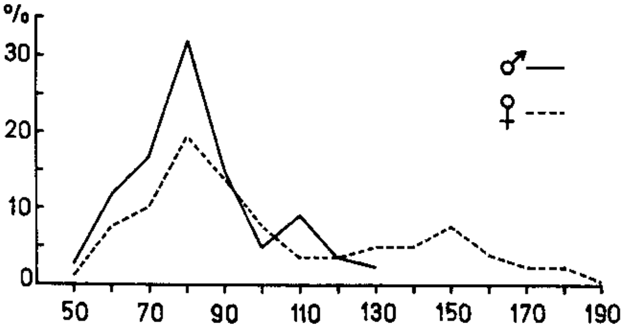


Fig. 8. Length distribution by 10 cm groups of males and females of halibut caught off Angmagssalik in 1958.

2. Survey of the Danish Halibut Research in Subarea 1, 1925-58.

a. Halibut Larvae.

The R/V "Dana" has fished with 2 m stramin net for fish larvae on stations on the recommended sections over the fishing banks in the Davis Strait in 1925, 1950 and every year from 1952 to 1958. The places where halibut larvae were caught are given in Figure 9. Only a total of 13 larvae were taken. With the exception of one taken on 19 June, 1925, all were caught in July. The northernmost catch is from 65°41'N. and the southernmost from 59'38'N. Three were taken over the offshore banks, the others over great depths west of the banks, among these seven between 55°W. and 60°W. Six larvae were taken with 100 to 25 m wire out, two with 200 to 125 m, and one with 1600 to 1400 m wire out. The lengths of the larvae were from 15 to 27 mm.

b. Age Analyses. (See Figure 10)

Age determinations were made on samples of halibut otoliths from West Greenland in the years 1935, 1936, 1937, 1938, 1947 and 1954. In 1958 a sample of 152 otoliths was collected from halibut taken by the research ship "Adolf Jensen" on offshore banks of East Greenland. This material

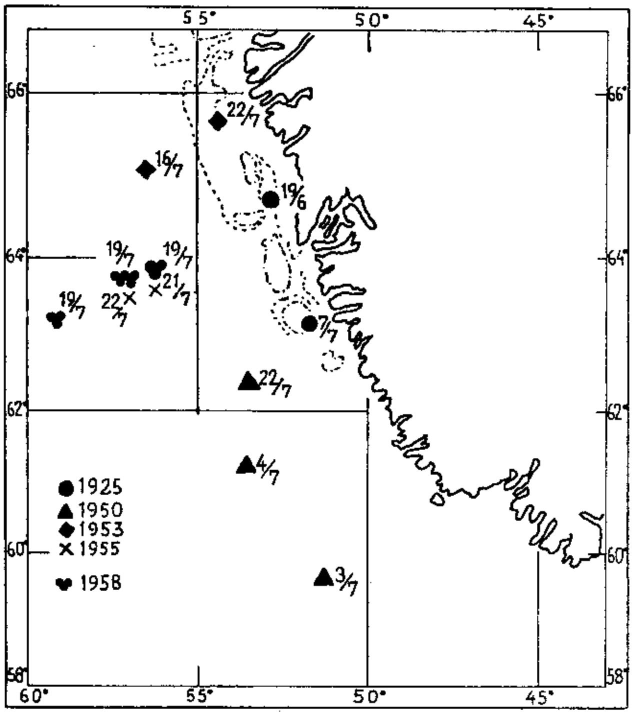


Fig. 9. Localities where larvae of halibut were caught.

has not yet been worked up. The samples from 1935 to 1954 are from commercial catches. The rich year-classes have been 1922, 1924, 1926, 1929 and 1936, and perhaps also the 1917 year-class. It is obvious that there is some agreement between this species and the stock of cod as to good and poor year-classes. In the small sample from 1954, however, the year-class 1937 seems to predominate. This year-class was not of importance in the Greenland stock of cod.

The otoliths of big, old halibut are rather difficult to read.

c. Tagging Experiments.

A total of 54 halibut were tagged off West Greenland. The years of tagging, together with the numbers tagged, are given in Figure 11. Some of the tagged halibut were taken by hand-line, but the majority were from long-lines. It has been rather difficult to get halibut caught by long-lines for tagging experiments. The big halibut are taken onboard by means of large hooks which spoil them too much. Usually the halibut swallow the hook and specimens which have done so have not been used for tagging.

Medium-sized and small halibut are taken onboard by means of a landing net. They are measured and tagged immediately after capture.

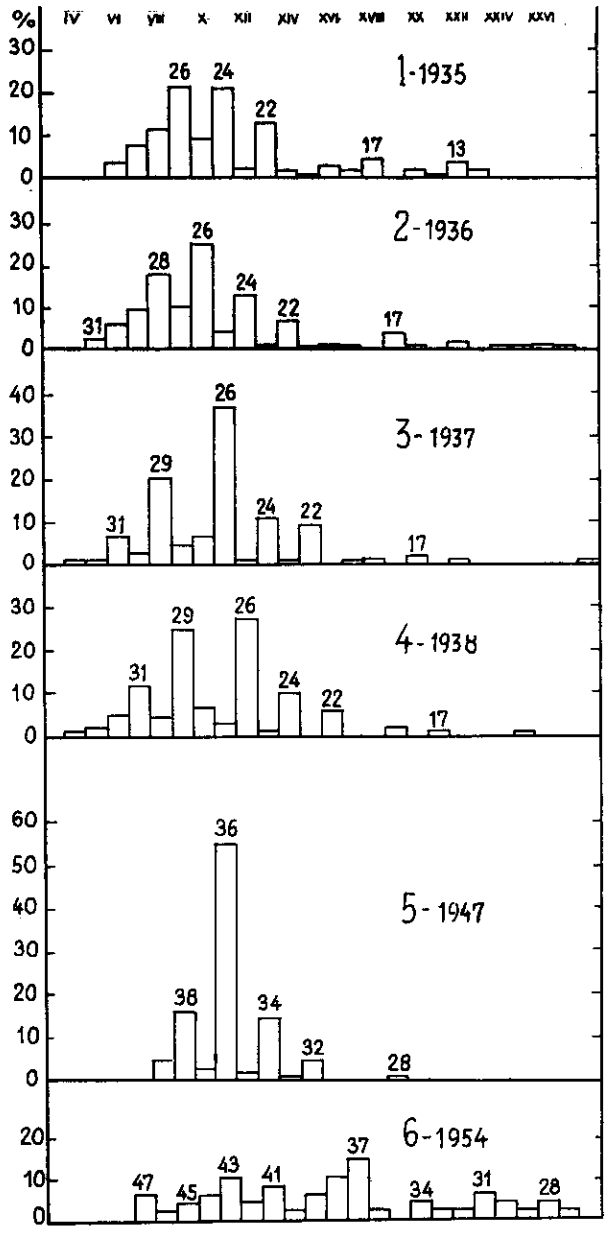


Fig. 10. **Age distribution of halibut. 1—Holsteinsborg, 147 spec., 1935; 2—Holsteinsborg and Kangamiut, 378 spec., 1936; 3—Holsteinsborg and Kangamiut, 389 spec. 1937; 4—Holsteinsborg and Kangamiut 279 spec., 1938; 5—West of Disko, 113 spec., 1947; 6—landed in Faeringerhavn, 50 spec., 1954.**

The Petersen disks were used, fixed by silver or stainless steel wire in the right operculum. Thirteen recaptures have been reported, which is 25%. The comparatively high percentage of recapture together with the long time between tagging and recapture show that this kind of tag is effective.

One halibut was recaptured in the tagging year, 2 in the 2nd, 6 in the 3rd, 3 in the 4th and 1 in the 9th year; 9 have been recaptured near the place where they were tagged, and 4, 30, 70, 100 and about 500 miles from the tagging place.

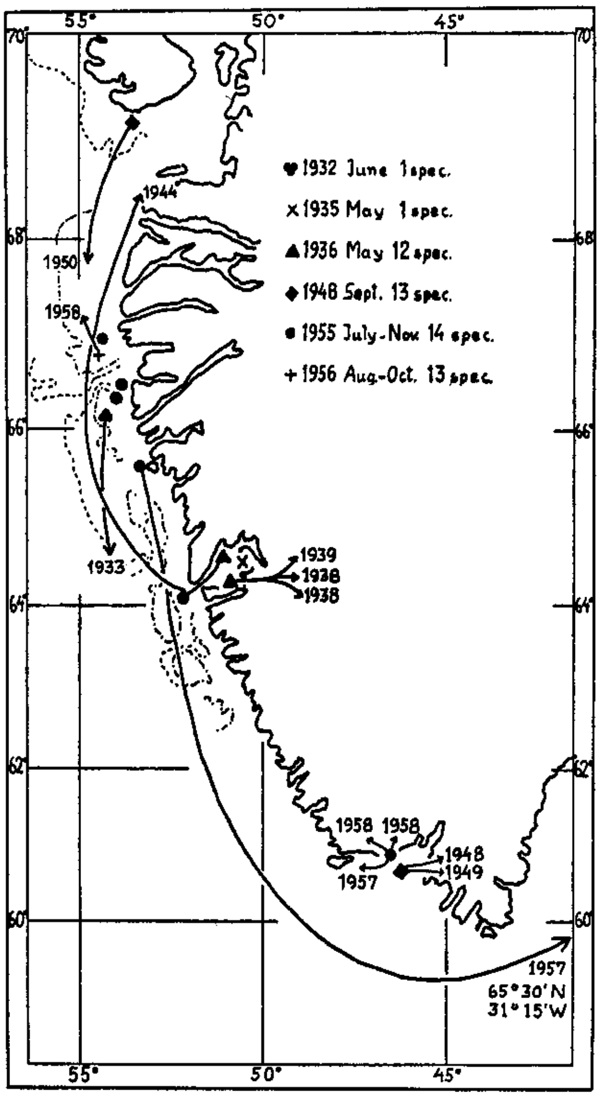


Fig. 11. Halibut tagging experiments.

One recapture is of special interest. It is a halibut which was tagged 4 August, 1955 off West Greenland (65°32'N., 53°25'W.) and recaptured 716 days later, 7 July, 1957, between East Greenland and Iceland (65°30'N., 31°15'W.) by a Norwegian fishing vessel. When tagged the halibut measured 117 cm. The length when recaptured was reported to be 110 cm. The difference in the lengths may be due to differences in the way in which the length of the fish has been measured from the nose to one of the tips of the tail fin. By recapture probably the fork length has been measured. The total length 117 cm corresponds exactly with the fork lengths 110 cm. (See Figure 12 in which the relation between fork lengths and total lengths is given).

In 1958, 17 halibut were tagged on the banks off Angmagssalik, East Greenland. Until now no recaptures have been reported from this experiment.

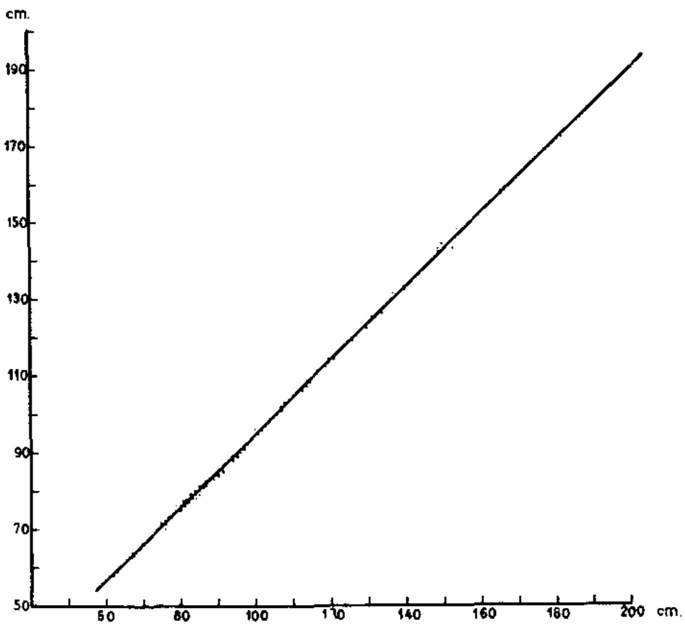


Fig. 12. **Halibut, Angmagssalik, 1958. Relation fork length (vertical) to total length (horizontal); 153 specimens.**

3. Short Review of the Halibut Fishery of the Greenlanders.

The Greenlanders have always been interested in halibut fishing. Many years ago before modern fishing methods were introduced some places in the southern Egedesminde district were frequented by a great number of natives in the months July to September. In 1908 the Royal Greenland Trading Company started buying halibut in Holsteinsborg, and in order to develop the halibut fishery two Danish fishermen were sent to Holsteinsborg in 1910. During the following years a commercial halibut fishery with long lines from dories developed.

In 1923 a new fishing method was introduced at Holsteinsborg, the lines were laid out and drawn directly by motorboats.

In 1924 and 1925 a schooner of 76 tons and with an engine of 40 h.p. was used as mothership for eight dories with 24 fishermen at Holsteinsborg. Besides this the fishery from motorboats and dorys was carried out as in the years before. In the same year a plant was built in Holsteinsborg for production of canned halibut. In 1926 two new motorboats were used in the fishery instead of the schooner. In the following years the output of the fishery decreased. The number of halibut on offshore and inshore fishing grounds diminished year by year and at the same time the size of the fish caught grew smaller, and several of the Greenlanders gave up this fishing for the benefit of cod fishing. The halibut fishery stopped in 1929 in Agto. In Holsteinsborg it was continued until 1933. In 1934 only one motorboat fished for halibut and in the following year no fishing was carried out owing to few and small fish. In 1936, 1938 and 1939 fishing experiments were made with a single boat. The fishery was unprofitable owing to poor occurrence and small sized fish. The halibut fishery at Kangamiut was carried out from two motorboats with very poor results until 1939.

After the war, 1947, an experiment with longline fishing for halibut was carried out southwest of Disko. In 1950 the freezing ship "Greenland" was sent to Godhavn and from August to October about 48.5 tons halibut were fished by the Greenlanders and delivered to the freezing ship. In 1951 about 114 tons were delivered. In 1952 the fishery totally failed at Godhavn. In Sukkertoppen district about 73 tons halibut were fished, and in 1953 only 68 tons were taken in Sukkertoppen, Holsteinsborg and Egedesminde districts. In the last years halibut fishing has been carried out in Julianehåb district. The output here was between 52 and 55 tons in 1954 and 1955, in 1956, 1957 and 1958 only 30, 14 and 15 tons respectively.

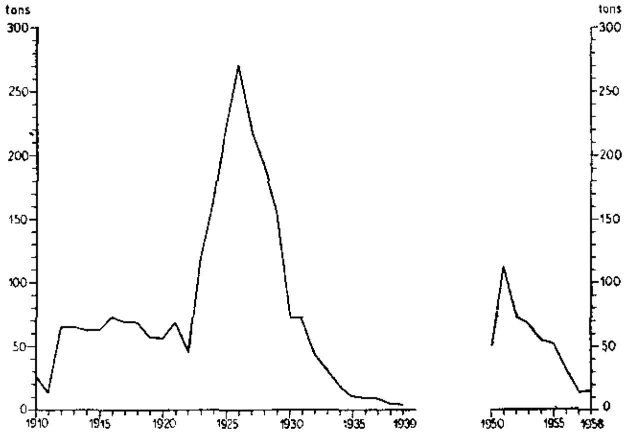


Fig. 13. The Greenlanders' production of halibut, 1910-58.

The graph Figure 13 shows the output of the Greenlanders' halibut fishery, 1910-1939 and 1950-1958. Until 1922 the output was very small, between 40 to 80 tons. In 1923 the output increased caused by the introduction of the new fishing methods and reached a peak in 1926 when about 285 tons were caught. Then a heavy decrease came which continued in the following years. From 1934 the plant in Holsteinsborg changed the production to canning of shrimps. Unfortunately we have no information about the catch per unit of gear, but the reports show a considerable decrease in sizes of fish caught in different periods: 1914-20 the mean-weight of halibut fished was from about 25 to 30 kg. From 1923 to 1931 the mean-weight was 15-20 kg, 1932-36, 9-15 kg, and 1937-39, 7-8 kg. Unfortunately information about the sizes of halibut in the years after the war is not available.

In Figure 14 is given the relation between length and weight of halibut.

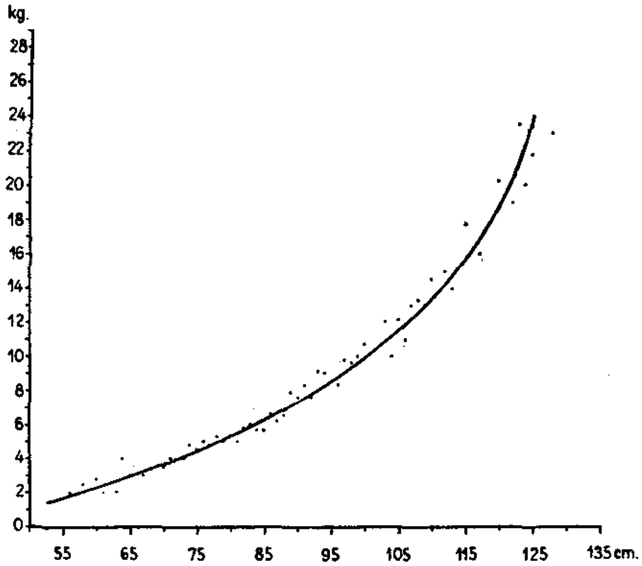


Fig. 14. Halibut, relation length-weight. West Greenland, Kangamiut, 1937, 379 specimens.

VI. Redfish.

Fishery with shrimp-trawl for small redfish was carried out in continuation of experiments of previous years in Gothåb Fjord (1D) and in Tunugdliarfik Fjord (Julianehåb district, 1F). Tables showing the length distribution of the samples will be presented in the 1958 Sampling Yearbook. The total catch was 4,107 redfish in the Godthåb Fjord (April: 2 hauls, May: 1, July: 2, and October 1) and 794 in Tunugdliarfik Fjord (October: 2 hauls, November: 2).

Otoliths were collected for age-determination, and various meristic observations were made for racial studies.

In the Godthåb Fjord 41 redfish were tagged.

B. HYDROGRAPHIC CONDITIONS IN THE EASTERN PART OF LABRADOR SEA AND DAVIS STRAIT IN 1958

BY FREDE HERMANN

The sections I to VI shown in Figure 15 were worked with R/V "Dana" from July to August.

Figure 15 further shows the temperature distribution at 50 metres. The sharp front between the Arctic and the Atlantic component of the West Greenland Current is clearly seen in the southern part of the area.

Off Godthåb a part of the West Greenland Current bends westward and later southwestward and meets the cold Labrador Current.

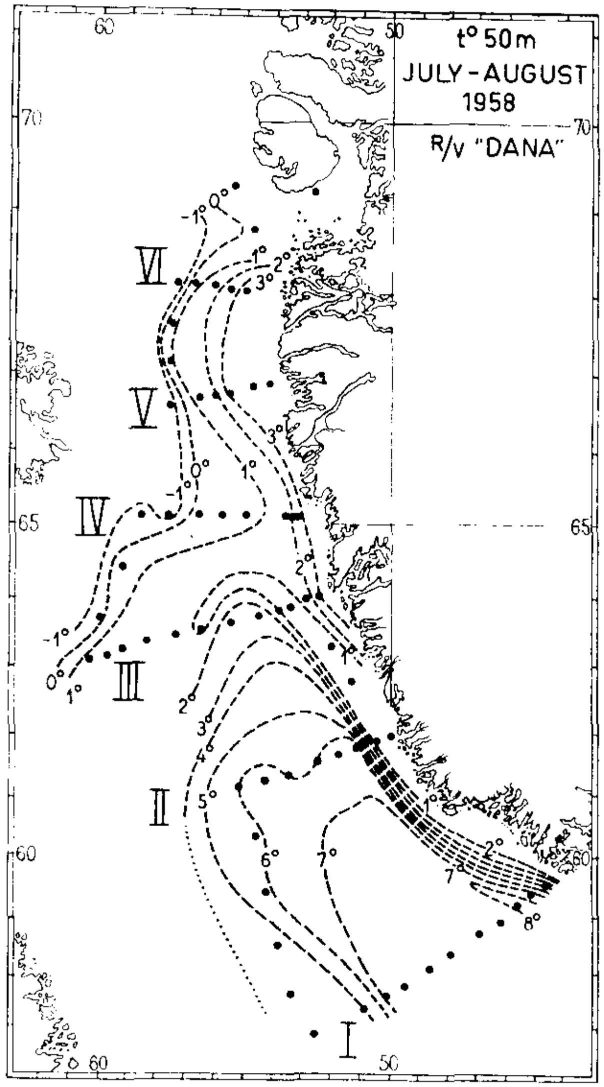


Fig. 15. **Location of sections and distribution of temperature at 50 metres.**

Over the West Greenland banks the temperatures were a little below normal on Dana Bank and Fiskenaes Bank but about normal from Fylla Bank and northward. In the area west of the banks the temperatures at 50 metres were lower than normal except in the southernmost part of the area.

The conditions are further illustrated by the sections Figures 16-21. Off Cape Farewell and Frederikshåb the arctic component of the West Greenland Current seems to be weak, and the temperature at its core was not as low as usual.

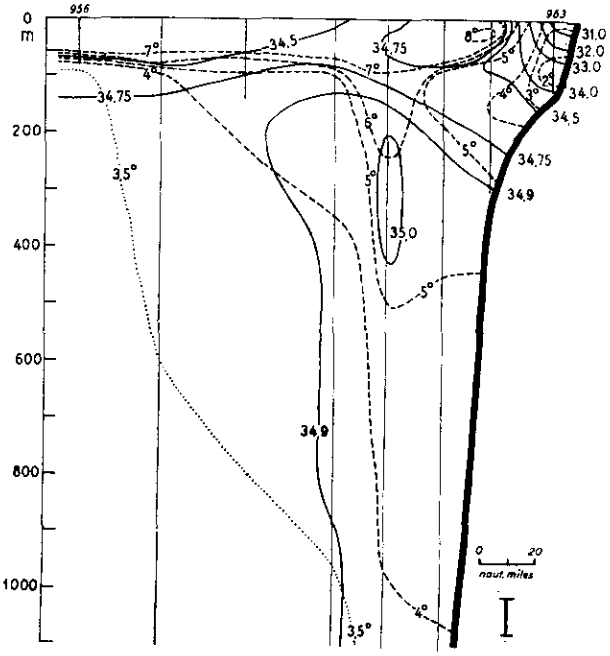


Fig. 16. **Section I off Cape Farewell, 13-15 Aug., 1958.**

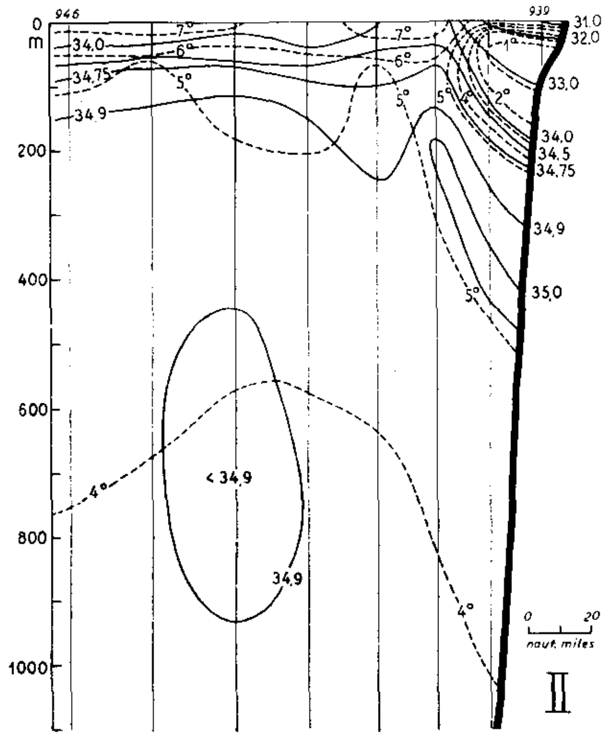


Fig. 17. **Section II off Frederikshaab, 9-10 Aug., 1958.**

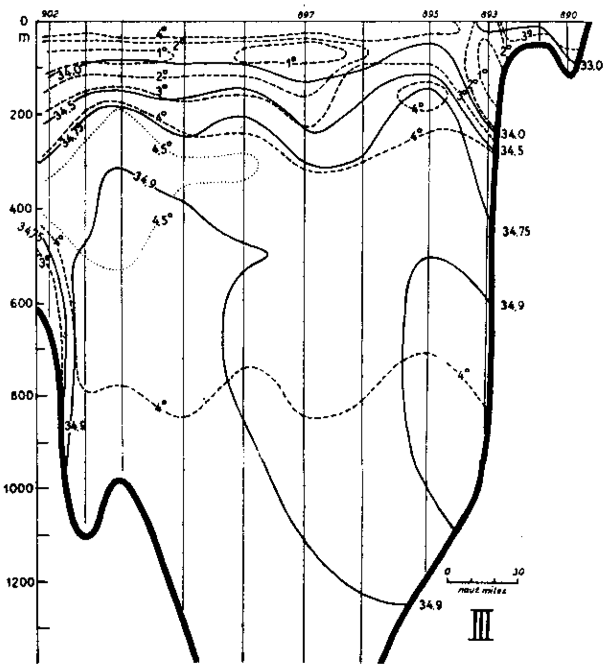
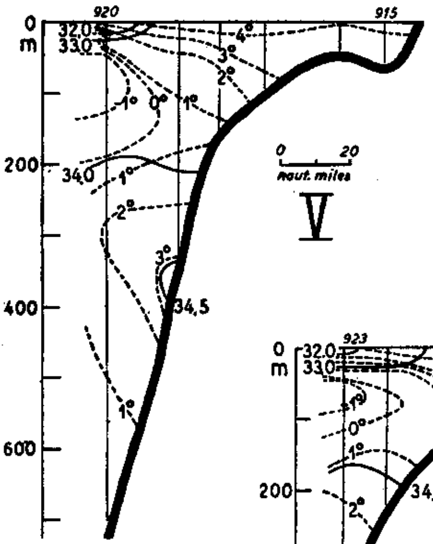


Fig. 18. Section III across Fylla Bank, 17-20 July, 1958.



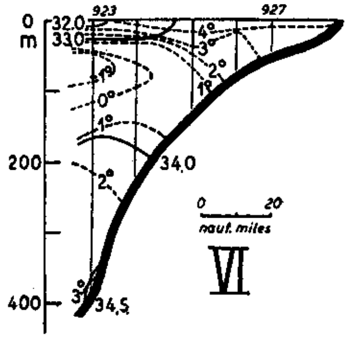


Fig. 20. (above left) Section V across Store Hellefiske Bank. 22-23 July, 1958.

Fig. 21. (below) Section VI off Egedesminde, 24 July, 1958.

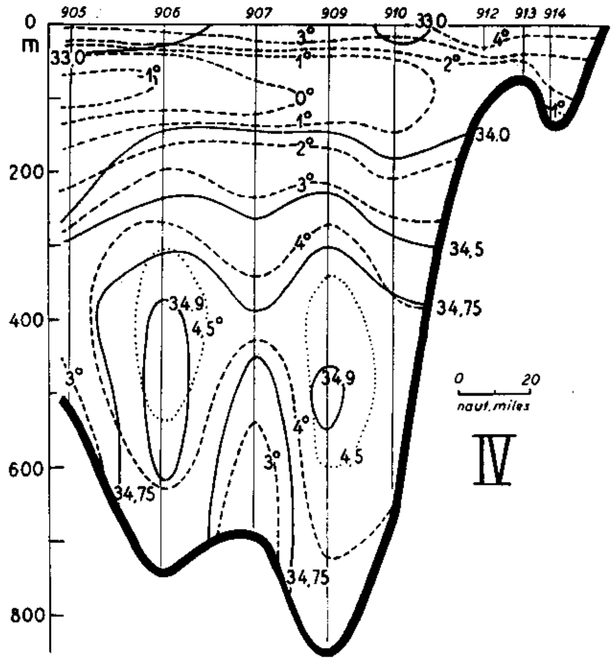


Fig. 19. Section IV across Lille Hellefiske Bank, 20-22 July, 1958.

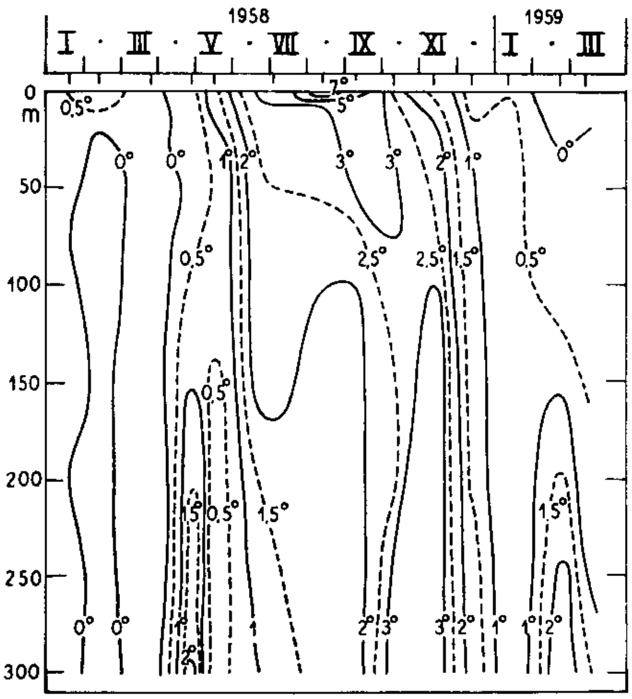


Fig. 22. Variation of temperature at the entrance to the Godthaab Fjord.

The warm Irminger Current was well developed. West of Fylla Bank and Lille Hellefiske Bank the temperature in the upper 100 metres was lower than in 1957, probably due to stronger winter cooling. The Irminger Current which is found here as an undercurrent was well developed.

In the western part of the three northernmost sections the cold Baffin Land Current with temperatures below -1° was met. The boundary of this current seems to lie further eastward than usual.

A fixed station at the entrance to the Godthåb Fjord (64°07'N, 51°53'W) was worked frequently throughout the year with the M/C "Adolf Jensen" and the M/C "Tornaq". The variation of the temperature from January 1958 to March 1959 is shown in Figure 22. The winter cooling in 1958 was strong, and water with negative temperature reached from surface to bottom both in January and March. In late April an inflow of warm bottom water took place and a still stronger inflow of warm bottom water occurred in October-November. The winter cooling in 1959 was less severe than in 1958.

III. French Research Report, 1958

BY J. FURNESTIN

The frigate "l'Aventure" has carried out researches in the Subareas 1, 2, 3, and 4. Hydrographic sections or stations were taken in the four Subareas where the French trawler fleet is operating.

The results of these researches will be published by the Service Hydrographique de la Marine, 13 Rue de l'Université, Paris VII.

As no special research vessels were available for use in the Convention Area, no biological investigations were carried out in 1958.

IV. German Research Report, 1958

BY

A. BÜCKMANN, G. DIETRICH, A. MEYER, AND A. VON BRANDT

A. Work at Sea.

During the International Geophysical Year the research ships "Anton Dohrn" and "Gauss" participated in the "Polar Front Survey" program sponsored by the ICES and ICNAF. Both vessels made two simultaneous cruises, one in March to April, and one in August-September. The investigations were carried out between the longitude 20°W (Iceland) and the meridian of Cape Farewell with a prolongation across Flemish Cap-Newfoundland Bank, and from Denmark Strait to the Azores in the South.

LINES OF RESEARCH.

Current registration of air temperature, surface salinity (tentatively), surface turbidity, surface currents (with G.E.K.), and echo depth.

AT HYDROGRAPHIC STATIONS.

Temperature, salinity, O_2-content at standard depths down to the bottom; bathythermograph records (partly between stations) salinity partly checked by salinometer and titration.

AT SELECTED STATIONS AND DEPTHS.

Seston dry weight, chlorophyll content, and albumine content. Phytoplankton assimilation in constant temperature and lighting (^{14}C. method). Total phosphorous. Microplankton samples. Zooplankton (by vertical and closing net hauls). Quantity of organic matter in solutions. Occurrence of fungi in bottom samples, in samples of water from bottom layers, in plankton etc. Benthic fauna (with van Veen bottom sampler, in the shallower parts of the area only).

A small number of trawl catches, principally analysed for the occurrence of different forms of *Sebastes*. Investigations on the blood of deep sea fishes and free amino acids in the muscle flesh of different species of fish (freshly caught and living, kept for different spans of time in aquarium tanks, kept dead at outdoor temperature on ice, and deep frozen).

Tenperature and salinity data of the 558 stations will be published in the "Bulletin Hydrographique du Conseil International pour l'Exploration de la Mer" and also distributed to the World Data Centres A and B of the IGY.

A first collection of 19 reports of the scientists, members of these cruises, will be published in 1959 in a special volume of the "Deutsche Hydrographische Zeitschrift." These reports give first results of the cruises concerning bottom configuration, physics and chemistry of the sea water, suspended matter, organic production, mycology of bottom sediments, micro plankton, bottom fauna, biochemistry of commercial fishes.

(Prof. Dr. A. Bückmann, Dr. G. Dietrich)

A searching program was sponsored by the Union of the German Deep Sea Fisheries with relief of the Federal Government and participation of the Federal Fisheries Research Institute.

Facing unfavourable fishing conditions off Iceland and in the northeast European regions four ships went to E.-S., and W.-Greenland in August-September, the season of hitherto least experiences. In order to extend the trips to 35 days at sea and to utilize the fishes caught in the experimental hauls, large, modern ships with fish meal processing plants were chosen:

(1) "H. Everling", 9.8-4.9 to S. and W. Greenland as far north as 69°56′N;

(2) "Zephyros", 3.9-7.10 to E. Greenland from 61°04′N to 67°41′N.;

(3) "Saarbrücken", 8.9-13.10. again to S. and W. Greenland until 68°04′N.;

(4) "Saturn", 13.9-14.10. to E. Iceland, Jan Mayen and eastern Greenland between 70°60′N and 63°32′N.

After recommendations and plans worked out by the "Institut für Seefischerei" these ships made 273 experimental trawl hauls (145 on the western side), and some temperature measurements on the sea surface and in the thick flesh of the fish immediately after capture. From the 21st day at sea they were free to fish commercially. Two biologists took part in each trip. A preliminary report concerning western Greenland can be summarized as follows:

(a) The catches of cod in the southern regions —Cape Farewell, Sermersok, Nanortalik —were less favourable than in the year before and in 1952, when the first German fishery was performed there. That had been expected because of the age composition of the cod stock, but 1960 and perhaps already 1959 a greater density of the cod stock off southern Greenland is probable, especially based on the rich and for the first time maturing year-class of 1953.

(b) The searching revealed good catching possibilities for redfish off Cape Thorwaldsen and in the Bay of Julianehåb, but the bad bottom conditions require a rather detailed knowledge of the trawlable grounds. Meanwhile some short and successful commercial trips have been made there, which were almost as favourable as those to Labrador with their longer duration.

(c) In the season April to July, especially in 1955 and 1957, very favourable catching conditions for redfish in the region of Fyllas Bank and Banana Bank had been found. The searching confirmed this and proved the same to be the case also farther northward at the outer edge of the Lille Hellefiske Bank during late summer.

(d) The Store Hellefiske Bank was examined rather thoroughly, and in conformity with earlier and present successes of foreign vessels it was found that German salting trawlers (especially if equipped with fish meal plants) and factory ships could extend their season until the early autumn by going more northward. Especially in 1959 an increase in average size of the cod is to be expected, the rich 1953 year-class then reaching about 60 cm in length.

(e) Experimental hauls around Disko were a complete failure quite similar to those of "Anton Dohrn" in 1955. Cod concentrations of commercial value were occasionally met north of the Store Hellefiske Bank, probably only within the territorial zone; furthermore this northernmost region is inhabited predominantly by smaller cod.

Dr. Arno Meyer.

B. Gear Technique.

No experiments on mesh selection and other gear application were carried out at sea in the ICNAF area.

The examination of the methods for measuring the trawl meshes now in use in Europe for accuracy and practical aptitude has now been terminated. This survey included longitudinally working pressure gauges from Scotland, England and Poland in comparison with those of ICNAF. The result was, that the Scottish design offers the highest security, even if used independently by several persons. This gauge, too, proved to be best qualified for practical application. Accordingly the proposal is made, that within the range of ICNAF activity, a longitudinal pressure gauge similar to the Scottish model should be adopted. The American report is not yet available, but the development of a new mesh measuring design has been announced.

Prof. Dr. A. von Brandt.

C. Cod Investigations.

Subarea 1

a. West Greenland.

Figure 1A presents for the first time the age- and size-distribution of the West Greenland cod during the spawning season, February-April 1958, on the western slope-area of Fylla Bank (Subdivision 1D). The cod at this season had attained an average length of 76.4 cm, which is extraordinarily high for West Greenland. Of the cod fished 85% were mature. By mid April, 70% of the mature cod had spawned, 25% were spawning, the remaining 5% were preparing to spawn.

Of the spawning stock 40% belonged to ages 8 and 11, i.e., the 1950 year-class (19%) and the 1947 year-class (21%). The proportion of the older year-classes, which already had lost their importance for the summer fishery, was surprisingly high in the spawning stocks. These 13-22 year old spawning cod accounted in 1958 for no less than 37% of the spawning stock; one third belonged to the rich 1942 year-class. Almost all the 16 year old cod spawned in 1958 for the tenth time, and had attained an average length of 86.7 cm. Specimens of the almost extinct 1936 and 1934 year-classes were found on the spawning grounds.

The remaining year-classes of importance to the fisheries had the following average lengths: 1945 year-class: 82.3 cm, 1947 year-class: 78.6 cm, and 1950 year-class: 71.9 cm.

The investigations revealed that for the West Greenland cod 8% spawned for the first time at age 6, 44% at age 7, 29% at age 8, 17% at age 9, and 2% at age 10. This corresponds to a mean age at first maturity of 7.6 years.

The cod (Figure 1B) caught in the early-summer fishery, mid April to beginning of June, from fresh-fish trawlers (together with redfish) operating on the western edge of the Fylla and Banana Banks (1D-1C) were considerably smaller (mean 69.9 cm) than those of the spawning stock. This was in the first place due to the fact that the new rich 1953 year-class was included in the fishery. The 1953, 1950, and 1947 year-classes accounted for 64% of the catches, whereas the older year-classes, still important on the spawning grounds, only accounted for 4%.

The many samples collected by the scouting trawler in August and September rendered a good summary of the composition of the Greenland cod stock at this season. On Store Hellefiske Bank 60% (Figure 2A) consisted of the rich 1953 year-class. The average lengths of these 5 year old cod were in August 54.6 cm and in September 56.7 cm. Owing to their high percentage in the catches the average length of the total catch was only 59.8 cm. It is noteworthy that in Subdivision 1B the 63 cm long 1952 cod excelled in numbers; the 1950 year-class and the 1947 year-class amounted to 8 and 6%.

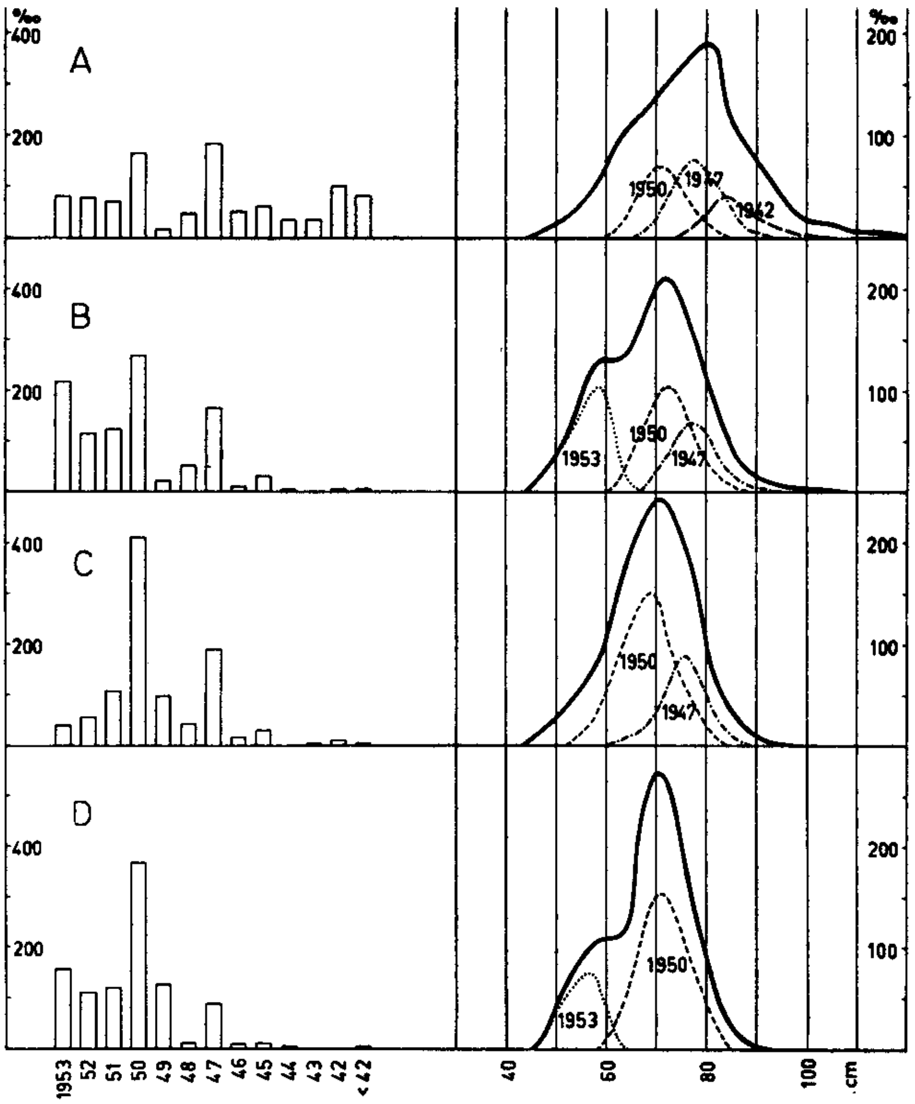


Fig. 1. Age- and length distribution (°/∞) of cod from W. and S. Greenland landed by fresh-fish-trawlers, 1958. A—from Fylla Bank (1D), fished end of Feb. to beginning of April. B—from the border-area of Fylla Bank and Banana Bank (1D-1C), fished from mid April to beginning of June. C—from S. Greenland, Nanortalik to Cape Farewell (1F), fished end of Nov., 1957 to mid February 1958. D—from S. Greenland, Nanortalik to Cape Farewell (1F), fished end of Nov. 1958 to end January 1959.

In late summer the densest stock of cod was observed on the feeding grounds of Store Hellefiske Bank, and only rather small catches were made in Subdivisions 1D and 1E. In these subdivisions, however, the cod were on an average larger, owing to the greater proportion of the 1950 and 1947 year-classes. The age- and length-distribution is shown in Figure 2B; it is rather similar to that observed for the early summer (Figure 1B). Larger concentrations of bigger and older cod were found in September on the eastern, shallower part of Fylla Bank, which indicates a coastward migration of cod during the autumn.

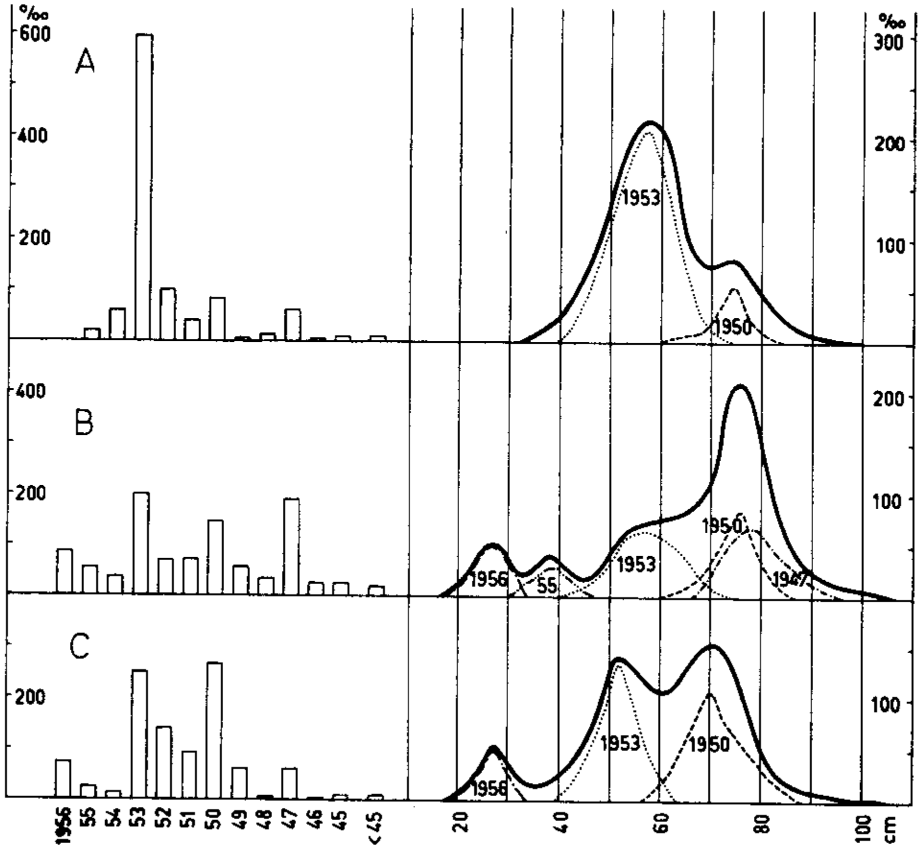


Fig. 2. **Age and length distribution (°/∞) of cod from W.- and S. Greenland 1958, catch from the scouting-trawler in Aug. and Sep. A—Store Hellefiske Bank (1B). B—Southern Banks (1D-1E). C—S. Greenland (1F).**

b. South Greenland.

The 1950 year-class was the most important year-class in the winter-fishery off South Greenland in 1957/58 and 1958/59, amounting to 40 and 38% respectively. Following the emigration (probably mainly to East Greenland) of the older year-classes the proportion of the 1950 year-class in the spring fishery of 1958 increased up to 52%.

A comparison of Figures 1C and 1D shows clearly the renewal of the South Greenland stock through the rich 1953 year-class; this is in good agreement with what could be predicted from the catches of "Anton Dohrn" in the summer of 1957 (see last year's Research Report). In the catches from the scouting trips in late summer (Figure 2C) the 1953 year-class was already nearly as strong as the 1950 year-class. The observations indicate that the 1953 year-class also is very abundant in the southern region, and it may well be assumed that this year-class, when becoming mature will be of importance for the cod fishery off East-Greenland, probably to the same extent as the 1945, 1949 and 1950 year-classes, which also were well represented in the South Greenland waters.

The proportionate rich occurrence (Figures 2B and 2C) of 2 year old cod (1956 year-class) in the catches of the scouting trawler is striking, especially as the catches were made with 110 mm meshes and as these 2 year olds only have an average size of 26.5 cm. This may indicate that the 1956 year-class is considerably richer than the two preceding, very poor, 1955 and 1954 year-classes.

Observations were made on the stage of maturity of the cod concentrated in the winter of

1958/59 off South Greenland. The immature specimens accounted for 60%, 20% were preparing to spawn for the first time, and another 20% for the second (or more) time. Compared to the West Greenland cod the cod from South Greenland become mature at a later age. Only ca 10% of the 6-8 year old cod were mature. Of the 9 year old cod 65% were still immature and of the 10 year old 50%.

The growth is also slower in the colder South Greenland water than off West Greenland. This appears clearly from a comparison of the two growth-curves in Figure 4. The growth is linear until the 6th year off West Greenland and until the 7th year off South Greenland. Thereupon follows a gradual decrease of the growth rate caused by the more frequently occurring ripening of the gonads.

It is of interest to note the 'knee-bending' of the two growth-curves for the 11 year old cod of the 1947 year-class. However, it is a well known fact that the 1947 year-class, due to poor conditions during its first years (crowding), had a fairly slow growth. This fact is further elucidated in Figure 4 by the growth curve for the 1947 year-class from samples in Subdivision 1F in 1954-1958. Quite contrary is the growth of the 1945 year-class which grew up mainly in South Greenland waters. Its growth from its 7th year of age (from the start of the German fishery in Greenland in 1952) is well known. The striking variability of the growth figures is no doubt caused by step-like emigration of individuals to East Greenland upon attaining maturity.

c. East Greenland.

The yields of the spring-fishery as well as the length-distribution of the samples from this fishery are in the main determined by the proportion of the 1949 and 1950 year-classes in the catches: 66% for the Angmagssalik area and 69% for the Dohrn Bank (Figure 3A). Still in the autumn these two year-classes together accounted for 65%. Compared to the preceding year the age-distribution had changed considerably as far as the 1945 year-class, which had dominated in the fishery since its start in 1955, had lost much in strength. The rich 1950 year-class,

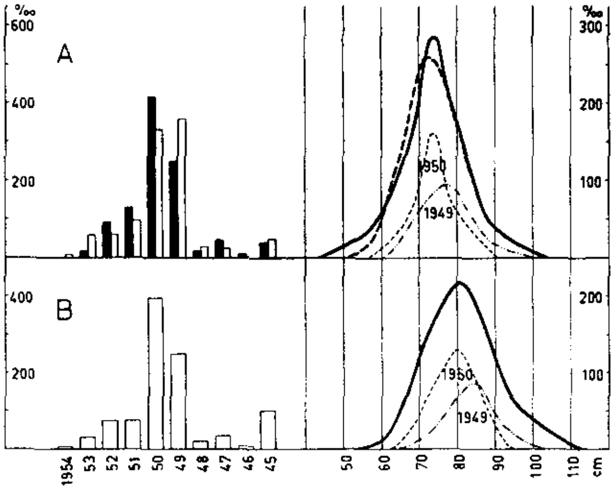


Fig. 3. **Age- and length distribution (‰) of cod from E. Greenland 1958, landed by fresh-fish-trawlers. A—Angmagssalik and Dohrn Bank in March; left—age distribution, Angmagssalik: black columns, Dohrn Bank: white columns; right—length distribution, Angmassalik: stipled, Dohrn Bank: full line; 1949 and 1950 for both areas. B—Dohrn Bank, fished in Aug. and Sept.**

which entered the fishery in 1956, was in 1958 the richest year-class (40%). In spring 1958 the average length of the cod off Angmagssalik was 74.3 cm. On the Dohrn Bank the length was 74.1 cm in spring, and 81.3 cm in early autumn (immigration of Icelandic cod?).

Figure 4 shows the mean lengths of cod caught off East Greenland in the spring seasons since 1956; for comparison a growth curve for the Icelandic cod is presented. It appears that the growth rate of the East Greenland cod is intermediary between those of the South Greenland and the faster growing Icelandic stock. However, the curves of Figure 4 hardly reveal the growth of the East Greenland cod proper, as the catch from the areas along the slope probably is a mixture of South Greenland, East Greenland, and Icelandic cod. This conception, which also has been expressed by Jón Jónsson, is supported by the fact that the Angmagssalik cod has a slower growth than the cod from the Dohrn Bank closer to Iceland.

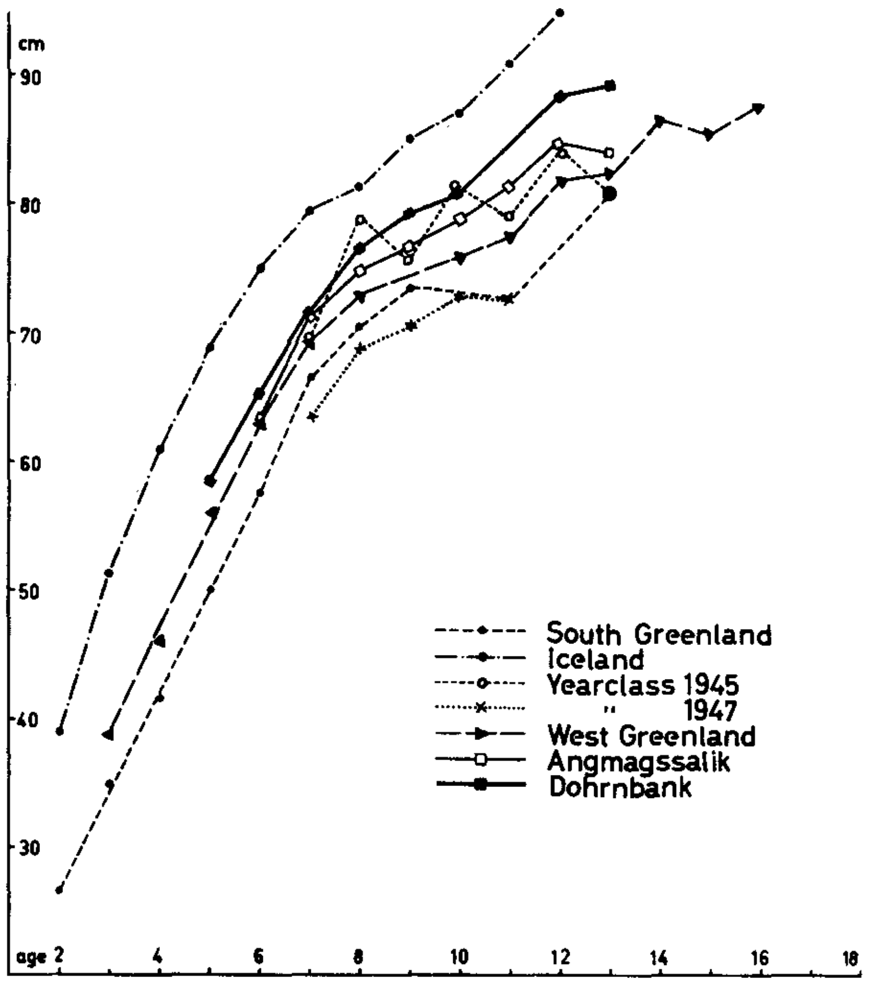


Fig. 4. **Average length of the various age-groups of cod from: West Greenland-South Greenland, autumn; Angmagssalik and Dohrn Bank, spring; Iceland (after Jónsson), spring; and the 1947 and 1945 year-classes from S. Greenland in autumn.**

Subarea 2.

A number of cod samples from Labrador waters were available for age determinations. The otoliths of the cod from the cold bank-water are said to be easy readable, but the interpretation of the otoliths of the cod from the warmer slope-water was more difficult; the age readings of 30% of these otoliths were considered as doubtful. A characteristic feature of the otoliths of the Labrador cod is the exceedingly clear delimination of the spawning zones, which facilitates the otherwise difficult determination of age when spawning.

The cod caught in the fishery for redfish in deeper water presents a fairly even age-distribution. The 1948, 1950 and 1952 year-classes predominated with 17, 14 and 13%, respectively, over the 1945, 1946, 1947, 1949 and 1951 year-classes, with percentages ranging only between 7 and 9.

The very slow growth of the Labrador cod is striking. In December, at the end of the feeding period, the three most abundant year-classes: 1952, 1950 and 1948 had only attained average lengths of 55.1, 60.6, and 65.0 cm respectively. This explains why the cod landed from Labrador in spite of its high average of 9.8 years only measure 63.4 cm in mean. This small size causes the Labrador cod to be not especially suitable for the fresh-fish trawlers.

Subarea 3.

In a sample from February from Subdivision 3P south the following percentage age-frequencies were observed: 1952 year-class: 33%, 1953: 24%, and 1949: 17%. These three year-classes together accounted for $\frac{3}{4}$ of the sample. The growth of the Newfoundland cod is considerably faster than that of the Labrador cod: 1953 year-class: 51.1 cm, 1952: 58.0 cm, 1949: 77.0 cm. However, as cod over 9 years of age only accounted for 13.5% of the catch the mean length of the landed cod was only 65.7 cm.

Dr. Arno Meyer

D. Haddock Investigations.

Subarea 3.

The 1958 investigations on haddock showed that in Subdivision 3P south, the 1949 year-class accounted for 65% of the stock; this year-class had a mean length of 49.7 cm. The 1952 year-class was present with 23%; the other year-classes were weak. The average length of all the landed haddock was 49.1 cm.

Dr. Arno Meyer

E. Fishing Activities.

The German fisheries in the ICNAF area increased in 1958 and were extended over wider regions. German trawlers now operate in Subareas 1, 2 and 3. A preliminary summary of statistical data for 1958 presents the following figures: 143 trips to S. and W. Greenland with 37,390 tons landed weight, 85 trips to Labrador with 19,298 tons landed weight and 7 trips to Newfoundland with 1,329 tons. These figures include 26 trips for salt fish to W. Greenland with 5,076 tons salt-fish, and 277 tons salt-fillets, as well as 7 combined factory-ship trips (deep-freezing and fresh-fish), thereof three to Greenland and four to Labrador.

The year 1958 was the first year in which fishery was carried out in Subarea 1 through the whole year. When the difficult South Greenland fishery (almost exclusively for cod) ended in February, the fisheries for spawning cod in the region of Fylla Bank and for redfish in the border-regions Fylla and Banana Banks commenced. Cod made up 60% and redfish 40% of the catches in February and March. In April-May the proportion of cod decreased to 15%; in June-September it increased to over 80%. When the fisheries of W. Greenland came to an end in September those off South Greenland still continued, but to a lesser extent, first as a pure redfish-fishery off Cape Thorvaldsen, later—towards the end of the year—mainly as a cod-fishery off Cape Farvel and Nanortalik.

In 1957 redfish accounted for 60% of the German landings, in 1958 the cod again (as in 1952, 1953, 1954 and 1956) made up a larger proportion, viz. 67%. With 24,417 tons cod (landed gutted weight) and 37,390 tons total landings, the year 1958 showed the largest landings from the German fishery since its start in Subarea 1 in 1952.

The catch of the German trawlers from East Greenland decreased further to 15,000 tons (1955: 46,000 tons, 1956: 44,700 tons, 1957: 21,800 tons). Cod which at the start of this fishery in 1953 only accounted for 6.5%, made up 31% in 1958, i.e., a further increase (1956: 16.6%, 1957: 26.8%).

After the Icelanders had observed a rich occurrence of redfish south-east of Hamilton Inlet Bank, German trawlers moved into Subarea 2 in August. Due to the extraordinarily large daily catches (33.9 tons), this fishery was very profitable in spite of the long trips of 2,150 nautical miles (15.9 days to and from). Proportionately small redfish made up 97% of the catches, the proportion of cod was exceedingly small.

Commercial fishing was tried again in the Newfoundland area in February and March. However, as the catch mostly consisted of average-sized saithe *Pollachius virens* (L.), and as the cod and haddock were too small-sized to satisfy the German market, the trips did not pay, in spite of a daily catch of 24.5 tons. The German trawlers operated mainly in Subdivision 3P South and 3O; some experimental hauls in 4R and 4V North were unsatisfactory.

Dr. Arno Meyer

V. Icelandic Research Report, 1958

1. COD — BY JÓN JÓNSSON

A. The Fishery.

The Icelandic fishery in the Convention Area in 1958 was mainly concentrated on redfish in Subareas 2 and 3. During the months July to December Icelandic trawlers made 263 trips to Subdivisions 2J and 3K to new fishing grounds discovered by the Icelandic trawler "Fylkir" in the latter part of July. This fishery will be discussed more thoroughly by Dr. Jakob Magnússon, who was the scientific leader of the "Fylkir" expeditions, in part 2 of this report. The total Icelandic catch of redfish from these new fishing grounds was 77 thousand tons, compared to only 152 tons of cod.

Icelandic trawlers made 25 trips to Subarea 1 during January to September. The total catch of cod from this area was about 9600 tons, compared to 9700 tons in 1957. The catch of redfish was only 4 thousand tons, against 13 thousand tons the year before.

B. Biological Investigations.

Figure 1 shows the age-composition of trawler-caught cod from some localities fished by Icelandic trawlers in 1958. For comparison the age-distribution of the Icelandic spawning stock of cod (January-May) in 1958 is also shown, but this material includes fish caught on long-lines.

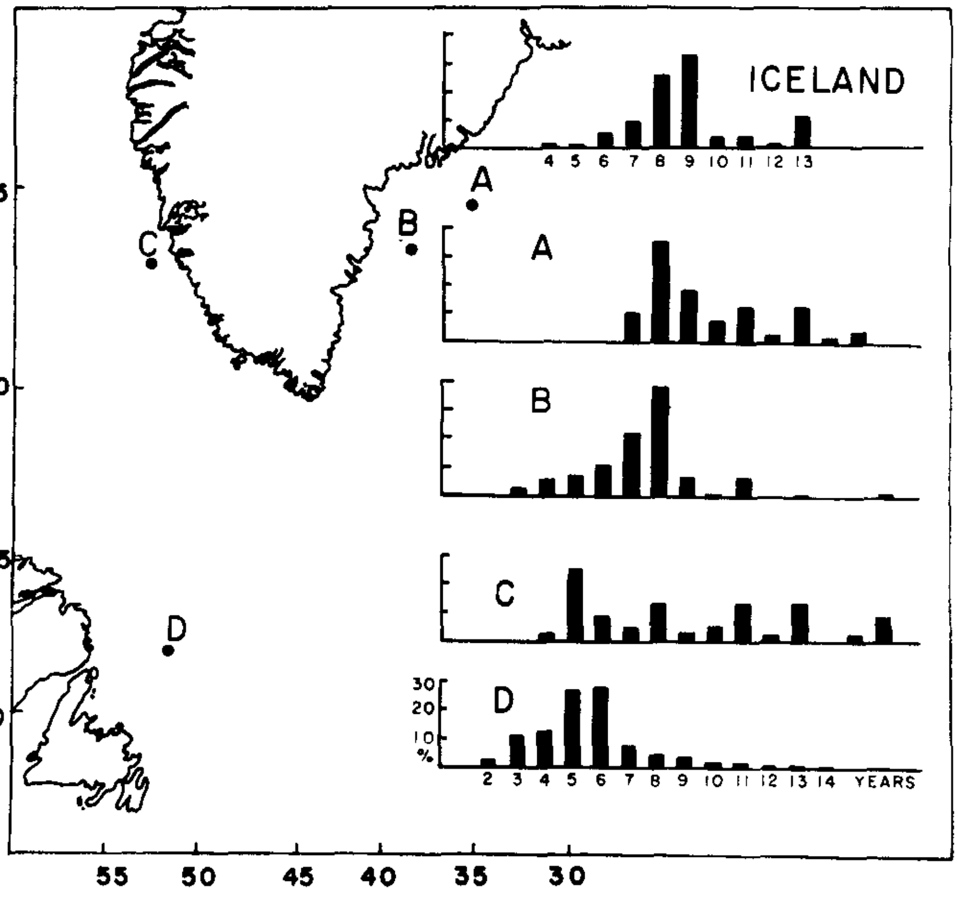


Fig. 1. Age-composition of cod caught by Icelandic trawlers in 1958; off Iceland (top curve); A and B—off East Greenland; C—off West Greenland; D—off Southern Labrador.

In the Icelandic stock of cod the 1949 and 1950 year-classes predominate. The rich 1945 year-class, 13 years old, was still contributing as much as 12% to the total catch.

Sample "A" from Jónsmid (64°40'N, 35°00'W) 12-20 April 1958, shows an age-composition very much like the Icelandic one. There is a clear dominance of the 1945, 1949 and 1950 year-classes and, further, of the 1947 year-class. This sample represents an almost pure spawning population, as most of the fish were spawning at the time of sampling. There were 52% first-time spawners. Most of the fish belonged to the first four spawning classes; one fish was found spawning for the ninth time.

Sample "B" from Fylkismid was taken 1-10 June 1958. It contains more young fish than the two previous ones, but the 1950 year-class is still dominating. Unfortunately, there is no information on sexual maturity for the sample.

Sample "C" from Fiskenesbank off the west coast 65°25'N, 52°43'W) was taken 11 July 1958. The 1953 year-class constituted about 25% of the catch, and the 1950, 1947 and 1945 year-classes about 13% each.

Sample "D" from the new Ritubank off the Labrador coast 52°15'N, 51°35'W) was taken onboard the trawler "Fylkir" during 20-23 September 1958. The depth at the sampling localities was 145-180 fathoms.

As stated earlier, the fishery in this area was almost exclusively based upon redfish, but samples were taken of the few cod caught. The age is mostly 3 to 6 years. Of the 282 fish included in this sample, 194 were immature, 106 maturing, 1 spawning, and 8 had recently spawned. The onset of maturity can be expressed by the following table, which shows the percentages of mature fish in each age-group:

Age	% Mature
2	0
3	3
4	14
5	32
6	43
7	62
8	62
9	67
10	80
11	100

A comparison between the average lengths of the age-groups in the various areas discussed here is shown in Table 1. In brackets are values based on five or less individuals.

The average sizes of the age-groups are by far highest in the Icelandic area, in spite of the fact that the observations there were made in the beginning of the year. There seems to be a gradual drop in the average sizes of the age-groups as we move to the southwest, with the lowest values found in the Labrador area.

TABLE I

COD. 1958. Average sizes of the age-groups. For data and positions see the text.

Age	Iceland	East Green-land	West Green-land	Labrador
2				34.0
3	56.6			37.7
4	66.3			47.3
5	70.5		55.5	52.6
6	77.6		64.6	58.8
7	82.3	71.2	(71.2)	63.6
8	79.0	74.2	72.9	61.6
9	82.3	80.0	(74.5)	73.3
10	86.6	77.4	(75.8)	(78.4)
11	89.3	77.3	81.7	(82.8)
12	94.8	(90.0)	(77.0)	(70.5)
13	97.2	89.8	81.3	(101.0)

2. REDFISH — BY DR. JAKOB MAGNÚSSON

In 1958 two cruises were made with the commercial trawler "Fylkir" to the Labrador Sea and the Newfoundland area in order to search for redfish.

The first cruise was from July 18th to August 2nd. Experimental hauls were made on the north and east part of the Hamilton Inlet Bank from July 22nd to 25th (Figure 1, T-58) at depths of 180-285 fathoms. Temperature measurements were made at the trawl stations. The bottom temperature varied between 3.4°C. to 3.9°C. with the exception of the northernmost station with 2.5°C. At station T58-8, July 27th, only one haul was made at a depth of 230-240 fathoms; there, the bottom temperature was 3.3°C At station T58-9, July 27th to 29th, 18 hauls were made at depths of 145-220 fathoms. Here, the bottom temperature was 3.2°C. at 220 fathoms and just 3.1°C. at 170 fathoms. As is seen from Figure 2, a layer of cold water is spread over the Hamilton Inlet Bank, below a thin surface layer warmed by the summer heating. The core of

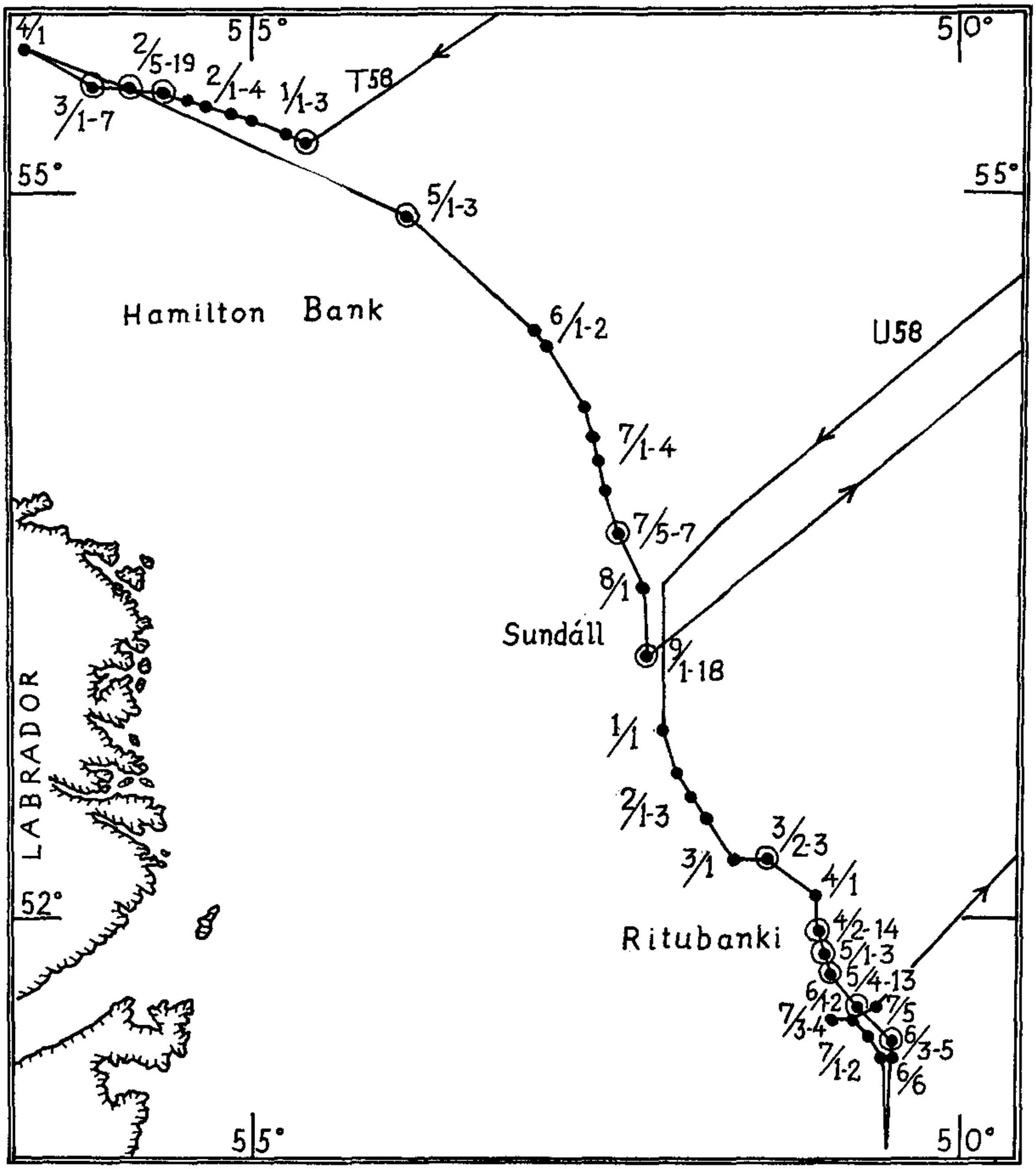


Fig. 1. The location of trawling-stations on the "Fylkir" expeditions in 1958. T58—the cruise in July; U58—the cruise in September. •-stations; ⊙ -stations with two or more hauls.

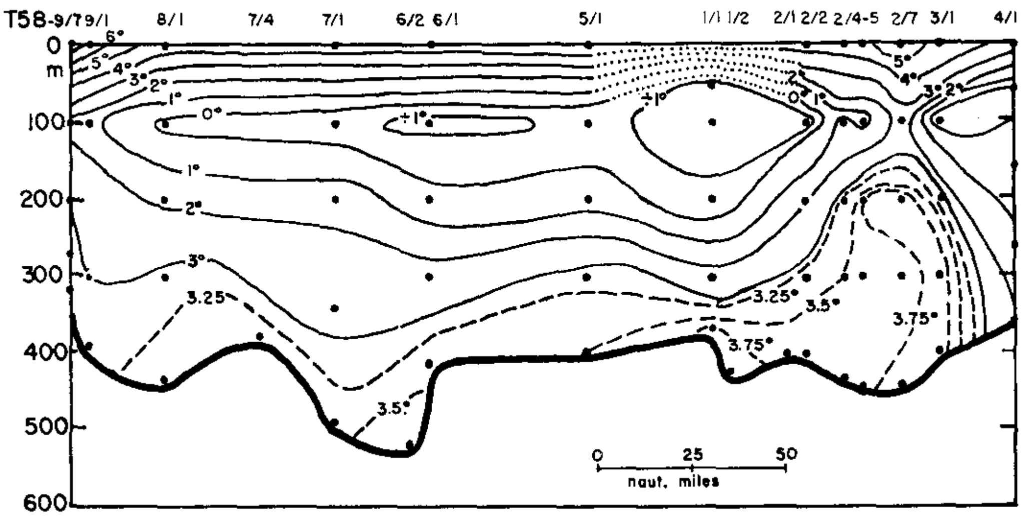


Fig. 2. Temperature distribution at the stations on the July cruise (T58).

this cold water is found at 100 m. Below this intermediate layer, a distinctly warmer bottom layer is found with temperature inreasing downwards. As indicated by the 3.25°, 3.5° and 3.75° isotherms, the temperature of this bottom layer increases slightly from south to north.

Forty hauls were made at the Hamilton Inlet Bank. These hauls were rather poor, on the whole. At station T58-2 the hauls were somewhat better, with an average of 3 tons and a maximum of 6 tons per trawling hour. At station T58-9 an excellent catch was made. Here, 18 hauls were taken with an average of 13.5 tons per trawling hour. The largest hauls were about 22 tons in 75 minutes, and 17 tons in 40 minutes. This new fishing ground was named "Sundåll".

In all the hauls from Hamilton Inlet Bank, the redfish were of a rather small size with the peak at 35-37 cm. At Sundåll, the larger size-groups appeared, but there were great differences according to depth. The size of redfish decreased and the bottom temperature increased with increasing depth.

At 215-220 fathoms, the 34-36 cm group made up the maximum and at 165-200 fathoms the 40-42 cm group, while at 145-155 fathom depth the maxima were found at 40-42 cm, 46-48 cm and 52-54 cm. Here, the size groups making up the maximum at 215-220 fathom depth are nearly completely lacking, as sizes of 36 cm and smaller were only making 6% of the total (Figure 3).

Some spawning females were found during this cruise, contrary to what was the case for cruises in previous years to East Greenland and Icelandic waters during July.

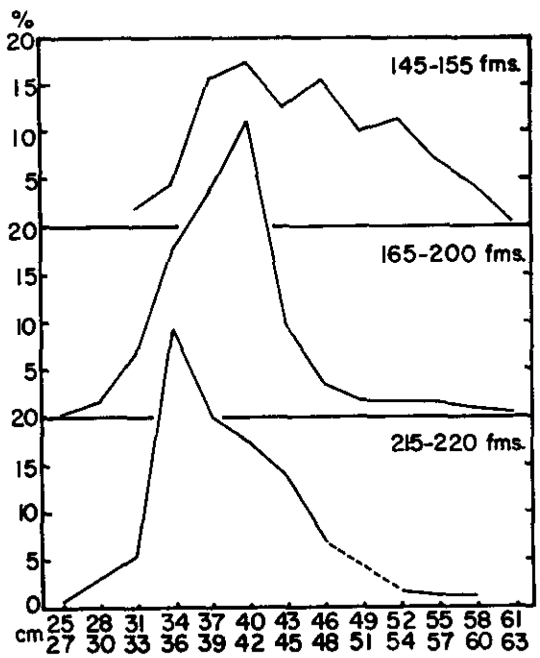


Fig. 3. Redfish. Length distribution for various depths at Sundåll (Station T58-9).

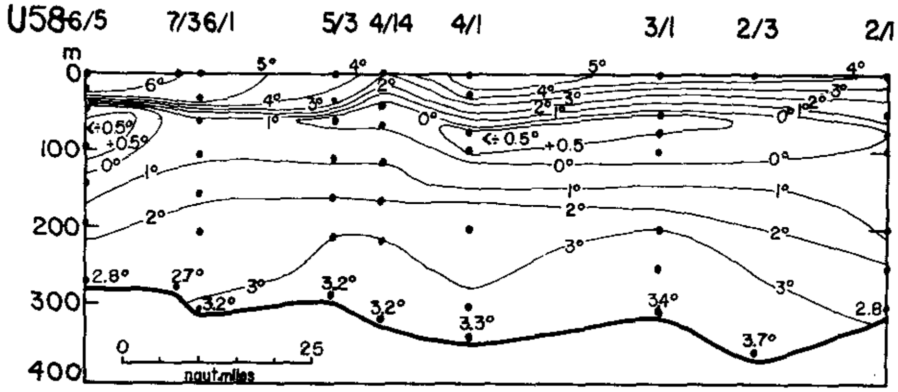


Fig. 4. **Temperature distribution at the stations on the September cruise (U58).**

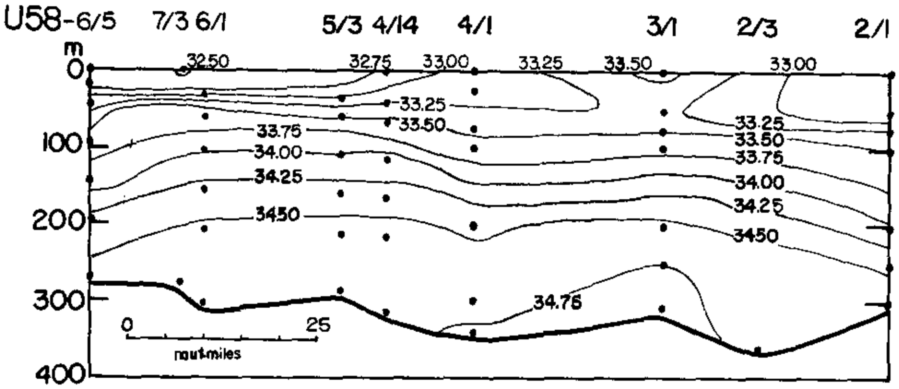


Fig. 5. **Salinity distribution at the stations on the September cruise (U58).**

Samples of the stomach content of the redfish at the southernmost station (Sundáll) where the densest concentrations of redfish were found, differed from those of the other stations. At Sundáll, the stomach content consisted mainly of *Calanus hyperboreus*. At the other stations some fish species were generally found in the stomachs, particularly *Scopelids* and *Paralepis*.

A marked infection by *Sphyrion lumpi* was noticed on the redfish of the Hamilton Inlet Bank. It varied somewhat in the hauls, with a maximum of 10% of the fish being infested. The redfish at Sundáll, however, were almost free of this parasite, with the exception of a haul from 215-220 fathoms, with an infestation of 1.6%.

The second cruise was from September 15th to 28th to the region south of the Sundáll Area (Figure 1, U58). Experimental hauls were made from September 19th to 24th on the slope of the continental shelf at depths of 150-200 fathoms. The bottom temperature varied between 2.7° and 3.7°C. The main features of the temperature distribution were the same as during the first cruise: a thin surface layer warmed by the summer heating, an intermediate layer of cold water with the core at 75-100 m., and a distinctly warmer bottom layer with temperature increasing downwards, (Figure 4). The salinity (Figure 5), increased with depth from 32.50°/oo at the surface to 34.75°/oo at the bottom.

In the northernmost part of the area surveyed (U58-1/1 to 4/1) hauls were taken at 160-200 fathoms. These hauls were rather poor, with a maximum of 3 tons in 40 minutes. On station U58-4/2 to 7/5 (Figure 1) an excellent catch was made. This new fishing ground was given the name "Ritubanki". However, the best hauls were at the stations U58-5/4 to 5/13, 156-

165 fathoms. Here 10 hauls were taken, with an average of 14.3 tons per trawling hour. The largest haul was about 20 tons after 40 minutes. In the whole Ritubanki area 38 hauls were taken at depths of 150-180 fathoms, with an average of 65 tons per trawling hour.

In the northernmost part of the area surveyed (station U58-1/1 to 4/1) the main size of redfish was 34-40 cm, whereas on the Ritubanki the 40-50 cm size groups predominated. In hauls from the shelf, the redfish was smaller than at the slope. This is illustrated in Figure 6 which shows the length distribution of redfish at station U58-7/3, 7/4, 6/1 and 6/2 and 7/5. (For location of stations see Figure 1). The distance between stations U58-7/3 and 7/5 is about 18 n.m.

The amount of stomach content of the redfish caught at the Ritubanki was less than that of the fish caught in the Sundáll area in July, and empty stomachs were also more frequently observed, particularly as regards the males. Also during this cruise a great part of the stomach

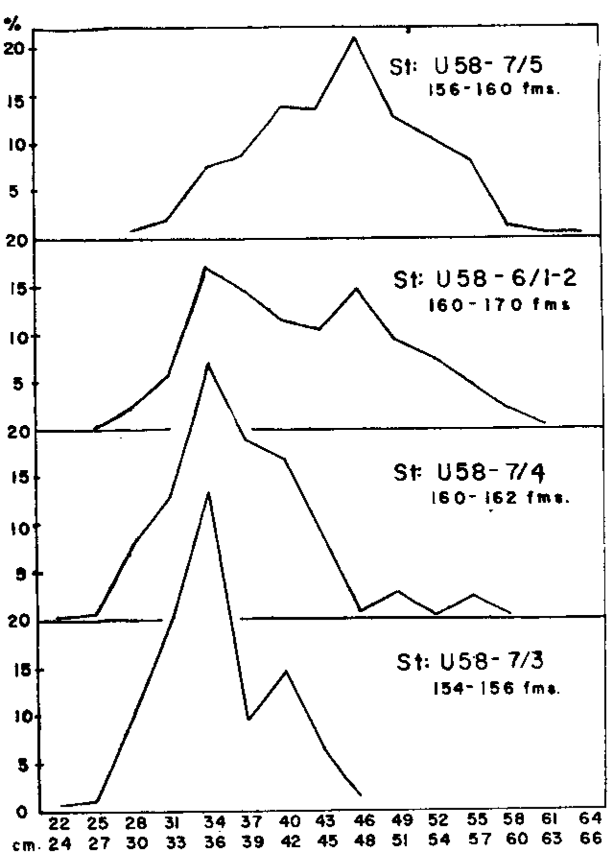


Fig. 6. **Redfish. Length distribution for different hauls taken on the shelf and the slope of Ritubanki.**

content consisted of *Calanus* sp., but fish species were more numerous than at the Sundáll.

During the rest of 1958 Icelandic trawlers fished on these new fishing grounds and made excellent catches. In July to September 102 trips were made to Subdiv. 2J, with an average duration of 14.1 days per trip (see Table 1). In September the catches were somewhat smaller than in July and August, as shown in Tables 1 and 2. This is confirmed by the longer duration of the trips and the number of hauls per trip. It should be mentioned that the July catches include the "Fylkir" expedition. Further, it is obvious that the catches of cod and halibut are of no importance compared to the catches of redfish. However, there is an increase in these catches from July to September.

Table 1 also shows that 162 trips were made to Subdiv. 3K in September to December with an average of 15.4 days per trip; further, that the number of days per trip and the number of days' fishing increase from September to December, the increase in number of days per trip being the strongest. This can be explained by bad weather conditions, as the catches were almost the same throughout the whole period with the exception of September (Table 3; catch per one haul). The catch of cod and halibut increased from September to December.

Table 4 shows that the Icelandic commercial trawler fleet fishing in Subdivisions 2J and 3K in 1958 is a very homogeneous one. The same type of gear was used by all trawlers.

The discovery of these new fishing grounds was of a very great importance for the Icelandic fishery in the year 1958. The total amount of fish caught by Icelandic vessels in 1958 was 505 thousand tons. The total catch of redfish was 110 thousand tons or 22% of the total catch, which is the highest yearly catch of redfish up to the present time. The total quantity of fish caught by Icelandic trawlers in 1958 was 199 thousand tons, of which the redfish made up about 55%. The amount of redfish caught by Icelandic trawlers in Subdivisions 2J and 3K was 80 thousand tons or nearly 77% of the total Icelandic catch of redfish in 1958.

The fishery was continued until the beginning of February, 1959, when it was discontinued because of unfavourable ice conditions and bad weather. Since early May, 1959, the fishery has been resumed.

TABLE I. Catches of Icelandic Trawlers in Subdivision 2J, Sundáll, and 3K, Ritubanki, in 1958.

Subdivision and	Month		No. of Trips	Days Absent	Days Fishing	No. of Hauls	Redfish kg.	Cod kg.	Halibut kg.	Others kg.	Total kg.
2J	July	Total	4	53	11.8	138	1,138,722		390		1,139,112
		Average		13.3	3.0	34.5	284,681		98		284,778
2J	Aug.	Total	59	792	196.3	2,441	17,660,513	7,580	10,550	4,270	17,682,913
		Average		13.4	3.3	41.4	299,331	128	178	72	299,716
2J	Sept.	Total	39	591	201.5	2,250	12,156,028	15,560	17,665	2,280	12,191,533
		Average		15.2	5.2	57.7	311,693	399	453	58	312,603
2J	Total	Total	102	1,436	409.8	4,829	30,955,263	23,140	28,605	6,550	31,013,558
		Average		14.1	4.0	47.3	303,483	227	280	64	304,054
3K	Sept.	Total	14	194	42.6	472	4,173,887	10,270	1,705	1,200	4,187,062
		Average		13.9	3.0	33.7	298,135	734	122	86	299,076
3K	Oct.	Total	70	1,031	306.5	3,147	20,848,159	48,715	11,154	4,510	20,912,538
		Average		14.7	4.4	45	297,831	696	159	64	298,751
3K	Nov.	Total	48	773	226.4	2,192	14,335,318	97,425	4,423	6,500	14,443,666
		Average		16.1	4.7	46	298,652	2,030	92	135	300,910
3K	Dec.	Total	30	501	144.5	1,353	9,001,103	102,500	8,887	1,065	9,113,555
		Average		16.7	4.8	45	300,037	3,417	296	36	303,785
3K	Total	Total	162	2,499	720.0	7,164	48,358,467	258,910	26,169	13,275	48,656,821
		Average		15.4	4.4	44.2	298,509	1,598	162	82	300,351
2J+3K		Total	264	3,935	1,129.8	11,993	79,313,730	282,050	54,774	19,825	79,670,379
		Average		14.9	4.3	45	300,431	1,068	208	75	301,782

TABLE 2. Icelandic Fishery in Subdivision 2J in 1958 Catch per-unit-effort (in kg).

Month	Species	Catch per Day Absent	Catch per Day Fishing	Catch per One Haul
July	Redfish	21,485	96,502	8,252
	Cod	—	—	—
	Halibut	7	33	6
	Others	—	—	—
Total		21,492	96,535	8,255
August	Redfish	22,299	89,967	7,235
	Cod	10	39	3
	Halibut	13	54	4
	Others	5	22	2
Total		22,327	90,082	7,244
September	Redfish	20,569	60,328	5,403
	Cod	26	77	7
	Halibut	30	88	8
	Others	4	11	1
Total		20,629	60,504	5,419
July September	Redfish	21,557	75,539	6,410
	Cod	16	56	5
	Halibut	20	70	6
	Others	5	16	1
Total		21,598	75,681	6,422

TABLE 3. Icelandic Fishery in Subdivision 3K in 1958. Catch per-unit-effort (in kg).

Month	Species	Catch per Day Absent	Catch per Day Fishing	Catch per One Haul
September	Redfish	21,515	97,979	8,843
	Cod	53	241	22
	Halibut	9	40	4
	Others	6	28	0.3
	Total	21,583	98,288	8,872
October	Redfish	20,221	68,020	6,625
	Cod	47	159	15
	Halibut	11	36	4
	Others	4	15	1
	Total	20,283	68,230	6,645
November	Redfish	18,545	63,319	6,540
	Cod	126	430	44
	Halibut	6	20	2
	Others	8	29	3
	Total	18,685	63.798	6,589
December	Redfish	17,966	62,291	6,653
	Cod	205	709	77
	Halibut	18	62	7
	Others	2	7	0.8
	Total	18,191	63,069	6,738
September-December Total	Redfish	19,351	67,165	6,750
	Cod	104	360	36
	Halibut	10	36	4
	Others	5	18	2
	Total	19,470	67,579	6,792

TABLE 4. Icelandic Vessels Taking Part in the Fishery of Redfish in Subareas 2 and 3 in 1958.

Brutto Reg. Tons	Number of Vessels	Average Br. Reg. Tons	Engine HP	Average Engine HP
450-500	1	491	950	950
501-550	—	—	—	—
551-600	—	—	—	—
601-650	3	620.7	1200-1400	1266.7
651-700	29	664.4	1000	1000
701-750	6	722.3	1000-1332	1110.7
751-800	—	—	—	—
801-850	2	826.5	1470-1600	1535
Total 27608	41	673.4	43484	1047.1

VI. Norwegian Research Report, 1958

BY ERLING BRATBERG

Introduction.

In 1958 a Norwegian fleet of 74 long liners participated in the fisheries in the Newfoundland banks and the banks off West Greenland. 68 of these vessels were engaged in the cod fisheries while 8 fished exclusively for halibut. One vessel fished both for halibut and cod. In this year nine Norwegian trawlers visited the area. A total of 13,420 tons of salted cod was landed. The catch of halibut amounted to 813 tons.

As in earlier years the fisheries off West Greenland started in early May. In June the fishery was relatively good on Fiskenes Bank and on the southern part of Fyllas Bank. As usual there was a slack period in the fishery in the first part of July. In late July the handline fishery on the banks between Faeringerhavn and Sukkertoppen was relatively good, but the really good handline fishery off Holstensborg did not start before the middle of August.

In the first part of June the cod was of relatively small size and the liver content was rather poor as the fish mostly fed on benthic animals. Towards the end of June and through the rest of the season the mean length of the cod grew larger. From the middle of July the liver content also increased as the fish began to feed heavily on sand eels.

Data on age — and size — composition of the commercial cod catches and observations of the temperature on the banks were sampled by an observer from the Norwegian Institute of Marine Research working aboard a commercial fishing vessel. The data on age and size will be published in the Sampling Yearbook, Vol. 3.

Hydrography.

Three temperature sections westwards from the banks were taken on July 5-6. Temperature registrations were also made where the vessel actually was fishing. All the registrations were made by means of a bathythermograph.

Compared with earlier years the temperature sections showed no exceptional changes.

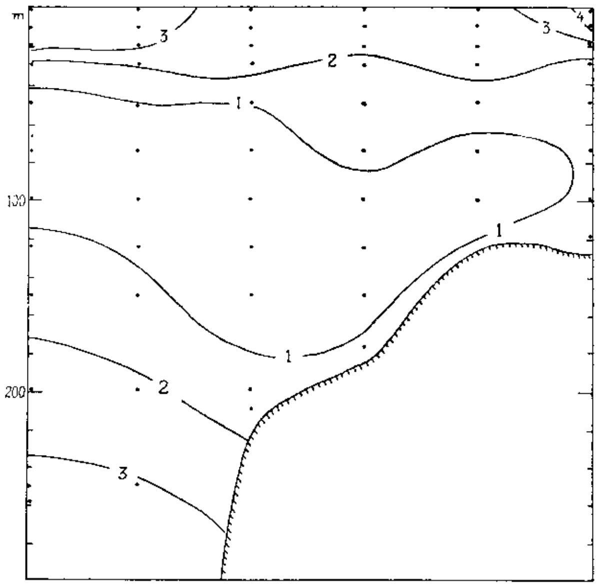


Fig. 1. **Temperature section (°C) from northern part of Lille Hellefiskebank westwards; bathythermograph; 5 July 1958.**

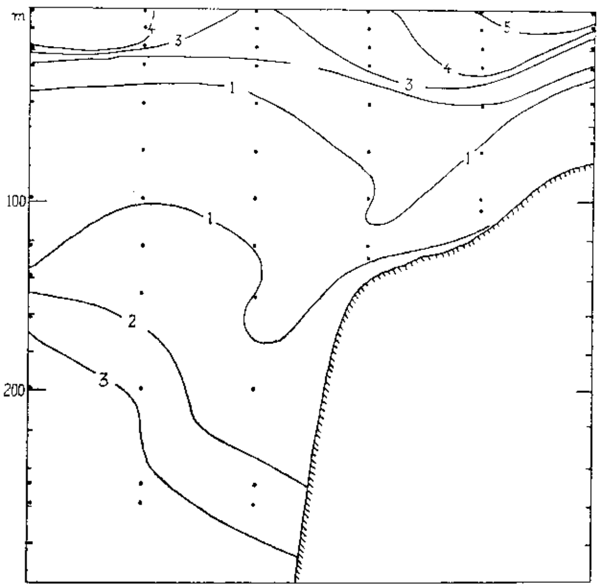


Fig. 2. **Temperature section (°C) across the middle part of Lille Hellefiskebank and westwards; bathythermograph; 5-6 July 1958.**

TABLE 1. Bottom temperatures and catch of cod by a Norwegian commercial fishing vessel during June 20 to July 4.

Position	Depth	Bottom temperature	Number of cod in the catch	catch/10 hooks
N 62°57′ W 51°05′	360 m	>2°C	370	1.6
N 62°54′ W 51°05′	110 m	0.5°C	660	0.8
N 63°23′ W 51°50′	161 m	0.9°C	250	0.6
Fiskenes Bank, S.	285 m	3.8°C	2400	2.0
N 63°03′ W 51°50′	285 m	3.9°C	1750	1.9
N 63°00′ W 51°52′	280 m	2.5°C	3550	2.4
N 63°00′ W 51°54′	280 m	3.0°C	3400	2.3
N 63°00′ W 52°02′	260 m	2.5°C	2600	1.7
N 62°58′ W 52°05′	280 m	2.2°C	2700	1.6
N 66°28′ W 54°20′	200 m	0.6°C	360	0.9
N 65°42′ W 54°15′	120 m	0.6°C	620	1.0
N 62°59′ W 52°00′	184 m	1.4°C	300	0.8
N 66°25′ W 54°23′	120 m	1.3°C	360	0.7

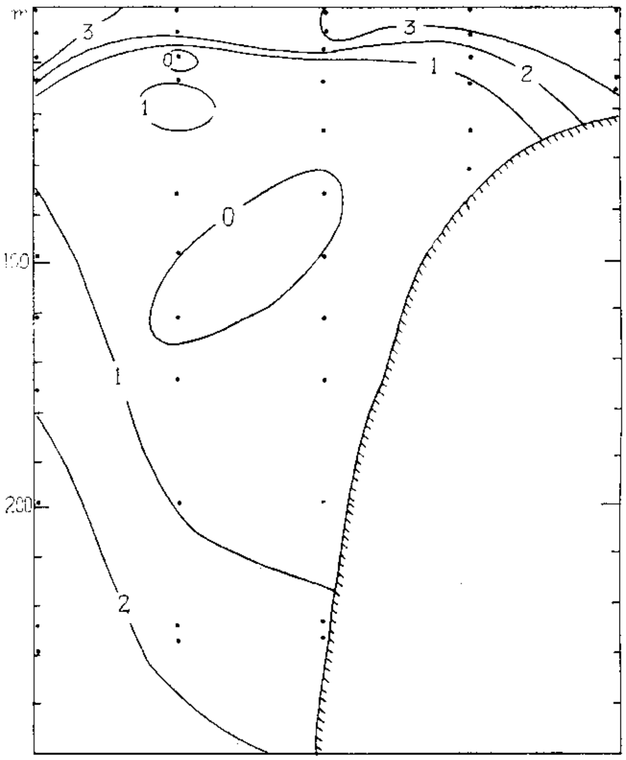


Fig. 3. Temperature section (°C) from Fyllabank westwards; bathythermograph; 6 July 1958.

On Lille Hellefisk Bank, Figures 1 and 2, a core of cold arctic water with temperature 0.5-2°C covered the top of the bank and the upper part of the bank slope in a depth from 25 to about 220 m.

Also on Fyllas Bank, Figure 3, cold arctic water with temperature 0-2°C was found on the upper part of the bank slope from about 15-300 m, but here warmer water with temperatures over 2.5°C was lying on the top of the bank.

Table 1 gives the registered bottom temperatures where the vessels were fishing; it appears that satisfactory fishing only took place where the temperatures were more than 2°C.

Cod Investigations.

In 1958 only samples of cod caught on bottom longline were collected. Altogether nine samples of cod were obtained from June 21 to July 4 in the area between the southern part of Fiskenes Bank and the northern part of Lille Hellefisk Bank. A total of 1353 length measurements and otoliths were collected.

The length frequencies of the cod in Subdivisions 1C, 1D and 1C + 1D are shown in Figure 4 (Data will be published in the Sampling Yearbook, Vol. 3).

The cod was in 1958, as in 1957, of good commercial size for the Norwegian vessels. The mean length in Subdivision 1C was 73.50 and in 1D 76.20 cm. For all samples the mean length was 74.12 cm and the mean age 9.47 years. In 1957 the mean length of all samples was 73.57 cm and the mean age 8.85 years.

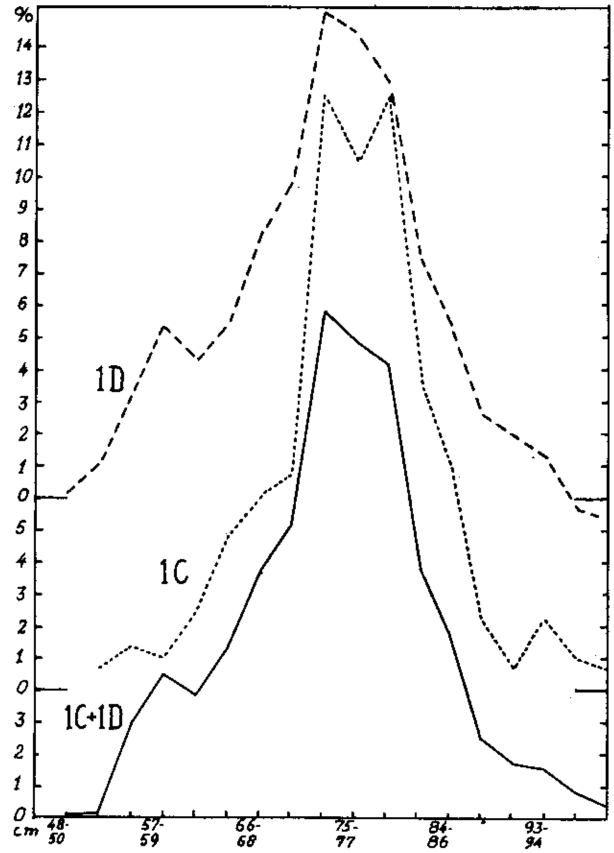


Fig. 4. Length composition of samples of cod taken on bottom long line off West Greenland, 20 June to 4 July 1958 in Subdivisions 1C, 1D and 1C + D. 3 cm length groups.

The age compositions of the samples by subdivisions (data will be published in the Sampling Yearbook, Vol. 3), and of all samples from 1958 and 1957 are shown in Figure 5.

The 1947 year class (11 years old) and the 1950 year class (8 years old) are still dominating in the fishery, and the 1947 year class is still the strongest one. The 1947 year class constitutes 26.31% of all the samples. The total mean length of this year class in all the samples is 78.34 cm. The same figures for the preceding year were 34 per cent and 76.09 cm. The 1950 year class constituted in 1958 20.32% of the total catch with a mean length of 72.28 cm. The same figures for this year class were in 1957 23.4% and 70.29 cm.

The strength of both the 1947 year class and the 1950 year class has decreased as compared with the 1957 catch, but it is expected that these two year classes also will dominate the fishery next year and give catches of good commercial size for the Norwegian needs.

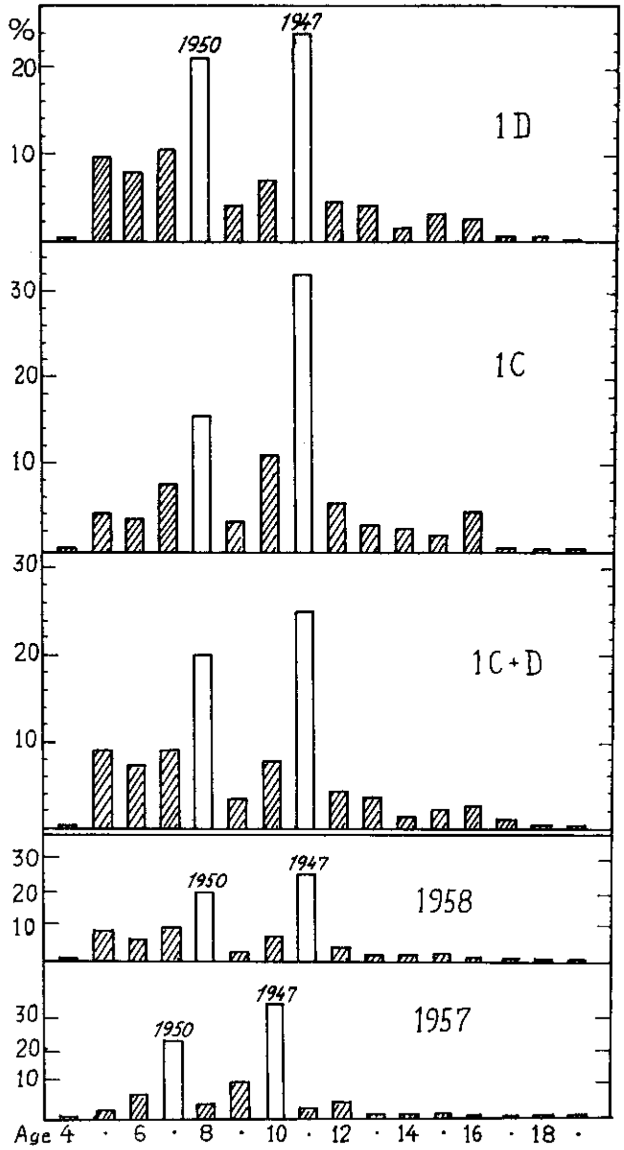


Fig. 5. Age composition of samples of cod taken on bottom long line off West Greenland, 20 June to 4 July 1958 in Subdivisions 1C, 1D and 1C + D. The two bottom panels show comparison of all samples from the Norwegian commercial fishery off West Greenland in 1958 and 1957.

VII. Portuguese Research Report, 1958

BY MARIO RUIVO AND GLICINIA V. QUARTIN

The present report summarizes the results of sampling from Portuguese cod-fishing vessels operating in the ICNAF area, Subareas 1 (Greenland, and 2 (Labrador) during the 1958 fishing campaign[1]) and in Subarea 4 (Gulf of St. Lawrence and the waters E. of Cape Breton) 1956-58.

The gear used, the system of sampling and the methods for the study of the material and data, are the same as those described in earlier reports (see ICNAF Ann. Proc. Vol. 7)

I. Observations on the cod, *G. callarias* L. in Subarea 1 (Greenland).

A number of 14 samples were collected (3 from dory fishing vessels and 11 from trawlers). The samples comprised ca. 1500 individuals; from 1300 otoliths were taken for age-determination. For the consideration of the material the samples were grouped as follows:

Sample Group	No. of Samples	Subdivision	Date
I	1,2,3	1D	29-V/ 2-VI-1958
II	4,5,6,7,8	1C	4/ 9-VI-1958
III	11,12,13	1D	12/14-VI-1958
IV	14	1C	17-VI-1958

The localities sampled are shown on the map in Figure 1.

1. Age-distribution.

(a) **Dory vessels (May-June).** Three samples from the line fishery by dories (Sample Group I) in Subdivision 1D in May-June showed a predominance of the age-groups XI (34%) and

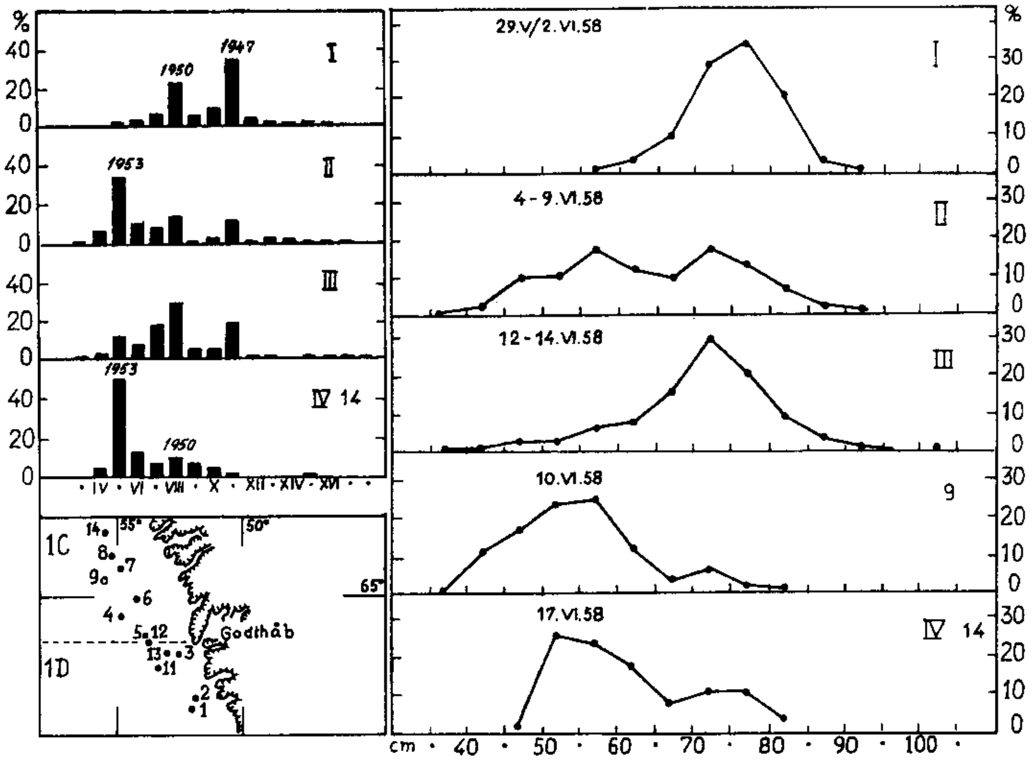


Fig. 1. **Age- and length distribution of samples of cod from Portuguese fishing vessels in West-Greenland waters 1958. Left, above — age distribution; left, below — position of samples; right — length distribution. I to IV denote samples groups.**

[1]) The data from the samples considered in this report will be published in tabular form in the Sampling Yearbook for 1958.

VIII (23%). All the other age-groups were each represented by less than 10%.

(b) **Trawlers, 1st Campaign** (**June**). In Subdivision 1C (June, Sample Groups II and IV) a clear predominance of age-group V was observed (35-52%). It was followed by age-groups VIII (10-15%) and VI (10-13%). Age-group XI which was very poor (2%) in sample group IV appears with 12% in sample group II.

In Subdivision 1D (June) age-group VIII is the strongest with 29%; it is followed by XI (19%) and VII (16%); age-group V was only present with 10%.

(c) **Summary.** In Subdivision 1D the 1947 year-class continued to predominate in the line fishery, and to a minor extent in the trawl fishery; this different degree of predominance is probably due to the different selectivity of the two types of gear.

The samples from the trawl fishery as well as from the line fishery showed a rich occurrence of the 1950 year-class. Also the 1951 year-class was fairly well represented. These results are in conformity with those obtained from the 1957 observations from the same season of the year.

In Subdivision 1C the 1953 year-class, which seems to be rather rich, and the 1950 year-class predominated; this is in accordance with previous observations.

2. Size-composition (Figure 1).

The samples from the dory fishery in Subdivision 1D showed a regular, unimodal distribution with the peak in the 77 cm group, corresponding to the predominance of the age-group XI (1947 year-class); the range of the length distribution was from the 57 to the 92 cm group. For the same subdivision the samples from the trawl fishery presented a far larger size range (37-92 cm) with a peak for the 72 cm group corresponding to age-group VIII.

The trawl samples from Subdivision 1C presented several peaks of the length-distribution curve, and a fairly large range of lengths; this especially was the case with the sample group II (range: 37-92 cm) with peaks at 57 and 72 cm corresponding to the V- and the VIII-groups.

Sample group IV is bimodal with the 52 cm group being the largest; this in accordance with the predominance of the V-group. The sample no. 9 showed the same type of length-distribution curve, with the peak in the 57 cm group.

TABLE 1. **Greenland, 1958—South region. Mean growth of males and females, and annual growth of the richer year-classes based on the sample groups I-IV, 29 May-17 June, 1958.**

Year-	Age	M. Length (cm)		♂♂ + ♀♀		Annual
class	(1958)	♂♂	♀♀	1957	1958	Growth
1955	III	41.5	38.0	—	39.8	—
54	IV	45.2	48.0	36.6	47.7	11.1
53	V	55.1	55.5	44.6	55.3	10.7
52	VI	61.0	64.1	50.2	62.3	12.5
51	VII	66.4	69.7	58.3	69.4	11.1
1950	VIII	73.0	71.9	66.4	72.4	6.0
49	IX	73.8	73.3	70.0	73.5	3.5
48	X	76.5	77.9	72.9	76.7	3.8
47	XI	75.5	79.2	73.3	76.9	3.6
46	XII	77.1	80.5	78.6	78.8	0.2
45	XIII	81.4	81.1	78.6	81.3	2.7

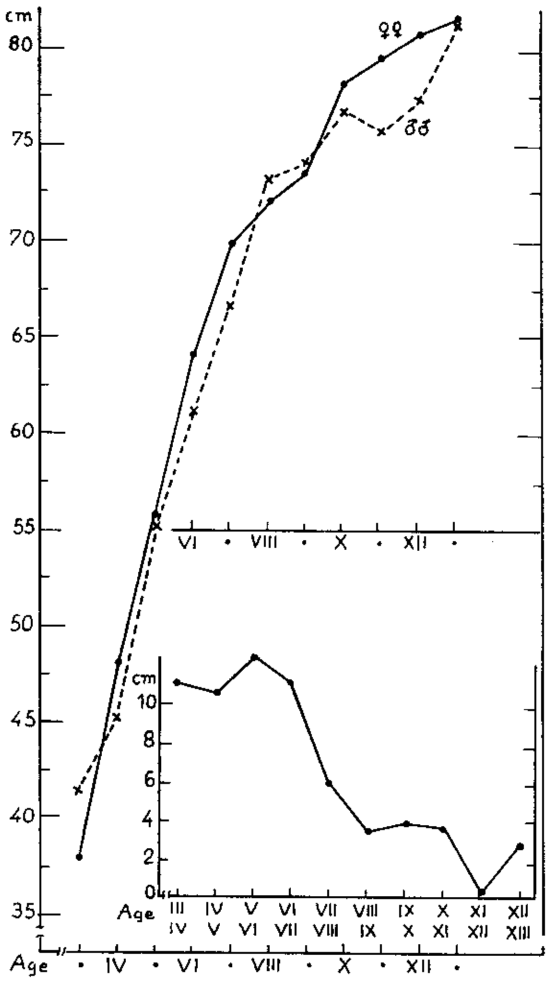


Fig. 2. **Cod, West-Greenland; growth curves for males and females. Inserted annual growth of age-groups III-XIII.**

3. Growth.

The average lengths of males and females from Subdivisions 1C-1D are presented in Table 1 and Figure 2, based on data from both the trawl fishery and the dory fishery. In the same figure is also shown the annual growth of the more abundant age-groups. The growth figures observed for 1958 were considerably larger than those observed in the year 1957.

4. Sex-ratio.

In the samples from the trawl fishery the percentages of males varied between 48-53% with the exception of sample no. 9 (1C) where the males accounted for as much as 60%. In the sample group I, from the dory fishery the females predominated strongly with 68%.

5. Maturity (Table 2 and Figure 3).

Males. In May and the beginning of June the majority of the males were in the developing stage (47-68%) or in the resting stage (20-39%); a small number (11%) were postspawners. A sample from the middle of June showed the majority (56%) to be in the resting stage, 33% in the developing stage, only few, 10%, were post-spawners; still fewer, only 2%, were in the spawning stage.

Females. In May and beginning of June all females were either in the post-spawning stage (60%) or in the resting stage 40%. By the middle of June the number in the post-spawning stage had decreased to 30%, and the resting stage predominated with 70%.

TABLE 2. **Stages of maturity of gonads determined by macroscopic observations in the months May-June for all samples.**

	Dory Vessel				Trawler	
	29/30 May 1958		2 June 1958		4/17 June 1958	
Stages of maturity	♂♂ %	♀♀ %	♂♂ %	♀♀ %	♂♂ %	♀♀ %
Resting	20.0	39.3	38.9	40.6	55.6	69.3
Developing	68.3	—	47.2	—	32.6	0.2
Spawning	1.7	—	2.8	—	2.2	—
Post-spawning	10.0	60.7	11.1	59.4	9.6	30.5
No. of specimens	60	140	36	64	509	489

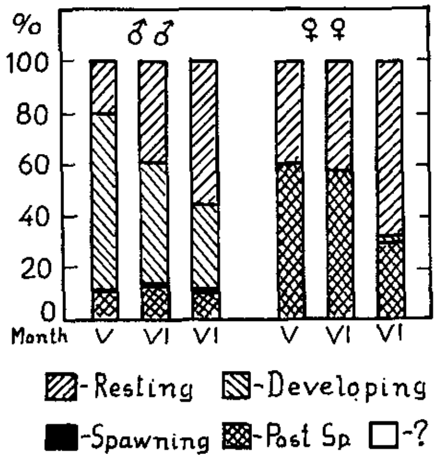


Fig. 3. **Cod, West-Greenland; percentage numbers of males and females of different stages of maturity during May-June, 1958.**

6. **Age at First Maturity** (Table 3 and Figure 4).

The study of the spawning rings showed, as was the case in the previous years, that first maturity is reached at ages 6 to 10, more especially at age 7 and 8. No significant difference as to age at first maturity was found between males and females. Compared to the previous year there was some disagreement as far as the age-groups younger than IX (inclusive) were concerned, obviously due to the difficulties in evaluating the marginal rings; for the older year-classes the results are in better agreement.

TABLE 3. Greenland, 1958. Age at first maturity of males and females of the more abundant age-groups (VII-XIII) in samples from May-June (Subdivisions 1C-1D). ⊖ - no spawning mark.

Year		♂♂ Age at 1st spawning								
Class		VI	VII	VIII	IX	X	XI	⊖	?	Total
VII	No.	—	9	—	—	—	—	53	—	62
	%	—	14.5	—	—	—	—	85.5	—	100.0
VIII	No.	2	44	19	—	—	41	8	—	114
	%	1.8	38.6	16.7	—	—	36.0	7.0	—	100.1
IX	No.	1	12	8	—	—	—	1	2	24
	%	4.2	50.0	33.3	—	—	—	4.2	8.3	100.0
X	No.	—	12	26	2	—	—	—	1	41
	%	—	29.3	63.4	4.9	—	—	—	2.4	100.0
XI	No.	—	27	38	11	—	—	—	—	76
	%	—	35.5	50.0	14.5	—	—	—	—	100.0
XII	No.	—	3	6	2	—	—	—	—	11
	%	—	27.3	54.6	18.2	—	—	—	—	100.1
XIII	No.	—	3	2	—	—	—	—	—	5
	%	—	60.0	40.0	—	—	—	—	—	100.0

TABLE 3. continued.

Year		♀♀ Age at 1st spawning								
Class		VI	VII	VIII	IX	X	XI	⊖	?	Total
VII	No.	—	6	—	—	—	—	47	—	53
	%	—	11.3	—	—	—	—	88.7	—	100.0
VIII	No.	1	60	21	—	—	—	40	12	134
	%	0.8	44.8	15.7	—	—	—	29.9	9.0	100.2
IX	No.	—	11	9	1	—	—	1	2	24
	%	—	45.8	37.5	4.2	—	—	4.2	8.3	100.0
X	No.	5	14	18	1	—	—	—	—	38
	%	13.2	36.8	47.4	2.6	—	—	—	—	100.0
XI	No.	—	21	86	32	1	—	—	1	141
	%	—	14.9	61.0	22.7	0.7	—	—	0.7	100.0
XII	No.	—	1	9	3	—	—	—	—	13
	%	—	7.7	69.2	23.1	—	—	—	—	100.0
XIII	No.	—	1	—	—	—	—	—	—	1
	%	—	100.0	—	—	—	—	—	—	100.0

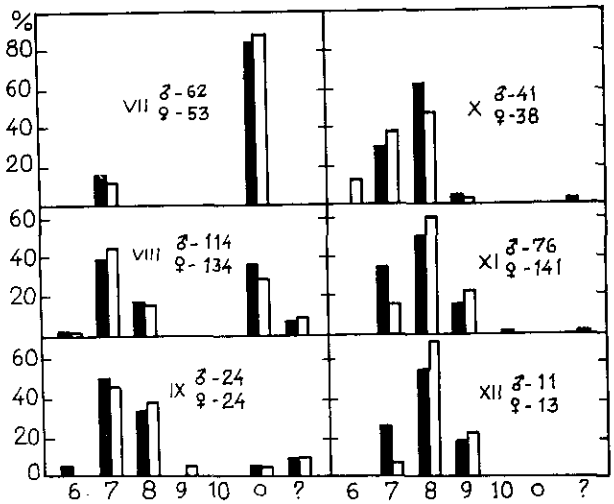


Fig. 4. **Cod, West-Greenland; Percentage numbers of males (dark columns) and females (white columns) of the various ages 6-10 spawning for the first time; only the age-groups VII-XV considered; o indicates no spawning mark.**

7. Weight Data.

Data on total weight, weight of liver, gonads and intestines were collected from 200 individuals. The data will be published in the Sampling Yearbook for 1958.

II. Observations on the Cod in Subarea 2 (Labrador).

Eleven samples were collected from trawlers in Subdivision 2J in September-October. The samples included about 2,000 cod. Otoliths were collected from 8 of the samples (800 cod).

The samples, all from Subdivision 2J, were grouped as follows:

Sample Group	No. of Samples	Subdivision	Date
A	1,2,4,6	2J	21/29 Sept. 1958
B	7,8	2J	1/2 Oct. 1958
C	9,11	2J	3/5 Oct. 1958

1. **Age-distribution** (Figure 5).

The age-group XI dominated in Subdivision 2J in September (sample group A) with 17% followed by the IX and X groups (12%); the groups XII and XIII account for 10%.

The samples from October (Sample groups B and C) differed in some characters from those of September. In sample group B the VIII-group was the best represented (17%), followed by IX (14%), XI and XII (13%). In sample group C the X-group predominated with 19%, the IX, XI and XII groups were found in about even quantities (12%).

Summary. The investigations from the Labrador area continue to show the lack of strongly dominating year-classes. As in the previous years the 1946, 1947 and 1950 year-classes are the best represented, occurring with about the same relative abundance as in 1957.

2. **Size-composition** (Figure 5).

Sample group A (September) represents a fairly regular size-distribution; the sizes observed ranged between 32 and 82 cm; the peak was at 62 cm, corresponding to the dominating 1947 year-class.

Also in sample groups B and C (from October) the size-distribution was fairly regular, with a peak at 57 cm, and the 62 cm class being nearly as abundant; this is in agreement with the predominance of the age-groups X, XI and XII.

The samples 3, 5 and 10 present in general a size-composition similar to that of the sample groups A, B and C.

3. Growth.

The average lengths and the annual growth of males and females in the samples from Subdivision 2J are presented in Table 4 and Figure 6.

The growth was virtually the same as that observed in 1957. However, it is to be noted that the growth curves for males and females diverge from age 6 and onwards.

4. Sex-Ratio.

The samples show some variation as far as sex-ratio is concerned. In sample groups A and C and in sample No. 5, males and females were present in equal numbers. In sample group B the females dominated with 57%, and in sample No. 10 the males with 57%.

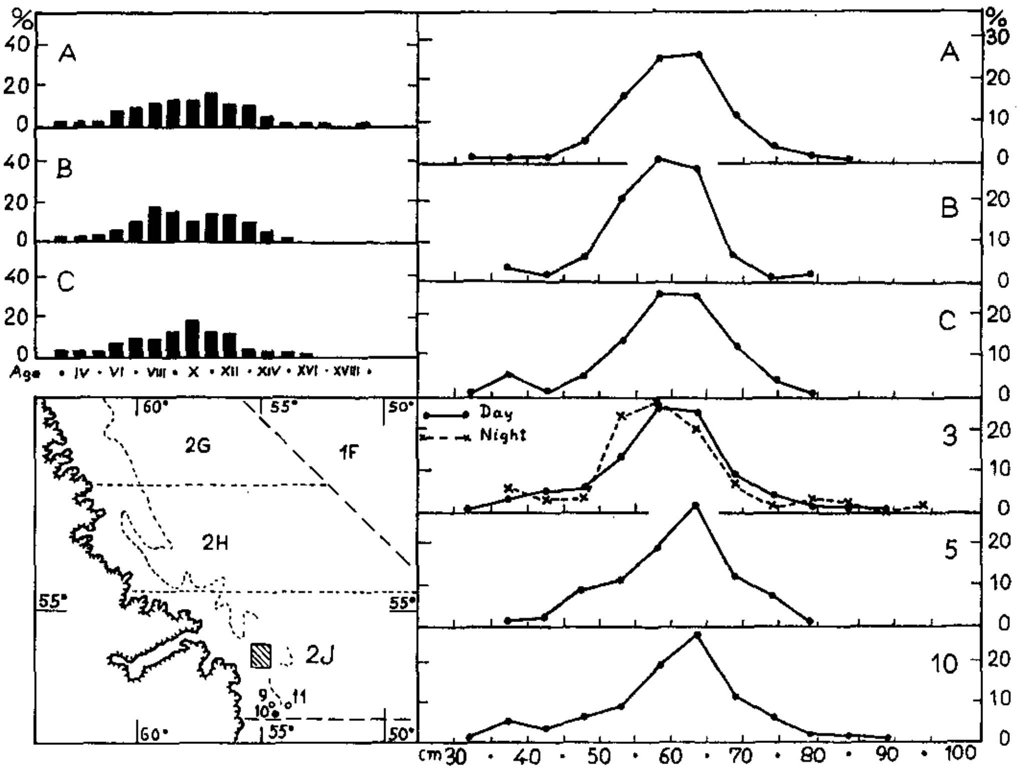


Fig. 5. Age- and length distribution of samples of cod from Portuguese trawlers fishing in the Labrador area in 1958. Left, above — age distribution; left, below — position of samples (most samples are from the small striated area). A,B,C, denote sample groups (see text).

TABLE 4. Labrador, 1958. Mean growth of males and females and annual growth of the more abundant age-groups based on Sample Groups A, B, and C (21 Sept.-5 Oct. 1958).

Year class	Age (1958)	M. Length (cm) ♂♂	M. Length (cm) ♀♀	♂♂ & ♀♀ 1957	♂♂ & ♀♀ 1958	Annual Growth
1955	III	36.3	35.2	—	—	—
54	IV	38.4	38.7	—	—	—
53	V	42.7	40.9	—	—	—
52	VI	50.4	50.6	44.9	50.5	5.6
51	VII	52.2	55.0	48.1	53.6	5.5
1950	VIII	54.5	57.8	53.0	56.2	3.2
49	IX	57.1	58.6	54.2	57.9	3.7
48	X	57.7	60.2	58.7	59.0	0.3
47	XI	60.0	62.2	60.3	61.1	0.8
46	XII	61.0	64.2	62.1	62.6	0.5

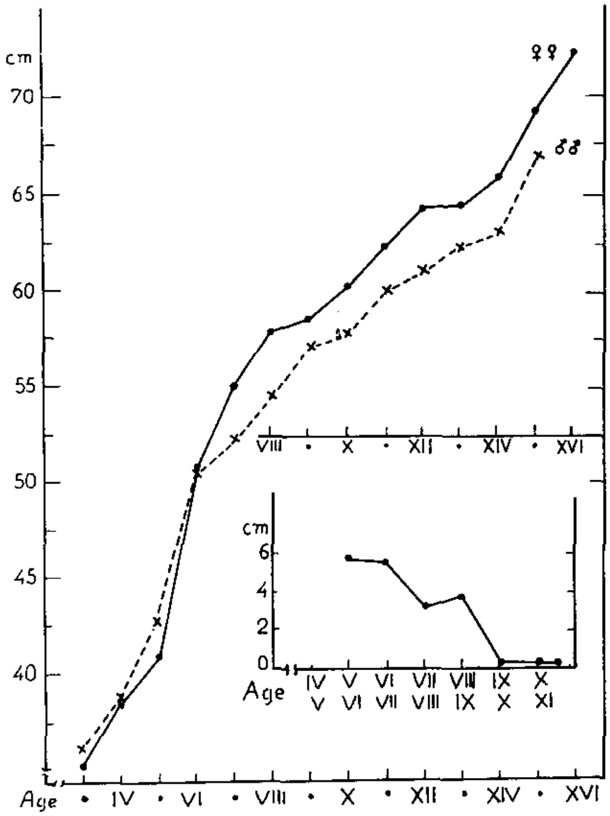


Fig. 6. **Cod, Labrador; growth curves for males and females. Inserted annual growth of age-groups IV-XI.**

TABLE 5. Stages of maturity of gonads determined by macroscopic observations, September - October, 1958.

	Trawlers			
	21/29–IX–58		1/5–X–58	
Stages of maturity	♂♂ %	♀♀ %	♂♂ %	♀♀ %
Resting	4.6	42.6	8.0	47.4
Developing	92.9	3.9	92.0	12.7
Spawning	0.5	—	—	—
Post-spawning	2.0	53.4	—	39.9
No. of specimens	196	213	187	213

Sample No. 3 included observations during day and night separately. In the day-catch males and females were present in equal quantities (50%); in the nightly fishery the females dominated with 55%.

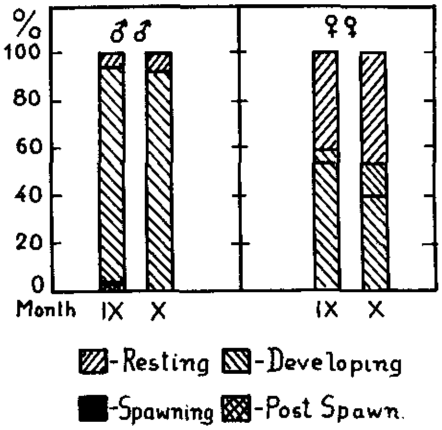


Fig. 7. **Cod, Labrador; percentage numbers of males and females of different stages of maturity during September-October, 1958.**

5. Maturity (Table 5 and Figure 7).

Males. In September-October nearly all cod (93%) were in the developing stage; a small number (4-8%) were in the resting stage, and barely 2% were post-spawners.

Females. In September the majority (53%) were in the post-spawning stage; 43% were in the resting stage and only 4% in the developing stage. In October the number in the post-spawning stage had decreased to 40%; the resting stage now accounted for 47%, and the developing stage for 13%.

6. Age at First Maturity (Table 6 and Figure 8).

Based on the interpretation of the "spawning rings" first maturity was found to occur between ages 6 and 9, most commonly between 7 and 8.

7. Weight Data.

Data on total weight, weight of liver, gonads and intestines, were collected from ca. 100 specimens. The data will be published in the Sampling Yearbook for 1958.

TABLE 6. Labrador, 1958. Age at first maturity of males and females of the more abundant age-groups (VII-XIV) in samples from September-October in Subdivision 2J.

Year Class		♂♂ Age at 1st spawning							
		VI	VII	VIII	IX	X	⊖	?	Total
VII	No.	—	4	—	—	—	32	4	40
	%	—	10.0	—	—	—	80.0	10.0	100.0
VIII	No.	5	26	2	—	—	9	10	52
	%	9.6	50.0	3.8	—	—	17.3	19.2	99.9
IX	No.	1	20	15	1	—	2	—	39
	%	2.6	51.3	38.5	2.6	—	5.1	—	100.1
X	No.	2	35	12	3	—	—	2	54
	%	3.7	64.8	22.2	5.6	—	—	3.7	100.0
XI	No.	4	34	17	—	—	—	1	56
	%	7.0	60.7	30.4	—	—	—	1.8	99.9
XII	No.	2	24	14	3	—	—	—	43
	%	4.6	55.7	32.6	7.0	—	—	—	99.9
XIII	No.	1	17	14	—	—	—	—	32
	%	3.1	53.1	43.8	—	—	—	—	100.0
XIV	No.	1	9	3	1	—	—	—	14
	%	7.1	64.3	21.4	7.1	—	—	—	99.9

TABLE 6. continued.

Year Class		♀♀ Age at 1st spawning							
		VI	VII	VIII	IX	X	⊖	?	Total
VII	No.	—	3	—	—	—	32	1	36
	%	—	8.3	—	—	—	88.9	2.8	100.0
VIII	No.	2	15	7	—	—	10	4	38
	%	5.3	39.5	18.9	—	—	26.3	10.5	100.0
IX	No.	—	22	32	3	—	—	4	6.1
	%	—	36.1	52.5	4.9	—	—	66	100.1
X	No.	—	31	17	3	—	—	—	51
	%	—	60.8	33.4	5.9	—	—	—	100.1
XI	No.	—	34	26	1	—	—	—	61
	%	—	55.7	42.6	1.6	—	—	—	99.9
XII	No.	—	23	17	4	—	—	2	46
	%	—	50.0	37.0	8.7	—	—	4.4	100.1
XIII	No.	—	21	13	1	—	—	—	35
	%	—	60.0	37.2	2.9	—	—	—	100.1
XIV	No.	—	12	11	1	—	—	—	24
	%	—	50.0	45.8	4.2	—	—	—	100.0

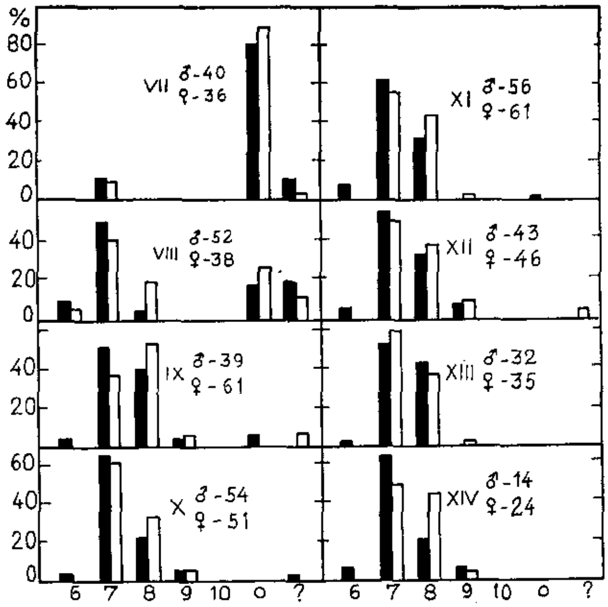


Fig. 8. Cod, Labrador; Percentage numbers of males (dark columns) and females (white columns) of the various ages 6-10 spawning for the first time; only the age-groups VII-XV considered; o indicates no spawning mark.

III. Observations on the Cod in Subarea 4 (Gulf of St. Lawrence) during the Fishing Campaigns 1956/58.

The evaluation of the benefits in Subarea 4 from the application of the enforced trawl mesh regulations ($4\frac{1}{2}''$) has been one of the main problems for consideration during the recent ICNAF meetings. Data at hand suggest an advantage by increasing the mesh-size to $5\frac{1}{2}''$ which would permit a greater escapement of fish without serious reactions on the landings.

A detailed study of this problem, in respect of haddock as well as of cod, is however necessary.

For this purpose it was considered indispensable to establish a basis for the work by compiling data from the various countries fishing in the area on the samplings from recent years, and to publish such data as soon as possible. Therefore a preliminary Portuguese report on sampling for age and size of the Subarea 4 cod in 1956/58 was presented to the meeting of the Groups of Advisers in Boston, Dec. 1958 (ICNAF Ser. No. 600, Meet. Doc. No. 3, app. VIII).

The present report, which also includes additional data (sex ratio, stage of maturity), has also a preliminary character; its aims are first of all to provide data for a comparative study and a critical consideration of the results, especially those from age reading of otoliths. In effect, the otoliths of the St. Lawrence cod provide great difficulties, which may lead to errors in interpretation, owing to the existence of numerous rings of the polymorph type (e.g. double-rings and "false rings"). The distinction between the 1st ring and the nucleus often offers difficulties.

The errors in interpretation, mentioned above will unavoidably react upon the evaluation of the age at first maturity. This evaluation is also made difficult by the fact that the spawning rings in many cases are less clear than for instance those in otoliths from Greenland and Labrador.

1. Material and Methods.

All samples studied arrive from fisheries with trawls with a cod-end mesh-size of approximately 117 mm. In 1956 the samples were taken from the fish to be landed, i.e., after discard of undersized cod. In 1957 and 1958 the samples were taken from the catches before discarding.

During the fishing campaigns the following numbers of samples were collected:

1956 - 16 samples	(2,000 individuals)
1957 - 13 ,,	(1,600 ,,)
1958 - 19 ,,	(1,900 ,,)

The position of the samples are shown in Figures 9-11. To facilitate the study of the samples these were grouped as follows:

	Group	Sample-nos.	Subdivision	Dates
Year 1956	A	1-3-4-5	4R	27-III/1-IV
,,	B	6-7	4V	3/4-IV
,,	C	8	4V	6-IV
,,	D	11-12-14-15	4T	17/21-IV
Year 1957	A	3	4R	22-III
,	B	4	4T	25-III
,,	C	5-6-8-9	4V	29-III/5-IV
,,	D	11-12-13	4R	15-IV/17-IV
Year 1958	A	1-2	4V	25/26-III
,,	B	3-5-6-7	4R	27/31-III
,,	C	9-10-11-12-15-16	4R	2/14-IV
,,	D	14-17-18	4T	11/20-IV
,,	E	19	4V	22-IV

The age determination, by means of otoliths, comprised the following numbers: 1956—1,000 spec., 1957—1,600 spec. and 1958—1,900 spec.

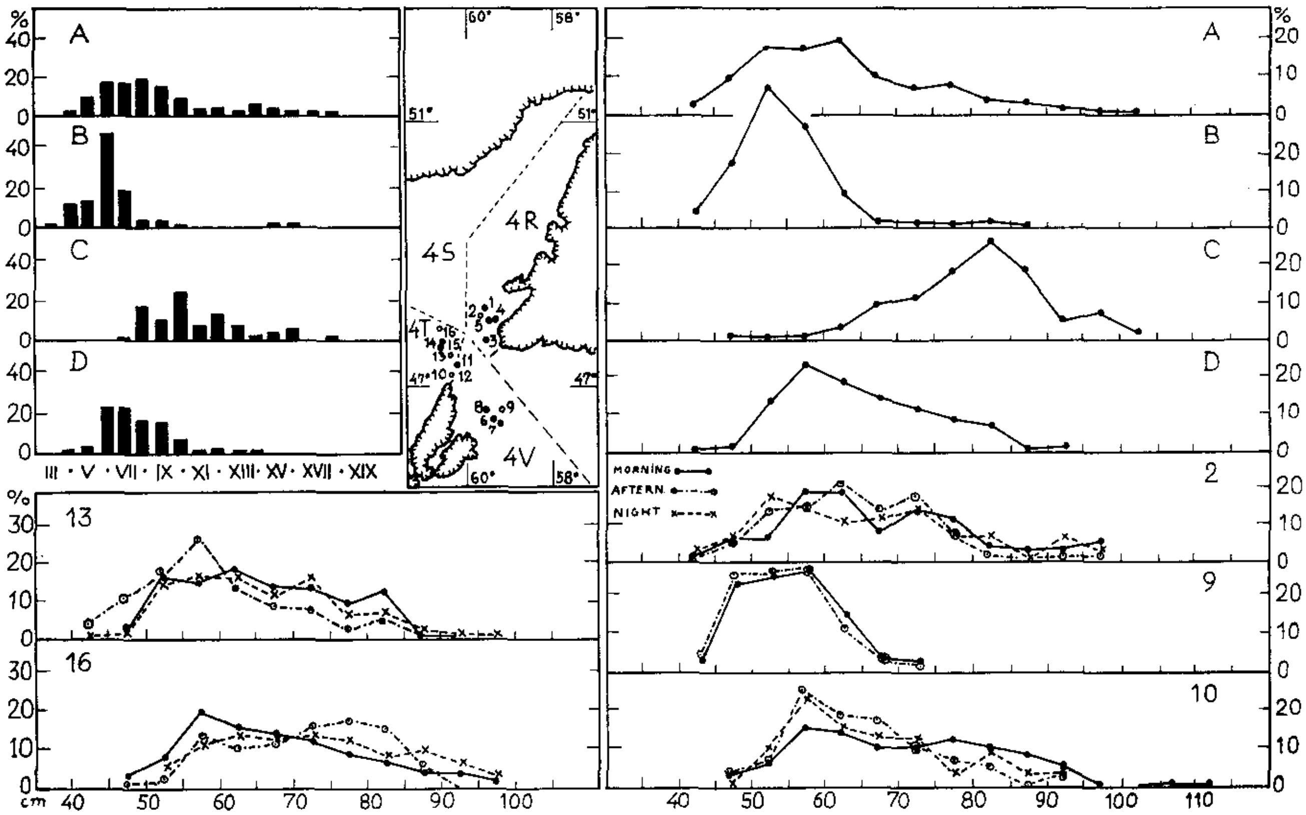


Fig. 9. **Age- and length distribution of samples of cod caught by Portuguese trawlers in Subdivisions 4R, 4V and 4T, 1956; left, above — age distribution and map showing position of samples; left, below and right — length distribution; A-D denote sample groups (see text).**

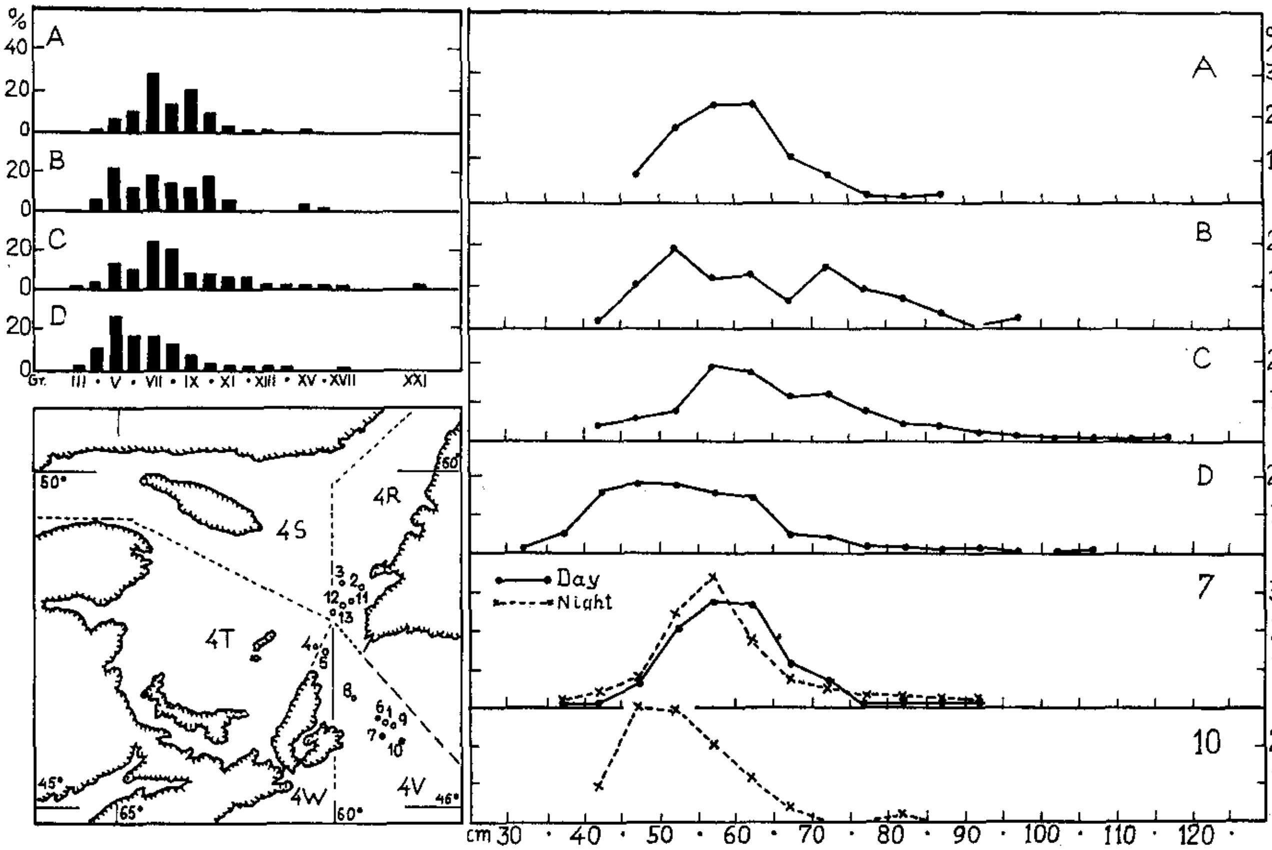


Fig. 10. **Age- and length distribution of samples of cod caught by Portuguese trawlers in Subdivisions 4R, 4V and 4T, 1957; left, above — age distribution; left below — position of samples; right — length distribution; A-D denote sample groups.**

2. Age-Composition.

(a) **1956—Campaign** (Fig. 9).

In Subdivision 4R (March-April, Group A) the age-group VIII predominated with 20%, followed by VI (17%), VII (17%) and IX (15%).

In Subdivision 4V (April, Group B) age-group VI predominated strongly with 49%; it was followed by VII (17%), V (13%) and IV (12%).

In Group C (also 4V, April) the age-distribution was different: Age-group X-26%, VIII-18%, XII-14% and IX-11%.

In Subdivision 4T (April, Group D) the age-groups VI and VII predominated with 26 and 23%, followed by VIII and IX with 17%.

(b) **1957—Campaign** (Fig. 10).

In Subdivision 4R (March, Group A) the most prominent age-groups are VII—30%, IX—22%, and VIII—14%. Groups X and VI are represented with ca. 10%. April (Group D) shows a different age-composition with the V-Group predominating (27%), followed by VI-17%, VIII—14% and IV—10%.

In Subdivision 4T (March, Group B) age-group V is the richest with 20%; it is followed by X—17%, VII—17%, VIII—13%, VI and IX—10%.

In Subdivision 4V (March-April, Group C) the age-groups VII (24%), VIII (20%) and V (12%) predominate.

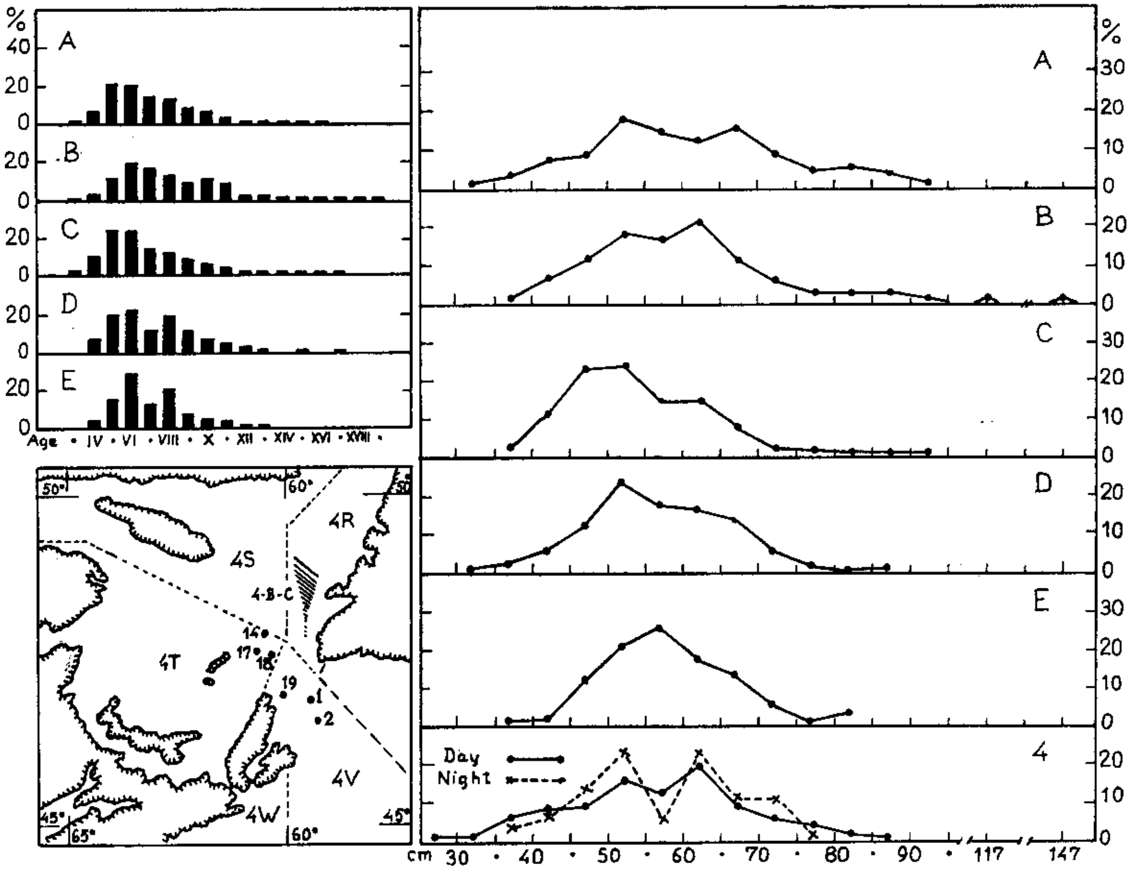


Fig. 11. **Age- and length distribution of samples of cod caught by Portuguese trawlers in Subdivisions 4R, 4V and 4T, 1958; left, above — age distribution; left, below — position of samples; right — length distribution; A-E denote sample groups.**

(c) **1958—Campaign** (Fig. 11).

In Subdivision 4R (March, Group B) the age-group VI predominates with 19%; next comes VII—16%, VIII and X—12%, and V—10%. In April, however, (Group C) the age-group V is the most numerous (24%), followed by VI—23%, VII—14%, and VIII—10%.

In Subdivision 4T (April, Group D) age-group VI is represented with 20%, V and VIII each with 19%, and groups VII and IX each with hardly 10%.

In Subdivision 4V (March-April, Groups A and E) the age-groups V (15-22%) and VI (20-28%) predominate, followed by VII—12 and 14%, and VIII—13 and 20%.

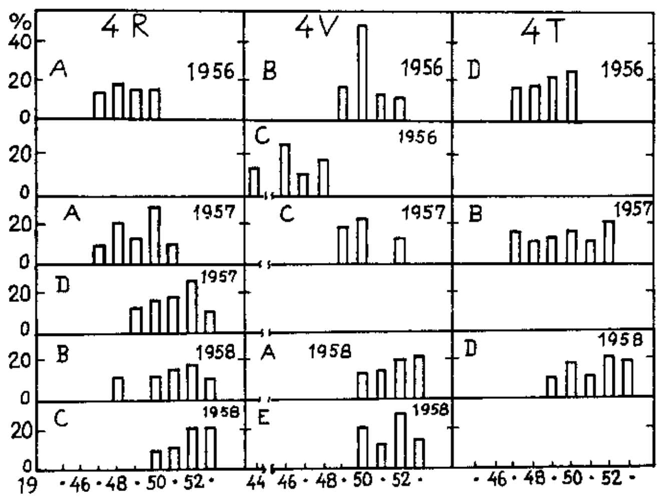


Fig. 12. **Age composition by year-classes of the various sample groups of cod from the Portuguese trawl fishery 1956/58 in Subareas 4R, 4V and 4T.**

(d) **Summary.**

In Fig. 12 the age- compositions of the various sample groups are summarized by subdivisions. The figure only includes age-groups represented by more than 10%.

3. **Size-Composition.**

The size-compositions for the sample groups are shown for each of the three years to the right in Figures 9, 10 and 11.

4. **Growth** (Figure 13).

Data on the growth of the Gulf of St. Lawrence cod in 1956/58 are shown in Fig. 13. As this material has only been studied provisionally, an analysis by subdivisions has not been made; however, the data at hand suggest that the stocks of Subdivisions 4V and 4T are different in growth from those of Subdivision 4R.

As the samples from 1956 only refer to fish for landing (after discard), the data for the younger age-groups, III and IV are misleading due to the exclusion of the slower growing fish (discard). This fact also explains some anomalies found for the growth of the younger year-classes from the 1957 material.

Generally speaking, and in accordance with what have already been noted, the growth-curves for 1956 and 1957 coincide fairly well with one another but they differ from those of 1958, which show a more rapid growth. The point of inflexion of the curves is about age 7.

5. **Stage of Maturity** (Figure 14)

The data for the years 1956, 57 and 58 coincide so well that they can be combined and analyzed together.

Males. In March 20-34% were in the resting stage, and 65-75% in the developing stage. Only few were spawning; in 1956 and 1958 ca. 1%; in 1957 14%. In April still many individuals (36-45%) were in the resting stage and the developing stage (46-54%). The spawning stages are now more frequent (2, 8, and 19%); very few were after-spawners (0.4%).

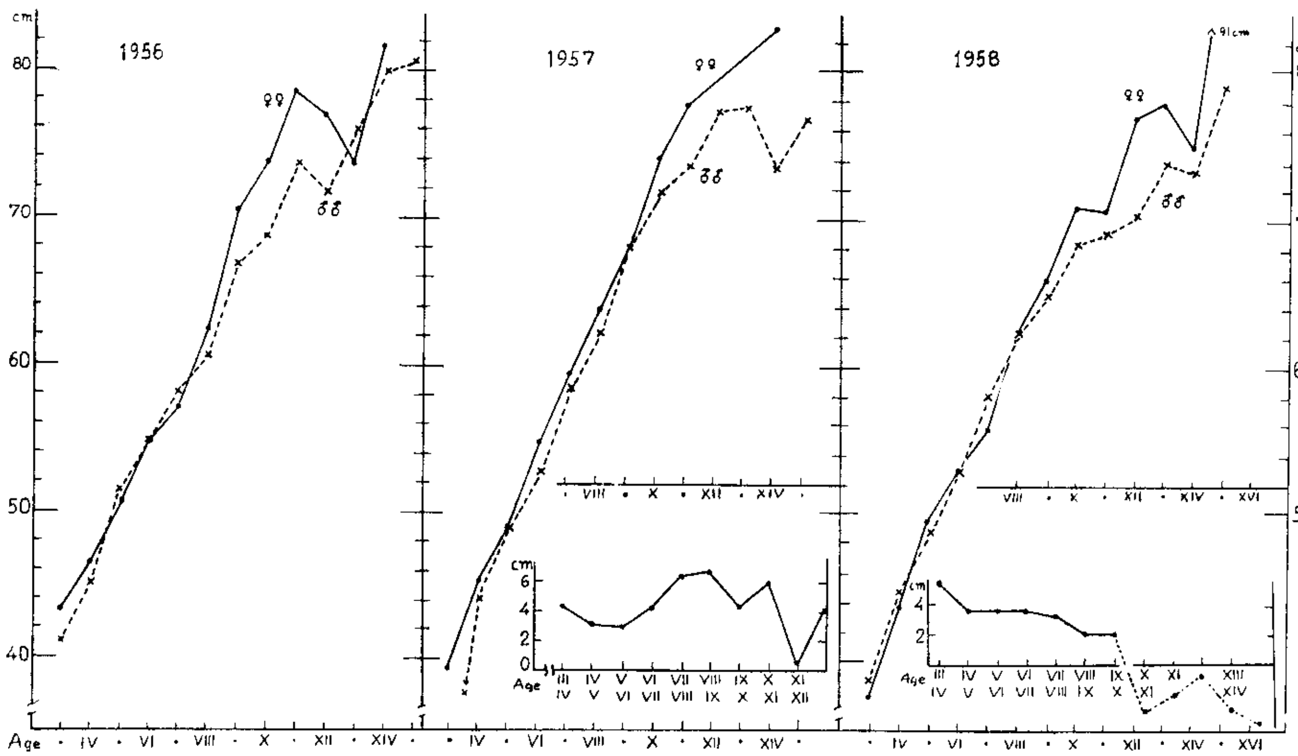


Fig. 13. Cod, Subdivisions 4R, 4V and 4T. Growth curves for males and females, 1956, 1957 and 1958. Inserted annual growth of age-groups III-XIV (1957 and 1958).

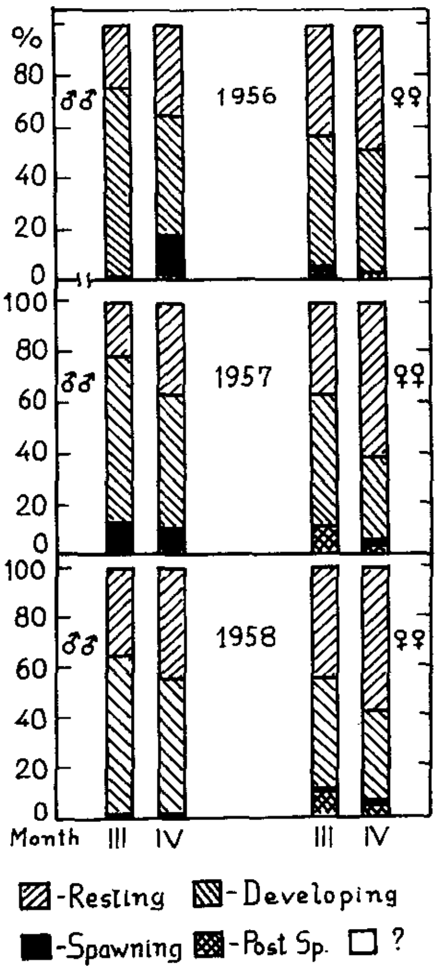


Fig. 14. **Cod, Subdivision 4R, 4V and 4T; percentage numbers of males and females of different stages of maturity during March to April 1956, 1957 and 1958.**

Females. In March the majority were in the developing stage (44-54%) or the resting stage (36-47%); very few (1%) were in the spawning stage, some (1, 8 and 11%) were after-spawners, the higher values corresponding to the samples from 1957 and 1958. In April the resting stage predominated with 49-61%, and the developing stage with 34-49%; spawners were only rarely observed (2-3%), post-spawners accounted for ca. 4%.

6. Age at First Maturity (Figures 15, 16, and 17).

By means of the spawning rings in the otoliths first maturity was found to be reached most commonly between ages 6 and 9, more exceptionally between ages 5 and 10. The majority reached 1st maturity at age 7 or 8, principally at age 7. No difference between males and females was observed.

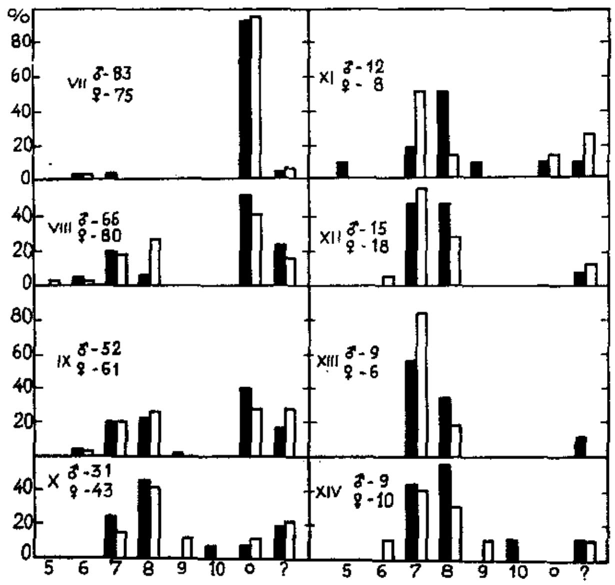


Fig. 15. **Cod, Subdivisions 4R, 4V and 4T, 1956; percentage numbers of males (dark columns) and females (white columns) of the various ages 5-10 spawning for the first time; only the age groups VII-XIV considered.**

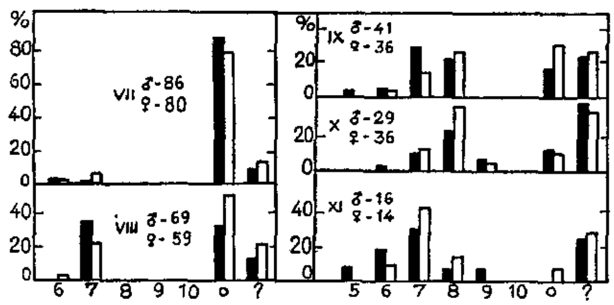


Fig. 16. **Cod, Subdivisions 4R, 4V and 4T, 1957; percentage numbers of males (dark columns) and females (white columns) of the various ages 5-10 spawning for the first time; only the age-groups VII-XI considered.**

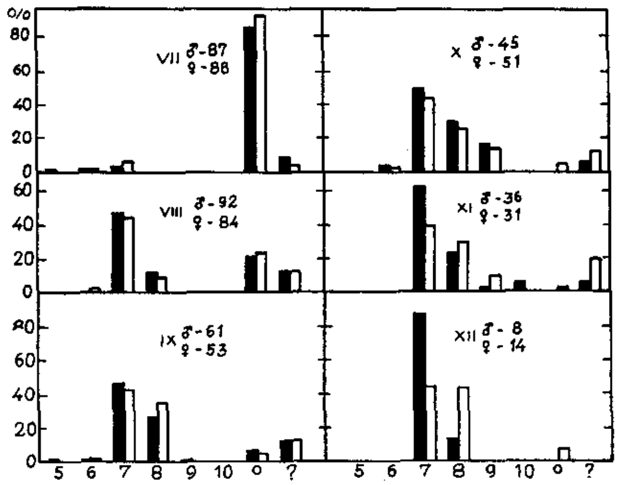


Fig. 17. **Cod, Subdivision 4R, 4V and 4T, 1958; percentage numbers of males (dark columns) and females (white columns) of the various ages 5-10 spawning for the first time; only the age-groups VII-XII considered.**

The comparative analysis of ages at first maturity within the same year-classes for the years of observation (1956-58) reveals considerable differences. Such differences could result from errors of interpretation of the spawning rings (including the age-determination proper) or from the fact that the material used was a combination of all samples from the Gulf of St. Lawrence where the different subdivisions are irregularly represented over the three years.

A further discussion of this problem is postponed until more data are collected.

7. Weight Data.

Data on total weight, weight of gonads, livers, and intestines were collected from 425 individuals (1956—275, 1958—150).

Rather high values were observed for the gonads, which confirms that the developing stages are fairly advanced, indicating spawning in the near future.

VIII. Spanish Research Report, 1958

BY OLEGARIO RODRIGUEZ MARTIN

During 1958 Spain has participated in the exchange of otoliths. The samples of otoliths received through the ICNAF Secretariat have been studied and returned together with a report on the results of the readings.

Following the program established at the Biarritz Meeting observers have been sent aboard the fishing vessels to collect data and material for further study in the laboratories. These observers are crew members of the fishing vessels, and they have been specially instructed for the work assigned to them.

In 1957 Spain commenced research work in the W. -Greenland waters (vide ICNAF, Annual Proceedings vol. 8, p. 61, 1958).

The research work in the W. -Greenland region was continued in 1958, but limited to the study of the size and age of the cod. The numbers of cod measured from the various subdivisions were as follows:

Subdivision 1B	—	1,199	spec.
,, 1C	—	7,619	,,
,, 1D	—	1,385	,,
,, 1E	—	4,782	,,
TOTAL		14,985	,,

The measurements were made aboard the trawler "Aliseo" of the company Pysbe between 26 May to 10 July 1958. The trawl used had a mesh-size in the cod-end of 160mm (6 3/8"), when new and dry.

The 14,985 cod were measured aboard immediately after capture, before being gutted.

Otoliths were collected from 1,500 of the cod measured. The reading of the otoliths has not yet been completed; the results will be reported when available.

Subdivision 1B.

Fishery was carried out from 19-22 June and the samples were collected from the area between

66°42′ and 66°30′ N. Lat. and 56°30′ and 56°15′W. Long., i.e., from Store Hellefiske Banke at depths of 230-280 m.

The length frequency is shown in Fig.1 B. The peak of the curve (31.4%) is off 60 cm. No cod below 45 or above 85 cm were observed.

Subdivision 1C.

The catches sampled were made on 26 May (64°35′N-53°20′W) and on 2-18 June (65°45′-64°24′N and 55°35′-54°15′W) on the Lille Hellefiske Banke, 155-350 m depth.

The frequency curve is shown in Fig. 1C. The highest number of cod (17.4%) was found in the group 60-65 cm. Only very few specimen were below 40cm which is the minimum size for marketable cod of the Spanish fishing fleet.

Subdivision 1D.

The samples were collected from fishery in the days 28-30 May in the area 63°31′ and 63°34′N - 53°35′ and 53°29′W, on Fylla Banke at depths of 150-165 m.

The most frequent size observed was 65 cm (16.3%), the size-group 75 cm accounted for nearly the same percentage (15%). No cod below 40 cm were found (Fig. 1D).

Subdivision 1E.

The samples were taken from trawlings in the period 25 June to 10 July in the area 61°50′ and 61°24′N - 50°35′ and 50°15′W on Dana Banke at depths of 150-200 m.

The most frequent size was at 70cm (22.2%), followed by the 65cm group (19.1%) and the 75 cm group (18.1%). See Fig. 1E.

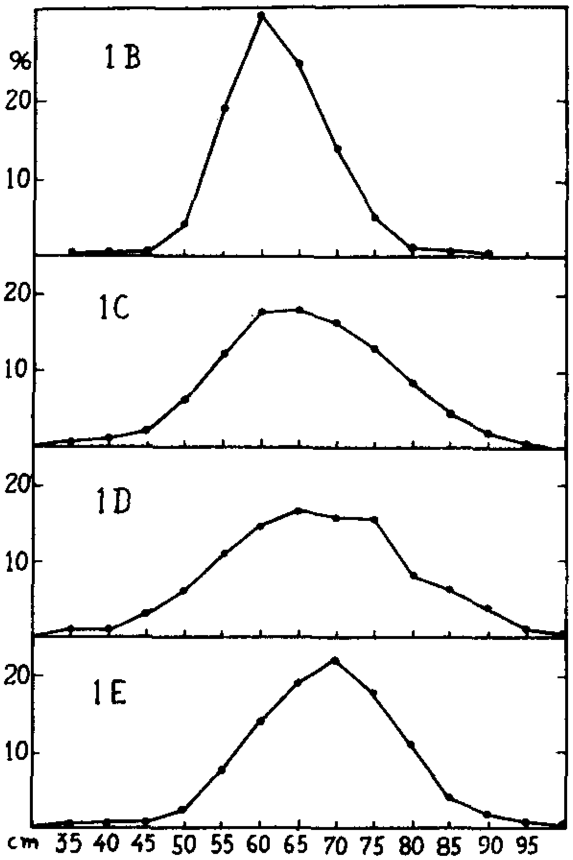


Fig. 1. Length-distribution curves for cod samples taken from Spanish trawl catches in 1958 in Subdivisions 1B, 1C, 1D and 1E.

IX. Union Soviet Socialist Republics Research Report, 1958

BY V. I. TRAVIN

As in the previous two years, the redfish was the main object of Soviet trawl fishery in the Northwest Atlantic, contributing 93% to the total catch by Soviet trawlers in the Convention Area, 85% falling to the share of *Sebastes mentella*. Therefore, the greatest attention was paid to the redfish investigations and to the exploration of the redfish fishing areas. Some cod samples were obtained, but in most cases cod constituted an insignificant by-catch of the redfish catch (5.2% on the whole).

Commercial trawlers operated on the east and northeast slopes of the Newfoundland Bank (Subdivisions 3K, 3L and 3M) and in the southern part of the Labrador area (2J), mostly in water layers preferred by redfish (300 to 550-600 m.). Exploratory vessels (*Odessa, Zapad, Novorossijsk*) carried out operations mainly within the areas fished, sometimes moving out to Subdivisions 3N, 3O, 3P, 2H, and 2G.

Investigations were also conducted in some of the areas not fished by Soviet commercial trawlers in 1958; thus the west coast of Greenland was explored during the period from April to October with short intervals.

Soviet investigators were mainly engaged in biological research: distribution of fish aggregations, size, age and sex compositions of the exploited fish stocks[1]). Hydrological investigations were conducted on a limited scale; they seem to point to a considerable increase in temperature in 1958, particularly on the Newfoundland Bank.

Subarea 1.

Explorations were conducted by the trawler *Novorossijsk* from April to June, and from late July to the middle of September and by the trawler *Zapad* in October. Both trawlers operated mainly in Subdivisions 1C and 1D, where during all that time commercial quantities of *Sebastes marinus* and cod were observed (*Sebastes mentella* were completely absent). Explorations in Subdivision 1E were carried out at the beginning and at the end of every trip, but without much success. No commercial aggregations were found in Subdivision 1B, explored by the *Novorossijsk* in July and August.

Redfish kept to the western slopes of the banks, particularly the Lille Hellefiske Bank, at depths of 250 to 350 m. and with temperatures in the bottom layers of 2° to 4° C (up to 5°C later).

Cod were caught together with redfish everywhere, but the greatest cod catches were obtained in shallower places, particularly on the slopes of the deeps between Lille Hellefiske Bank and Fylla Bank and between Fylla and Fiskenaes Banks at a much lower temperature (sometimes lower than 1°C).

Data on the size composition of redfish in the area of the greatest aggregations (Figure 1) show that prior to July the females were smaller

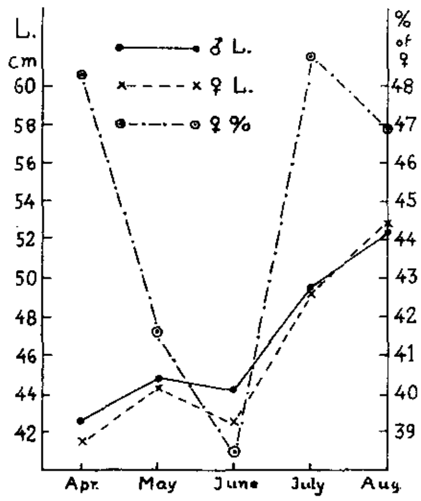


Fig. 1. Length of males and females of redfish, *Sebastes marinus*, and percentage number of females in samples from Subdivision 1C, 1958.

in size than the males, and that in June the percentage of females in the catches decreased considerably. This points to the fact that in the West Greenland area the shedding of larvae takes place in June, and that by this time the females pass the Lille Hellefiske Bank on their way to the breeding places which may be situated in deeper and warmer waters. The age composition of the catches shows that redfish were youngest in June, when the males predominated and the oldest females were absent.

The smallest (average 49.3 cm—5,369 spec.) and the youngest (mainly 4 to 5 years) cod were caught in Subdivision 1C. In 1D and 1E cod were somewhat larger (1D : 59.8 cm—11,246 spec.; 1E : 56.9 cm—1,454 spec.) and 5 to 8 years old. In 1B (July to August) the catches consisted of still larger fish (62.3 cm—4,619 spec.). Two age samples of cod taken in 1C (May) and 1D (June) indicate that the 1953 year-class in West Greenland is rich.

Subarea 2.

Investigations off Labrador were carried out by the *Odessa* and the *Novorossijsk* from the middle of August to late December, 1958. In August the northern part of this subarea (2G and 2H), was explored, but no commercial aggregations were found. Small quantities of cod

[1]) The data in tabular form will be published in the Sampling Yearbook.

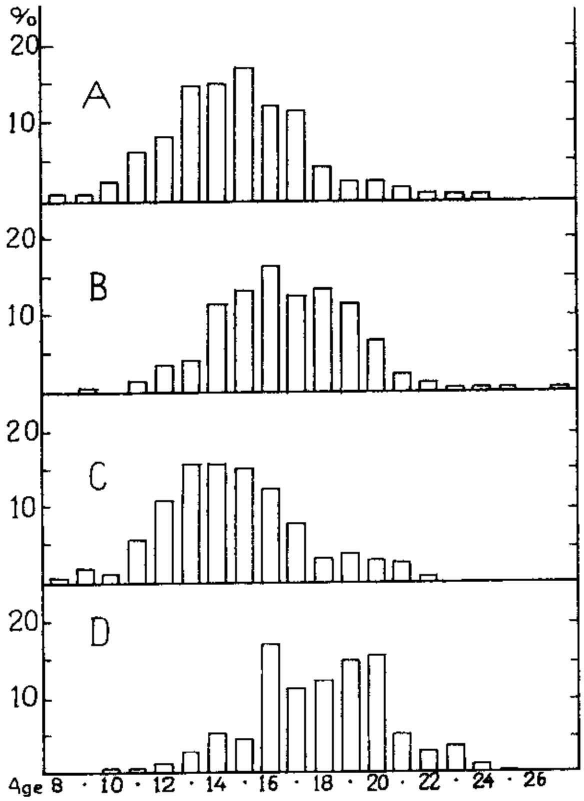


Fig. 2. **Age composition of *Sebastes marinus*, Subdivision 1C, 1958**
A—April, 261 spec., average weight 957 g
B—May, 342 spec., average weight 1266 g
C—June, 180 spec., average weight 987 g
D—August, 188 spec., average weight 1707 g

were caught (from several fish to several hundred kg) of the average size of 52 cm.

Commercial quantities of fish were found in Subdivision 2J, particularly in its southern part on the slope of the continental shelf. The greatest catches consisted of *Sebastes mentella* taken at a depth of about 300 m, with a bottom temperature of about 3°C. *Sebastes marinus* was almost always present in the by-catch (15% and more). Cod was also present at times, particularly in shallower places. The redfish were relatively large, the ground conditions favourable, and most Soviet trawlers moved to that area by September.

Age compositions of catches are given in Figures 2-6.

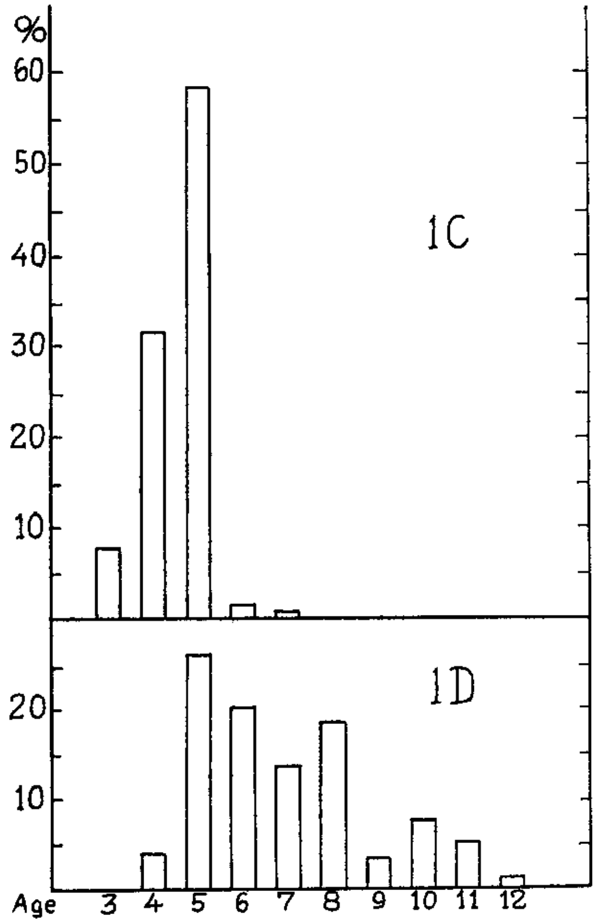


Fig. 3. **Age composition of cod, Subarea 1, 1958**
Subdivision 1C, May, 299 spec., average weight 901 g
Subdivision 1D, June, 299 spec., average weight 2722 g

In *Sebastes mentella* catches females predominated prior to November, particularly in September and October. The condition of gonads showed that mating took place in August. Starting in November, the percentage of females began to decrease. The catches in 2J were stable to the end of the year, but beginning in October a tendency was observed to a displacement of *Sebastes mentella* aggregations (females in the first place) southeastward, to the northeast slope of the Newfoundland Bank and to greater depths.

All data available indicate that Subarea 2 may be considered the place of summer feeding for the redfish and, ice conditions permitting, this fish may be caught in the southern half of

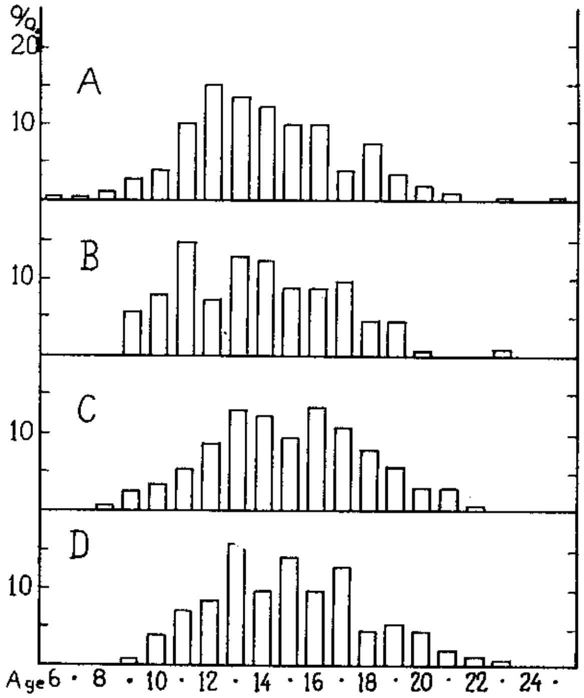


Fig. 4. **Age composition of** ***Sebastes mentella*****, Subdivision 2J, 1958**
A—August, 378 spec., average weight 829 g
B—Sept., 176 spec., average weight 761 g
C—Nov., 277 spec., average weight 833 g
D—Dec., 259 spec., average weight 765 g

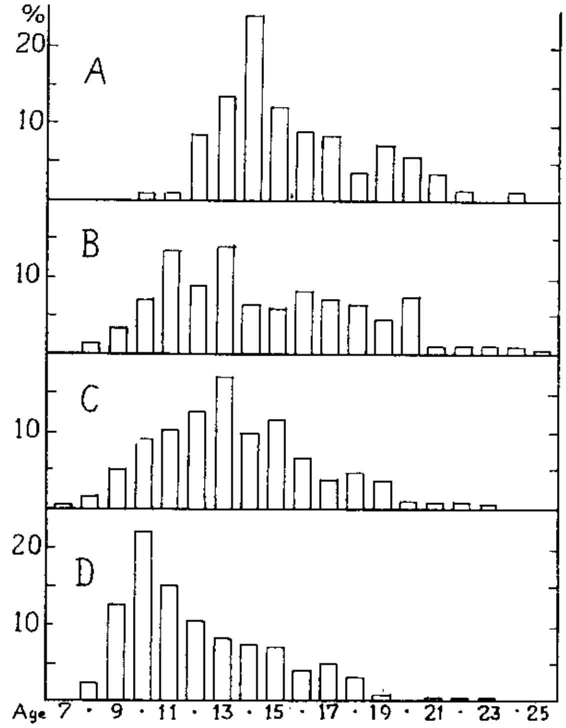


Fig. 5. **Age composition of** ***Sebastes mentella*****, Subdivision 3L, 1958**
A—March, 141 spec., average weight 854 g
B—April, 157 spec., average weight 950 g
C—August, 398 spec., average weight 764 g
D—Dec., 244 spec., average weight 764 g

the subarea during the greater part of the year, the males predominating there during the earlier part of the year, whereas both sexes inhabit it during the latter half.

Almost everywhere *Sebastes marinus* was present in the catches in different quantities. At the coasts of Labrador the two species mix to a much greater extent than in any other area of the Atlantic, even during the mating period. Therefore, quite a great number of redfish with mixed characteristics of both types may be observed.

The material of cod is very limited; it was based on the cod from the by-catch. This consisted of fish 20 to 120 cm in length and 3 to 14 years old. The main part were 40 to 70 in length and 5 to 9 years old.

Subarea 3.

The northeast and east slopes of the Newfoundland Bank (Subdivisions 3M, 3L, and 3K) were the main fishing areas for the group of Soviet trawlers, which fished in the Convention Area. Only 9.7% of the total catch was obtained off the Labrador coast, the rest were taken on the Newfoundland Bank: 52.6% in 3M, 27.2% in 3L and 10.5% in 3K.

The exploratory vessels operated mainly in the same areas in March to June, August to September, and November to December. The banks of the southwestern and southern slopes were explored in April, May, November, and December, but the commercial trawlers did not fish there, as no fish aggregations as large and as stable as those on the eastern and northeastern slopes were found.

At Flemish Cap, the fleet operated from January to September, but this fishing ground was of particular importance in January to March and June to August. Subdivision 3L was fished by commercial trawlers from April to September, mostly in April and May. In October to December the entire fleet operated in 3K.

In all these subdivisions the catch was based on *Sebastes mentella*, which form dense aggregations at depths of 300 to 450 m (on the Flemish Cap to 600-650 m during the winter months) and at a temperature of 3° to 4°C. *Sebastes marinus* was always present in the by-catch, particularly in Subdivision 3K. Cod was caught in smaller quantities, and mostly on the Flemish Cap in March (over 10%) and in June to July (about 10%).

In all subdivisions of Subarea 3 the females of redfish predominated somewhat, in 3L they constituted over 70% of the total catch by the end of the year. Fishing operations and size and sex compositions of the redfish catch show that the same stock is fished at the Labrador coast and on the eastern slope of the Newfoundland Bank, this stock moving southward in winter and northward in summer. The shedding of larvae takes place on the east and southeast slopes of the Newfoundland Bank in May.

At Flemish Cap the redfish are, on the whole, smaller in size; apparently they do not mix with the Newfoundland redfish, but move along the slopes of the Flemish Cap, where extremely uniform hydrological conditions and a closed circular current are observed. The shedding of larvae takes place on the south and southwest slopes of the Flemish Cap, the feeding of males and females and the hibernation of males and immature females, on the north slope.

The spawning of cod in the shallow places of the Flemish Cap and on its slopes takes place in March and the by-catch of cod at this time increases considerably. The age of spawning cod is mainly 7 to 9 years.

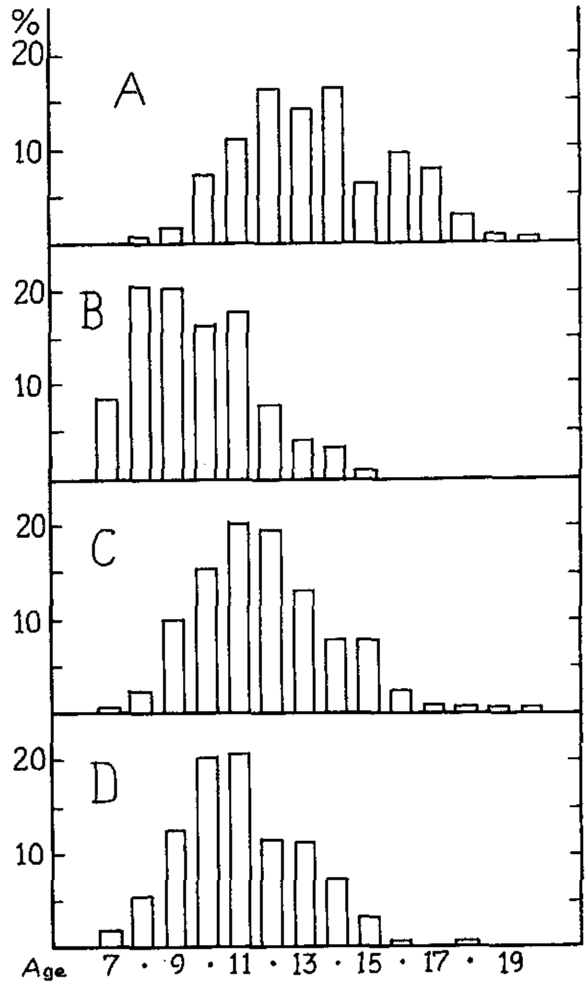


Fig. 6. **Age composition of *Sebastes mentella*, Subdivision 3M, 1958**
A—March, 125 spec., average weight 779 g
B—May, 151 spec., average weight 485 g
C—Aug., 294 spec., average weight 584 g
D—Sept., 239 spec., average weight 523 g

X. United Kingdom Research Report, 1958

BY C. E. LUCAS AND R. S. WIMPENNY

Commercial Fishing.

Compared with the previous year, there was an increase in effort from 40 to 47 trawler voyages to Subarea 1. These resulted in a total catch of 5,873.3 metric tons of all species—of which cod (5,326.2 metric tons) was the most important—and showed a small reduction in catch per vessel for the year and a reduction in quantity of cod of the category 'large.'

Also from Subarea 1 were two landings from a factory trawler totalling 903.9 metric tons of which the major part was landed as cod fillets.

One trawler and two factory trawler voyages were made to Subarea 3 and provided 119.4 metric tons and 753.3 metric tons respectively, the latter again consisting mostly of fillets.

Market Sampling.

This was restricted to Subdivision 1F. The raised cod measurements (2,841) gave the length composition of the total landings as in the accompanying figure.

Comparative Fishing.

Although no comparative fishing experiments were conducted in the ICNAF area in 1958, work carried out in the ICES area provided data which should be of direct relevance to the Commission's scientific programme. In particular, work is proceeding on investigations of the effects of codend top-side chafers, and preliminary results will be communicated at the 1959 Meeting.

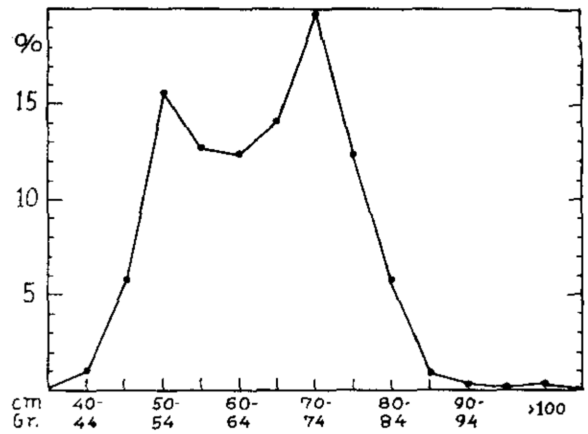


Fig. 1. **Cod, Subdivision 1F, 1958. Percentage length composition by 5 cm groups of U.K. Landings based on 2,841 measurements, raised to numbers landed.**

Addendum

PROGRESS REPORT ON TRIALS OF TOP-SIDE CHAFERS

BY R. J. H. BEVERTON, B. B. PARRISH AND G. C. TROUT

Barents Sea Cod.

A number of tests of the effect on cod-end selectivity of top-side chafers have been carried out on recent cruises of the 'Ernest Holt' in the Barents Sea. The investigations are still in progress, but some provisional results have been obtained which it may be of value to place on record.

The tests have been carried out by the covered cod-end technique, the cod-end being fished alternately with and without a chafer. Some tests were made with a loose chafer according to the ICNAF specification, and some with a tight chafer as used commercially. The mesh size of the cod-ends (double manila, runnage about 40 yds/lb.) ranged between 105 mm and 110 mm, except for one cruise when it was 130 mm. The chafers were of the same kind of netting as the cod-end, but partly by design and partly by accident (shrinkage) their mesh size was sometimes less than that of the cod-end, sometimes the same and, in one instance decidedly larger.

Most of the results obtained so far have been on cod, but it is hoped that data for haddock will be obtained on tests later this year.

The results to date can be summarized as follows:—

(1) Tests made with cod-end of 105 mm fitted with a tight chafer having a mesh size of about 95 mm, showed that the selectivity for cod was markedly reduced by the chafer, the 50% length being decreased from about 40 cm to below 30 cm, that is, to a length substantially smaller than would be expected from even the smaller mesh of the chafer.

(2) Tests in which the cod-end and chafers were of the same mesh sizes as above, (i.e. cod-end 105 mm and chafer mesh 95 mm) but in which the chafer was fitted according to the ICNAF specification, gave a reduced selectivity for cod, but this reduction was less severe than with tight chafers. The 50% length corresponded, in fact, to what would have been expected if the mesh size of the chafer had been the determining factor for selection.

(3) Tests in which an ICNAF specification chafer was fitted to a cod-end of the same mesh size (110 mm) gave, as it happened, rather variable results, but on average the selectivity of the

chafered cod-end was somewhat less than that of the unchafered cod-end.

(4) Finally, some tests were made in which a chafer (ICNAF specification) of above 150 mm was fitted on alternate hauls to a cod-end of about 130 mm. The selection curves with and without the chafer were virtually identical.

It appears from these results that a tight chafer has a very severe effect on selectivitiy—as indeed would be expected. Whether it was coincidence that the selectivity of cod-ends fitted with an ICNAF chafer happened to coincide with what would be predicted from the chafer mesh size remains to be seen. If it is not, then it would seem that even with a loose chafer unattached at its lower end, the fish were escaping vertically through both the cod-end and the chafer meshes rather than through the open end of the chafer. This is in fact, what would be expected from the behaviour of fish observed by underwater television. The covers used in all these tests were of nylon shrimp netting and were made extra large to avoid interfering with the chafer. Nevertheless, it may still have been that the cover was having a masking effect, overlaying the chafer and forcing it to lie closer to the cod-end than it would normally. To test this requires the alternate haul technique instead of using covered cod-ends, and it is hoped to carry out such tests if opportunity permits.

Perhaps the most encouraging results were those obtained with the chafer having a substantially larger mesh size than the cod-end. Further work is planned, including the effect of variations in (i) shoal density and (ii) length composition, over a wider range of conditions than have been investigated hitherto and on other species than cod, to confirm whether the use of the large meshed chafer does indeed leave the selectivity of the cod-end unimpaired; and if so, to find what is the minimum difference between the mesh size of the cod-end and chafer that is needed to ensure this result.

Faroe Haddock.

Similar trials to the above have also been made on haddock by F.R.S. 'Explorer' in the Faroe area.

These experiments were made with a loose chafer according to ICNAF specification with a mesh size (130 mm) substantially greater than that of the cod-end mesh (90 mm). The chafer was made of 3 strand manila twine, (runnage 112 yds/lb) while the cod-end was made of double, 4 strand manila twine (runnage 75 yds/lb). A loosely fitting topside cover made from "courlene" was used in the trials.

The results of these trials revealed a large chafer effect. While the selection factor for haddock in the hauls without a chafer averaged 3.1, in the hauls with a chafer it averaged only 2.6.

The results point therefore to a large masking effect of the chafer on haddock escapement. However, as in the Barents Sea experiments it is not possible to determine from the data the extent to which the apparent masking in these trials was a function of the cover. Further trials on haddock, using both the alternate haul and covered haul techniques are planned to test this possible effect.

XI. United States Research Report, 1958

I. FISHERY AND BIOLOGY

BY HERBERT W. GRAHAM

SUBAREA 5

Haddock (*Melanogrammus aeglefinus* (L.))

The Fishery. U. S. haddock landings were lower than in 1957. The Boston landings for 1958 were approximately 12% less than landings for 1957, with only about 1% difference in effort. A trend toward higher proportions of larger fish over the past few years continued in 1958, which was the first year since 1949 that more large than scrod haddock was landed. The total haddock catch-per-trip was 5,000 pounds less in 1958 than in 1957.

Preliminary analysis of Georges Bank age composition in 1958 shows the 1954 year-class continued to dominate the fishery. The 1952 year-class is no longer important in the fishery and the 1956 year-class was weak, thus ending the cycle of alternating large and small year-classes which began in 1947. With weak year-classes in 1955 and 1956, the outlook for the 1959 haddock fishery is poor. A young-of-the-year census cruise aboard *Albatross III* suggests that the 1958 year-class is of greater than average strength and may contribute substantially to 1960 landings at age two.

Tagging. The haddock tagging program in Subdivisions 4X, 5Y, and 5Z continued in 1958. Tagging was conducted at four widely separated areas in spring and fall cruises. The plastic tube ("spaghetti") tag attached dorsally was used exclusively in the program in which about 2,600 otter-trawl-caught fish were tagged.

Returns analyzed by season tagged show spring tagging most successful, fall and winter tagging only moderately successful and summer tagging least successful.

Ecology. A program to study the relationship of haddock to its environment was conducted in 1958. A small haddock ground off Cape Cod was fished by a chartered commercial otter trawler once each month. Bathythermograph drops were made on each trip and a sample of 50 male and 50 female haddock was returned to the laboratory. This sample was examined for age, growth, weight, and to determine the seasonal changes in gonad development. Stomachs were collected from the 100 fish for analysis of food habit changes throughout the year.

Abundance data indicate that although some haddock are present on the ground throughout the year, they tend to congregate there in the spring for spawning.

Age Determination. Special studies of otoliths, scales, and fin rays designed to refine age readings continue.

Effects of Mesh Regulation. The increase in average weight of landed haddock at ages 2 and 3 which was observed shortly after enactment of mesh regulation in Subarea 5 continues, and is now observed in fish 4 and 5 years of age. The persistence of this increase well beyond the 100% selection point of the $4\frac{1}{2}$-inch mesh may indicate a greater-than-predicted saving of small fish, substantially a reduced fishing effort on early ages.

Growth studies covering the period 1953 to 1958 eliminate the possibility of the increase in weight having resulted from an increase in rate of growth.

Cod. (*Gadus callarias* L.)

The Fishery. A definite increase in abundance of cod in Subarea 5 occurred in 1958 due to successful recruitment into the fishery of one or more year-classes of what are tentatively considered two and three-year-old fish.

Research. Study of age and growth of cod on Georges Bank and adjacent areas showed that scales are of very limited value for this work but that otoliths are apparently easily read. Rough growth rates calculated from otolith readings agree with earlier Bureau of Fisheries work in that this is a very rapidly growing stock of fish, attaining sizes on the order of 50 cm in three years.

Some preliminary exploration of the possibility of identifying subspecific groups of cod by paper chromatography of muscle tissue has been made. This work indicates that degenerative changes in the muscle of fish stored for two or three days on ice are probably not serious.

Examination of data on infestation with the parasite *Lernaeocera* has been completed and the evidence obtained bears our previous theories about distribution of stocks of fish in Subarea 5.

Accumulation of material on a cod bibliography continues and it is expected to have this substantially completed by the autumn of 1959.

Flounder.

Extensive age and growth studies of the yellowtail flounder (*Limanda ferruginea* (Storer)) from three principal New England fishing grounds are completed. Tagging data have been analyzed for all returns through 1958.

The yellowtail flounder appears to be increasing in abundance on southern New England grounds and the southeast part of Georges Bank. Catches in 1958 were the best since 1949. Fish from the 1955 and 1956 year-classes contributed substantially to the landings.

During 1958, monthly samples of the dab (*Hippoglossoides platessoides* (Fabr.)) were obtained for age-growth and life history studies.

Industrial Fishery.

Species composition studies of industrial fish landings were extended and analyzed to determine the role of bottom temperature in the distribution and relative abundance of various species in specific areas.

Industrial fish generally was not as abundant in 1958. The red hake (*Urophycis chuss* (Walb.)) in particular was in short supply relative to the prior three years.

Silver Hake (*Merluccius bilinearis* (Mitchell))

Research. Annual summaries presenting biostatistical data are being prepared for the the years 1956 through 1958. The summaries will include landing statistics for all major New England ports, the percentage utilization of landings (food, reduction, etc.) and the age-length composition of these landings.

A study of the feeding habits of the silver hake indicates that invertebrates, especially euphausiids and decapod shrimp, are the principal food in the New England area.

The Fishery. Landings of silver hake were generally off compared with 1957. The decrease appeared to be associated more with the colder water conditions inshore than with a decrease in absolute abundance.

Redfish (*Sebastes marinus* (L.)).

The Fishery. Abundance in the Gulf of Maine held steady, as did landings.

Research. Biological data were collected regularly from the commercial catch. These data include length, age, abundance, size at maturity, time of spawning, and incidence of parasites.

Racial studies were intensified in preparation for the Redfish Symposium in October. For these studies collections were received from many areas in the North Atlantic.

The vertical distribution of larval and postlarval redfish was described for the Gulf of Maine.

Certain phases of the growth and migration studies of the Eastport stock were completed and will be reported at the symposium.

Sea Scallops (*Placopecten magellanicus* Gmelin)

The Fishery. U. S. landings from Subarea 5 in 1958 were 14.4 million pounds, compared to 17.3 million pounds in 1957. The decrease was entirely due to a decrease in effort from 10,500 days fished in 1957 to 8770 days in 1958.

Research. Two cruises were made to collect data to be used in estimating growth and mortality rates and to conduct tagging experiments. Routine collection of catch, effort, and size composition data continued at all ports of landings. Catch and effort statistics tabulated by 10-minute squares were forwarded monthly to Commission headquarters at Halifax. Results of analyses of data are reported elsewhere in Commission documents.

Plankton Ecology.

A study of the vertical distribution of larval and juvenile haddock in the Gulf of Maine-Georges Bank area indicates that young haddock remain in the upper layers for a considerable period. Maximum numbers of larval and postlarval haddock (4.5-20.0 mm.) occurred in the upper 20 meters in all areas. Maximum numbers of juvenile haddock (50-90 mm.) were found at the 20-meter level. No diurnal migration pattern was indicated. A study of the vertical distribution of larval and juvenile haddock in relation to the distribution of zooplankton has been initiated.

OTHER SUBAREAS.

Most of the United States research was restricted to Subarea 5. Co-operative studies with Canada of Subarea 4 haddock continued. Redfish abundance and racial studies extended to catches from other areas as in past years.

II. HYDROGRAPHY

BY DEAN F. BUMPUS

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Hydrographic research by the U.S.A. in the Convention area was carried out by four agencies during 1958: the U.S. Coast Guard, U. S. Coast and Geodetic Survey, the Bureau of Commercial Fisheries and the Woods Hole Oceanographic Institution.

A. The U.S. Coast Guard, as the agency operating the International Ice Patrol, examined the temperature and salinity distribution from the surface to 1500 meters in 3 net work surveys in the Grand Bank region. The fiist survey, 3-15 April, covered waters over and immediately seaward of the southern and eastern slopes of the Grand Bank from just westward of the Tail of the Bank northward to the latitude of Flemish Cap. The second survey, 27 April to 5 May, covered the area immediately seaward of the northeastern slope of the Grand Bank from Flemish Cap northwestward and included the Bonavista triangle. The third survey, 23 May-5 June, covered an area similar to the first but with the addition of a southward section, to 3000 meters, along 50°15′W long. across the Atlantic Current to 37°30′N lat. The post season cruise, 27 June to 6 July, occupied the Bonavista triangle and the Labrador-Cape Farewell section to within $7\frac{1}{2}$ miles of Cape Farewell.

The abnormal amount of onshore winds along the Labrador coast during the first three months of 1958 resulted in an alteration of the usual thermo-haline structure of the Labrador current; the minimum observed temperature was about a degree warmer than usual, but extended to abnormal depth. The warm water found was not as warm as usual, but was of normal geographic extent; the salinities at intermediate depths were lower than usual.

The report *in toto* will be published in U.S. Coast Guard Bulletin No. 44.

B. "In August 1958 the Coast and Geodetic Survey anchored a Roberts radio current buoy in 42 fathoms and one in 104 fathoms at the outer edge of the continental shelf near Georges Bank, 155 miles east of Cape Cod. Half-hourly observations of current speed and direction were made for four days from current meters suspended near the surface and bottom in 42 fathoms and near the surface, mid-depth and bottom in 104 fathoms. Nansen bottle casts were made at each station at time of planting and recovery, and a BT was obtained at each station every six hours. Velocities up to 1.8 knots were encountered, the currents were predominantly tidal and rotary, at least to 290 feet. The meter at 590 feet, near the bottom at the break in the slope, became inoperative after one day and the data were insufficient to attempt a rotary reduction. However, for the 18 simultaneous observations at 590 and 290 feet, the currents averaged 0.1 knots stronger at the bottom.

"Profiles of temperature-with-depth plotted against time show internal waves with heights up to 100 feet and suggest periods of tidal magnitude, although the data on the latter are not conclusive. These were most pronounced in a layer of warm water at about 425 feet, where the temperature was some 6° above that at 200 feet." (Quoted from abstract by H. B. Stewart, Jr., G. G. Salsman and A. J. Goodheart in Program, Fortieth Annual Meeting, American Geophysical Union.)

The Coast Survey has noted that sand ridges on Georges Shoal in 10 fathoms of water, which rise to within 2 fathoms of the surface have migrated 900 feet to the westward since 1931. During the summer of 1958 these ridges were studied by underwater swimmers, photographed, and sampled to evaluate the processes affecting sediment movement.

C. The Bureau of Commercial Fisheries has collected a limited amount of temperature (bathythermograph) and salinity data in Area 5 (including hydrographic sections across Browns and Georges Banks in April and September).

In concert with the Fisheries Research Board of Canada 7600 drift bottles were released in

Area 5 with 5% returns. It is now possible to deduce the circulation pattern in Area 5 year-round.

D. The twelve lightship stations from Maine to Georgia equipped, at the end of 1955 by the Woods Hole Oceanographic Institution under contract with the Fish and Wildlife Service, as observation posts to collect surface temperature and salinity observations daily, bathythermograph drops daily and bottom water samples weekly, have continued in operation. The data for 1956 were reported in Special Scientific Report—Fisheries No. 233, for 1957 in Special Scientific Report—Fisheries No. 282.

The Institution conducted monthly cruises from May through September in the area of the cold wedge south from Martha's Vineyard and Nantucket, to investigate variations in the position and morphology of the temperature and salinity gradients between the coastal and slope water. Closely spaced hydrographic stations and bathythermograph lowerings indicate maximum gradients of 1.0 ‰ per 5 meters, and 10°F. per 5 feet. The volume of cold coastal water decreases with the advancing season, being in September about 1/5 of that in May. In June and July the cold coastal water extends relatively far southward into the slope water, indicating that bubbles of cold coastal water calving into the slope water may be quite large in early summer. (Excerped from part of abstract by G. M. Cresswell in Program for International Oceanographic Congress.)

PART 3

B. Compilation of Research Reports by Subareas 1958.

BY ERIK M. POULSEN

Summaries of researches carried out in 1958 were reported by Canada, Denmark, France, Germany, Iceland, Norway, Portugal, Spain, U.S.S.R., United Kingdom and United States.

The table below shows the distribution of field researches by subareas and countries (+ + denotes investigations from special research vessels, + investigations from other vessels).

Subarea	1	2	3	4	5
Canada		++	++	++	+
Denmark	++				
France	+	+	+	+	
Germany	++	++	++		
Iceland	+	+	+		
Norway	++				
Portugal	+	+	+	+	
Spain	+				
U.S.S.R.	++	++	++		
United Kingdom	+				
United States	+	+	+	++	++

The main development compared to 1957 is that Canadian researches on scallops are reported from Subarea 5, that Germany and Iceland—in conformity with the expansion of their commercial fisheries—have extended their researches to cover also Subareas 2 and 3, and that Portugal has reported for the first time on her research work in Subarea 4 (Gulf of St. Lawrence).

The French researches in 1958 have been limited to hydrographic observations. The U.S.S.R. investigations are carried out from "exploratory trawlers", they include as well biology as hydrography. United Kingdom has, in addition to the sampling in Subarea 1, carried out—outside the Convention Area—comparative fishing experiments in direct relevance to the ICNAF program.

SUBAREA 1.

A. Hydrography.

As in previous years a number of sections were taken by Denmark and Norway from the W-Greenland coast between Cape Farewell and Disko across and beyond the banks; further France and U.S.S.R. have made a series of observations in the subarea and the USA Coast Guard and the Canadian AOC, St. Andrews, have taken sections between Labrador and Greenland.

Over the W-Greenland banks the temperatures were normal or just below normal; west of the banks the temperatures in the upper 100 m were below normal. Off S.-Greenland water of the Irminger current was a little warmer than normal.

Figure 1 compares the temperature in the upper 300 m on and W. of Fylla Bank in 1955-58 (Danish sections). In 1959 a tongue of water below 1°C was present on the western slope, where in 1956 and 1957 the temperature was 2-3°. West of the Bank cold water penetrated further eastward than in the two preceding years.

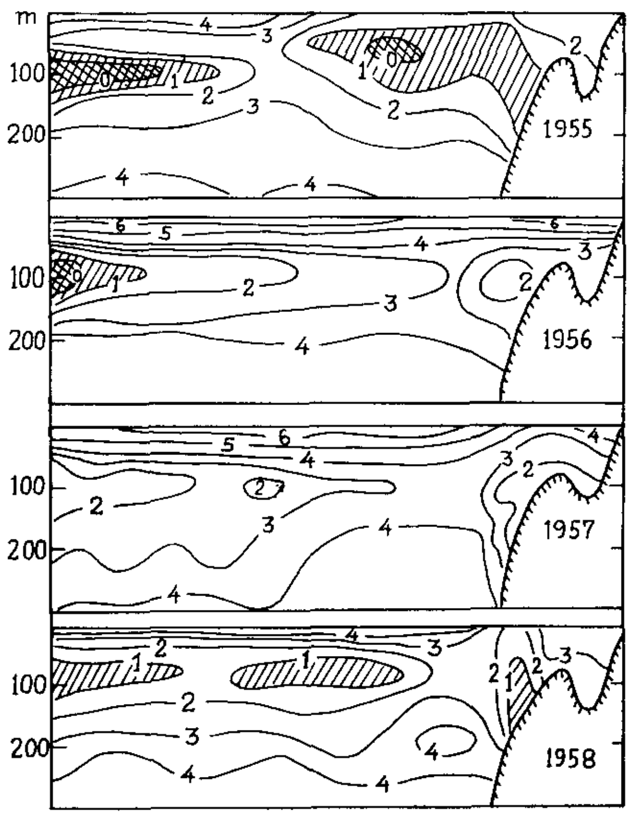


Fig. 1. **Comparison of water temperatures on and off Fylla Bank in 1955 to 1958. Water masses below plus 1°C hatched, below 0°C double hatched. (Danish sections.)**

B. Cod.

The numbers of larvae found by the Danish investigations on and west of the banks were considerably lower than in 1957, as appears from the following survey of mean numbers of larvae per 30' hauls since 1950:

Year	1950	1951	1952	1953	1954	1955	1956	1957	1958
no.	8	?	1.6	4.1	1.3	1.3	1.2	87.8	4.6

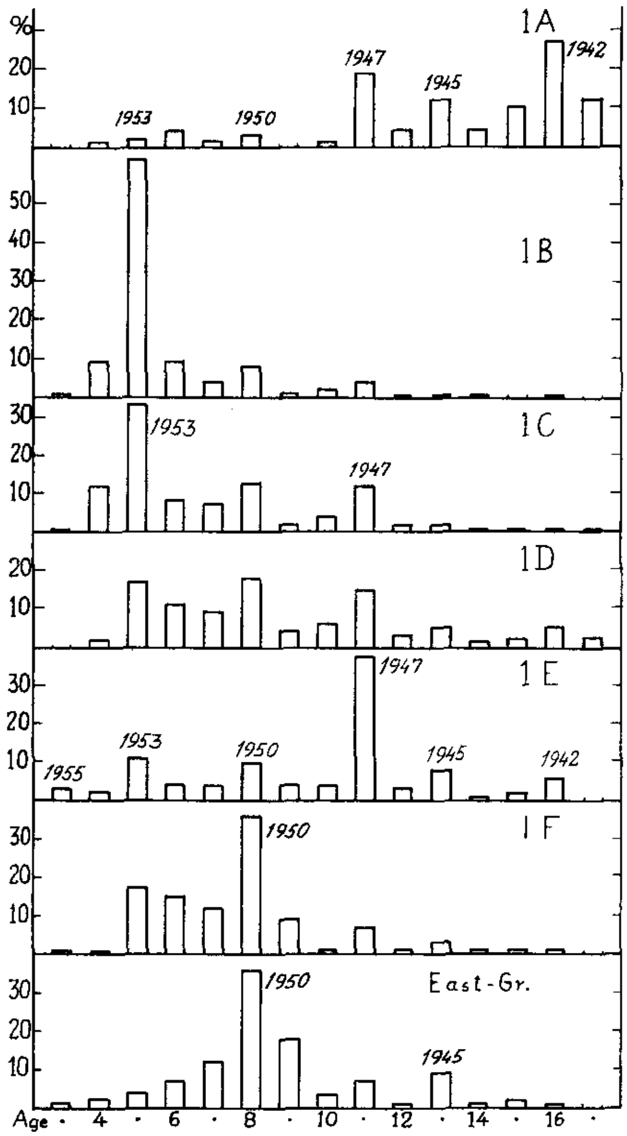


Fig. 2. **Percentage age frequency of cod caught in Subdivisions 1A-F and off East Greenland in the summer of 1958. All countries various gears.**

Age-composition of catches by commercial gears were reported by Denmark, Germany, Iceland, Norway, Portugal and USSR; the same countries, as well as Spain and U.K. reported length-distribution.

Figure 2 shows the age-distribution by subdivisions; the Danish data from the coast and fjord area are only included for 1A, 1E and 1F where Danish offshore samples are not available.

In the northernmost region, 1A, cod of the 1947 year-class and older cod predominate. In 1B, however, the picture is the reverse; here only very few cod of the rich 1947 year-class are left and hardly any still older cod. The 5 year-old cod of the 1953 year-class dominate with 62%, fairly well represented are the 1954, 1952 and 1950 year-classes. In 1C the distribution is about the same, only the predominance of the 1953 cod is less pronounced (33%). In 1D the 1953 class is with 17%, just surpassed by the 1950 class with 18%. In this subdivision, as in 1C, the 1947 year-class is fairly well represented (12-15%). In 1E the picture changes again. The 1947 year-class predominate with 48%, followed by the 1950 and 1953 classes. In 1F again somewhat younger cod predominate: 1950--36%, and 1951, 52 and 53—12, 15 and 17%. In the East-Greenland waters the 1950 year-class predominates with 36% followed by 1949 wth 18%.

For Subarea 1 the main differences from previous years are the increased importance of the 1953 year-class in 1C (immigration from 1B) and the decrease in strength of the 1950 year-class in 1E (emigration toward the South and East).

Redfish. The Danish observations on size and age of young redfish in coastal areas have been continued. USSR has reported data on size and age of commercially caught redfish. Germany had earlier reported a series of length data by month for 1958; these data were included in the Sampling Yearbook, vol. 2 together with similar data from 1955, 56 and 57.

Halibut. Denmark and Norway have continued the tagging work and the collection of data on size and age.

SUBAREA 2.

A. Hydrography.

Sections: Seal Island, Hamilton Inlet Bank; 4-5 Aug. Canada

Labrador-Greenland, Canada
Labrador-Greenland; 27 June-6 July, USA.

Canada, Germany, Iceland and USSR made hydrographic observations in connection with the experimental fishery.

Canadian and USA results agree in showing the salinity in deeper layers to be lower than usual.

B. Cod.

The age distributions of cod caught by Icelandic and Portuguese trawlers from 2J are compared in Figure 3. There is a marked difference between the two samples: In the Icelandic sample the 5 and 6 years old (1952- and 1953 year-classes) predominate; in the Portuguese, however, the 1947 and 1948 cod dominate with 14% each, closely followed by the rest of the year-classes 1946-51; the average age of the Icelandic sample is only 5.8 years against 9.6 years for the Portuguese sample. The growth rate also differs for the two set of samples:

Mean length (cm) at age	3	4	5	6	7	8	9	10-13
Iceland	38	47	53	59	64	62	73	71-101
Portugal	36	39	43	50	53	56	58	60-65

The two set of samples are from different zones in 2J: The Portuguese from the SW part of Hamilton Inlet Bank and from the coastal area N. of Belle Isle (55°W) ca. 80-120 fathoms; the Icelandic from an area farther east (ca. 51°W); 150-180 fathoms. Judging from the Canadian hydrographic section across Hamilton Bank, the Portuguese samples are fished in cold water (0 to 1°(C), the Icelandic ones in warmer water (ca. 3,6°C). It is to be noted that a similar difference as to stocks is observed when comparing coastal samples from Subdivision 1A with bank samples from 1B (Figure 2).

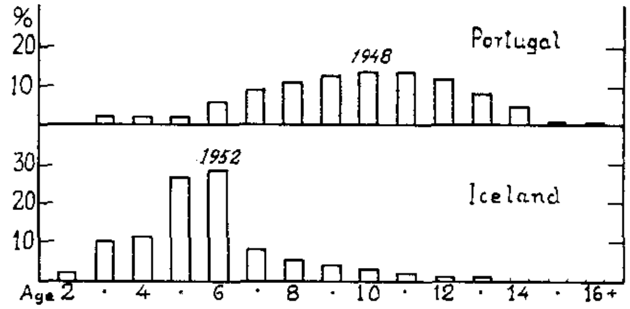


Fig. 3. Percentage age frequency of cod caught in Subdivision 2J by Icelandic and Portuguese trawlers in 1958.

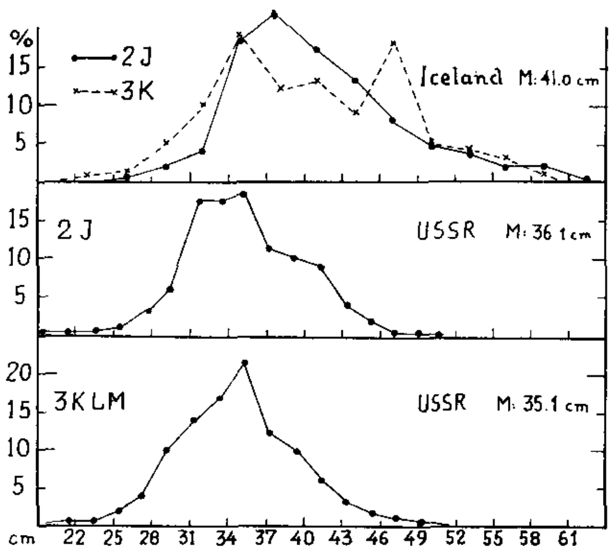


Fig. 4. Size-distribution of samples of redfish from the Icelandic and USSR (*Sebastes mentella*) fishery in Subareas 2 and 3 in 1958.

C. Redfish.

In 1958 a considerable fishery for redfish developed in Subarea 2 (71,000 tons); of the countries participating in this fishery Canada, Iceland and USSR have reported samples of their catches.

Canada reports that big quantities of the large *marinus* type were caught east of Hamilton Bank: in a halfhour haul 480 pounds to only 80 pounds of the smaller *mentella* type; farther south in 2J 11% were made up by the *marinus* type.

The Icelandic and USSR reports include data on length. These data are used in Figure 4 together with data from Subarea 3KLM. The Icelandic curves for 2J and 3K refer to "redfish" without differentiation between *marinus* and *mentella*. The USSR data are referred to *mentella*. This may explain the differing size, Iceland, mean length 41, USSR 36 cm. The USSR report states that in the various catches 15% or more are of the *marinus* type. The peak of the Icelandic curve for 3K off 46 cm may be caused by a considerable intermixture of *marinus*; the small bulge on the USSR curve off 41-42 cm may indicate that a small number of *marinus* are still included in the sample. The two USSR curves for 2J and 3KLM are rather similar, and the mean lengths close to one another.

SUBAREA 3.

A. Hydrography.

Sections: Five sections across the bank area from off Bonavista to the southern slope of the Grand Bank, July-August; Canada. Four net work surveys in the Grand Bank region, April to July; USA.

Further hydrographic observations from fixed stations or in connection with biological researches through the year; various countries.

Off the NW coast of Newfoundland the upper cold water layer extended deeper than usual. E. of Newfoundland the bottom temperatures on the shallower parts of the Bank were slightly higher than in the previous year.

B. Cod.

Researches on the cod have been reported by Canada and USSR for Subarea 3.

The Canadian observations show for the cod caught by longliners in the region off Bonavista a general decrease in mean size of 10 cm from 1952 to 1958.

USSR has reported measurements of cod caught in otter trawl from four of the subdivisions; the following mean lengths were found:

3M	—	53.0 cm
3N	—	52.2 cm
3L	—	61.0 cm
3O	—	58.9 cm

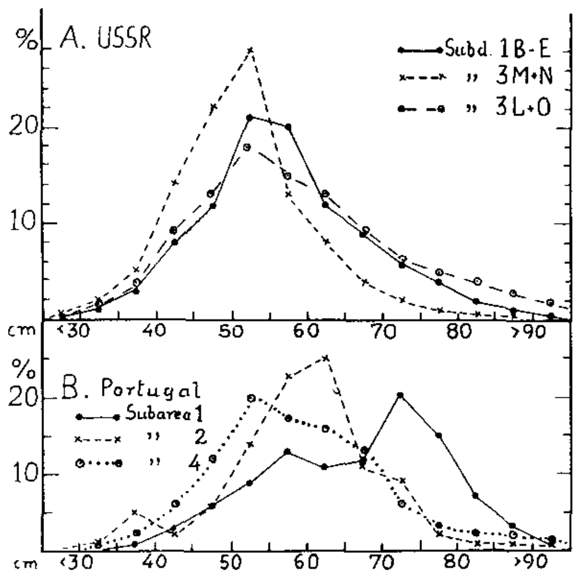


Fig. 5. **Size-distribution of samples of cod from the USSR trawl fishery in Subareas 1 and 3 in 1958 (A) and Portuguese trawl fishery in Subareas 1, 2, and 4 in 1958 (B).**

It appears that the cod caught in L and O, the Grand Bank area proper, are considerably larger than the cod caught in the area E and SE of the Bank, M and N.

The length distribution curves for these two regions are shown in Figure 5A together with the length distribution of cod caught by USSR in Subarea 1. Apparently there is only a small difference in size between the cod caught on the Bank proper (L+O) and in Subarea 1; the mean length for 3L + O being 60.0 cm and for 1B + E 57.8 cm.

C. Haddock.

The Canadian investigations indicate that there has been no significant survival of young haddock on St. Pierre Bank since the 1949 year-class. On the Grand Bank the 1955 year-class was the most abundant and it is expected to contribute significantly to the fishery in 1959 and 1960. The 1956 and 1957 year-classes do not appear to have survived well.

D. Redfish.

The Canadian researches, as well as those by USSR, show that the stock in the northern and eastern part of the Subarea includes both *marinus* and *mentella* types.

Length measurements by USSR (*mentella*) show hardly any difference in size between redfish of the same type from the different subdivisions:

3M	—	mean length 34.7 cm
3K	—	mean length 34.7 cm
3L	—	mean length 36.3 cm

These averages differ not much from the average length of 3 German samples from Subarea 3 (subdivision not stated) from 1958, published in Sampling Yearbook vol. 2, namely 37.5 cm.

SUBAREA 4.

A. Hydrography.

A section across the Scotian Shelf; May, August, October; Canada.

Hydrographic survey of the Scotian Shelf; quarterly; Canada.

Analysis of volume transport; Cabot Strait; Canada.

B. Cod.

Canadian researches show that the 1954 year-class is of above average abundance.

Portugal reports on investigations of cod in the Gulf of St. Lawrence in 1956, 57 and 58. The length curve for 1958 shows a fairly broad peak off the 50-65 cm groups. In Figure 5B the length distribution of the Portuguese trawl samples from Subdivisions 4STV in 1958 are compared with other Portuguese trawl samples from the same year from other subareas. The comparison shows the Labrador cod as being not a particular small-sized cod:

Subdivision 1C	—	62.0 cm
" 1D	—	71.7 cm
" 2J	—	60.1 cm
" 4 STV	—	59.3 cm

C. Haddock.

Canada is the only country reporting on haddock researches, carried out partly in cooperation with U.S.A. (See Canadian Research Report.)

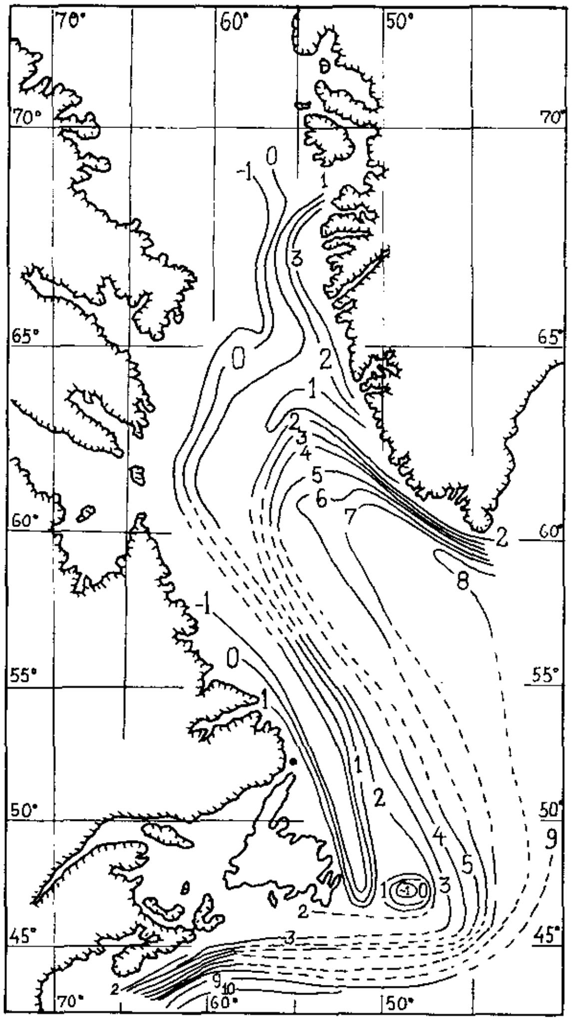


Fig. 6. **Isotherms (°C) in 50 m depth in the Convention Area, July-August 1958. Canadian, Danish and Norwegian observations.**

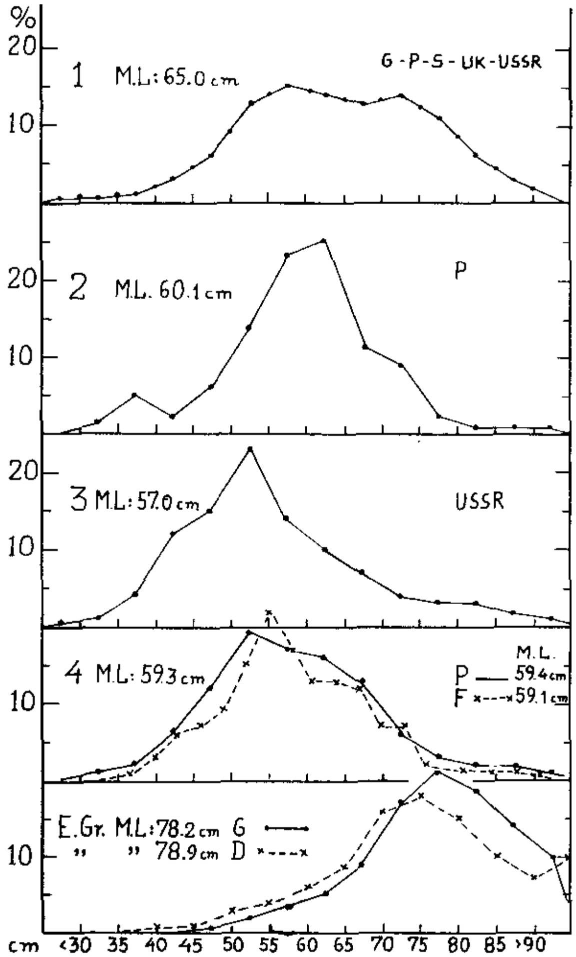


Fig. 7. **Cod. Length-distribution of samples from otter trawl in Subareas 1-4 and off East Greenland in 1958 by Germany, France, Portugal, Spain, United Kingdom and USSR (indicated in the figure by their initials).**

C. Others.

The Canadian Research Report further deals with American plaice, redfish, sea-scallops, taggings of cod, haddock and plaice, observations on discards and researches on gear selection.

SUBAREA 5.

Data on researches in this Subarea were reported only by USA (see USA Research Report.)

ALL SUBAREAS.

A. Hydrography.

Isotherms (°C) for 50 m depth are shown in Figure 6, based on sections reported by Canada, Denmark and Norway. A comparison with 1957 shows a decrease in temperature on the western slope of the Greenland banks and in the area west of the banks (see also Figure 1). Off SW-Greenland the tongue of warmer water penetrating into the Labrador Sea from the Atlantic seems to be broader than in 1957.

Off Labrador and E of Newfoundland a small increase in temperature is observed in certain cases.

B. Cod.

The length distribution of 1958 samples of cod caught by otter trawl in Subareas 1-4, and reported either in the research report for 1958 or published in the Sampling Yearbook vol. 2, is presented in Figure 7.

It is apparent from the curves that cod from the East Greenland Area, those caught by German trawlers as well as those taken by the "Dana," are considerably larger than the cod from the various parts of the Convention area, the mean length being 78-79 cm. Within the Convention Area the samples showing the largest individual size are those from Subarea 1 (German, Portuguese, Spanish, British and USSR trawlers), thereafter come the Portuguese samples from Subarea 2, and following them closely, USSR samples from Subarea 3 and Portuguese and Spanish samples from Subarea 4.

The mean lengths for the samples cited here are by Subareas as follows.

East-Greenland	—	78.6 cm
Subarea 1	—	65.0 ,,
Subarea 2	—	60.1 ,,
Subarea 3	—	57.0 ,,
Subarea 4	—	59.2 ,,

These figures from 1958, as well as those presented in the summary of 1956 cod samples published in the Sampling Yearbook vol. 2, indicate that as far as these trawl fisheries are concerned no considerable difficulties would be involved by introducing the same mesh-size regulations for the whole of the Convention Area.

C. Redfish.

Whereas the trawl caught cod samples from the various parts of the Convention Area show a great conformity as to size-composition, considerable differences in size are found in samples of redfish from the various subareas and even within one and the same subarea. The great variety in size-composition, of the redfish samples is of course in the first place due to the fact that at least two species of redfish are included in the samples.

Figure 8 gives length-distribution curves for commercially caught redfish samples from Subareas 1 to 5 for the years 1957 and 1958 (not all samples reported are included.)

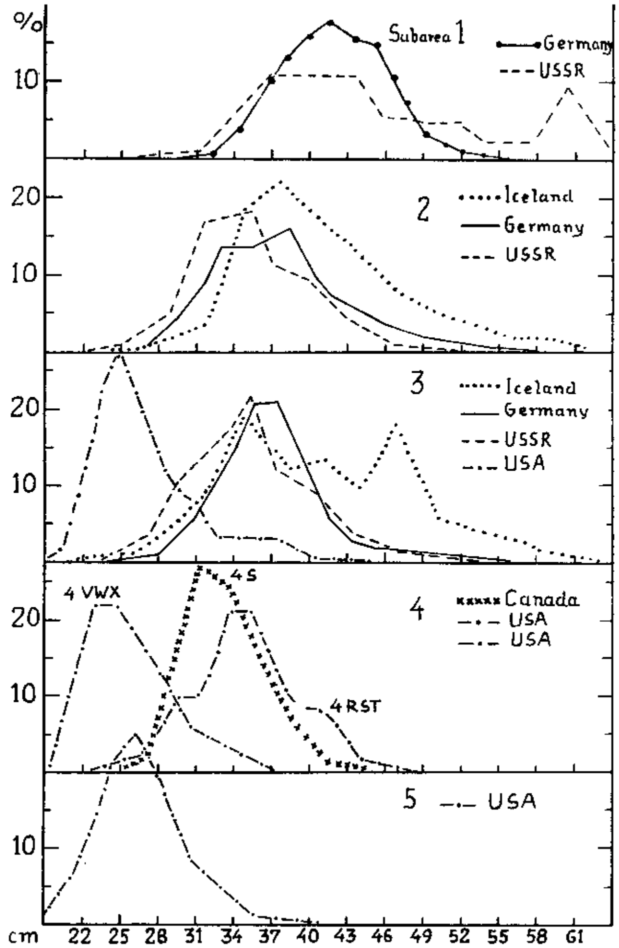


Fig. 8. **Redfish. Length-distribution of samples from otter-trawl in Subareas 1-5, 1957 and 1958 by Canada, Germany, Iceland, United States and USSR (indicated in the figure by their initials).**

The largest sized redfish are caught in Subarea 1, where the *marinus* type predominate. Somewhat smaller redfish are met in Subareas 2 and 3, where the populations in places are composed both of *mentella* and *marinus* types. The smallest redfish are from Subareas 4 and 5.

The samples by Germany and USSR from Subarea 1 are similar in size with a peak between 40 and 45 cm. Also the samples by Germany, Iceland and USSR from Subarea 2 are of about the same size-composition with peaks between 33 and 38 cm.

On the contrary, in Subarea 3 the picture is very diversified. Icelandic samples from 3K show two maxima, one at 35 cm (*mentella*) and another at 47 cm (*marinus.*) The samples by Germany (subdivision and type not stated) and by USSR (3K, L, M - *mentella*) agree fairly well, with their maxima around 37 cm. Far below in length are the samples by USA from 3 N, O, P - the SW. part close to Subarea 4- with a peak around 25 cm.

In Subarea 4 the redfish is smaller than in 3. A Canadian sample from 4S has a peak between 30 and 35 cm. The USA samples vary regionally in size-distribution; those from 4R, S, T, Gulf St. Lawrence, have peaks around 35 cm, those from 4V, W, X, closest to Subarea 5, have peaks around only 25 cm. These latter agree in size fairly well with the USA samples from Subarea 5, peaks at 25-28 cm.

No doubt a comparative study of the numerous samples now collected from the fishing fleets of a number of countries by sub-divisions and by months could provide valuable information on the degree of intermixture of the different types of redfish in the populations, and possibly also on migrations.

PART 4

Selected Papers from the 1959 Annual Meeting

I. ICNAF Mesh Regulations, Operation of 10% Annual Exemption October 1, 1957, through March 31, 1959

BY LAWRENCE H. COUTURE, F.R.B.[1]

The United States Bureau of Commercial Fisheries, Fish and Wildlife Service, issued 23 exemption certificates during the first year, and 16 additional certificates during the first six months of the second year to U.S. vessels. These certificates were issued by month and year as follows:

Month	Year	Certificates
October	1957	6
November		3
December		2
January	1958	3
February		4
March		2
April		1
May		1
August		1
	Total—1st 12 months	23
October	1958	5
December		1
January	1959	8
February		2
	Total—1st 6 months 2nd year	16

At the completion of the first year, eight (8) certificates expired and were not renewed by the vessel owners. Two (2) certificates were revoked for failure to submit required reports. On March 31, 1959, there remained **29 certificates in effect.**

Tonnage classes of the vessels issued certificates:

		Number of vessels		
Gross tons	Class	12 months (1st year)	6 months (2nd year)	Total
0 - 25	OTS	1	0	1
26 - 50	OTS	5	6	11
51 - 100	OTM	7	6	13
101 - 150	OTM	2	2	4
151 - 200	OTL	7	2	9
Over 200	OTL	1	0	1
		23	16	39

The landings by these vessels are presented in the attached table.

[1]) BCF Biological Laboratory, Woods Hole, Mass., May 6, 1959.

ALL SUBAREAS

		12 months (1st year) No.	%	6 months (2nd year) No.	%
Exempted vessels[1]		23		29	
Fishing trips		707		560	
All species	000 lb.	37,125	100.0	19,363	100.0
Haddock	,,	2,827	7.6	1,453	7.5
Cod	,,	505	1.4	338	1.7
Redfish	,,	20,686	55.7	10,067	52.0
Other species[2]	,,	13,107	35.3	7,505	38.8
No. of trips with haddock		558		398	
No. of trips with cod		560		384	
No. of trips with redfish		342		250	
Range of haddock landings per trip, lb.		15—113,000		10—61,750	
Range of cod landings per trip, lb.		10—20,650		10—23,035	
Excess trips[3]		158		67	
Pounds excess haddock[4]	000 lb.	1,254		548	
Pounds excess cod[4]	,,	68		19	

1) Operating under 10% annual exemption certificates.
2) Other species includes halibut, white hake, cusk, pollock, flounders and silver hake.
3) Trips of more than 5,000 pounds and more than 10% haddock or cod.
4) Quantity of haddock or cod in excess of that covered by trip exemptions.

SUBAREA 3

		12 months (1st year) No.	%	6 months (2nd year) No.	%
Exempted vessels[1]					
Fishing trips		9		7	
All species	000 lb.	2,107	100.0	1,605	100.0
Haddock	,,	0	0	28	1.7
Cod	,,	0	0	9	0.6
Redfish	,,	2,106	99.9	1,486	92.6
Other species[2]	,,	1	0.1	82	5.1
No. of trips with haddock		0		3	
No. of trips with cod		0		3	
No. of trips with redfish		9		7	
Range of haddock landings per trip, lb.		—		275—16,800	
Range of cod landings per trip, lb.		—		90—6,900	
Excess trips[3]		0		0	
Pounds excess haddock[4]	000 lb.	0		0	
Pounds excess cod[4]	,,	0		0	

1) Operating under 10% annual exemption certificates.
2) Other species includes halibut, white hake, cusk, pollock, flounders and silver hake.
3) Trips of more than 5,000 pounds and more than 10% haddock or cod.
4) Quantity of haddock or cod in excess of that covered by trip exemptions.

SUBAREA 4

		12 months (1st year) No.	%	6 months (2nd year) No.	%
Exempted vessels[1])					
Fishing trips		70		30	
All species	000 lb.	11,840	100.0	5,083	100.0
Haddock	,,	374	3.2	213	4.2
Cod	,,	34	0.3	36	0.7
Redfish	,,	11,247	95.0	4,481	88.1
Other species[2])	,,	185	1.5	353	7.0
No. of trips with haddock		24		26	
No. of trips with cod		21		25	
No. of trips with redfish		68		30	
Range of haddock landings per trip, lb.		200—89,300		455—58,240	
Range of cod landings per trip, lb.		35—6,550		80—5,925	
Excess trips[3])		4		5	
Pounds excess haddock[4])	000 lb.	108		105	
Pounds excess cod[4])	,,	0		0	

1) Operating under 10% annual exemption certificates.
2) Other species includes halibut, white hake, cusk, pollock, flounders and silver hake.
3) Trips of more than 5,000 pounds and more than 10% haddock or cod.
4) Quantity of haddock or cod in excess of that covered by trip exemptions.

SUBAREA 5

		12 months (1st year) No.	%	6 months (2nd year) No.	%
Exempted vessels[1])					
Fishing trips		628		523	
All species	000 lb.	23,178	100.0	12,674	100.0
Haddock	,,	2,453	10.6	1,212	9.5
Cod	,,	471	2.0	292	2.3
Redfish	,,	7,333	31.6	4,100	32.3
Other species[2])	,,	12,921	55.8	7,070	55.9
No. of trips with haddock		534		369	
No. of trips with cod		539		356	
No. of trips with redfish		265		213	
Range of haddock landings per trip, lb.		15—113,000		10—61,750	
Range of cod landings per trip, lb.		10—20,650		10—23,035	
Excess trips[3])		154		62	
Pounds excess haddock[4])	000 lb.	1,146		443	
Pounds excess cod[4])	,,	68		19	

1) Operating under 10% annual exemption certificates.
2) Other species includes halibut, white hake, cusk, pollock, flounders and silver hake.
3) Trips of more than 5,000 pounds and more than 10% haddock or cod.
4) Quantity of haddock or cod in excess of that covered by trip exemptions.

II. Top Chafing Gear Studies

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At the 1958 Annual Meeting of ICNAF the prevalent use of top chafing gear was recognized. Recommendations from this meeting assigned highest priority in chafing gear studies to covered-net selection trials with the prescribed ICNAF type top chafing gear. During September 3-6, 1958, experiments with top chafing gear were carried out in Subdivision 4W where haddock of adequate size were taken in good quantities by the M.V. *Harengus*.

These experiments show that topside chafing gear of the same mesh size as the codend, 1½ times the width of the codend and to ICNAF specifications (described below), did not reduce escapement of haddock.

Methods

Twenty-three tows, each of 45-minutes duration, were carried out with a No. 36 manila trawl (60-foot headline). A new, double-strand, manila codend of 75-yard, 4-ply, untreated twine was used. Mesh sizes of the codend are shown in the following table, as measured in series along the length of the codend with the ICNAF-type wedge gauge.

Mesh size averaged between 4 7/8 to 5 inches, with considerable variation along the length of the codend. Larger meshes, about 5 inches, were found in the aft half of the codend. Within this portion of the codend the meshes were largest, about 5 1/8 inches in the bag. Since with moderate catches the aft portion of the codend has been shown to be most effective in allowing fish to escape, the codend mesh size of the aft half, about 5 inches, has been used in calculating selection factors.

The topside chafing gear used complied closely with ICNAF specifications. A new piece of double manila netting, 18 meshes long, was attached across the codend 4 meshes ahead of the splitting strap (halving becket) attachment. This piece of netting was attached along the laceage (selvage) to a point 3 meshes from the codline mesh.

Because this netting was new and not subjected to much strain while fishing, shrinkage was excessive. To counteract this, the piece of netting was stretched with the trawl winch after the first tow. Mesh size of the chafing piece became about 4 7/8 inches and inspection on deck indicated that about the 4 aftermost meshes of the codend were clear.

The top chafing netting was 1½ times the width of the codend, although the width was probably not wholly effective, since the cover over the whole was only about 1/3 wider than the codend itself. The cover used was of 1½-inch mesh, single Nyak (nylon and cotton).

Twelve successful covered-codend tows without top chafing gear were carried out in sequence (15 tows were made but the first three were discarded). Following these, the topside chafing gear was attached to the codend under the cover

Mesh size of manila codend used for chafing gear experiment

Date	Mesh size			
	No. meshes measured	Aft half (inches)	Forward half (inches)	Average (inches)
Sept. 4/58	76	5	4¾	4⅞
Sept. 5/58	78	5 1/16	4⅞	5
Sept. 6/58	78	5	4¾	4⅞

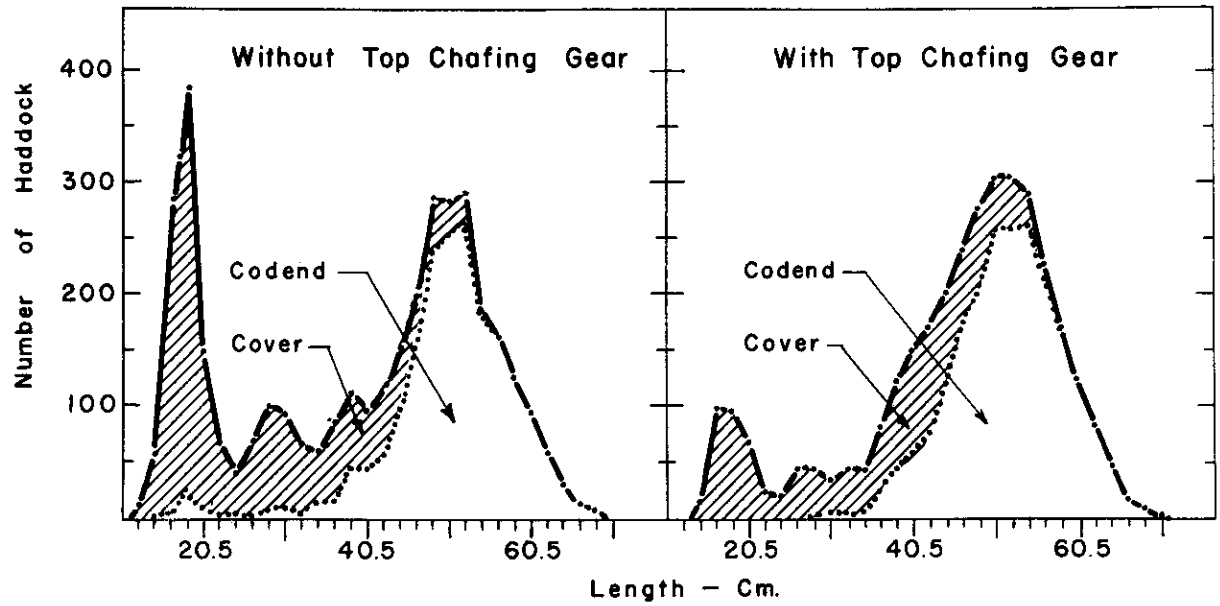

Fig. 1. **Number and sizes of haddock in codend and cover with and without chafing gear.**

and 8 successful tows made. The results are shown in Figure 1.

Catches of haddock averaged about 1,000 pounds per tow. Numbers of haddock within the effective selection range were similar in the two portions of the experiment. However, many more small haddock (mode about 20 cm) were taken during the trials without chafing gear. Numbers and sizes of haddock retained in the codend and escaping into the cover are shown in Figure 1 for each portion of the experiment. The resulting selection curves for the codend with and without top chafing gear are shown in Figure 2.

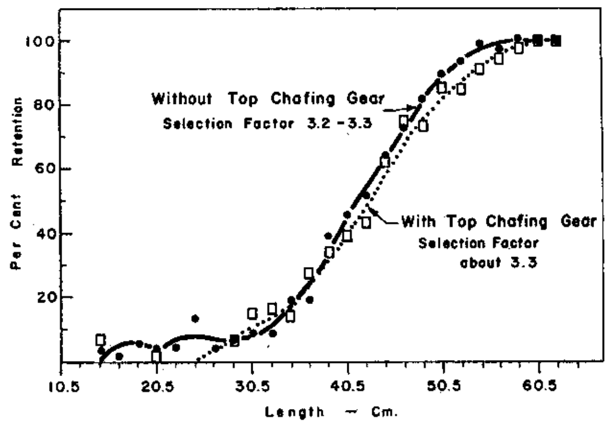

Fig. 2. **Selection curves for 5-inch mesh, double-strand, manila codend with and without top chafing gear.**

Both selection curves are quite similar in shape and position with a 50% retention length for the 5-inch mesh codend of about 41-42 cm. The selection factor for each is about 3.2 or 3.3.

Discussion.

With catches of the size shown, top chafing gear mounted according to ICNAF specifications had no influence on retention within the codend. Since the effective slack of the top chafing gear was less than that specified by ICNAF, the results suggest that netting less than $1\frac{1}{2}$ times the width of the codend might be used.

Netting $1\frac{1}{2}$ times the width of the codend is awkward and bulky on top of the codend. It would seem desirable to use a narrower top chafing gear if it does not affect escapement. It should be remembered that the $1\frac{1}{2}$ times width specified by ICNAF regulation was arbitrarily chosen to provide what was believed to be ample slack. If experimentation shows that this width is more than enough, reduction in width would seem logical.

Previous Canadian experimentation has shown that double-layered codends drastically reduced escapement of both haddock and cod. They have also shown that top chafing gear 10% wider than the codend affected escapement. A chafing gear somewhere between 10% wider and 1½ times as wide as the codend seems likely to be adequate.

To define precisely the minimum effective width may be impractical, since it may depend upon such variables as size of catch, length of codend bag, mesh size, and species of fish. Less extensive experimentation, however, might allow significant reduction in width of specified chafing gear.

III. Cod Investigations in Subarea 2 - Labrador, 1950 to 1958

BY A. W. MAY

1. Introduction.

The cod sampling programme for Labrador during this period has been somewhat irregular, being carried on for the most part incidentally to other researches. A total of 1,448 pairs of otoliths were taken and 20,596 length measurements made. All samples were taken between mid-July and the end of September. One sample was jigged inshore in 15-20 fathoms and all others were taken offshore in depths ranging from 96 to 200 fathoms. The age readings and length measurements have been combined as shown below and in Figure 1.

Year	Subdivision	Gear	Otoliths	Length Meas.
1950	2G Inshore	Jigger	239	239
	2G Offshore	Trawl	110	251
	2H	Trawl	117	195
	2J	Trawl	118	579
1951	2J	Trawl	231	465
1952	2J	Trawl	None	2,233
1953	2J	Trawl	124	8,023
	2J	Longline	230	6,630
1954	2J	Trawl	120	450
1957	2J	Trawl	None	85
1958	2J	Trawl	159	1,446

2. Age Composition.

In the **1950** samples the 1942, 1944 and 1945 year-classes predominate, comprising together approximately 70% of each sample. The samples from 2G show a greater proportion of 6-year-old (1944 year-class) than 5-year-old fish (1945 year-class), while the reverse is true for the samples from 2H and 2J. There is a comparatively high number of 8-year-old fish (1942 year-class) in the offshore sample from 2G, and a high number of 5-year-old fish (1945 year-class) in the sample from 2J.

In **1951** the 1946 and 1947 year-classes appear in quantity (compared to 1950), and together make up 50% of the samples, with the 1947 year-class more abundant. The 1944 and 1945 year-classes are still present in fair quantity, but the 1942 year-class is not nearly as abundant as in 1950. The latter three year-classes now make up only 35% of the samples. As in 2H and 2J in 1950, the 1945 year-class is better represented than the 1944 year-class.

In the trawl sample of **1953**, the age distribution is much the same as in 1951. The 1942, 1944, 1945, 1946 and 1947 year-classes together account for 88% of the sample. Again the 1947 and 1945 year-classes are better represented than those of 1946 and 1944, while the 1942 year-class is more evident than it was in 1951.

In contrast, in the longline sample the 1946 and 1947 year-classes are comparatively poor (14%), while the 1942 year-class is very prom-

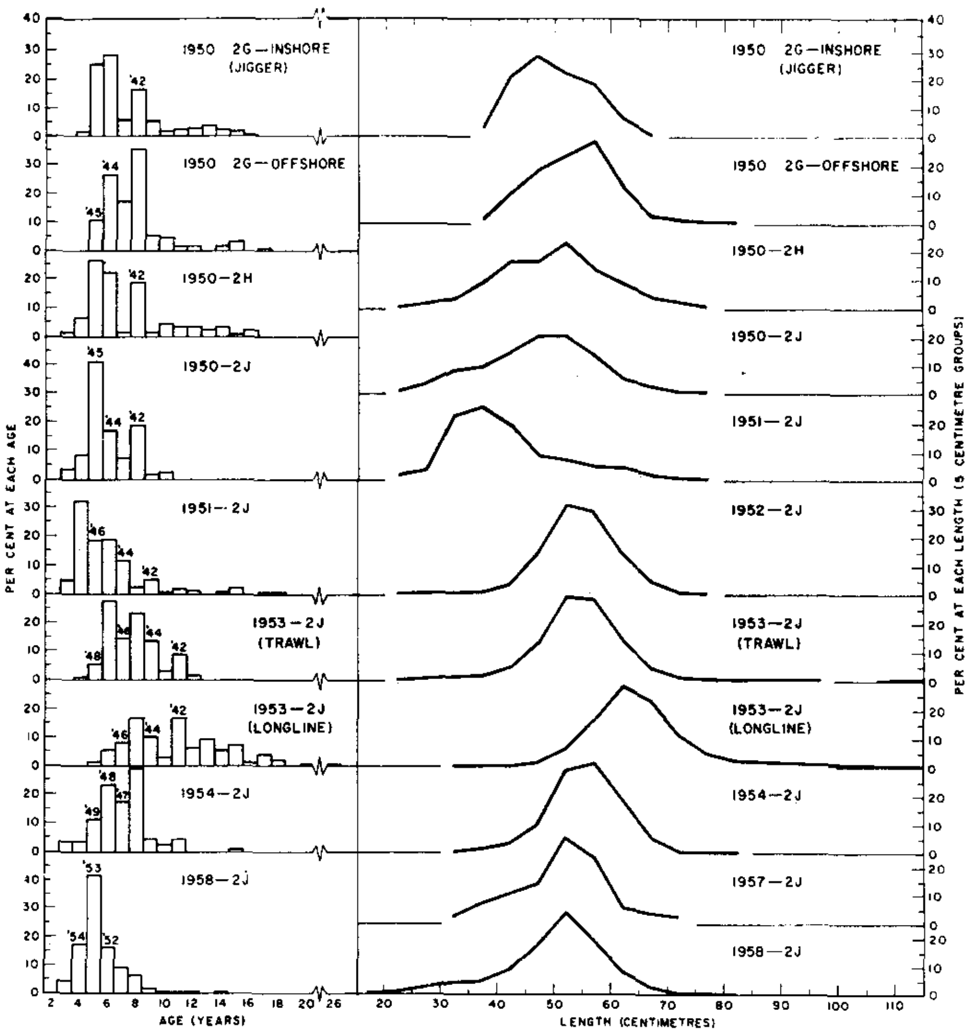

Fig. 1. **Age and length distributions of Subarea 2 cod combined by subdivision and method of capture. Length distributions are of all fish measured.**

inent (17%). The 1945 year-class is again more abundant than the 1944 year-class. The 1942, 1944 and 1945 year-classes are present in approximately the same total proportion in both the trawl and longline samples (46% and 44%). However, whereas most of the remainder of the trawl sample is composed of the 1946 and 1947 year-classes (42%), most of the remainder of the longline sample consists of fish of year-classes older than 1942 (37%).

In the **1954** sample the 1942 year-class is absent and the 1944 and 1945 year-classes are poorly represented. However, the 1946 and 1947 year-classes are still well represented (47%) and the 1948 and 1949 year-classes have appeared in fair numbers (35%). The 1946 and 1948 year-classes are predominant.

In the **1958** sample the 1953 year-class predominates (41.5%), followed by the 1954 (17.6%) and 1952 (16.4%) year-classes. The 1951 and 1950 year-classes combined account for 16% of the sample; all other year-classes are poorly represented or non-existent.

Summary and Conclusions.

Although the otolith samples were small, the trend from year to year allows some conclusions.

There are no strongly predominating year-classes, yet a fair amount of variability in year-class survival is evident. From 1942 to 1948 it appears that best survival occurred in 1942 and 1947, followed by comparatively good survival in 1944, 1945, 1946 and 1948. Survival in 1943 seems to have been very poor. The 1954 and 1958 samples are too small to permit valid conclusions to be drawn concerning year-class survival after 1948.

3. Length Distributions (Figure 1).

The length distribution of fish taken from 2G (inshore) in **1950** shows a peak in the 45-49 cm group, with a lesser peak in the 55-59 cm group, corresponding to the rich 1944 and 1945, and the 1942 year-classes respectively. In the offshore sample from 2G the peak is in the 55-59 cm group corresponding to the 1942 year-class. The length distributions from 2H and 2J also indicate the abundance of the 1945, 1944 and 1942 year-classes, though overlapping occurs. Here these three year-classes are represented by the large proportion of fish between 40 and 59 cm.

Most of the fish taken in **1951** are in the 30-49 cm range (1947, 1946 and 1945 year-classes), with the 1942 year-class evident in the 55-64 cm range.

In **1952** fish in the 50-59 cm range predominate. No age determinations were made but the length distribution indicates the presence in quantity of 6-to 8-year-old fish (1946, 1945 and 1944 year-classes).

It is evident from the **1953** age and length distributions that older and larger fish are taken by longline than by trawl. There is a predominance of fish of length 60-69 cm (mainly of the 1942 and older year-classes) in the longline samples, in contrast to a predominance in the 50-59 cm range (1947, 1946 and 1945 year-classes) in the trawl samples. Also, 23.5% of the fish taken by longline are above 70 cm in contrast to only 1.9% above 70 cm for trawl-caught fish.

In **1954** fish of length 50-59 cm predominate, corresponding to age-groups 6, 7 and 8 (1948, 1947 and 1946 year-classes).

In **1957** the peak is in the 50-54 cm group. This corresponds to fish of ages 6 and 7 (1951 and 1950 year-classes). However, the length distribution is probably not reliable, being of 85 fish only.

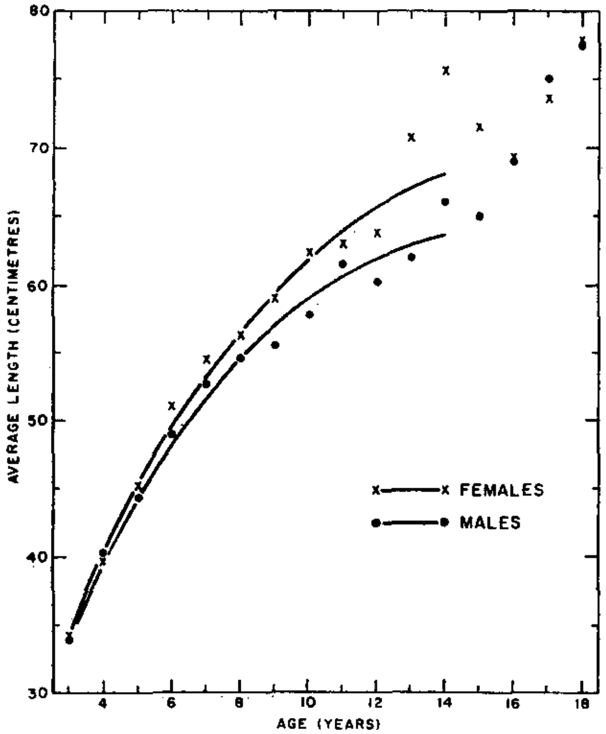

Fig. 2. Subarea 2 cod, 1950 to 1958. Growth curves for males and females, ages 3 to 18 years.

In **1958** the peak is in the 50-54 cm group, again pointing to a predominance of 6-and 7-year-old fish (1952 and 1951 year-classes). This probably gives a better picture of the age composition than was obtained from otolith readings, since the number of fish from which otoliths were taken (159) is small in comparison to the number represented in the length distribution (1,446).

4. Growth.

Although some variation in growth was evident from year to year, and from one area to another, the samples were considered too small to allow any conclusions as to the nature and causes of these variations. The average growth curves for males and females, for all years and subdivisions combined, are shown in Figure 2. The growth of females exceeds that of males from the fifth year.

5. Sex Composition.

The females predominate in all but one of the samples. The percentage of females varies between 51.6% and 68.3% of the samples except in 1958 (49.1%).

IV. The Measurement of Fishing Power and its Relation to the Characteristics of Vessels

BY

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EXPLANATION AND SUMMARY

Preparation of this paper followed a suggestion made during the 1958 Annual Meeting of ICNAF that a simple account be prepared of the results of research on the performance of fishing units conducted for purposes of resource assessment and fisheries management. The paper defines the fishing power of a fishing unit and describes how it is measured by comparative fishing trials and analysis of catch and effort statistics. The results obtained in correlating fishing power with measurable characteristics of the craft are briefly summarised and the uses to which this information is put for purposes of resource assessment and management are outlined. Needs for future studies are discussed.

INTRODUCTION

Measurement and analysis of the performance of fishing units has interested fisheries scientists since they first started, towards the end of the nineteenth century, to examine statistics of fish catches and measure the sizes of fish caught in an endeavour to understand why intensive fishing sometimes became unprofitable, and to find remedies for this condition. They have therefore been trying to discover and understand the quantitative relations between fishing activities and the sizes and compositions of exploited fish stocks, and of the catches obtained from them, with the principal aim of predicting the changes in fishing activity that will result in better catches.

Fishing activities comprise a collection of discrete operations by fishing units (each consisting of vessel, gear and crew). During each operation an input of **fishing effort** results in an output of **catch**. Measurement of these two elements—effort and catch—provides the basic information used for the assessment of fish stocks. For this purpose, effort and catch data for single operations have to be combined in such a way that the sum of the catches divided by the sum of the efforts in a given area and over a given period is a proportional index of the average amount of commercial-sized fish present in that area during that time. If it were possible to measure stock abundance directly, and in absolute terms, by the use of echo sounders, underwater cameras, or other such instruments, we should be able to determine the appropriate unit of fishing effort for this purpose. In the absence of such knowledge it has been usual to attempt to foresee the factors of effort variability which could result in non-proportionality of catch-per-unit-effort and fish density. The hypothesis that any given factor does indeed have such an effect in practice is then examined experimentally by the methods described in later sections of this paper; if the factor does not introduce an effect large enough to affect the estimates significantly, then that factor is ignored in further treatment of the data. If the effect is great enough to be thus measured, the factor can be taken into account in devising an appropriate standard measure. It is in this manner that for certain fisheries there has been a progressive modification of the effort unit for trawlers as follows: number of trips, days absence from port, days spent fishing, hours spent fishing, number of steam-trawler ton-hours spent fishing. (See later.)

The compilation of catches presents no special problems other than the identification of the stock from which they are taken; in general the catches must be of the same kind—species, subspecies, or perhaps race—and refer to the same condition of product, e.g., whole fresh fish. For the latter purpose, simple conversion by factors is usually satisfactory.

Effort data are not so easily combined. Not all unit operations are quantitatively equivalent; thus one haul by a big trawler obviously does not represent the same amount of effort as one by a small trawler. Because the size compositions of fleets vary, because there is a tendency for small trawlers to operate in different places from large ones, and because the species composition and the size composition of the catches of small and large vessels differ, some adjustment must be made to the effort units before they can be compiled. Of course there are many factors other than vessel size which affect catches and which must be taken into account when they vary.

It is therefore necessary to establish standard units of fishing effort so that we may say that on the average X operations by fishing unit A are equivalent to Y operations by unit B. By equivalent we mean no more than that if the two units A and B could fish at exactly the same time and place, A would catch in X operations the same amount and kind of fish that B would catch in Y operations.

Before examining how such relations are discovered, we should mention two points. Firstly an aim in selecting effort units is to obtain a measure of effort which is related in a known way, and preferably directly and simply, to the physical characteristics of the system the processes within which are being analysed. Thus a good unit of effort might be proportionally related to the area of ground or volume of water "covered" or "explored" by the gear during an operation and hence simply related to the probability that a fish present in the area at the time will be captured, and thus be related in a simple manner to the **fishing mortality** caused in the fish population by each operation.

Secondly it should be noted that while standard fishing effort measurements are used to determine the condition of the stock and to analyse its dynamic properties of change in size, composition and yield in response to exploitation, the standards might be required to specify desirable amounts of fishing effort if the analysis shows that some control of the fishing activity would be beneficial to the industry, politically desirable and administratively possible.

DEFINITION OF EFFORT

A measure of effort which often satisfies the above conditions is, for any fishing unit, the product of the **fishing power** of the fishing unit (i.e. its catching power) and the period of **time** during which it operates. These therefore constitute the two elements of the unit of effort. The total effort exerted by the fleet of fishing units operating in a fishery is the sum of these products for all the units comprising the fishing fleet. The primary tasks in effort measurement for any fishery are therefore first to choose the appropriate time unit for the particular method of fishing engaged in the fishery, and secondly to measure the fishing powers of the units. The time unit may refer in cases where fishing is "blind", as with trawlers not carrying fish detection instruments, to the time during which the gear acts; for other kinds of fishing the time spent searching for fish is more appropriate; probably in most cases a function containing measures both of "searching time" and of "fishing time," appropriately weighted, would be better.

In practice, the **absolute fishing power** of a fishing unit cannot usually be determined, because the absolute abundance of fish in the locality fished is not known. All that can be measured are indices of **performance** (e.g. catch per unit operation) of the fishing unit under the particular circumstances of the fishing operations. The performance of a unit will vary from place to place and from time to time as a result of variations in the abundance of fish and other external factors, so that this cannot be used as an index of fishing power for computing total effort. Instead, it is necessary to measure **relative fishing power,** defined as the ratio of the performance of one fishing unit to that of another operating under the same external conditions (abundance and composition of fish, etc.). The total effort exerted by the fleet can then be computed in terms of one component of the fishery (e.g. steam trawlers of a certain size, seiners, etc.) whose fishing power is taken as unity, the effort units of the other components being adjusted by their relative fishing powers. The relative fishing powers may refer to groups within a single class of fishing units (e.g. motor trawlers of different sizes), to classes of units within a single gear fishery (e.g. steam and motor trawlers) or to different components of a mixed gear fishery. The complexity of the task is a function of the heterogeneity of the fleet and the extent to which its composition changes with time or place.

A consequence of this concept of fishing-effort is that separate effort units and relative fishing powers may apply for the different species of fish caught in a mixed species fishery; the relative fishing powers of two units or groups of units may differ markedly for different species of fish.

The Measurement of Relative Fishing Power

The relative fishing power of a unit is the ratio of its performance to that of another unit under identical conditions. The method of measurement must therefore involve the analysis of the catches of vessels working at the same time and place, in their normal manner. An assumption made here is that different units fishing apparently at the same time and place are fishing on stock of the same density. Whether this is so can be tested only by having direct estimates of stock density or by searching for differences in catches, such as their size composition, which would indicate that the different units are really fishing different groups of fish. It is necessary to assume that such a difference does not exist, until it is detected; interpretation of data for fishery assessment purposes does not however usually depend critically on the validity of that hypothesis. In testing it by examination of catch compositions it is necessary to know, and to take account of, inherent differences in the selectivity of the various units.

One method of undertaking such comparisons is carefully controlled comparative fishing experiments using two or more vessels. With this procedure allowance can be made for the effect of variations in external conditions such as the size and composition of the fish concentrations, the nature of the sea-bed, wind and tide, all of which modify the performance of fishing units. Since many of the characteristics of the fishing units can be carefully measured and controlled, such experiments also provide information on the causes of the observed differences in fishing power.

The relative fishing powers of all units of the fishing fleet could, in principle, be determined from the results of many such experiments in which either one unit is used throughout as standard (e.g. a research vessel) or successive comparisons are made between different pairs of units of the fleet (e.g. A is compared with B, B with C, C with D, and so on). They would be accurate and highly informative, but also time-consuming and costly. For reliable estimates of relative fishing power numerous haul replicates are required in each experiment, and these have to be repeated under different external conditions.

In practice, especially in large mixed fisheries, it may be necessary to adopt a different method of measurement. This is the analysis of the records of commercial fishing operations giving detailed statistics of the catches of each species of fish and efforts of the various fishing units, by short time periods and for small subdivisions of the fishing area. Comparisons are made of the performances of groups of units fishing in the same area at the same time. The applicability and precision of this method for any fishery are governed by the statistical breakdown; the smaller the area and time subdivisions in which statistics are given, the less is the danger of variable external circumstances influencing the relative performances of the fishing units. This method is less costly and time-consuming than comparative fishing experiments, and estimates can easily be made for all seasons and localities fished. It is not applicable, of course, in fisheries in which different components of the fleet are segregated on the fishing grounds. This is sometimes the case for the vessels of different countries and those using different types of gear. In such instances, the first method must, if possible, be used to make the comparison between the segregated types of units. In any case it is probably best in practice to employ both methods and compare the results obtained from them.

Where fishing units of similar types but different powers operate on different grounds for such reasons as differences of working range, then comparison of operation statistics cannot give the required estimates of power factors, but in such situations the costlier method of comparative fishing is available. When, however, different gears are used on different grounds for some reason connected with their fundamental method of action, quite a different situation is presented. There are varying degrees of possible segregation, extreme cases being offered by fixed stake traps and otter trawlers exploiting the same stock in adjacent but quite separate areas without any overlap.

Resolution of the problem of the correct procedure in such cases can only come from knowledge of the relative concentrations of fish actually available to the fishing units. Meanwhile, it seems better to use apparent relative fishing power factors derived from catch and effort statistics than not to attempt to bring effort to a common standard, but the implications and consequences of this need further study.

Factors Governing Fishing Power.

Ideally, the measurement of total fishing effort exerted in a fishery should involve determination of the relative fishing power of each unit in the fleet. This is seldom possible in practice, and experience has shown that it is usually not necessary. For a large fleet it is impracticable to conduct a comprehensive series of comparative fishing experiments, and in the method of comparing commercial statistics there is a considerable chance variation in the estimated fishing powers of individual units. The fishing powers of units having similar characteristics with regard to vessel, gear and number of crew, however, are not usually found to differ markedly. That is to say, the differences between the fishing powers of fishing units of clearly identifiable types are greater than the differences between units of the same type which differ in the skill of the skipper or other more subtle ways. The main task is therefore to identify factors closely correlated with fishing power variations within the fleet, and to measure the effects of each.

Some guidance to the identification of these factors can be obtained by a close examination of fishing practices. For convenience, the possible factors might be grouped in the following categories:

(1) Vessel characteristics
(2) Gear characteristics
(3) Crew characteristics (e.g. number, skill in operating gear, etc.)

In practice the various factors in either the same or different categories, will not vary independently. For example, size and power of vessel and type or size of gear often vary together. In such instances, the fishing power might be expressed in terms of that factor which is most easily measured.

The factors of particular relevance for this paper are those falling within the "vessel" category, and it is in relation to these that most fishing power assessments have been made, especially for trawlers. The two most obvious vessel characteristics which have been investigated are "size of vessel" and "propulsive power", and some examples of the results obtained are given below.

Some Results

The following statements summarise findings reported in the publications listed at the end of this paper.

For British and German North Sea steam trawlers, fishing power has been found to increase with gross tonnage and with overall length for all demersal species. It is more nearly directly proportional to the former, and proportionality is a desirable property because it simplifies computation of fishing effort, as "steam-trawler ton-hours." The fishing power of British motor trawlers working in the same area is also proportional to gross tonnage but the constant of proportionality is in this case higher, so that one-ton-hour fished by a motor trawler is equivalent to about 1.4 ton-hours fished by a steam trawler. Comparative fishing experiments with research vessels have confirmed this relation. The fishing power of a motor trawler is also quite closely proportional to the brake-horse-power of its engine. The proportional relations described above do not seem to hold for vessels of all sizes. Icelandic motor trawlers, averaging

660 gross tons and 1,000 horse-power and used for catching cod, have only 40 percent more fishing power than those in the 320-ton class with 625 horse-power engines.

Significant correlations have been found between fishing power and gross tonnage, and fishing power and horse-power of U.S. motor trawlers working on Georges Bank in the northwest Atlantic.

In the cases of Dutch motor and steam herring trawlers, and motor cutters trawling for demersal fish in the North Sea, the correlation of fishing power with horse-power is much better than with tonnage, and it appears from statistics that new motor trawlers have higher fishing powers than older trawlers of the same tonnage and horse-power. A detailed analysis has been made of English statistics from this point of view but significant effects of age or year of construction were not apparent. By comparing performances of ships of the same class it is possible to examine the variability due to crew differences but little work has so far been done along these lines. Gulland has put forward arguments, based on an examination of data for British trawlers, indicating that although it may be that the better skippers tend to be in bigger or newer boats than the less skilful ones, the effect of this in increasing the fishing power of the bigger units is not so great as the direct effects of size of unit.

Studies are now being made of some fisheries by more refined statistical methods, to determine the interdependence of the different factors, particuarly those expressing size of unit. Thus it seems that for trawlers fishing power increases with length, horse-power, and tonnage; it increases with headline length, and faster than vessel length, but slower than tonnage, so that it would appear that engine power increases in such a way with size that bigger trawlers tow faster than smaller ones, but less than proportionally with their tonnage. These results are highly variable, however, with regard to differences in species, fish density and conditions of operation.

Inove and Watanabe (1958) have examined the catches per day of 97 Japanese drift-net vessels fishing from Awa-Gun for Saury (*Cololabis saira*). Within each gross tonnage class, 10-19, 20-29, 30-39, 50+ tons, are given relative fishing power factors, engine horse-power, number of crew and number of days spent fishing within a certain period. Vessels over 30 tons (mean, 57 tons) caught 67 percent more fish on the average than those of less than 30 tons (mean, 23 tons).

Within each of the four tonnage classes, however, there was no trend of power factor with tonnage, nor with horse-power nor crew number. Their data suggest that within each tonnage class the boats with higher fishing power fished for more days during the period, but boats over 30 tons did not fish more days than those below 30 tons.

Some preliminary studies have been made of the effect of variations in the mode of operating the same fishing unit. For example, increases in towing speed of a Dutch trawler resulted in decreases in catches of flatfish, especially plaice. Studies have been made to gain understanding of the changes in fishing power which seem to occur when the cod-end mesh size of a trawl is altered. Such changes differ considerably for different fish species—thus catches of one may be increased and of another, decreased.

For Scottish seiners catching demersal fish there may not be a relation between fishing power and size of vessel; one day's fishing by any one seiner seems about equivalent to one day by a 350-ton trawler in terms of whiting catches. Differences in culling practice between trawlers and seiners, or ineffective mesh size, may however be affecting the statistics used for this comparison, and would have to be considered before the results were applied in practice.

In comparisons between different kinds of gear, the "area swept" by the gear may be computed when it is difficult to define equivalent fishing times. For example, time spent trawling is easy to measure, but the duration of a seine haul is more difficult to define. However, Scottish seiners work in such a way that in each operation the gear sweeps out an area of about six or seven million square feet, which is about the same as that swept by a 30-foot trawl with 30-fathom sweeps towed at 3 knots for 2½ hours. In terms of catch per calculated area swept, it is found that the seiner has, for all demersal species, a fishing power about half that of the trawler, but if catches of small whiting alone are considered, its fishing power is found to be 30 percent greater than that of the trawler.

CONCLUSION

The relative fishing powers of fishing units within a group, together with specifications of the structural and operational features of the fishing units, constitute the basic information with which critical examination of fishing capacity and performance may be attempted, using the techniques of correlation and analysis of variance. Findings of the kind outlined above can be used to bring the fishing effort statistics of a heterogeneous fleet to a common standard; the most important criterion of usefulness of a discovered relation for this purpose is whether it is a proportional one, since the adjustment of crude statistics is then a simple routine task.

The factors causing differences of fishing power cannot be identified with certainty by these purely statistical methods but clues may be obtained that can help in the design of critical experiments. Such experiments are in principle the same as the comparative fishing tests except that some deliberate and usually small changes will be made in the structure or operation of one of two otherwise similar units, or the same unit may make alternate operations with and without the modification. This will be done to test a particular hypothesis as to the magnitude of the effect of a particular factor in determining the fishing power of the type of unit being studied. A special case of this kind is a gear selectivity experiment with, say, alternate hauls of a trawl using cod-ends of differing mesh size to test the hypothesis that changes in power ratios with increasing size of fish are proportional to the maximum girth of the fish and hence to its ability to escape through the meshes. It should be noted, in this connection, that such experiments revealed the inter-dependence of selectivity and fishing power; thus, increasing the cod-end mesh of a trawl to permit small fish to escape can also increase the fishing power with respect to large fish, and this even when the towing speed is apparently unchanged. The relative change in fishing power thus caused differs for different species in the catches so that the species compositions of large fish, as well as the size compositions and the total effective effort exerted by a given fleet, are also altered to some extent.

The increased attention being paid to fish girth in net selection studies is a good example of a change in emphasis in gear research towards closer study of causative factors. There has been little sign so far of a corresponding change in studies of the factors relating to the vessel itself, or to the crew. Only the crudest of physical measures, such as gross tonnage, overall length and horse-power, have been examined for their relation with fishing power of trawlers. It seems opportune now for naval architects and marine engineers to contribute to this work.

Those scientists who have started the kind of work described above have often not been familiar with the several different ways in which the characteristics, such as vessel length or displacement, which they have chosen for consideration are measured in practice; yet one measure of engine power may be much more closely related to fishing power than another. Surely there are other characteristics of craft, perhaps more complex functions of the apparently simple attributes of hull size and engine power, and of other attributes, which are more appropriate for scientific studies of fishing power?

The methods for comparing performance, which have been quite highly developed for purposes of stock assessment and fisheries regulation, may be worth considering as tools for improving vessel design, though they would need to be elaborated to cover the comparisons of overall performance rather than just performance at the fishing site. One word of warning is, however, necessary with regard to this question' Experiments carried out so far give data of a complexity quite sufficient to show that it is the whole fishing unit and its mode of operation, rather than craft or gear, which must be considered in the analysis. We must not forget that the catch of fish in a particular operation is the result of a complex interaction between the behavioural characteristics of the fish, the hydrodynamic properties of the gear, the kinds of forces exerted by the vessel, and the conditions of the sea at the time, which affect the behaviour of craft, gear and fish. Big trawlers catch more fish than small ones, and roughly in proportion to their sizes but such a statement appears to be near the limit to which we can regard catching fish, even by trawl, as a mechanical process of "sweeping" a certain area or volume. For other types of gear and methods of fishing, it is even more difficult to make quantitative statements with any security.

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PART 5

Lists of Scientists and Laboratories Engaged in the Commission's Work

Canada

W. Templeman	Director, groundfish-biology	Fisheries Research Board of Canada, Biological Station, St. John's, Nfld.
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Marjorie E. Prouse	Groundfish population studies, cod	,, ,, ,, ,,
E. J. Sandeman	Redfish	,, ,, ,, ,,
T. K. Pitt	Pleuronectids	,, ,, ,, ,,
R. M. Chilvers	Pleuronectids	,, ,, ,, ,,
H. J. Squires	Plankton	,, ,, ,, ,,
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F. D. McCracken	Haddock, fishing gear	,, ,, ,, ,,
L. M. Dickie	Population dynamics, scallops	,, ,, ,, ,,
Y. Jean	Cod	,, ,, ,, ,,
A. C. Kohler	Age and growth	,, ,, ,, ,,
P. M. Powles	Plaice	,, ,, ,, ,,
J. E. Paloheimo	Mathematical statistics	,, ,, ,, ,,
N. F. Bourne	Scallops	,, ,, ,, ,,
L. M. Lauzier	Hydrography	,, ,, ,, ,,
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France

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A. Vincent	Biology-hydrography, fishes	,, ,,
Delais	Biology-hydrography, fishes	,, ,,
Allain	Physical oceanography	,, ,,
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J. Ancellin	Pleuronectidae, cod, haddock	Laboratoire d'Oceanographie, Boulogne sur Mer.
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Germany

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G. Krefft	Redfish, tagging, ichthyology	,, ,,
A. Kotthaus	Redfish	Bundesforschungsanstalt für Fischerei; Biologische Anstalt Helgoland; Abtl. für Fischereibiologie. F.A.- Pust-Platz, Bremerhaven-F.
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Unnstein Stefánsson	Hydrography	,, ,, ,,
Adalsteinn Sigurdsson	Pleuronectids	,, ,, ,,
Ingvar Hallgrímsson	Zooplankton	,, ,, ,,
Mrs. Thorunn Thordardóttir	Phytoplankton	,, ,, ,,
Ingimar Óskarsson	Cod, shellfish	,, ,, ,,

Italy

Norway

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J. Eggvin	Hydrography	,, ,,
S. Olsen	Halibut	,, ,,
E. Bratberg	Redfish	,, ,,
B. Berland	Parasites	,, ,,

Portugal

Tavares de Almeida	Cod, hydrography	Comissão Cons. Nac. das Pescarias do Noroeste do Atlantico, Gabinete de Estudos das Pescas, Av. da Liberdade, 211, 4°, D°, Lisbon.
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Emygdio Cadima	Fishes	,, ,, ,, ,,
L. Nunes-Ruivo	Parasites	Museu de Historia Natural, Lisbon.

Spain

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Union of Soviet Socialist Republics

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T. F. Dementjeva	Clupeidae and cod	,,
A. I. Treschev	Fisheries Techniques	,,
M. N. Fedosov	Hydrography	,,
A. P. Kusmorskaya	Plankton	,,
V. I. Travin	Redfish	Polar Institute of Marine Fisheries & Oceanography, Moscow.
V. P. Sorokin	Redfish	,,
E. I. Surkova	Redfish	,,
A. A. Elizarov	Hydrography	,,
K. P. Janulov	Gadoid fish	,,
I. G. Judanov	Clupeidae	,,
K. A. Nesis	Benthos	,,
K. A. Paton	Fisheries Techniques	,,
K. A. Pavlov		Baltic Institute of Marine Fisheries & Oceanography, Kaliningrad.

United Kingdom

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B. B. Parrish	Population theory	,, ,, ,, ,,
A. D. McIntyre	Redfish, halibut	,, ,, ,, ,,
R. Jones	Haddock	,, ,, ,, ,,
H. A. Cole	Director, fishery ecology	Fisheries Laboratory, Lowestoft,
R. J. H. Beverton	Population theory	Suffolk, England.
C. C. Trout	Cod, redfish	,, ,, ,, ,,
John Corlett	Plankton	,, ,, ,, ,,

United States

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J. F. Puncochar	Regional Director	Bureau of Commercial Fisheries, Gloucester, Mass.
H. W. Graham	Director	Laboratory, U. S. Bureau of Commercial Fisheries, Woods Hole, Mass.
R. L. Edwards	Fishery Biology	,,
A. Fleminger	Plankton	,,
R. L. Fritz	Hake	,,
G. F. Kelly	Redfish	,,
F. E. Lux	Flounder	,,
J. A. Posgay	Sea Scallops	,,
R. L. Wigley	Bottom Ecology	,,
J. P. Wise	Cod and Haddock	,,
D. F. Bumpus	Hydrography	Woods Hole Oceanographic Institution Woods Hole Mass.
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PART 6

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