INTERNATIONAL COMMISSION

FOR THE

NORTHWEST ATLANTIC FISHERIES

ANNUAL PROCEEDINGS

Vol. 10

for the year

1959-60

Issued from the Headquarters of the Commission
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1960

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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 publications from the Commission are issued 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, and as a rule every second year Lists of Scientists engaged in the various branches of the Commission's work, and of Main Laboratories concerned with this work (last printed in Ann. Proc. Vol. 9).

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 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 Publications include reports of scientific meetings. No. 1, dealing with a symposium held at Biarritz, France, 1956, on some problems for biological fishery survey and techniques for their solution, was published in 1958. No. 2, containing the reports of the joint ICNAF-ICES-FAO meeting in Lisbon, Portugal, on fishing effort, the effect of fishing on resources and the selectivity of fishing gear, is printed by FAO, Rome, in 1960. No. 3, a joint ICES-ICNAF publication on the redfish symposium held by the two organizations in Charlottenlund, Denmark, in 1959, is in print.

A list of the Commission's publications is found on the two last pages of the cover.

Erik M. Poulsen,
Executive Secretary.

Halifax, 30 November, 1960.

PART 1

Administrative Report for the Year Ending 30 June 1960, with Financial Statements

BY THE EXECUTIVE SECRETARY, ERIK M. POULSEN

1. Officers during the Year.

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

Vice-Chairman of Commission—

Mr. G. R. Clark, Canada

Chairman Panel 1: Dr. Jón Jónsson, Iceland

" Panel 2: Dr. Ju. Ju. Marty, USSR

" Panel 3: Capt. T. de Almeida, Portugal

" Panel 4: Capt. L. J. Audigou, France

" Panel 5: Mr. T. A. Fulham, U.S.A.

The above officers were elected at the 1959 Annual Meeting, and are serving for a period of two years.

Chairman of the Standing Committee on Finance and Administration—
Mr. J. H. MacKichan, Canada.

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

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

2. Panel Memberships 1959-60.

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
USSR	+	+	+			3
United Kingdom	+		+			2
United States			+	+	+	3
	9	5	7	5	2	28

3. Newsletters.

Newsletters were distributed from headquarters in order to circulate information relevant to the Commission's activities and interests on

8 July, 2 November 1959, and 22 March 1960.

4. Commission's Publications.

The Annual Proceedings, Vol. 9, for the year 1958-59, was issued in December, 1959. This volume is somewhat larger than the preceding ones, owing to the inclusion of a series of selected papers from the 1959 Annual Meeting.

The Statistical Bulletin, Vol. 7, for the year 1957, was distributed in December 1959.

The Sampling Yearbook, Vol. 3, for the year 1958, was distributed in June 1960.

Following a recommendation of the 1959 Annual Meeting a new issue of the "Red Book," including papers relating to the work of the Standing Committee on Research and Statistics, was prepared in the Secretariat and distributed within the Commission during December 1959. The paper includes the Report of the Standing Committee on Research and Statistics with appendices, further a number of documents from the 1959 Annual Meeting relevant to that report and to the Commission's research activities.

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 first part of the report is in print; it includes the proceedings of the Workshop. The second part, to be printed in a short time, will include papers prepared for the Workshop.

The proceedings of the 1959 ICES/ICNAF Redfish Symposium, including the scientific papers prepared for the Symposium, with summaries of those papers to be printed elsewhere, are being edited by the Chairman of the Meeting, Dr. J. Lundbeck, Germany, and the Vice-Chairman, Mr. G. C. Trout, United Kingdom. The report, to be printed in Copenhagen, will appear as a joint ICES/ICNAF publication.

An ICNAF Directory in pocket format, including the text of the Convention, rules and regulations, fisheries regulations introduced through ICNAF, and a number of data about the Commission's status, has been prepared and printed in the Secretariat, and was circulated at the 1960 Annual Meeting.

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.

A joint FAO/ICES/ICNAF Expert Meeting on Fishery Statistics in the North Atlantic area was held in Edinburgh, 22-30 September 1959. Mr. R. S. Keir attended the meeting as ICNAF representative. As one of the results of this meeting, a continuing Working Party on Fishery Statistics in the North Atlantic Area was established; Mr. R. S. Keir has been nominated as ICNAF expert to serve on the Working Party.

A joint ICES/ICNAF Symposium on Redfish was convened in Charlottenlund, Denmark, 12-16 October 1959. It was attended by about 50 participants from member countries and observers from non-member countries.

6. Co-operation with Non-member Countries.

Poland has, during recent years, carried out fisheries in parts of the Convention Area. The secretariat is in co-operation with Polish fisheries institutions who have reported statistical data on their fisheries in the Convention Area. Observers from Poland attended the 1960 Annual Meeting.

Belgium and Cuba have been carrying out minor fisheries in the Convention Area during the last two years. The secretariat has established contact with fisheries institutions of these two countries and is receiving statistical data on their fisheries.

A fleet of trawlers fron Rostock in eastern Germany is now fishing in part of the Convention Area, mainly for redfish. Following a contact established by the secretariat, the Fisheries Institute of Rostock has reported statistical data on the fishery to the Commission.

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 1959 were forwarded from member countries to the Secretariat in the period December 1959 to April 1960 They were distributed during the same months, together with a summary prepared in the Secretariat.

Particulars about the hydrographic research, especially sections taken in 1959, were forwarded by member countries and circulated by the Secretariat to provide a picture of the extent of hydrographic research in the Convention Area.

8. Summaries of Research.

Summaries of the researches by the various member countries in 1959 were received in the Secretariat and distributed as documents for the 1960 Annual Meeting.

9. Sampling.

Data from samples of fish taken both by commercial vessels and research vessels in 1958 have been forwarded by member countries to the Secretariat. After being edited and converted to the Commission's standard form they were published in Sampling Yearbook, Vol. 3, together with some samples from previous years, not hitherto reported to the Commission.

10. Collection of Statistics.

The Commission's collection of statistics and the compilation of the data in the Secretariat have been continued according to the Commission's requirements and—as far as possible—in conformity with decisions of the Edinburgh Statistical FAO/ICES/ICNAF meeting in 1959. 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. Statistical data on fisheries by non-member countries in the Convention Area are also collected.

The collection of data on the species, quantities and sizes of fish discarded at sea has lagged behind, but more attention is now being paid to this fundamental question.

11. Otolith Exchange Program (Cod and Halibut)

In connection with the cod otolith exchange program effectuated in 1958/59, a number of data on the techniques for reading otoliths of cod and other commercial fishes have been reported by the member countries. These data were compiled and distributed as a document for the 1960 Annual Meeting.

In conformity with Commission's decision at the 1959 Annual Meeting, an exchange between interested member countries of otoliths of halibut has been initiated.

12. Fisheries Regulations.

The collection of detailed information, from the member countries concerned, on systems of inspections and on the results of inspections carried out is being continued. The material collected for 1959 was considered by the Commission at the 1960 Annual Meeting.

13. Tenth Annual Meeting.

The Tenth Annual Meeting was convened in Bergen, Norway, in the week beginning 30 May, 1960. In the week preceding the Standing Committee on Research and Statistics and the Groups of Advisers to Panels met.

14. Assessment of Fisheries in Relation to Regulation.

In conformity with Commission's decision at the 1959 Annual Meeting, a number of additional data on stocks of fishes and on fisheries were collected by member countries. This material, together with other material made available earlier, was processed by a group of population scientists nominated by the Chairman of the Standing Committee on Research and Statistics, which met for a week in Lowestoft, England during March 1960. This group met again just before the Annual Meeting. A report for the Commission was prepared, and considered at the Annual Meeting.

15. Other Matters.

In December 1959 meetings of the Groups of Advisers to Panels 4 and 5 were held in St. Andrews, Canada; Mr. S. J. Holt, FAO, attended the meeting, and the Executive Secretary and the Biologist-Statistician were present. Work carried out through the year was reviewed and plans for future researches were elaborated.

At the Statutory Meeting of ICES, October 1959, Dir. G. Rollefsen, Norway, the Executive Secretary and the Biologist-Statistician acted as observers for ICNAF. After the meeting the Executive Secretary considered and discussed with the General Secretary of ICES various matters relevant to the cooperation between the two organizations, especially concerning the collection and publication of statistical data, and the editing of the proceedings of the joint ICNAF/ICES redfish symposium.

A list of annotated papers relevant to the Commission's work and the annual addition to the Guide to ICNAF Papers have been circulated.

16. Financial Statements for the Fiscal Year ending 30 June, 1960.

The accounts of the Commission for the year ending 30 June, show an appropriation of $ Can. 53,000.00 and a total expenditure of $52,873.15.

The audit of the Commission's finances for the fiscal year ending 30 June, 1960, was made by the Auditor General's Office of the Government of Canada in July, 1960.

The report from the Auditor General's Office, of 6 Sep. 1960, says:

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

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

(b) 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 certificate received direct from the Commission's depositary.

We were given free access to all books of account and records necessary for the performance of the audit and all information necessary for the purposes of the audit was made available to us. 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 1

Statement of Budget Appropriations, Obligations Incurred, and Unobligated Balances of Appropriations, for the year ended 30 June, 1960

Purposes of Appropriations	Appropriated by Commission	Authorized Transfers	Amended Appropriations	Obligations Incurred	Unobligated Balance of Appropriations
Personal Services—					
Salaries	$26,600.00	$ —	$26,600.00	$26,599.80	$ 0.20
Superannuation	2,107.36	86.85	2,194.21	2,194.21	—
Travelling	5,700.00	388.00	6,088.00	6,088.00	—
Transportation of things	300.00	78.55	378.55	378.55	—
Communication Services	1,000.00	69.76	1,069.76	1,069.76	—
Rent and Utility Services	1,800.00	—	1,800.00	1,800.00	—
Other Contractual Services, including Printing	8,800.00	300.00	9,100.00	9,100.00	—
Supplies and Materials	2,000.00	-253.71	1,746.29	1,619.64	126.65
Equipment	500.00	-369.45	130.55	130.55	—
Annual Meeting	4,192.64	-300.00	3,892.64	3,892.64	—
	53,000.00		53,000.00	52,873.15	126.85

Statement 2

Statement of Income and Expenditure for the year ended 30 June, 1960

Income:		
Members' contributions assessed—		
Canada	$ 7,014.92	
Denmark	2,098.71	
France	7,014.92	
Germany	2,098.16	
Iceland	2,098.73	
Italy	194.73	
Norway	2,098.71	
Portugal	7,014.92	
Spain	7,014.92	
Union of Soviet Socialist Republics	5,641.80	
United Kingdom	3,737.44	
United States	5,376.19	$ 51,404.15
Contribution of Union of Soviet Socialist Republics re 1957-58 (½ year) under Financial Regulation 5.8		2,657.10
Sales of publications		471.70
		54,532.95
Expenditure:		
Obligations incurred (Statement 1)		52,873.15
Excess of income over obligations, carried to Surplus Account		1,659.80

Statement 3

Statement of Assets and Liabilities as at 30 June 1960

Assets		Liabilities		
GENERAL FUND				
Cash on deposit	$ 8,135.81	Unliquidated Obligations		$ 3,390.46
		Advance on future contributions		3,829.01
		Surplus Account:		
		Excess of income over obligations incurred, 1959-60 (Statement 2)	$ 1,659.80	
		Less—Deficit as at 30 June 1959	743.46	916.34
	8,135.81			8,135.81
WORKING CAPITAL FUND				
Cash on deposit	$ 10,088.05	Principal of Fund		$ 10,000.00
		Bank interest		88.05
	10,088.05			10,088.05

PART 2

Report of the Tenth Annual Meeting

30th May - 3rd June, 1960

BY THE CHAIRMAN, MR. A. J. SUOMELA

1. Time and Place of Meeting.

The Tenth Annual Meeting of the Commission was convened in Bergen, Norway, on 30th May, 1960, and continued through to 3rd June. The meeting was preceded, 23rd to 28th May, by meetings of the Standing Committee on Research and Statistics and its various subcommittees, and by Groups of Advisers to Panels. On 29th May a tagging excursion was made on the Norwegian research vessel "G.O. Sars."

2. Participants (Appendix I)

Commissioners, most of them accompanied by advisers and experts, were present from all twelve member countries.

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 1946, International North Pacific Fisheries Commission and the World Meteorological Organization.

3. Opening of the Meeting (Agenda Item 1)

The opening session was convened in the Institute of Marine and Fisheries Research, Bergen, where also all the following meetings were held. Present were: His Excellency, the Minister of Fisheries of Norway, Mr. Nils Lysø; the Lord Mayor of Bergen, Mr. A. D. Michelsen, and His Excellency the Ambassador for Canada in Norway, Mr. R. A. MacKay, and the participants in the meeting.

The Chairman opened the meeting, welcoming guests, observers and delegates. He proposed the sending of the following telegram to His Majesty, the King of Norway: "The members of the International Commission for the Northwest Atlantic Fisheries, present in Bergen on the occasion of this Commission's Tenth Annual Meeting, beg permission to offer to Your Majesty their most respectful greetings." This was agreed. His Excellency, Mr. Nils Lysø, welcomed the delegates and observers to Norway, and the Lord Mayor of Bergen, Mr. Michelsen, welcomed the participants on behalf of the city of Bergen.

The Vice-Chairman, Mr. G. R. Clark, thanked the Minister of Fisheries and the Lord Mayor for their words of welcome.

After the adjournment of the opening session, the First Plenary was opened by the Chairman.

4. The Agenda (Agenda Item 2—Appendix II)

The agenda, circulated sixty days in advance of the meeting, was adopted.

5. Publicity for the Meeting (Agenda Item 3)

A committee consisting of the Vice-Chairman, the Chairman of the Standing Committee on Research and Statistics, and Dir. G. Rollefsen, Norway, was appointed to work with the press. At the Final Plenary, the Vice-Chairman gave an account of this committee's work.

6. Review of Panel Memberships (Agenda Item 4)

Applications were received from the Federal Republic of West Germany and from the United Kingdom for memberships in Panel 2, and from Italy for memberships in Panels 3 and 4. These applications were considered in accordance with the Convention, Article IV, 2, and panel memberships for 1960/61 were established as follows:

Panel	1	2	3	4	5	**Total**
Canada		+	+	+	+	4
Denmark	+					1
France	+	+	+	+		4
Germany	+	+				2
Iceland	+					1
Italy			+	+		2
Norway	+					1
Portugal	+	+	+	+		4
Spain	+	+	+	+		4
U.S.S.R.	+	+	+			3
U.K.	+	+	+			3
U.S.A.			+	+	+	3
TOTAL	9	7	8	6	2	32

7. Report on Staff Matters and Auditor's Report (Agenda Items 5, 6 and 18)

The Auditor's Report for 1958/59 was accepted and transfers made in the interval between the 1959 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 1959/60 (up to 8 May 1960) and the transfers included in the statements; it further approved that the estimated deficit of $486.73 be covered from the Working Capital Fund and repaid this fund by a special item in the 1960-61 budget, this subject to adjustment during the remainder of the fiscal year.

8. Budget (Agenda Items 7, 8 and 18)

The Commission approved the recommendation of the Committee on Finance and Administration to appropriate $59,300 for the financial year 1960/61 for the following purposes:

Personal Services	
Salaries	$27,900.00
Superannuation	2,600.00
Additional help	200.00
Travel	9,500.00
Transportation of Things	400.00
Communication Services	1,000.00
Rent and Utility Services	2,400.00
Other Contractual Services	9,600.00
Supplies and Materials	2,200.00
Equipment	1,000.00
Annual Meeting	2,000.00
	58,000.00
To provide for 1959/60 deficit	500.00
	$59,300.00

It was noted that in section "Travel" are included $6,500 to cover travels to meetings by members of the Assessment Group and the Group concerned with Environmental Studies.

The Commission noted that the Committee had adopted a budget forecast for the year 1961/62 of $61,000.00 for the following purposes:

Personal services	
Salaries	$27,900.00
Superannuation	2,600.00
Additional help	400.00
Travel	9,500.00
Transportation of Things	400.00
Communication Services	1,100.00
Rent and Utility Services	2,400.00
Other Contractual Services	11,800.00
Supplies and Materials	2,200.00
Equipment	1,000.00
Annual Meeting	1,700.00
	$61,000.00

9. The Commission further adopted the following recommendations by the Committee on Finance and Administration (Agenda Item 20)

(a) That the date of billing be 1 August 1960.

(b) That an invitation by USSR to hold the 1962 Annual Meeting in Moscow, USSR, be accepted with gratitude, the meeting to be convened on June 4, 1962.

In this connection, it was noted that the 1961 Annual Meeting, following an invitation by USA accepted in the 1959 Annual Meeting, would be convened in Washington, D.C., on 5th June 1961, and that the meeting would be preceded by a Marking Symposium (Convener, Mr.

Beverton) lasting four days, and by a week's meetings of the Standing Committee on Research and Statistics and of Groups of Advisers (Agenda Item 12).

(c) That an invitation from ICES to attend its Annual Meeting in Moscow in 1960 be accepted, with Dr. Meseck as observer,

That an invitation by the General Fisheries Council of the Mediterranean to attend its 1960 Meeting be accepted, with Dr. Cannone as observer,

That an invitation by UNESCO to attend the Conference on Oceanography in Copenhagen, July 1960, be accepted, with Dr. M. Ruivo as observer.

10. Change in Financial Regulations (Agenda Item 15).

Following recommendation by the Standing Committee on Finance and Administration the Commission approved that the Financial Regulations, Section IV, 5, be amended to read:

"4.5 No transfer between appropriation sections may be made without authorization by the Chairman of the Commission."

After having approved the above-cited recommendations (Item Nos. 7, 8, 9 and 10) by the Standing Committee on Finance and Administration, the Commission approved in their entirety (with a few minor amendments) the two reports by that Committee (Proceedings Nos. 3 and 10), and noted that Mr. J. H. MacKichan had been re-elected Chairman for the ensuing year.

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

The report by the *ad hoc* Committee set down to deal with Annual Returns (Proceedings No. 11) was adopted. It was noted that the report recommended the continued collection of data on results of inspections, the annual review of these data, as well as the use of the prescribed forms for the reporting.

12. In a **Special Meeting of Commissioners,** the Chairman of the Standing Committee on Research and Statistics reported on the work of the Assessment Group (Agenda Item 10) and other matters of research. After consideration of the various matters referred to, the meeting expressed its satisfaction with the research work carried out and the results achieved.

13. Reports by ICNAF observers on meetings of other international fisheries organizations were tabled or given (Agenda Item 11).

14. Report of the Standing Committee on Research and Statistics. (Agenda Items 10, 13, 14 and 17).

This Committee, and its *ad hoc* subcommittees, met during the period 23rd May to 3rd June.

The Committee's report (Proceedings No. 4) commences by drawing attention to the two main tasks for research in the Convention Area: fishery assessment as a basis for conservation measures, and effects of the environment on the fish stocks; and by stressing the importance of the most close co-ordination of the research work on both sides of the North Atlantic.

The report summarizes the work of the Committee and its subcommittees and includes a number of recommendations under the following headings:

a. **Fishery assessment in relation to regulation problems.**

The working group of six scientists established at the 1959 Annual Meeting had met in Lowestoft, England, for a week in March 1960, for four days in advance of the Bergen meeting and had continued its activity during that meeting. Two progress reports described the work done and the conclusions reached so far. The Committee considered the steps needed for completing the work on Fishery Assessment and **recommended**

That funds be made available for the present group of scientists to continue its activities in the coming year, for (a) The convener of the group, Mr. Beverton, to attend the meeting of advisers to Panels 4 and 5 at Woods Hole, December 1960, (b) The group to meet for two weeks at Lowestoft, February 1961. (Approximate cost, $3,500).

b. **Environmental Studies.**

The Committee considered the work in progress and agreed on certain tasks which should be given priority in a continuing program of environmental studies. The Committee once again stressed that it was seriously handicapped in its work by the lack of fisheries hydrographers in the delegations for the Annual Meeting.

In view of the urgent need for co-operation between biologists and hydrographers, it was **recommended**

That a small working party of three fisheries hydrographers and three biologists be invited to meet during 1960-61, at the Commission's expense (approximate cost, $3,000) to advise on some specific questions, and

That a Symposium on "the Influence of the Environment on the Distribution and Abundance of the Principal Groundfish in the ICNAF Area" be held by the Commission in 1962 or 1963.

The Committee agreed to a number of **recommendations**, mainly dealing with the extending of the Continuous Plankton Recorder Survey and with co-operation with other organizations working with Environmental Researches.

c. **Statistics and Sampling:**

The Committee dealt in detail—by means of various subcommittees—with a number of problems connected with the collection and compilation of data on fisheries statistics and on sampling of stocks, and made a series of **recommendations** relevant to the following problems: (1) Co-ordination of FAO/ICES/ICNAF statistics, (2) Statistical Unit Areas, (3) Discards, (4) List of Fishing Vessels, (5) Fishing Power, and (6) Sampling.

d. **Gear Research and Selectivity:**

Progress of research work during the year was considered and **recommendations** for the furthering of the researches were made.

e, f and g. **Halibut, Sea Scallops and Redfish:**

After consideration of the present status of research, a series of **recommendations** concerned with research work were adopted.

h. **Marking Symposium:**

The agenda and other plans for the Marking Symposium to be held through four days in conjunction with the 1961 Annual Meeting were considered, and it was decided that contributions be invited also from workers outside the Convention Area. The Symposium would be chaired by Mr. Beverton.

i. **Ageing Techniques:**

The results of the cod otolith exchange program and of the questionnaire on age reading techniques were considered. It was found that important disagreements between methods and readings of different workers still existed. It was **recommended** that a Working Party on Ageing Techniques be set up with Dir. G. Rollefsen as convener. It was proposed that the Party should meet in Bergen in autumn 1961, if the preparatory work could be completed in time. The program for the meeting should be drawn at the 1961 Annual Meeting.

j. **Publications:**

The Committee considered papers prepared for the 1960 Annual Meeting and **recommended** an additional publishing in the Red Book of "Annotated List of Papers," Halibut Bibliography" and separately of "List of Fishing Vessels."

k. **General Recommendations:**

The Committee finally considered improvements in the organization of the Committee's work during the Annual Meeting and in the preparative work for the meetings, and made a number of relevant **recommendations.**

1. It was proposed that the next meeting of the Committee should be held in Woods Hole

in the week prior to the 1961 Annual Meeting in Washington.

In the course of the Annual Meeting, the following two lectures were given:

(1) Dir. G. Rollefsen on the development of the new Norwegian Institute of Marine Research and Aquarium in Bergen, and

(2) Dr. Grim Berge on methods of measuring primary production in the sea.

Dr. Mario Ruivo was re-elected Chairman.

After consideration by the Commission, the Report of the Committee and the included recommendations were adopted.

The full report by the Standing Committee on Research and Statistics will be published in the "Red Book."

15. Reports of Meetings of Panels 1 to 5 (Agenda Items 4, 16 and 19).

In the meetings of the five panels, the status of the fisheries, the researches carried out and plans for future work were discussed and reports from the separate groups of scientific advisers were considered and approved. Dr. H. Graham invited the scientific advisers to Panels 2, 3 and 4 to attend the planned meeting of the Scientific Advisers to Panel 5 in December 1960.

(a) **Panel 1** adopted a number of **recommendations** by its Group of Advisers, especially aiming at an intensification of hydrographic researches during the winter half of the year, of investigation of the distribution of cod eggs, larvae and young of the cod, and of tagging of cod in the southern part of Subarea 1. It was agreed that the group of advisers should meet in the week prior to the 1961 Annual Meeting.

(b) **Panel 2** considered applications by the Federal Republic of Germany and by the United Kingdom for membership on the Panel and **recommended** their acceptance. It was noted that France expects to have her new research vessel working in the Subarea in the following year. It was decided that the group of advisers should meet again in the week preceding the 1961 Annual Meeting.

(c) **Panel 3.** An application by Italy for membership in the panel was approved for **recommendation** to the Commission. When considering the plans for future work, it was noted with satisfaction that France would have a new research vessel working in the Subarea by next year, and that Portugal was planning the building of a research vessel. It was agreed that the Group of Advisers should meet again in the week preceding the 1961 Annual Meeting.

(d) **Panel 4.** The Panel agreed to **recommend** to the Commission that the Italian application for membership in Panel 4 be accepted. It was agreed that the group of advisers should meet again in the week preceding the 1961 Annual Meeting.

(e) **Panel 5.** The United States reported on its new laboratory facilities at Woods Hole and on plans for the construction of a stern trawler type research vessel. A review and evaluation of the two-year 10% annual exemption experiment in Subarea 5 was presented by the United States, which requested a two-year continuation of the experiment. The Panel **recommended** that this request be granted.

It was agreed that a meeting of the Scientific Advisers should be held in Woods Hole in December 1960.

The above-mentioned five Panel Reports and their recommendations were approved by the Commission.

16. Acknowledgements and Adjournment (Agenda Items 20 and 21)

The observers for Poland, FAO, ICES, WMO, and the Permanent Commission thanked the Commission for the opportunity to attend the Annual Meeting.

The Commission's Chairman thanked the observers for their attendance. He thanked the Government of Norway for the excellent support rendered the Commission during the Annual Meeting, and expressed the Commission's best thanks to the Lord Mayor of Bergen and to Bergens Handelsforening for the receptions given. He thanked the Secretariat—the perpanent, as well as the additional Norwegian staff —for the excellent work during the Meeting. He concluded by offering his most sincere thanks to the Vice-Chairman, to the Chairmen of Panels and Standing Committees, to all Commissioners and advisers for the hard and excellent work accomplished during the Annual Meeting.

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

APPENDIX I
LIST OF PARTICIPANTS

CANADA:

Commissioners:

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

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INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA:

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INTERNATIONAL FISHERIES CONVENTION 1946:

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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.
5. Report on staff matters, with presentation of the Administrative Report 1959/60 and financial statements for 1959/60.
6. Presentation of Auditor's Report for the financial year 1958/59 with approval of transfers.
7. Consideration of budget estimate for 1960/61.
8. Consideration of advance budget estimate for 1961/62.
9. Consideration of "Annual Returns" showing inspections carried out in connection with ICNAF trawl regulations. Further, the appointment of an ad hoc committee to consider the collected information.
10. Review of the work carried out by the group of population scientists on Fishery Assessment in Relation to Regulation Problems.
11. Reports by ICNAF observers on meetings of other organizations during the preceding year.
12. Date and place of Annual Meeting 1961.
13. Report on the Redfish Workshop in Copenhagen, 1959, by the Chairman of the Workshop, Dr. J. Lundbeck.
14. Report on the Joint FAO/ICES/ICNAF Statistical Meeting in Edinburgh, 1959, by the ICNAF representative Mr. R. S. Keir.
15. Proposal of the following change of the Financial Regulations for the Commission, Section IV, 5: Insert after "the" at the end of second line (vide Report of the First Annual Meeting, 1951, p. 37) the words "Chairman of the"; the so-amended item to read: "4.5 No transfer between appropriation sections may be made without authorization by the Chairman of the Commission."
16. Review and evaluation of the results of the 2 year 10% annual exemption experiment in connection with trawl regulations in Subarea 5, and a possible change of the corresponding paragraph two (II) of the regulation of cod and haddock trawl fishery in Subarea 5.
17. Report on the meetings of the Standing Committee on Research and Statistics, May/June 1960.
18. Report on the meetings of the Standing Committee on Finance and Administration, May/June 1960.
19. Reports on meetings of Panels 1-5, May/June 1960.
20. Other business.
21. Adjournment.

PART 3

Summaries of Research 1959

A. Summaries by Countries

I. Canadian Research Report, 1959

A. SUBAREAS 2 AND 3 — BY W. TEMPLEMAN

The Fisheries Research Board of Canada has carried out researches during 1959 in Subareas 2 and 3 on cod, haddock, redfish and American plaice. Hydrographic sections were taken in July-August over the area from southern Labrador to the southern Grand Bank.

Cod, *Gadus morhua* L. Otolith age readings for cod collected in Labrador, 1950-58, indicated the most successful year-classes to be 1942 and 1947, followed by moderately successful year-classes in 1944, 1945, 1946 and 1948 and very poor survival of the 1943 year-class. In collections of cod both inshore and offshore in Labrador, 1959, the 1950 and 1952 year-classes were most abundant and the 1949 year-class poorly represented.

A survey (intended to be repeated annually) of baby cod in the inshore areas of Newfoundland was begun by seining on the beaches of the east coast. Cod of the 0+ group were most numerous, cod of the 1+ group relatively scarce and although only a few of the 2+ group were caught the fairly large number of this year-class present in the harbours is indicative of high survival from the 1957 spawning.

Observations on the inshore and the long-line fisheries were continued at Bonavista. This area has apparently been affected detrimentally by the combined effects of the local catch and of the large catch in the local and neighbouring areas in recent years by European trawlers and longliners. Although the cod landings in the Newfoundland inshore area were 40% higher in 1959 than in 1958, the increase at Bonavista was only 11% higher and only 9.6 million pounds were caught compared with 15.3 million pounds in 1957. Of the 1959 total, 45% was from handlines (both jiggers and baited hooks), 30% from traps, 5% from line trawls operated by hand from small boats and 20% from longlines.

In the period 1952-58 the inshore fishery at Bonavista was mainly based on a group of fish which in the handline catches had a modal length of 52-53 cm in 1952 and which gradually increased in size to a mode of 62-63 cm in 1958. This group has now been very much reduced and the future success of this fishery will depend on the strength of a new group of small cod which made their first appearance in the catch in 1959.

The cod-trap fishery in the St. John's area has been studied since 1957. In 1957 and 1959 trapping began in the latter half of June and continued to the middle of August or later. In 1958 cod trapping began early in June and ceased before the end of July. The winters of 1957 and 1959 were cold and fishing was somewhat delayed, but in both years cod were available to the traps (which are set in 8-20 fathoms) because of being concentrated inshore in the trapping areas by the cold, below 0°C, water layer underneath a shallow layer of warmer surface water. In 1958, on the other hand, the warm surface water extended deeply enough for cod to descend below the range of the traps by the end of July.

In the cruise of the *A. T. Cameron* to Baffin Island, Ungava Bay and northern Labrador from August 18 - September 14 (Fig. 1) no cod were caught north of Line V at Lat. 63°N where 2 individuals (19 lb) and 14 individuals (83 lb) were caught at 125 fathoms (-0.25°C) and 150-160 fathoms (1.13°C) respectively. A few cod were caught off Frobisher Bay in Lat. 62°14′ to 62°20′N in 150-200 fathoms. In Ungava Bay cod occurred in small numbers (3-64 indididuals, 20-215 lb) in all 7 half-hour hauls in 27-200 fathoms (-0.6 to 2.0°C). No commercial concentrations of cod were encountered on the cruise, the greatest catch being 500 pounds in a half-hour's dragging at 99 fathoms (-0.4°C) off Cape Mugford, Labrador, Lat. 57°33′N. On the other

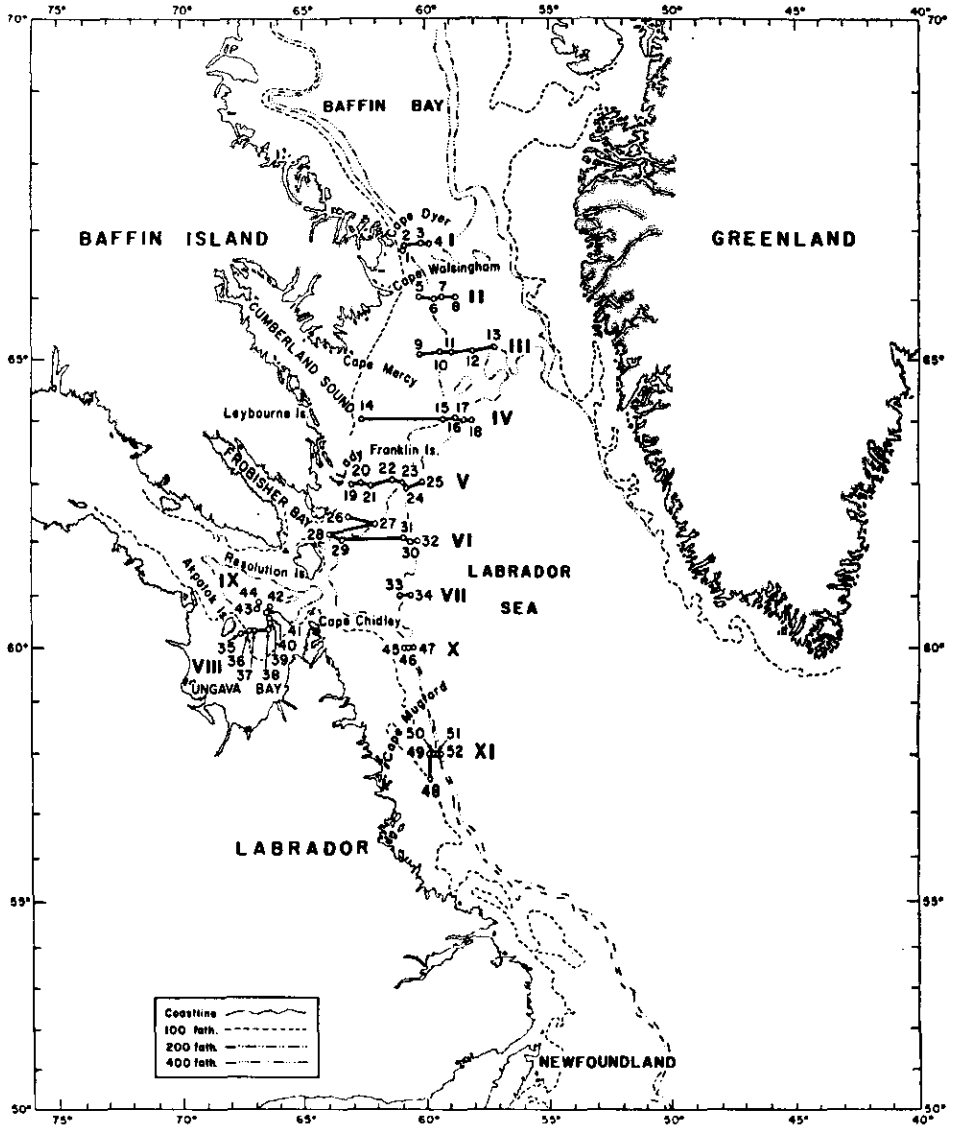

Fig. 1. Cruise of R.V. "A. T. Cameron" to Baffin Island, Ungava Bay and Northern Labrador, August 18 - September 14, 1959. Position of trawling stations.

hand ice conditions and the necessity to investigate the deepwater redfish areas limited the amount of shallow-water exploration on this cruise.

Haddock, *Melanogrammus aeglefinus* (L.). The annual otter-trawl survey for haddock was made by the *Investigator II* on the southern half of the Grand Bank from May 1-9 in depths from 25-100 fathoms. At the same time the *A. T. Cameron* explored the deeper areas of the southwestern slope between 80 and 400 fathoms in a redfish-haddock survey. The survey of St. Pierre Bank was carried out by the *Investigator II* in June. In the intensive commercial haddock fishing by Newfoundland trawlers on the southwestern slope of the Grand Bank in late winter and early spring preceding the above survey, haddock had been concentrated much more and much deeper than usual. Catches as high as 25,000 pounds were often made in 15-20 minutes dragging. The haddock, also, were driven much deeper than usual, presumably by low temperatures due to the unusually cold winter. Whereas

usually in late-winter, early-spring most commercial fishing for haddock on the Grand Bank extends down only to about 80 fathoms, in March 1959 large catches of haddock were being made as deeply as 120-140 fathoms. By the time of the *Investigator II* and *A. T. Cameron* surveys these late-winter, early-spring pre-spawning concentrations of haddock had largely dispersed northward, probably to some degree at least pelagically, and the only moderately good catches obtained per half-hour's dragging were one of 5,000 pounds at 50 fathoms and two of 2,300 and 4,000 pounds at 125 fathoms on the southwestern slope of the bank. On St. Pierre Bank the 4 largest haddock catches per half-hour's dragging ranged from 360-900 pounds in 80-110 fathoms on the southwestern slope of the bank.

On the Grand Bank the most abundant group present was the 1955 year-class, with a mode in the length distribution at 33 cm, which accounted for nearly 50% by number of the research vessel catch. The once very abundant 1949 year-class had become reduced significantly in numbers and accounted for only 7% of the catch, whereas the moderately abundant year-classes of 1952 and 1953 together comprised 28% of the catch. The 1956 year-class which showed some promise in 1958 did not survive well and initially was probably not more than one-fifth as abundant as that of 1955. The 1957 brood appears to have been a complete failure and the same is true of the 1958 year-class.

From a survey of the deep-water areas along the southwestern slope of the Grand Bank, the 1955 year-class was abundant at all depth ranges from 47-50 fathoms to 117-196 fathoms, but there was a definite trend toward an increase in the number of haddock of the older year-classes with increasing depth. A cruise in July to the shallowest part of the bank revealed very large concentrations of haddock of the 1955 and 1956 year-classes in capelin-spawning areas at 23 fathoms on the Southeast Shoal of the Grand Bank, year-classes older than that of 1955 being almost completely absent from the catches. It would appear that pelagic or other movement of haddock from the deeper wintering areas to the shallower water of the Southeast Shoal of the Grand Bank in 1959 was limited mainly to the younger year-classes, whereas the older mature haddock remained in the deeper water along the slope and did not migrate so extensively. This is similar to the habits of cod off northeastern Newfoundland—the large older fish remaining all summer in the deep water and the younger fish moving pelagically toward the shallower water which in this area is only to be found inshore.

The length frequencies and the age composition of the commercial landings of haddock from 1957-59 show the rapid reduction in abundance of fish of the once very abundant 1949 year-class. The 1952 and 1953 year-classes were moderately successful and contributed significantly to the catches during 1957, 1958 and the early part of 1959, but they are declining in abundance rapidly. At present, the 1955 year-class is the only very abundant one on the Grand Bank and haddock of this year-class are only now becoming of marketable size. There is no evidence of any significant survival of year-classes since that of 1955, and even if the 1959 brood has been successful in surviving, the 1955 brood alone cannot be expected to maintain the haddock fishery at a high level for the 5 years required for haddock of the 1959 year-class to grow to marketable size.

Large quantities of small Grand Bank haddock (30-40 cm) appeared inshore along the eastern coast of the Avalon Peninsula during late June and July 1959 and large numbers were caught by cod traps. They appeared to move northward along the east coast and did not remain in one place for more than a few days. The appearance of haddock in quantity along the east coast is unusual, and may have been due to cold Labrador Current water, unsuitable for haddock, covering the bottom of the Grand Bank in early summer, thus forcing the haddock to assume a pelagic existence in the warmer water near the surface. (Bottom water temperatures on the southwestern Grand Bank in the summer of 1959 were lower than usual and relatively unsuitable for haddock.) In the pelagic phase, in the rather shallow surface layer of warm water over water too cold for the haddock to go to the bottom, the vertical movements are restricted and the horizontal movements greatly increased

until finally the haddock reach the only shallow water available near the western Grand Bank region, i.e. the water near the coast of the Avalon Peninsula. On the eastern side of the Grand Bank there were during the summer months correspondingly great concentrations of haddock of the same size group (30-40 cm) in the shallow water of the Southeast Shoal.

In October and November haddock were caught by otter trawlers on shallow banks in the vicinity of Cape Race and catches of up to 5,000 pounds per set were obtained. These probably were part of the schools which migrated northward earlier in the summer and by late autumn had moved southward again.

There has been very little commercial fishing for haddock by Newfoundland trawlers on St. Pierre Bank since the winter and early spring of 1956. It appears unlikely that there will be a significant fishery for haddock there in the near future, as there has been a very low survival of all year-classes since that of 1949.

Redfish, *Sebastes marinus mentella* Travin and *Sebastes marinus marinus* (L.). A study, based on otolith age readings, of the age and growth of *mentella*-type redfish in Hermitage Bay, indicates that at the smallest length at which redfish are acceptable in the Canadian fishery, 25 cm, male redfish are about 10 years old and female redfish approximately 9 years old. At a length of 30 cm males are about 16 years and females 12 years of age. At 35-38 cm which represents the usual peak sizes of the larger redfish from the Gulf of St. Lawrence and from the southwest coast of Newfoundland, male redfish are on the average more than 30 and females 19-25 years of age. Some specimens of both sexes apparently live to 50 years of age or more, but in Hermitage Bay only about 2 or 3 centimetres additional growth in length occurs between 24 and 48 years of age.

In 1959 the *A. T. Cameron* made 4 redfish cruises in Subareas 2 and 3. A No. 41 otter trawl was used on a series of lines usually in standard depths from 100-400 fathoms. Bottom temperatures and bathythermograph records were obtained at each fishing station and dragging was for a half-hour on bottom in each case. In a survey of the southwestern part of the Grand Bank in May-June between 80 and 400 fathoms only 2 good redfish catches were made, 5,800 pounds (averaging 1.3 lb) at 290 fathoms and 4.0° C in the mid-southwestern slope and 13,000 pounds of small redfish (average 0.7 lb) at 125 fathoms at the southern tip of the bank at Long. 50°31'W. All other catches were of 3,000 pounds or less. The *A. T. Cameron's* fishing with the larger No. 41 net on the southwestern slope of this bank was notably less successful than the fishing of the *Investigator II* with the smaller No. 36 net in the same area in May-June 1952 and especially in early May 1951.

On the southwestern Grand Bank almost all the redfish fishing is done by United States vessels and there appears to be a great reduction of the redfish concentrations found in earlier years. Redfish increased in size with increase in depth. Previous to the *A. T. Cameron* cruise to the southwestern Grand Bank, in which 26 *marinus*-type redfish were caught, there were only 8 definite records of *marinus*-type redfish from the southwestern slope of the Grand Bank. Most *marinus*-type redfish were caught at 125 fathoms and none occurred at depths greater than 200 fathoms.

Investigations on the eastern slope of the Grand Bank were carried out between June 10 and July 21. On the southeastern part of the bank 3 large catches (9,600, 7,100, 8,400 lb; average weights 0.6, 0.7 and 1.1 lb) were taken in 165, 150 and 195 fathoms respectively, at bottom temperatures between 2 and 3°C. Northward toward the middle and northeastern Grand Bank larger redfish were found, the largest catches being 6,000, 4,200 and 2,400 pounds at 170-175 fathoms (average weights 1.3, 1.5 and 1.0 lb, bottom temperatures between 2 and 3°C), and a catch of 4,200 pounds at 200 fathoms and 1,900 pounds at 250 fathoms (average weights 1.5 and 1.9 lb, bottom temperatures 3.0 and 3.4°C). No catches of commercial quantities of redfish were found below 250 fathoms, and at 400 fathoms, the greatest depth fished, the average catch of redfish in 6 drags was 3 fish.

Along the eastern slope of the Grand Bank, especially northward, commercial quantities of redfish lay deeper than on the southwestern slope

and on the southern tip of the bank. This was partly due to the presence of considerably larger redfish and the relative scarcity of small redfish in the northeastern area. With occasional exceptions, and these generally in small catches, the sizes of redfish increased with depth.

During this survey of the eastern slope of the Grand Bank 83 *marinus*-type redfish were caught, 70 of these in a single set at 125 fathoms, 2°C, at the southeastern corner of the bank. With the exception of one *marinus*-type fish taken at 300 fathoms all the *marinus*-type redfish occurred in depths of 150 fathoms and shallower. On each line of stations crossing the slope from shallower to deeper water the large *marinus*-type fish occurred at shallower depths than the peak catch of the smaller *mentella*-type fish.

Thirty successful sets were made on the northeastern Newfoundland Shelf from September 27 - October 5, at and near the continental slope area from Hawke Channel (off Hawke Harbour, Labrador) to northeast of Fogo Island. The two most northerly lines were in the area immediately south of Hawke Channel where a very great fishery for redfish was developed in 1958. In 1959, up to October, both commercial and research vessel catches of redfish in this whole area proved to be disappointing. Of 30 successful sets by the *A. T. Cameron* only 4 (1,700-2,600 lb per half-hour's dragging) approached minimum commercial quantity. One of these catches was taken at 135 fathoms (average weight 2.1 lb), 2 at 250 fathoms (average weights 1.7 and 2.1 lb) and the largest catch at 300 fathoms (average weight 2.3 lb). All 4 of these catches were obtained at bottom temperatures above 3°C. The sizes given above are of *mentella*-type redfish which usually made up almost all the catch. These *mentella*-type redfish were much larger than those of the southwestern and southeastern Grand Bank and somewhat larger than those of the northeastern Grand Bank. *Mentella*-type redfish in this area were situated more deeply than in the areas to the south. The average catch in 4 sets at 400 fathoms, the greatest depth fished, was 26 redfish (average weight 2.1 lb).

Although the *marinus*-type redfish were far outnumbered by the *mentella* type they were considerably more abundant than in the more southern areas and over 300 *marinus*-type redfish weighing 1,300 pounds and averaging 4 pounds were caught in 30 sets. The *marinus*-type fish were as usual much larger than the *mentella* type. They also lay considerably shallower, being most numerous at 140-200 fathoms. A total of only 12 *marinus*-type redfish occurred in 8 sets at 250 and 300 fathoms and none below 300 fathoms.

The *A. T. Cameron* cruise of August 18-September 14 to Baffin Island, Ungava Bay and northern Labrador was to an area which, although largely north of Subarea 2, provided information of importance for understanding the redfish of Subarea 2. Otter-trawling stations on this cruise are shown in Figure 1. Beginning with a line of stations off Cape Dyer at the southern end of Baffin Bay in Lat. 66°42′ to 66°48′N and continuing in a group of stations, usually on each degree of latitude line as far south as Lat. 58°N off Labrador and also in Ungava Bay, fishing by otter trawl was carried out in depths generally of either 100 or 150 fathoms or both and 200, 250, 300 and 400 fathoms.

On Line I off Cape Dyer only 2 small redfish were found and on Line II, Lat. 66°N, only one. One hundred and fourteen redfish were obtained on Line III at Lat. 65°N. Only a few small redfish were found in Ungava Bay. No commercial catches of redfish were obtained over the whole area. The greatest quantities in a half-hour's dragging were 500 pounds at 297 fathoms (2.3°C) on Line IV at Lat. 64°N and 800 pounds at 305 fathoms (3.8°C) on Line VI at Lat. 62°N.

Apart from a total of 11 large *marinus*-type fish obtained (10 at 300 fathoms and 1 at 400 fathoms) on all lines from Lat. 65° to 62°N all redfish were definite *mentella*-type fish of the Labrador-northern Grand Bank type. Although many large females were present all female redfish were immature southwards to Lat. 62°N. Small 6-13 cm redfish were present from Line IV off Cumberland Sound (Lat. 64°N) to Ungava Bay and were especially plentiful (173 individuals) at 155 fathoms (1.1°C) on Line V north of Frobisher Bay (Lat. 63°N) but none were found on the

two lines at Lat. 60° and 58°N, off northern Labrador.

The northerly distribution of the young redfish over areas where the Labrador Current was proceeding rapidly southward and where all the female redfish were immature, strongly indicates that these young redfish are the result of a drift of redfish larvae from West Greenland.

American plaice, *Hippoglossoides platessoides* (Fabr.). From the 1,000 American plaice tagged on the northeastern slope of the Grand Bank in 1954 approximately 5% have been recaptured. Most of these were taken within a 75-mile radius of the tagging locality. However, a few returns indicated a general westward and southwestward movement; 1 tagged fish was recaptured near Sable Island. The St. Mary's Bay tagging of 1954 seems to indicate no movement of plaice from this coastal bay to offshore bank areas. One thousand plaice were tagged on the southern and southeastern slopes of the Grand Bank during the past year.

A study of the catch of plaice per unit of effort by commercial trawlers on the Grand Bank for 1953-58 indicates a sustaining yield in the northern and northeastern part of the bank, a fluctuating condition on the central eastern slope and a somewhat declining trend on the southern and southeastern slopes.

Hydrography. The usual six hydrographic sections across the Labrador Current, the banks and continental shelf from Labrador to the southern Grand Bank were taken from July 25-August 26 by the *Investigator II*.

The winter of 1958-59 was colder than usual in eastern Newfoundland whereas the winter of 1957-58 was relatively warm. The mean air temperatures at Torbay Airport, near St. John's, in December-March were 23.3, 30.9 and 21.8°F (-4.8, -0.6, -5.8°C) in 1956-57, 1957-58 and 1958-59 respectively, compared with the long-term average of 26.5°F (-3.1°C).

In the Seal Islands section (Fig. 2), off Labrador, temperatures of the cold intermediate layer were little different from those of 1958. The volumes of water with temperatures below 0°C were quite similar in the 2 years, possibly a

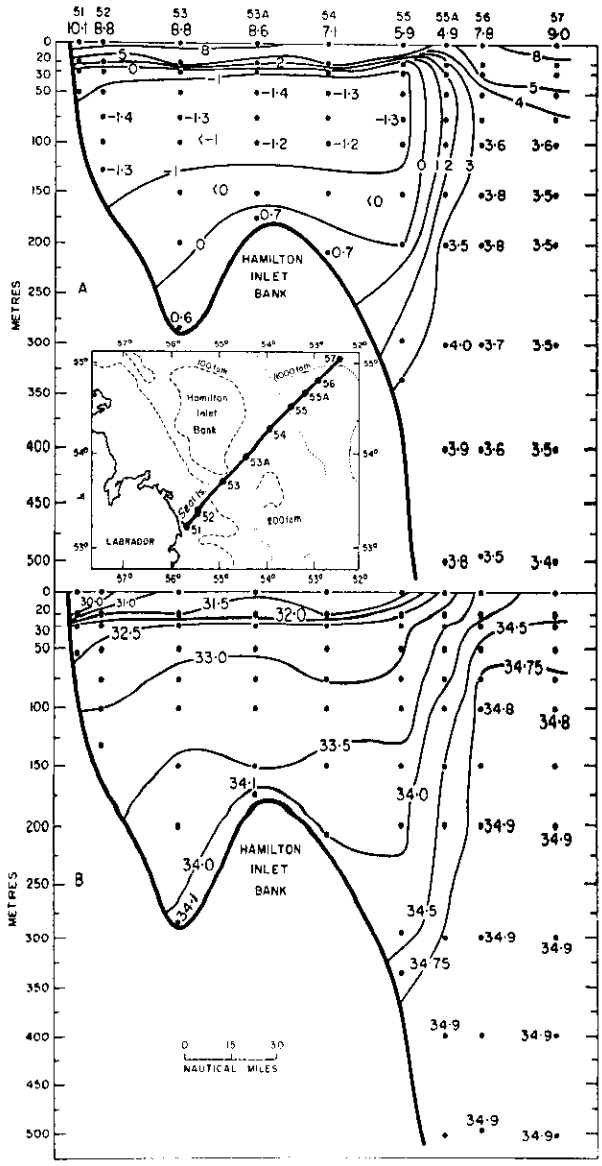

Fig. 2. Hydrographic section off Seal Islands, across Hamilton Inlet Bank, Labrador, August 7-10, 1959. A—Temperature °C; B—Salinity per mille.

little less in 1959, but water with temperatures below 0°C and below -1.0°C in the inshore area was much closer to the surface in 1959 than in 1958. The deep water to the east of Hamilton Inlet Bank in 1959 was slightly warmer than in 1958 but not nearly as warm as in 1957 when the deep-water temperatures were unusually high. Water with a temperature as low as -1.5°C was not noted in 1959 and existed at only one level at one station in 1958.

In the St. John's-Grand Bank-Flemish Cap section (Fig. 3) the general temperature system

at all depths resembled that of 1957. (The winter of 1956-57 was unusually cold in eastern Newfoundland but not as cold as that of 1958-59.) There was considerably more water with temperatures below 0°C and below -1°C than in 1958, but, as also occurred in the section off Bonavista, temperatures at the surface and in the water layer shallower than 25 metres were higher in 1959 than in 1958.

On the whole throughout the six sections, temperatures in the northern sections resembled those of 1958, in spite of the much colder winter (at least in eastern Newfoundland) in 1958-59 than in 1957-58. Progressively southwards temperatures were lower in 1959 than in 1958, and on the southwestern slope of the Grand Bank the temperatures of the deeper water in 1959 were considerably lower than usual.

In the summer of 1959 the Atlantic Oceanographic Group at St. Andrew's, N. B., completed the fifth of a series of seasonal surveys covering the Atlantic waters off Newfoundland. Variations in the Labrador Current and the slope water give rise to extreme variations of temperature and salinity over the banks. In March, for example, the temperature distribution over the Grand Banks suggests an exceptionally large flow of Labrador Current water and abnormal local cooling in 1959, as compared with 1958. A study of variations in the thermal structure of the Labrador Current indicates that this water moves south in bodies which at times seem to be semi-independent.

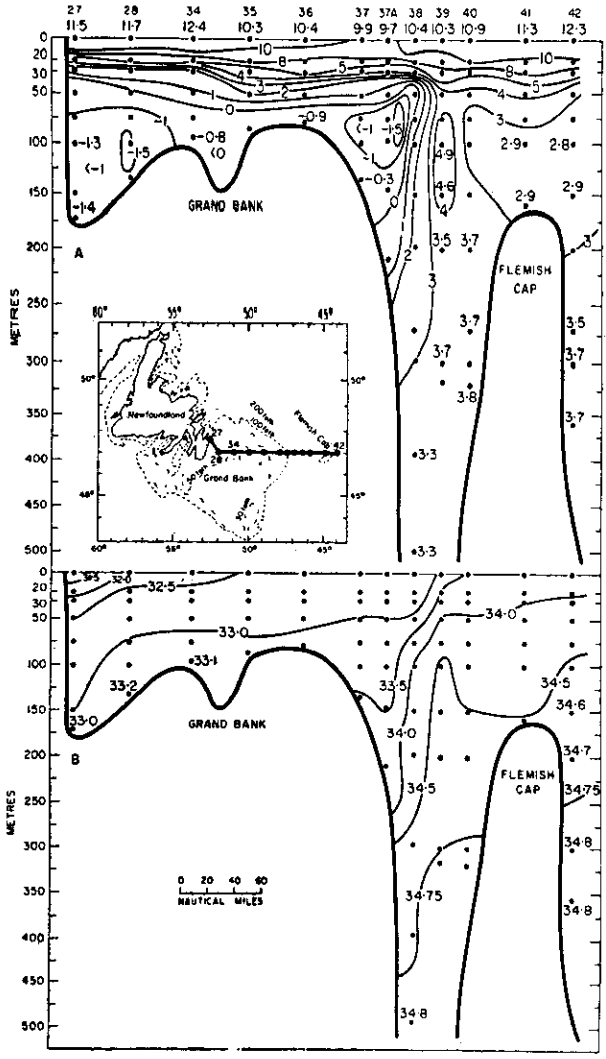

Fig. 3. Hydrographic section St. John's - Grand Bank - Flemish Cap, July 25-27, 1959. A—Temperature °C; B—Salinity per mille

B. SUBAREAS 4 AND 5 — BY W. R. MARTIN

Canadian research pertinent to ICNAF is conducted by the Fisheries Research Board of Canada and the Quebec Department of Fisheries. The Board's research on commercial fisheries in Subareas 4 and 5 is largely the responsibility of the Biological Station at St. Andrew's, N. B. Hydrographic research is done by the Atlantic Oceanographic Group of Halifax, N. S. These programs are providing predictions of fishing success under various natural conditions and with conservation measures.

Groundfish field work included studies of commercial operations and investigations from research vessels. The main species studied were cod, *Gadus morhua* L., haddock, *Melanogrammus aeglefinus* (L.) and American plaice, *Hippoglossoides platessoides* (Fabr.). Commercial fishing was assessed by a statistics and sampling program on landings at fishing ports (reported elsewhere), and by making sea trips on commercial trawlers to sample the quantities and sizes of groundfish discarded at sea. Research

vessels were used to examine fish distribution, movements and growth in relation to the environment, and to define the selective properties of fishing gears. The major development in 1959 was use of the new offshore research vessel *A. T. Cameron*, which permitted extended coverage of offshore banks during the winter season. IBM methods are being introduced to improve efficiency in handling voluminous statistics and research vessel data.

Discards at sea. Observations on discards of groundfish from otter trawlers were made in two areas, Nova Scotian Banks and the western Gulf of St. Lawrence.

On Nova Scotian Banks estimates of sizes, numbers and weights of haddock discarded during the months of May to August are available for two periods. The first period, 1951-53, was prior to mesh regulation when nets were about $2\frac{7}{8}$ inches internal mesh. In the second period, 1958-59, all vessels were using meshes of 4 inches or more, but with various sizes and kinds of top chafing gear. Size compositions of haddock catches and landings for sea sampling trips are presented for the years 1952, 1953, 1958 and 1959 in Figure 1. The numbers of haddock measured at sea per year varied from 3,000 to 8,000 fish. Percentage discards are summarized as follows:

Year	Condition of fish landed	Discards % by Weight	Discards % by number
1952	gutted	31	62
1953	gutted	20	44
1958	round	2	5
,,	gutted	10	22
1959	round	8	16
,,	gutted	17	35

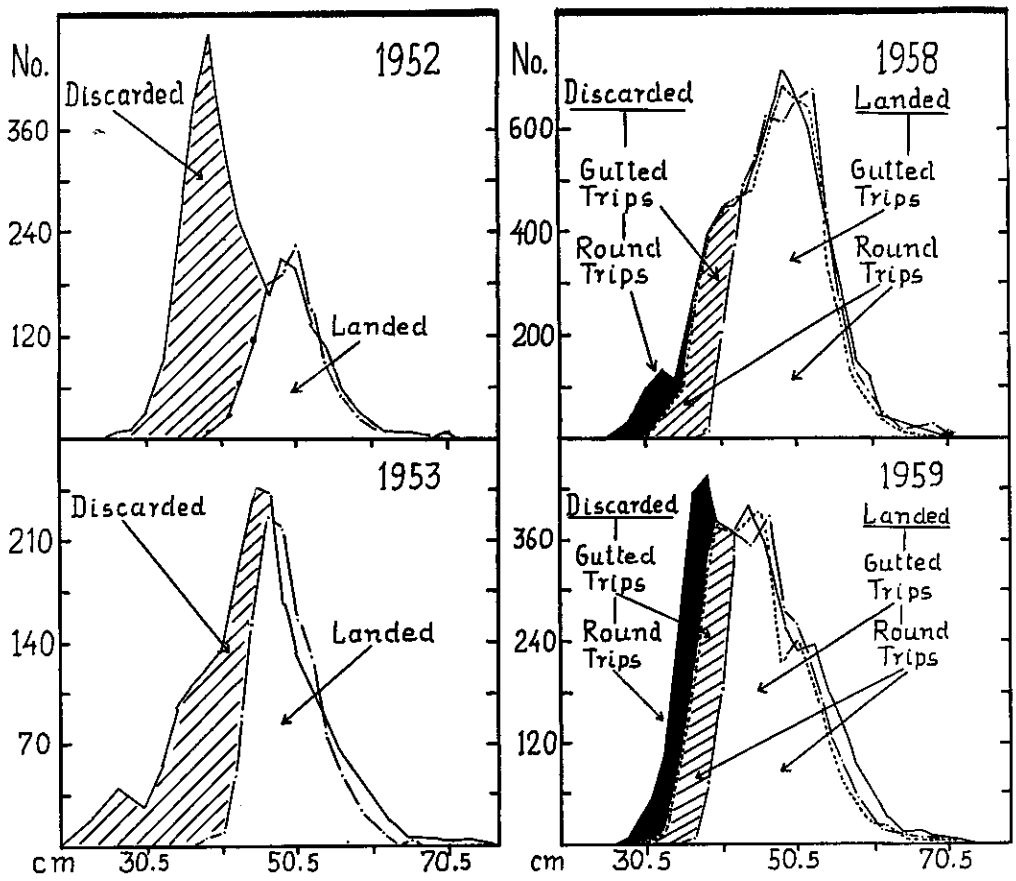

Fig. 1. **Size compositions of haddock caught and landed in 1952-53 and 1958-59, Nova Scotian Banks, showing sizes and estimated proportions discarded and landed.**

Lower discards in the later period are related to the larger mesh size and the lower minimum size of marketable fish. Annual changes in the numbers of small haddock available to the fishery also caused variations in the quantities discarded.

Observations of low cod discards on Nova Scotian Banks in 1958 and 1959 agree with earlier observations. For trips sampled in 1958-59 cod discards were about 10 to 15% by number and 4 to 5% by weight. The mean size of discarded cod was about 38 cm ($\frac{7}{8}$ lb) and all cod larger than about 48 cm ($1\frac{3}{4}$ lb) were retained.

Estimates of proportions of incidentally caught species discarded at sea were made in 1958 and 1959. Large proportions of hake (*Urophycis*), yellowtail (*Limanda*), skate (*Raja*) and silver hake (*Merluccius*) were discarded as unmarketable fish. However, only in the case of hake did discarding seem to be on the basis of fish size.

Proportions of groundfish discarded at sea were observed on nine sea trips in the western Gulf of St. Lawrence. Observations were from late May to early September on draggers using $4\frac{1}{2}$-inch mesh codends. Cod discards ranged from 1 to 22% by number and from 0.4 to 11% by weight. Early in the season average discards were comparatively low at 3% by number and 1% by weight. During three later trips discards were 22% by number and 11% by weight. The change reflects an increase in the minimum size of fish acceptable at landing ports, and consequently at sea.

Wastage of American plaice in the same area amounted to 85% by number on two trips. This reflects the large numbers of fish between the 50% selection point (23 cm) for $4\frac{1}{2}$-inch manila meshes and the 50% cull point (34 cm) for commercially acceptable sizes. Survival of discarded plaice returned to the water is being investigated.

Witch flounders (*Glyptocephalus*) were all large in size and none were discarded. White hake discards were 95% by number, with only the largest fish retained for markets.

Tagging. Tagged groundfish provide useful information on definition of stocks, migrations, growth and mortalities. Numbers of tagged haddock released in 1959 were 522 on Emerald Bank in March, and 218 on Sable Island Bank in September. Numbers of cod tagged were 469 on Banquereau in February, 65 on Emerald Bank in March, 1,398 in the western Gulf of St. Lawrence (4T) in August-September, and 112 on Sable Island Bank in September. Tags were attached to 879 American plaice in the southwestern Gulf of St. Lawrence. Most of the tags were Petersen yellow plastic discs, attached by a stainless steel wire through the back of the fish.

Low recoveries from offshore taggings of haddock and cod probably reflect high tagging mortalities and possibly low fishing mortalities. Recoveries of Gulf of St. Lawrence plaice were highest at 37% per year in the Shippegan Gully area where there is concentrated fishing in May and June.

Returns of cod and haddock tags support earlier observations of seasonal migrations. No definite migratory patterns have been observed for plaice, although a few individuals moved distances up to 100 miles.

Surveys. Research vessel surveys on Nova Scotian Banks and in the southwestern Gulf of St. Lawrence were continued in 1959. These surveys provide assessments of the effects of environmental factors on abundance and distribution of fish. They also give a basis for predicting recruitment of young fish before they enter the fishery. On the Nova Scotian Banks emphasis was on haddock, and in the Gulf of St. Lawrence on cod and plaice.

In summer small haddock under 40 cm were taken most abundantly in shallow water (less than 30 fathoms) on top of the banks. In winter they had disappeared from this shallow water, but large catches were taken from deeper water along the edge of the banks, between 60 and 120 fathoms.

Large haddock were not numerous anywhere in summer, except for a very small area on top of Emerald Bank. In winter large catches were made at 50 to 60 fathoms around Emerald Bank.

In summer small haddock were most abundant in warm shallower water above 7°C. In

most areas temperatures do not seem to have been limiting, but temperatures between 1° and 3°C over much of Banquereau probably reduced abundance there.

During winter haddock were absent from the shallow water where temperatures less than 1°C prevailed. Between 1° and 3°C small haddock predominated in the catches, and their numbers increased in the warmer portion of this temperature range. Large haddock were most abundant at bottom temperatures between 3° and 5°C, at depths of 50 to 60 fathoms, in the vicinity of Emerald Bank.

The 1956 and 1957 year-classes of haddock are relatively numerous. Modal lengths for these year-classes were about 30 and 20 cm in August 1958; 34 and 24 cm in March 1959; 34 to 36 and 28 to 30 cm in July 1959. The 1956 brood is expected to start contributing to the commercial fishery in 1960, and the 1957 brood in 1961. This should result in above-average abundance of haddock in 1961 and 1962. There are indications, however, that the 1958 year-class is weak and a return to normal catches is predicted for about 1964.

In 1959 the Gulf of St. Lawrence cod survey was continued for the third consecutive year and was extended to the Cape Breton coast, along the western edge of the Laurentian Channel.

Distribution of cod throughout the survey area varied with fish size. Small fish, 31 cm and less in length, were more numerous in the shallower Shippegan Gully area where temperatures were higher in summer and early fall. Larger cod were more abundant in cooler waters of the northern part of Subdivision 4T.

The size composition of cod caught off the Cape Breton coast in May is similar to that found near the Gaspé coast in June. The size composition of smaller catches of cod off Cape Breton in November is similar to that for Gaspé area cod in October. The interpretation that cod caught south of the Gaspé coast in summer months are found off Cape Breton in winter agrees with results of earlier tagging experiments.

Analysis of catches in relation to bottom temperatures showed that in summer in the western Gulf of St. Lawrence highest catches of cod are found between -1° and 5°C. This is a wider range than the 0° to 4°C found in spring off Cape Breton, or the 1° to 3°C preferred temperature range in winter on Nova Scotian Banks.

The success of longline fishing for cod south of the Gaspé coast has been studied in relation to seasonal and annual variations in the distribution of cod food and temperatures. When euphausiids were abundant in plankton samples, they were also abundant in cod stomachs. Longlines set on bottom and floated at 10 and 20 fathoms from the bottom showed vertical migrations of 51 to 70 cm cod in August. These movements were related to the vertical distribution of euphausiids and the sharpness of the thermocline.

The main features of the dragger cod fishery in Subdivision 4T may be predicted from survey catches. On the basis of the 1958 survey it was predicted that the 1954 year-class would replace the 1953 year-class and that these small cod would be dominant in the 1959 landings (refer Canadian Research Report, 1958). Five-year-old cod of the 1954 year-class were in fact dominant in the 1959 landings. These cod had a mean length of 50 cm.

Survey catches of 1959 indicate that the 1955 year-class was the dominant one in the 3rd quarter of the year. The mean size of these 4-year-olds was 40 cm. It is expected that the 1955 year-class will be the dominant one in 1960 landings. No increase in the small average sizes landed is expected. In fact, average sizes of cod landed in 1960 may be smaller than those landed in 1959. Age determination of otoliths collected in 1959 indicates that the mean lengths of nearly all year-classes were smaller in 1959 than in 1958. If no change in growth rate occurs, the 1955 year-class will have a mean length of about 45 cm at age 5, compared with 50 cm at age 5 for the 1954 year-class.

Cod of the 1956 year-class were taken in large numbers in 1959 survey catches. They were almost all released by the $4\frac{1}{2}$-inch mesh codends used by commercial draggers. Larger numbers of the 1956 year-class will appear in

the commercial catches in 1960, but most will probably be discarded. They will not contribute significantly to landings until 1961.

Growth Studies. A special study has been made to relieve uncertainty in interpreting the first annual check in otoliths from cod taken in the western Gulf of St. Lawrence (4T). Collections of small cod were made by using small-mesh liners in shrimp trawl and No. 36 nets. Length compositions showed a peak of 6 cm for young of the year in October. The age I mode was 13 cm in June and 17 cm in October. The age II peak was at 19 to 20 cm in June. Examination of otoliths of these fish showed that the small central hyaline zone should be counted as an annual ring in making age determinations.

Even with satisfactory age determinations for individual cod, it is difficult to obtain suitable average growth rates because of variations among fish from different sources. Cod distribution changes with fish size and season, and the various fishing gears differ in their selective properties. Some of the difficultes have been explored for 4T cod: (1) There appears to have been a substantial increase in average size at age of 5- to 10-year-old fish between 1949-52 and 1955-58; (2) Cod appear to be segregated by size in their seasonal movements with resultant effects on growth curves; (3) Line-caught fish above 8 years of age are larger than otter-trawl caught cod of the same age. In predictions it is necessary to recognize the complexity of average population and fished-stock growth curves.

A study of growth of American plaice from Subdivision 4T has been started. Beyond the age of 5 years (25 cm) females grow faster than males. Differences in size at age are shown between shallow- and deep-water stocks, confirming tagging observations of little movement. Plaice enter the commercial fishery (landings) at age 7.

Gear Selection. Equitable enforcement of mesh regulations requires knowledge of equivalent selectivity of manila meshes and the new synthetic twines which are being introduced to the commercial trawlers. The selectivity of the increasingly popular terylene codends was tested on haddock, cod and plaice. Terylene was found to be similar to other synthetic twines in releasing larger fish than manila meshes. The following mesh sizes of single-strand terylene are approximately equivalent to 4½-inch manila: for haddock 3⅞ inches; for cod 3⅝ inches; for American plaice 3⅝ inches.

The selectivity of large meshes in a cod trap was tested in July on the north shore of the Gulf of St. Lawrence (4S). An auxiliary back of 3.0-inch meshes was used to catch released cod. The 5.2-inch back released 64% of the total catch. The 50% selection point was 57.5 cm, giving a selection factor of 4.4. Lower selection factors were obtained in previous experiments, and the average selection factor is now 4.1 for a cod trap with 5.2-inch meshes. At times many cod were gilled in the large meshes.

Comparative fishing. In November the research vessel *Harengus* fished a No. 36 otter trawl for two days alongside a commercial Danish seiner, the *Cape St. Mary*. The otter trawl had a 4½-inch mesh, double manila codend and the Danish seine had a 3½-inch mesh nylon parachute cord codend. The seiner used 900 fathoms of rope on each side of the seine. The *Harengus* made four 1¼-hour and five 1½-hour hauls. The seiner made 7 sets. All tows were in daytime. Average catch per tow in pounds of the important species was as follows:

	Danish Seine	Otter Trawl
American plaice	1,471	346
Witch	254	14
Cod	239	263
Hake	321	125

The Danish seine caught larger plaice and smaller cod and hake than the otter trawl.

Sea Scallop. Four sea trips were made to Georges Bank on commercial draggers to gather information for abundance and mortality studies. As in previous years, the boats are able to saturate the shucking power of the crew, and hence it is shucking power rather than abundance which continues to limit the catches.

Canadian crews continue to discard over half the catch since these discards are too small to

make shucking profitable. The 50% cull point is between 95 and 100 mm shell height.

A preliminary experiment tested the effect of using 4-inch rings as opposed to 3-inch rings in the drags. Trials were made on a commercial boat in October and November. Results indicate that the larger rings are slightly more efficient at catching market-size scallops. The major advantage, however, is the big reduction in the amount of trash and small scallops landed on deck. Less time is needed to cull the catch and more time can be devoted to shucking.

Hydrography. The main feature of surface temperature changes from 1958 to 1959 was a decrease at all stations, except in the Gulf of St. Lawrence. The temperature conditions in deeper water layers seem to be the result of long-term cooling and also of intense cooling during the winter of 1958-59. A very cold intermediate temperature layer was still persistent on the Scotian Shelf in October 1959 (Fig. 2). The cold-water layer in the Gulf of St. Lawrence was observed to cover a much larger area of the bottom than in previous years.

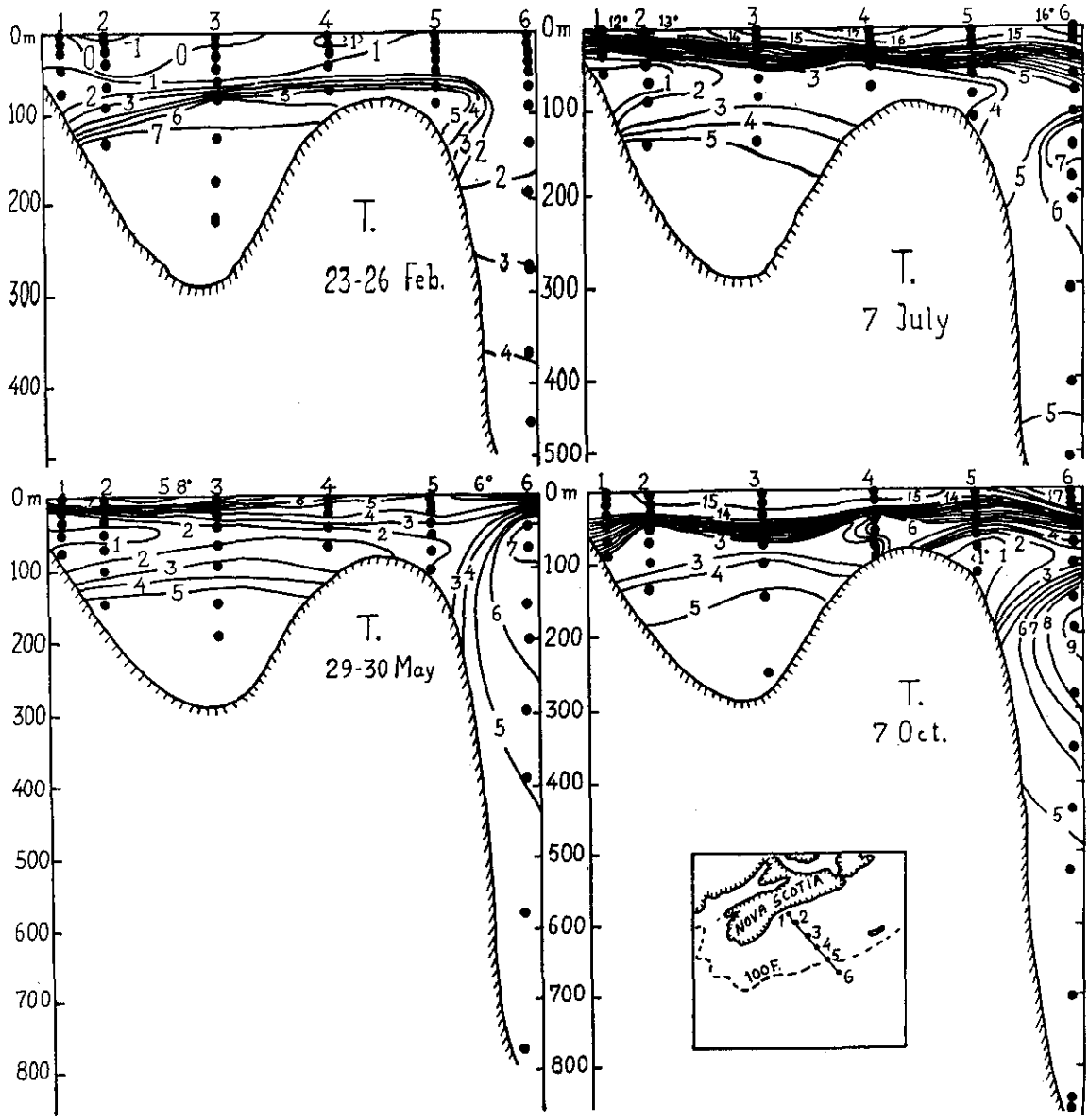

Fig. 2A. Hydrographic sections off Halifax, 1959. Temperature °C.

Analysis of temperature data from the deep waters of the Scotian Shelf and other areas has indicated a long-term cooling trend in the last decade from a maximum which occurred either in 1951 or 1953. There is evidence that some of the "cold" year conditions that existed during the thirties have been restored.

The cooling trend, first observed in the surface temperatures along the Atlantic Seaboard, is now known to be general for the deep waters at the entrance to the Bay of Fundy and on the Scotian Shelf. The St. Andrew's surface temperature variations have proved to be an excellent index for surface and deep water temperature variations in other areas.

The seasonal temperature variations of the bottom waters of the central sector of the Scotian Shelf have been studied. They indicate that the minimum temperatures occur during the second quarter of the year, and the maximum temperatures occur during the last quarter along the coast and during the first quarter on the offshore banks.

Drift bottle experiments have shown seasonal and year-to-year changes in surface circulation in the Bay of Fundy and the Gulf of Maine. In general, the results have tended to confirm the concept that the surface circulation pattern in the Bay of Fundy is "closed" in the winter and "open" in the summer.

A submarine geological program has been initiated in the Atlantic waters. Areas of investigation are centered around several major fishing banks in the Gulf of St. Lawrence and on the Scotian Shelf.

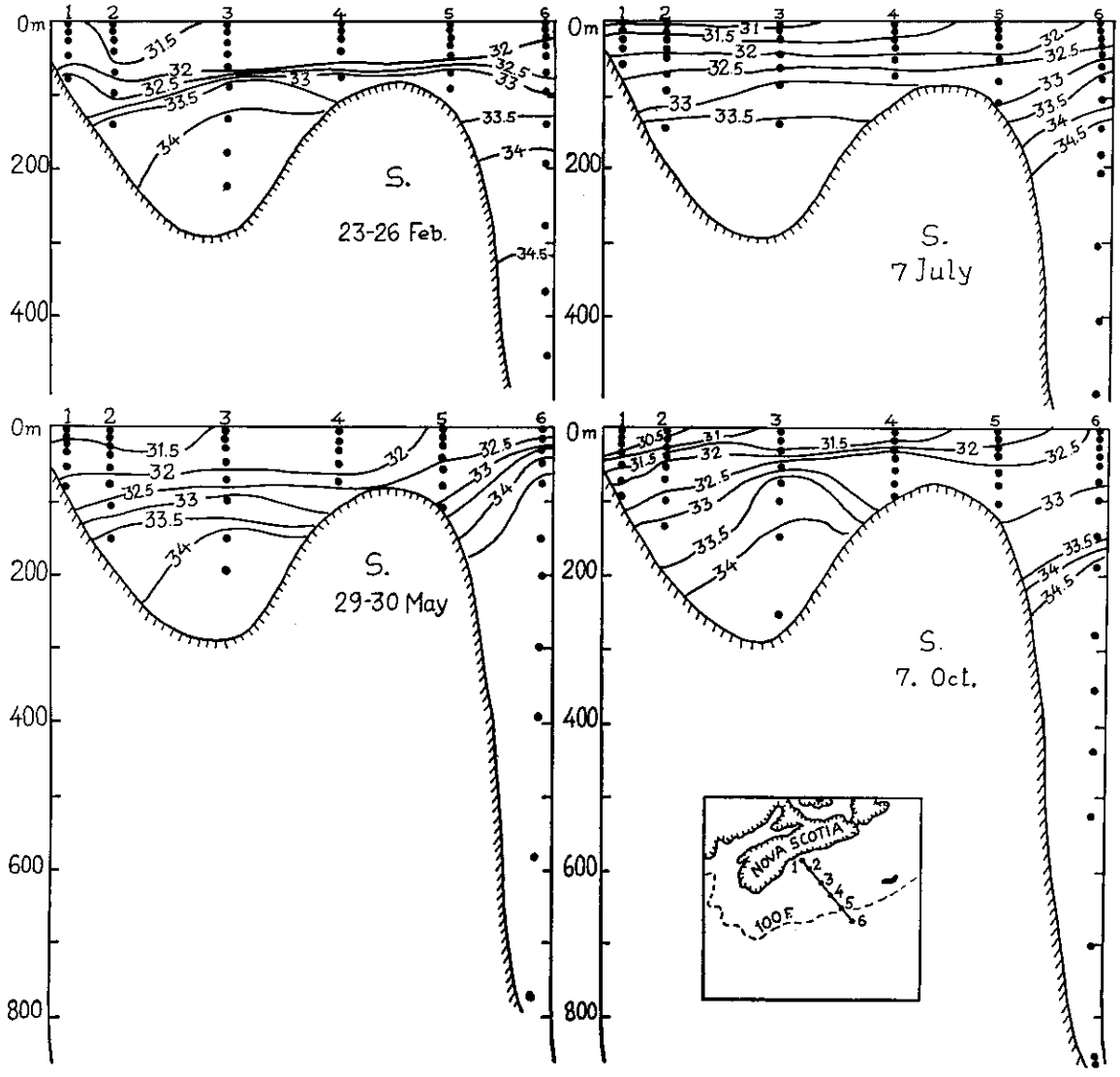

Fig. 2B. Hydrographic sections off Halifax, 1959. Salinity per mille.

II. Danish Research Report, 1959

A. W. GREENLAND — BY PAUL M. HANSEN, GREENLAND FISHERIES INVESTIGATIONS

I. Cod.

1. Cod Fry and Small Cod, Coastal Waters and Offshore Banks.

a. Occurrence of Eggs and Larvae.

The catches of cod eggs in 1 m stramin net, 30 min. hauls, 100-50 m W. in the Godthaab Fjord area were much smaller than in previous years. The highest number caught was 1973 eggs, taken on 4th April on a spawning ground near Kapsigdlit in the innermost part of the fjord. On the 10 May 1036 and on the 13 May 1133 eggs were taken at two other stations in the fjord. On no other station did the number of eggs exceed 100.

Three hauls with a 1 m stramin net were made in the Davis Strait on the 5 June. A haul between the coast and Fylla Bank yielded 7 eggs, a haul on the bank none, and a haul on the western slope of the bank 93 eggs. In addition on the first station one cod larvae was caught, on the last station 7, but none at the station on the bank. As the cod spawn on the western slope, it is only natural that the largest catches of egg and larvae were made there.

The numbers of cod eggs and larvae caught with stramin net by "Dana" in July are shown in Figure 1. For the first time during the nine years' investigations from "Dana" in the Davis Strait in July eggs were observed in the hauls.

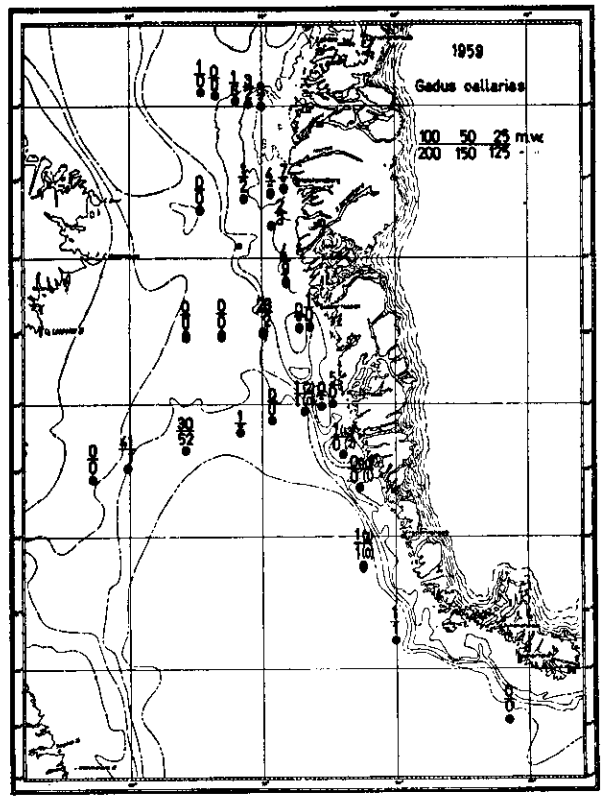

Fig. 1. Catches of cod larvae in 30 minutes hauls with the 2 m stramin net.

TABLE 1. Small cod, age-groups I, II and III.

a	70°40′N	52°00′W	22	July	705	specimens	hand-seine
b	69°05′	51°00′	29	,,	889	,,	,,
c	68°50′	51°05′	30	,,	870	,,	,,
d	67°57′	53°35′	2	,,	1019	,,	,,
e	66°55′	53°35′	1	,,	1156	,,	,,
f	66°44′	53°28′	26	June	961	,,	,,
g	63°53′	51°28′	18	Jan.	1224	,,	shrimp-trawl
h	63°53′	51°28′	3	March	1429	,,	,,
i	Utorqarmiut		3	,,	386	,,	,,
j	63°53′	51°28′	24	,,	572	,,	,,
k	Utorqarmiut		24	,,	329	,,	,,
l	,,		23	Nov.	153	,,	,,
m	63°53′	51°28′	24	,,	114	,,	,,
n	63°53′	51°28′	21	Dec.	108	,,	,,
o	60°56′	45°47′	18	Feb.	337	,,	,,
p	60°34′	45°55′	30	July	969	,,	hand-seine
q	60°34′	45°55′	30	,,	152	,,	pound-net

In Figure 1 the numbers of eggs are given in brackets. A total of 30 eggs were taken in six hauls from four different stations. These catches of eggs indicate a retarded spawning in 1959.

The distribution and frequency of cod larvae did not differ much from the year 1958. The largest numbers were observed west of Fylla Bank (63°18'N-57°47'W). On the westernmost station of the section across Fylla Bank (62°52'N-61°18'W), close to the edge of the ice covering the western part of the Strait, no larvae were caught.

The scarce occurrence of eggs and larvae indicate that the year-class 1959 will become a poor year-class of small importance for the fishery.

b. Occurrence of Age-groups I, II and III.

Small cod occurred in large quantities along the coast. Good catches were made with fine-meshed seine near the beach and with shrimp trawl in 200-250 m. A summary of the catches is presented in Table 1, and the length-distribution of the different catches in Figure 2. A total of 11,373 small cod from 17 catches were measured, and 1,582 otoliths were aged from fifteen of these catches.

It is apparent from the length-distribution that one age-group, the II-group (1957 year-class) predominates strongly in most of the catches. This was to be expected as the 1957 year-class occurred numerously along the coast of Godthaab (1D) and Holsteinsborg districts (1B) in 1958. In the samples a-h and in j, it is—practically speaking —the only year-class present. Samples g-n are from shrimp trawl at two localities close to one another in Godthaab district (1D). In six of these samples the II-group predominates, in the two remaining, i and k, the III-group. From the length distribution, it could appear as if the III-group dominated in l and m. However, the age determinations show that the II-group is the one predominating. The reasons for the great difference in the length distribution of the II-group in samples g-k and l-n is due to the fact that the g-k samples are taken January-March, while the l-n samples are from November-December. Between the two sets is an interval of 7-8 months, and in that time the individuals of the II-group have grown 7-10 cm.

The samples o, p and q are from catches with shrimp-trawl, fine-meshed seine and pound net, respectively, from Subdivision 1F. p and q are

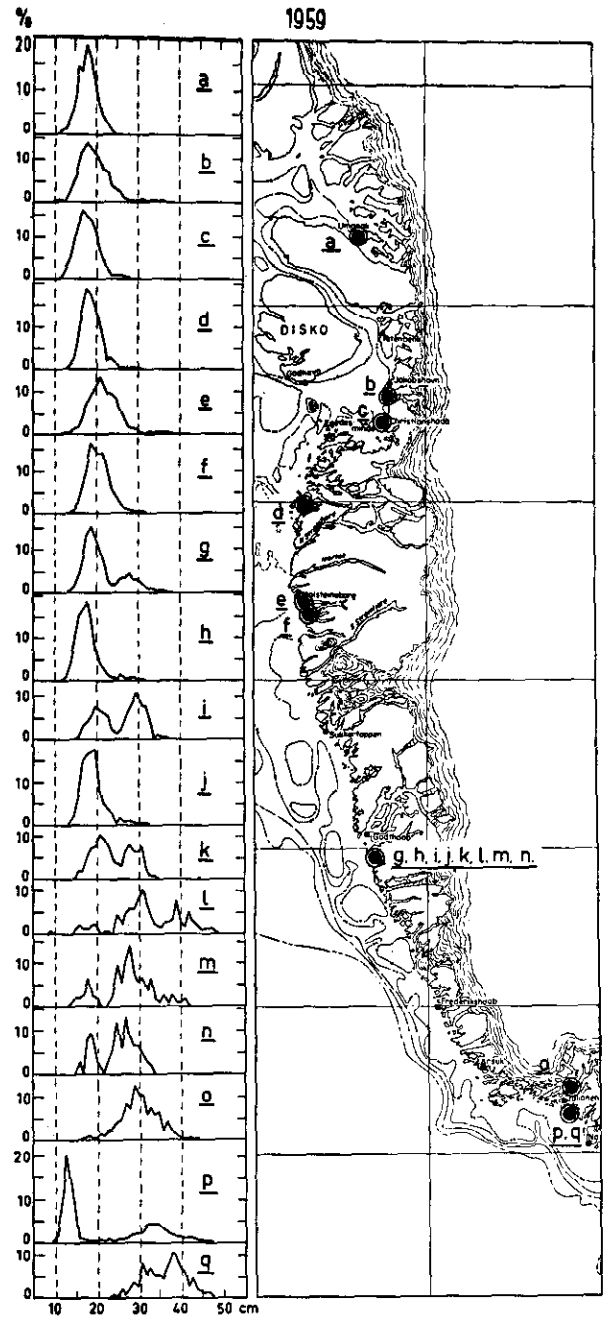

Fig. 2. Length distribution of small cod from inshore waters.

from the same locality and time, but they are highly different as regards length distribution, as the seine easily retains the small fish, while such small fish easily escape through the meshes of the pound net. o and q include exclusively the III-group (1956 year-class), apart from very few specimens of the IV-group. In p the I-group is predominating, but the III-group is fairly well represented. All the three samples from 1F differ from the samples from the other subdivisions insofar as the II-group (1957 year-class) is lacking.

The rich occurrence of the 1957 year-class in the catches of small cod (I-, II- and III-group) confirms the assumption, cited in the 1958 research report, that this year-class is to be considered a rich one, which in the future will be of importance to the West Greenland fishery (vide Ann. Biol. ICES Vol. XV, p. 86). Table 2 presents the average lengths of cod of the I-, II- and III-age-groups in the samples a-o.

TABLE 2. Mean-lengths of small cod of age-groups I, II and III.

Age-group	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
I	—	—	—	—	—	—	—	—	—	—	—	17.2	17.4	18.6	—
II	19.4	19.9	18.8	21.0	23.3	19.8	19.1	19.0	20.4	19.3	20.7	29.7	28.5	27.5	19.6
III	—	30.3	—	—	32.4	—	28.5	28.7	29.6	27.1	28.6	39.7	38.0	—	31.6

2. Commercial Fish, Coastal Waters and Offshore Banks.

a. Age-composition.

Offshore Banks:

Otoliths of 974 cod were collected from the banks: 94 from long-lines, "Adolf Jensen," 5 June, Fylla Bank; 880 from hand-lines, "Dana", 23 July-2 August. Figure 3 presents age- and length distribution (by 5 cm groups).

It is to be noted that otoliths for ageing were taken of those cod in the catches, which due to damage were not suited for tagging. As small cod are most apt to be hurt, these will be included in the samples for age determination with too high percentages compared to the larger fish. This especially holds good for the catches Nos. 4 and 5 in Figure 3, where the length distribution curves, including measurements of tagged as well as aged cod, show a higher frequency of larger cod than expected from the age analyses. For the remaining samples this is of no importance.

The 1953 year-class predominates in five of the catches, the 1955 year-class in three; the 1947 year-class is dominating in the long-line catches from the edge of Fylla Bank on 5 June.

Mainly smaller and middle-sized cod are present in the catches from Store Hellefiske Bank (1B) which almost exclusively consist of cod of the 1953 year-class or of younger cod.

The catches from Lille Hellefiske Bank and Banan Bank comprise small as well as large cod, including, besides the 1953 and younger year-classes, also some older cod, especially of the 1947 and 1950 year-classes. In the age analyses of these catches, however, the older year-classes 1950 and 1947 are, as already mentioned, too weakly represented. The catches from Fylla Bank and Fiskenaes Bank (1D) include in the main larger cod, as hardly any cod younger than the 1953 year-class were caught.

The 1953 year-class was in 1959 without doubt the most important for the fishery in the whole of the Davis Strait. The older, rich 1947 and 1950 year-classes appear to have played a bigger role on the more southern banks than on Store Hellefiske Bank, but they are now strongly reduced in number.

Inshore Waters and Fjords:

From the coastal area and the fjords 5403 cod from 31 catches were aged. Age analyses and localities are presented in Figure 4. The catches are distributed through the subdivisions as follows:

1A	1B	1C	1D	1E	1F
3	2	5	10	3	8

Of the 10 catches in 1D five are from the Godthaab Fjord.

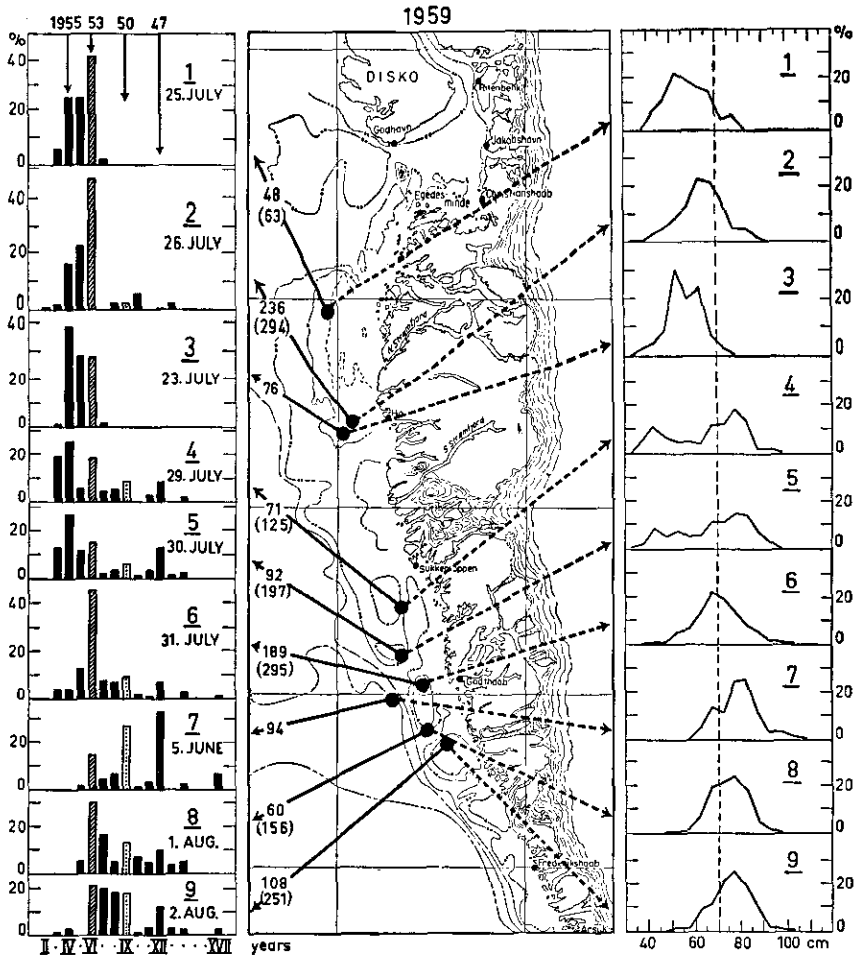

Fig. 3. **Percentage age- and length-distribution of cod from West Greenland banks. The numbers of cod examined and of cod tagged (bracketed figures) are shown on the map.**

Samples No. 1 and 2 are from 1A. The 1947 year-class predominates in No. 1 with 25%. The 1945 and 1942 year-classes, are present with ca. 11% each. The older year-classes have always accounted for a considerable portion of the catches at this northern locality. The 1942 year-class predominated in all samples from 1951 to 1958. The 1953 year-class predominates in No. 2 with more than 35%; 1947 accounts for 20%, while all other year-classes are below 10%.

The three samples (Nos. 3, 4 and 5) from 1B are dominated completely by the 1953 year-class, with 60-65%.

In 1C the 1953 year-class predominates in four of the five (Nos. 6, 7, 8, 9 and 10) samples; in No. 6 it makes up more than 65%. The 1947 and 1950 year-classes are better represented in this subdivision than in 1B. In No. 8 the 1947 year-class predominates, while the 1950 year-class holds the second place.

In Subdivision 1D samples Nos. 11-15 are from the mouth of Godthaab Fjord, and 16-20 from the fjord proper. The samples from the mouth of the fjord are from long-line, with the exception of No. 11 taken by hand-line. The 1953 year-class predominates in No. 11 with the 1956 year-class as second; the remaining year-classes are unimportant. The other four catches (Nos. 12-15), long-line catches from deep water, are more uniform as to age composition, with the 1947 year-class dominating. The five samples from the fjord proper present a rather differing composition. The two long-line catches (No. 16 and 18) are from deep water, ca. 300 m, and

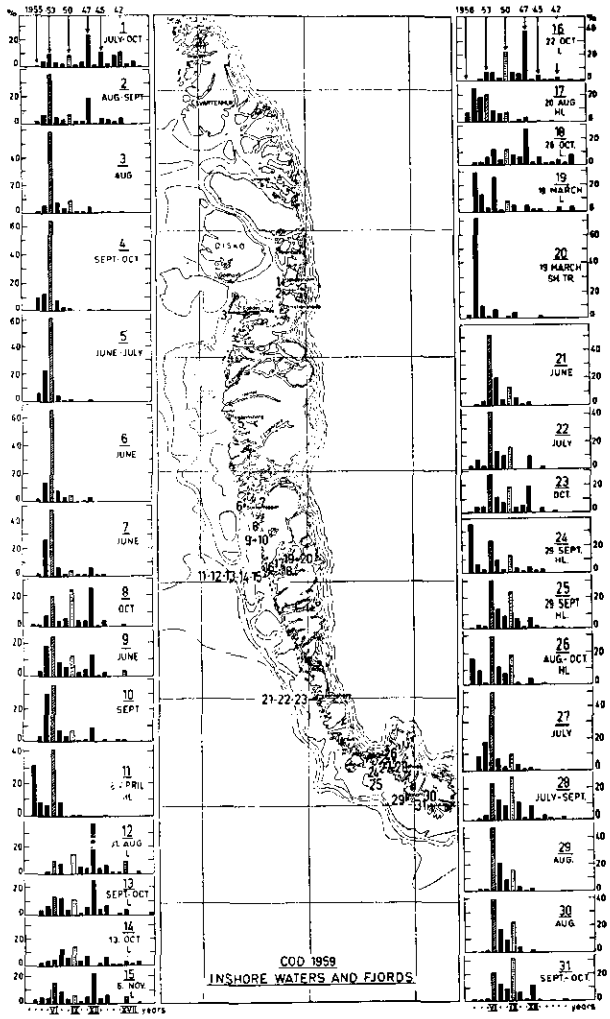

Fig. 4. Percentage age-distribution of cod from inshore waters.

are rather homogeneous, with the 1947 year-class predominating. No. 17 taken on hand-line and No. 19 from long-lines, only 50-100 m depth, include—contrary to No. 16 and 18—mainly small fish. In No. 17 the following year-classes —mentioned in their order of frequency—are dominating: 1955, 1953 and 1954. The 1955 year-class is the richest in No. 19, next comes 1952. The 1952 year-class dominated in several of the samples from Godthaab Fjord in 1958. Therefore it is surprising that it is of greater importance only in one of the samples from 1959.

Sample No. 20 is from a shrimp-trawl, and therefore includes almost only small cod of the 1955 year-class.

In three samples No. 21, 22 and 23 from Subdivision 1E the 1953 year-class is the richest. In No. 21 from June it accounts for more than 50%. In No. 23 from October the 1947 and 1950 year-classes are better represented, with between 15 and 20%.

In eight samples (No. 24-31) from Subdivision 1F the 1947 year-class is only very weak, while the 1950 year-class on the whole is more numerous than in the other subdivisions. It dominates in two samples (No. 28 and 31) and comes next in three (No. 25, 26 and 30). The 1953 year-class is here—as in most of the other subdivisions—the strongest, predominating in five of the eight samples. In No. 24 the 1956 is the richest with ca. 35%. This year-class was only of importance in one sample from the other subdivisions, viz. No. 11 from the mouth of the Godthaab Fjord (1D).

3. Maturity.

Age at first maturity is determined by means of the otoliths of all aged, mature cod. A larger material of such determinations is only available for the 1947 year-class, therefore only this year-class is included in Table 3.

The data are given separately for the following regions: West Greenland Banks, Coastal Area north of 63°N., Coastal Area south of 63°N and East Greenland.

As is apparent also from previous data, males as a rule mature earlier than females. The age is higher for cod from East Greenland than for cod from West Greenland.

4. Tagging.

In 1959 a total of 4091 cod were tagged in West Greenland waters. A number of 596 tagged cod were recaptured.

The recaptures made in 1959 are shown in Tables 4 and 5. As shown in Table 4 a total of 8 cod tagged at West Greenland were recaptured at East Greenland in 1959: from 1955 tagging 1 cod, 1957-5 and 1958-2 (Table 5). One would be inclined to expect, that most returns would be from the southern Subdivisions 1E and 1F. However, only one of the recaptures was from tagging in 1F, although many cod are tagged in 1F every year. The returns are distributed as

TABLE 3. Age at first maturity of the 1947 year-class of Greenland cod in 1959.

Coastal area north of 63°N.

Age	♂♂ No.	♂♂ °/₀₀	♀♀ No.	♀♀ °/₀₀
Imm	1	4	4	15
6	19	84	3	12
7	117	522	98	378
8	69	308	113	436
9	16	71	34	131
10	2	9	7	27
Total	224		259	
Mean age		7.4		7.7

Coastal area south of 63°N.

Age	♂♂ No.	♂♂ °/₀₀	♀♀ No.	♀♀ °/₀₀
Imm.	2	24	—	—
6	9	106	5	83
7	46	541	29	483
8	20	235	18	300
9	5	59	8	133
10	3	35	—	—
	85		60	
		7.2		7.5

Banks off the west coast

Age	♂♂ No.	♂♂ °/₀₀	♀♀ No.	♀♀ °/₀₀
Imm.	—	—	1	25
6	3	68	1	25
7	24	545	15	375
8	12	273	15	375
9	4	91	5	125
10	1	22	2	50
11	—	—	1	25
Total	44		40	
Mean age		7.5		7.7

East Coast

Age	♂♂ No.	♂♂ °/₀₀	♀♀ No.	♀♀ °/₀₀
Imm.	—	—	—	—
6	2	57	—	—
7	14	400	11	366
8	12	371	11	366
9	6	171	7	233
10	1	29	1	33
11	—	—	—	—
	35		30	
		7.7		7.9

follows as to subdivision where tagged:

1B	1C	1D	1E	1F
1	1	5	0	1

Of the five returns from 1D, three were tagged on Fylla Bank and two in the coastal area of Godthåb. The three from the other subdivisions were all tagged at the coast.

TABLE 4. Cod tagged at West Greenland in different years and recaptured by countries in 1959.

	West Greenland	Iceland	East Greenland
Greenland	227	—	—
Faroe Islands	13	—	—
Norway	43	—	—
Iceland	3	10	4
United Kingdom	20	1	—
France	7	—	—
Germany	17	8	4
U.S.S.R.	3	—	—
Spain	7	—	—
Portugal	186	1[1]	—
Total	526	20[1]	8

1) One recaptured at Newfoundland.

II. Redfish.

The fishing experiments with shrimp-trawl at Pisigsarfik in Godthaab Fjord for small redfish have been continued. Six hauls were made, distributed over the months March, June, October, November and December. A total of 7319 redfish were caught and measured (see "Sampling Yearbook"). Otoliths for age analysis were collected from parts of the samples.

III. Greenland Halibut.

Investigations on the Greenland halibut have been carried out in Umanak Fjord, Disko Bay and Godthaab Fjord. Catches by longlines have been measured and weighed and otoliths have been collected. Tagging of 266 Greenland halibut was made in Godthaab Fjord.

TABLE 5. Cod tagged at West Greenland recaptured at West Greenland (Gr.) and at Iceland (Ic.) in 1959, tabulated according to age and year of liberation.

Year class	Age-group	1952		1953		1954		1955		1956		1957		1958		1959		Total		
		Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	%	Ic.
1940	XIX	—		—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	0.3	—
1942	XVII	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.3	—
1943	XVI	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	0.3	—
1945	XIV	—	—	—	—	1	—	—	—	3	—	—	—	3	—	1	—	8	2.2	—
1946	XIII	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	0.3	—
1947	XII	1	—	2	—	9	—	4	—	4	—	6	1[1]	6	—	3	—	35	9.6	1[1]
1948	XI	—	—	—	—	2	—	—	—	2	—	1	—	2	—	—	—	7	1.9	—
1949	X	—	—	1	—	2	1	1	—	2	—	3	2	1	1	—	—	10	2.7	4
1950	IX	—	—	—	—	2	—	2	1	9	—	25	6[2]	23	3[1]	4	—	65	17.8	10[1,2]
1951	VIII	—	—	—	—	—	—	—	—	1	—	8	1[1]	8	—	3	—	20	5.5	1[1]
1952	VII	—	—	—	—	—	—	1	—	4	—	56	—	25	—	2	—	88	24.1	—
1953	VI	—	—	—	—	—	—	—	—	—	—	36	2[2]	44	—	6	—	86	23.6	2[2]
1954	V	—	—	—	—	—	—	—	—	2	—	7	—	8	1[3]	2	—	19	5.2	1[3]
1955	IV	—	—	—	—	—	—	—	—	—	—	4	—	—	—	6	—	10	2.7	—
1956	III	—	—	—	—	—	—	—	—	—	—	—	—	1	—	10	—	11	3.0	—
1957	II	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	0.5	—
??		1	—	1	—	4	1	6	2[1]	15	1	50	3[2]	62	2[2]	22	—	161		9[1,4]
Total		2	—	5	—	20	2	14	3[3]	42	1	198	15[5]	184	7[6]	61		526		28[7]

1) including one recaptured on Fylkis Bank.
2) ,, ,, ,, at East Greenland.
3) ,, ,, ,, at Newfoundland.
4) ,, two ,, at East Greenland.
5) ,, two ,, on Fylkis Bank and three at East Greenland.
6) ,, one ,, on Fylkis Bank, one at East Greenland and one at Newfoundland.
7) ,, four ,, on Fylkis Bank, four at East Greenland and one at Newfoundland.

B. W. GREENLAND — BY J. S. JOENSEN

DANISH INSTITUTE FOR FISHERIES AND MARINE RESEARCH — FAROE DIVISION

I. Cod.

Faroese investigations of commercial catches of cod from the W. Greenland banks were carried out for the first time in 1959. The observations were made partly on board the S/T "Skalaberg" (955 br. tons) from 30 April-15 May, and partly on material collected from the M/K "Hamranes" (152 br. tons) from line fishery in the period 3-12 August.

As both vessels salted their catch, only cod (on board "Skalaberg" also larger halibut were frozen) were used. The total catch by the trawler from 30 April-15 May was 335 tons round fresh. Of this the marketable cod (over 50 cm) made up 277 tons; the remainder of the catch was as follows:

Small cod (below ca. 50 cm)	=	ca. 33 tons
Sebastes marinus	=	,, 19 ,,
Hippoglossoides platessoides	=	,, 3 ,,
Anarhichas sp.	=	,, 2 ,,
Other species (incl. halibut)	=	,, 1 ,,
		,, 58 tons

Thus about 17% of the catch were discarded. Catfish and flatfish are as a rule alive when discarded even after having been on the deck for a while. Also some small cod are able to swim down, when discarded, but the greater part flow in the surface together with redfish.

In the liner "Hamranes" the catch consisted almost exclusively of cod of a size suitable for salting, as the lines do not catch as many small cod as the trawl; of other species were only caught few redfish and halibut.

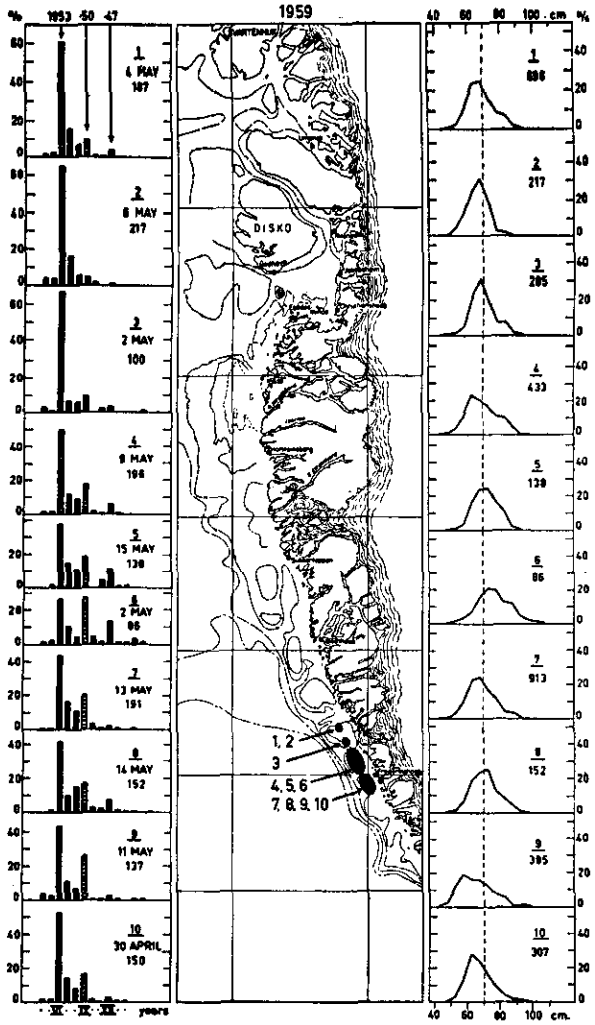

Fig. 5. Age- and length distribution of cod, "Skalaberg", Apr.-May 1959.

The material collected from the cod on board the two vessels was 2645 otoliths and 5935 length measurements: "Skalaberg", 1626 otoliths, 4483 measurements; "Hamranes" 1019-1552. The material from "Skalaberg" was mainly from cod for salting, of the discarded small cod only few samples were taken, they were composed almost exclusively of 3-4 year old cod (3 years-75%, 4 years-25%). The length distribution of discarded small cod was as follows:

cm	No.
20-24	7
25-29	69
30-34	326
35-39	369
40-44	148
45-49	69
50-54	21
55-59	5
60-64	1

Figures 5 and 6 present age and length distribution of the cod from S/T "Skalaberg" and M/K "Hamranes." In all the trawler catches the 1953 year-class is predominating but also the 1950 is of importance. Also in the line catches 1953 is the predominating year-class in most localities, but the 1950- and the 1947 year-classes are present in important quantities.

The spawning of the cod was in the main completed, only 2% of the mature females and a little more mature males had not yet finished spawning.

II. Other Fish.

Of other fish than cod are already mentioned redfish, wolffish and American plaice. From the "Skalaberg" the following more rare species were caught:

Myxine. 1 specimen.
Raja radiata. A few specimens.
Argyropelecus. 1 specimen.
Macrurer. 3 specimens. 2 species.
Melanogrammus aeglefinus. A total of 15. Mostly large and fat, the largest 83 cm. Ripening, full-ripe and spent individuals.
Gadus ogac. 1 specimen.
Molva byrkelange. ca. 50 spec.
Brosme brosme. Only 3.
Cyclopterus lumpus. A few.
Hippoglossus hippoglossus. A few every day, mostly small.
Reinhardtius hippoglossoides. Few.
Glyptocephalus cynoglossus. Few.

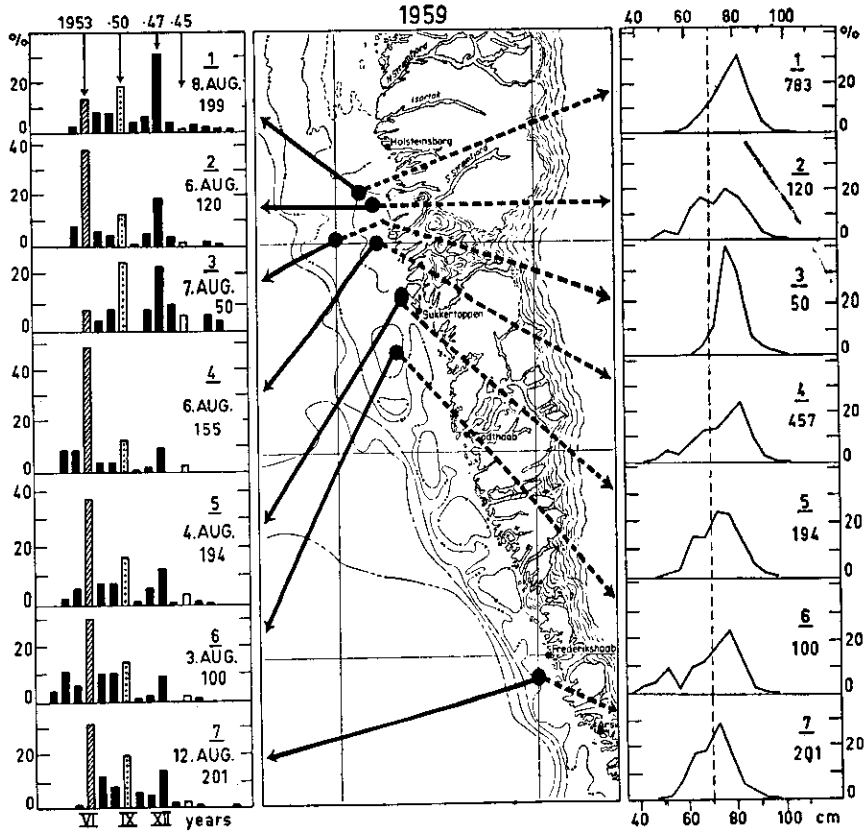

Fig. 6. Age- and length distribution of cod, "Hamranes," Aug. 1959.

C. E. GREENLAND — BY PAUL M. HANSEN, GREENLAND FISHERIES INVESTIGATIONS

The investigations off S.E. Greenland (60°-66°N) during the two preceding years were continued from 9 August-18 September 1959. The researches were concentrated in the two inhabited areas Skjoldungen (63°15'N) and Angmagssalik Fjord (65°45'N). Contrary to 1957 and 1958, the work was much impeded by polar ice. It was impossible to go to the banks off Angmagssalik, and even in the fjords the large quantities of ice hindered the operations. The cod fishery, which started successfully in 1958 at Kungmint in the Angmagssalik, where Greenland rowing boats with hand-lines, and a salting mother-vessel, caught 865 tons, gave only 539 tons in 1959. The mother-vessel had to leave earlier than planned due to the adverse ice conditions. The cod caught in the fjord area in 1958 was of a very fine quality; in 1959 it was very lean.

Figure 7 presents age and length distribution of six samples of cod from Skjoldungen and Angmagssalik. No. 5 is a long-line catch from Fylkis Bank off Skjoldungen, the rest are from hand-line catches. The figure shows that the catches from Skjoldungen mainly include large, old cod, whilst those from Angmagssalik almost exclusively contain smaller, younger cod. In the catches from Skjoldungen old cod, 10 years or more, account for 79% of the catches, while at Angmagssalik cod of that age only make up 3.6%.

The 1950 year-class, which in the two preceding years—especially 1958—was of great importance in the catches, is much reduced in strength in 1959. Only in the sample from Skjoldungen, 18 Sept., it dominates, with 35%. The strong reduction of the 1950 year-class may indicate that a greater emigration of this year-class to Icelandic waters has occurred; this is confirmed by returns from the tagging experiments of the two preceding years. The six year-classes younger than 1950, present in the Angmagssalik samples, occur in about equal quantities.

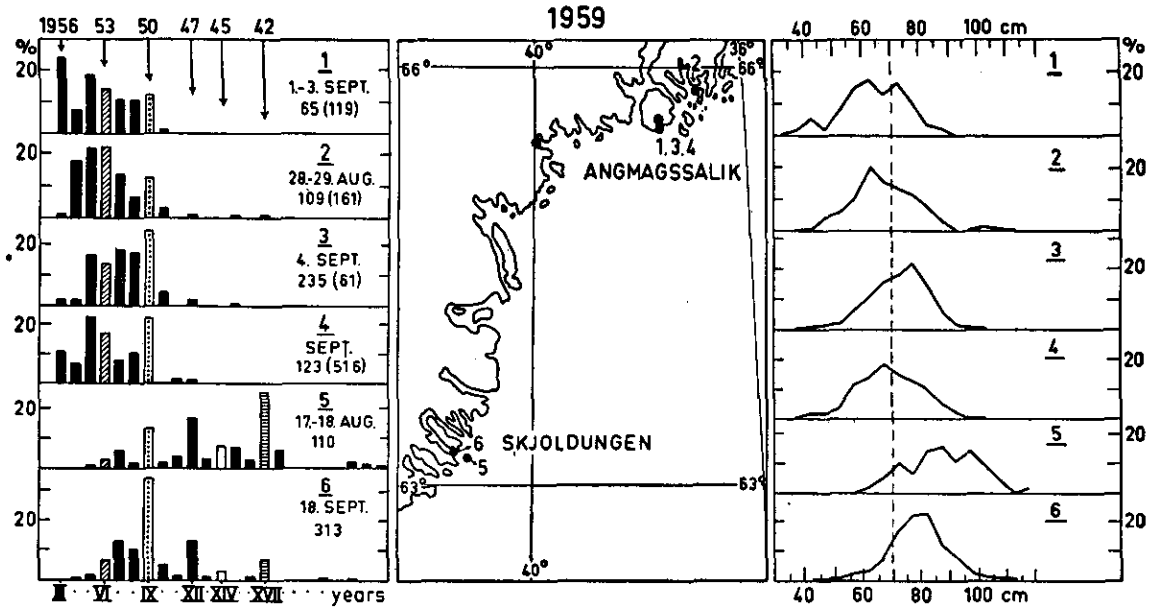

Fig. 7. Age- and length distribution of cod, East Greenland waters.

TABLE 6. Cod tagged at East Greenland recaptured at East Greenland (East), Iceland (Icel.) and West Greenland (West) in 1959, tabulated according to age and year of liberation.

Year class	Age-group	1957 East	1957 Icel.	1957 West	1958 East	1958 Icel.	1958 West	1959 East	1959 Icel.	1959 West
1943	XVI	—	—	—	—	—	—	—	—	1
1949	X	—	3	—	1+	1	1	1	—	—
1950	IX	2+	4	—	2'	8	—	—	—	—
1951	VIII	—	1	—	1+	2	—	—	—	—
1952	VII	—	—	—	1+	—	—	—	—	—
1953	VI	—	—	—	—	1	—	—	—	—
??		1	2	—	1	7	1	—	—	—
Total		3	10	—	6	19	2	1	—	1

A rather rich occurrence of small cod of the age-groups I-III was observed in the harbour-basin of Skjoldungen in mid-August. As the bottom did not permit the use of fine-meshed seines, fishery with small jigs was tried. Only 13 cod, of which 8 belonged to the I and 5 to the II-group were caught. At Tasiusaq near Angmagssalik and in the inner part of Angmagssalik Fjord smaller amounts of young cod were observed, according to size they belonged to the II-group. Here, as off Skjoldungen it was impossible to fish with seines, and jig yielded only few cod. However, the observations show that small and young cod occur in the coastal area and in the Fjords around Angmagssalik.

Tagging at East Greenland in 1959 included 966 cod: 13 off the coast at 60°42'N, 79 at Skjoldungen, and 874 in the Angmagssalik area.

TABLE 7. Cod tagged at East Greenland recaptured by countries in 1959.

	East Greenland	Iceland	West Greenland
Greenland	3	—	1
Norway	—	—	1
Iceland	1[1]	13	—
United Kingdom	—	4	—
Germany	6[2]	12	—
Portugal	—	—	1
Total	10	29	3

1) No position.
2) Five on Dohrn Bank and without position.

Already the tagging experiments from 1927-33 showed that the E. Greenland cod is connected with the Icelandic stock. Of 772 cod tagged at Angmagssalik in that period, 20 were returned:

18 from Iceland and only two at E. Greenland, where the fishery in that period was only very small.

In 1959 29 returns of E. Greenland tagged cod were reported from Iceland as shown in Tables 6 and 7. Age analyses of 20 of these cod showed that 12 belonged to the 1950 year-class. From the same tagging 10 were recaptured at E. Greenland and only three at West Greenland in 1959. Of the 3 cod tagged at E. Greenland and recaptured at West Greenland in 1959 one was taken at the coast of Subdivision 1C, one in a fjord in 1F and the last at Kap Farvel (1F).

D. HYDROGRAPHIC CONDITIONS IN THE DAVIS STRAIT IN 1959

BY FREDE HERMANN

DANISH INSTITUTE FOR FISHERIES AND MARINE RESEARCH – HYDROGRAPHIC DIVISION

In July 1959 the stations shown in figure 8 were worked by R/V "Dana." The figure further shows the temperature distribution at 50 metres. It is seen that over the southern banks, from Fylla Bank and southwards, cold conditions are prevailing, which shows that the influence of the arctic component of the West Greenland Current here was very strong. This is in good accordance with the fact that greater amounts of "Storis" than usual were carried round Cape Farewell earlier in the year.

On the shallow part of Lille Hellefiske Banke the temperatures were only a trifle below normal, but west of the bank the cold Baffin Island Current was extending much farther to the east than usual so that very cold conditions prevailed here between 50 metres and 150 metres.

As usual it was found that a part of the West Greenland Current turns westward between 64°N and 65°N.

Over the shallow part of Store Hellefiske Banke the temperatures were about normal. The influence of the arctic component of the West Greenland Current is relatively small here and the conditions depend more on the local meteorological conditions than on the origin of the currents.

The conditions are further illustrated by the sections I to IV. (Fig. 9-12). In the Atlantic component of the West Greenland Current, here found as an undercurrent, both temperature and salinity were lower than in 1958 in the two southernmost sections, but not in section III off Holsteinsborg, where relatively warm conditions prevailed in the deeper layers.

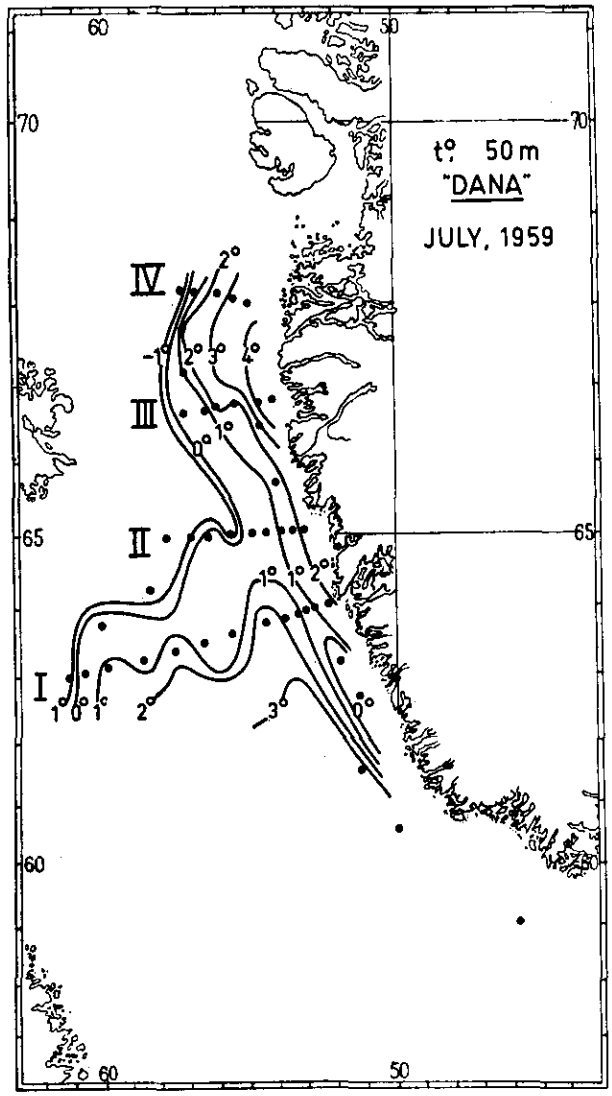

Fig. 8. **Location of hydrographic sections and distribution of temperature at 50 m. 19-25 July 1959.**

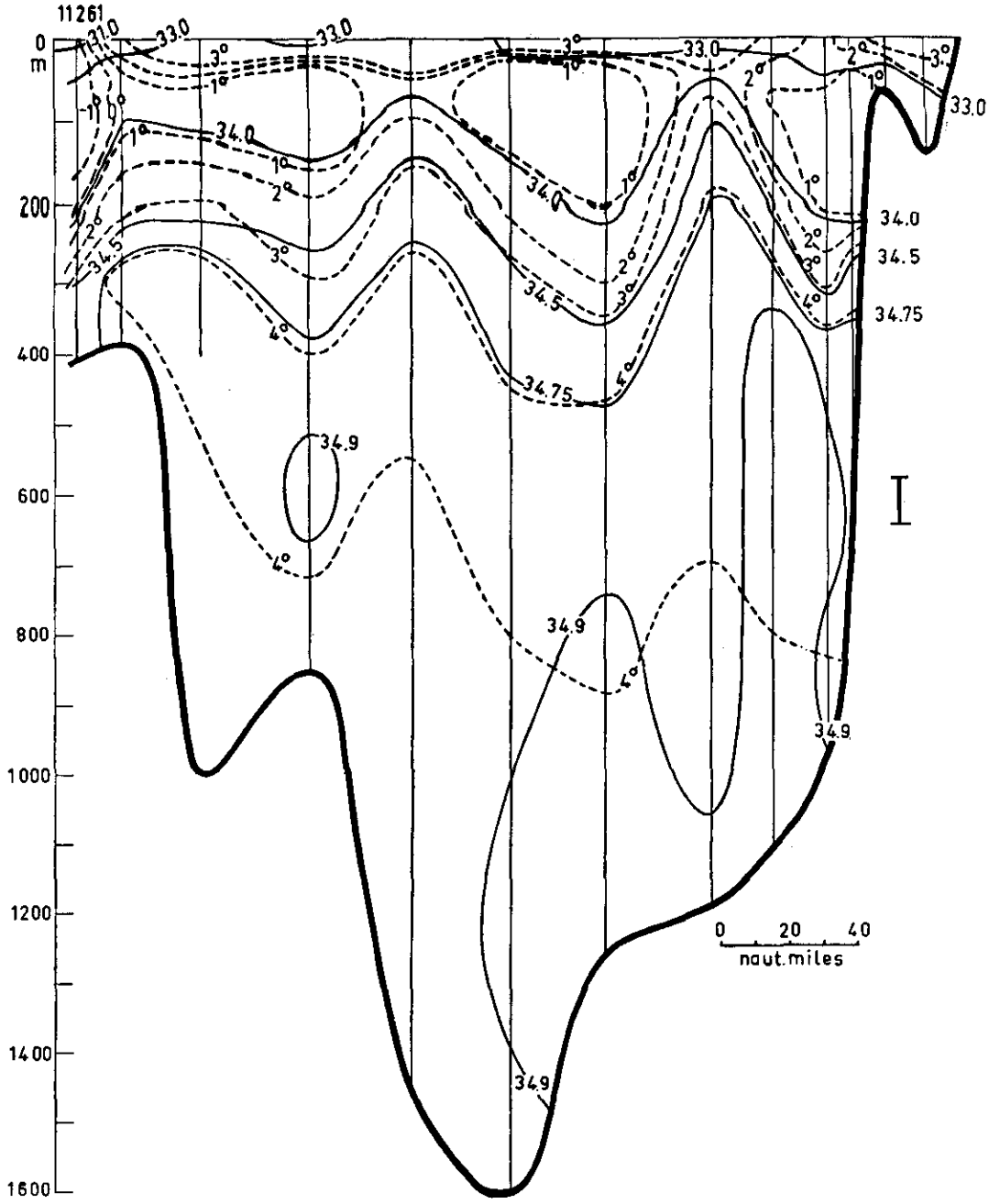

Fig. 9. Section I, across Fylla Bank.

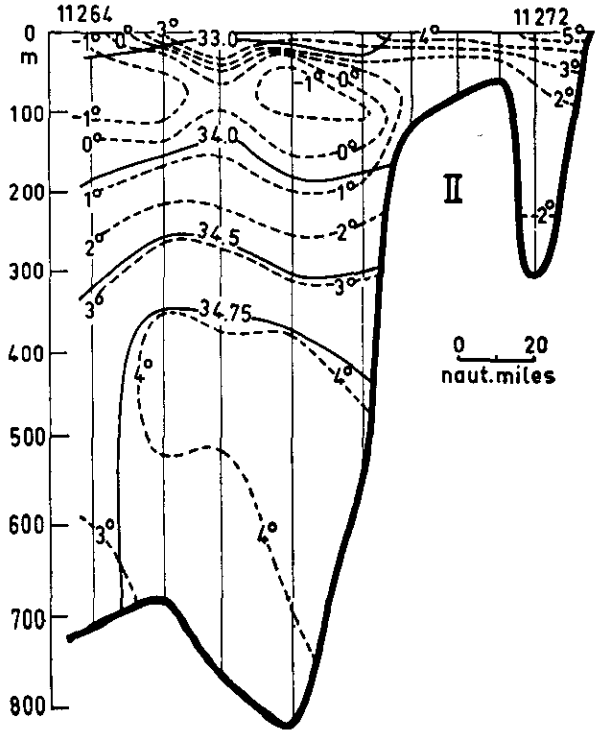

Fig. 10. Section II, across Lille Hellefiske Bank.

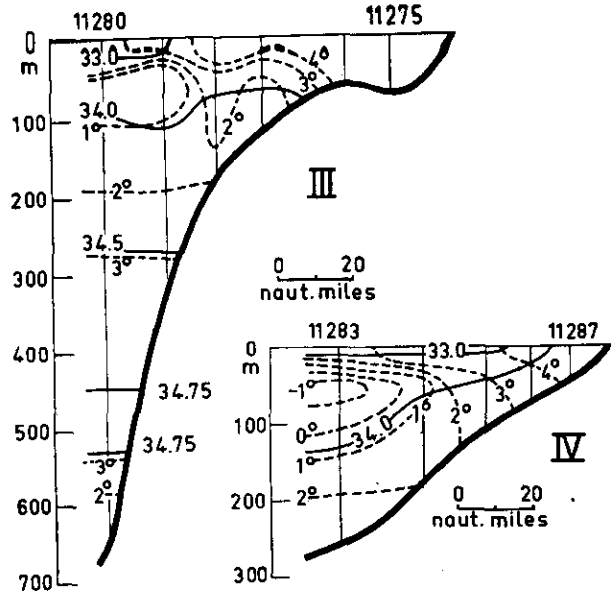

Fig. 11 and 12. above left: Section III, across Store Hellefiske Bank. below right: Section IV, off Egedesminde.

A fixed station at the entrance of Godthåb Fjord (64°07'N - 51°53'W) was worked frequently throughout the year with the M/C "Adolf Jensen" and M/C "Tornaq." Figure 13 shows the variation of temperature here. The winter cooling in the first months of 1959 was not very strong and was in the deeper layers counteracted by an inflow of warm water in February. A new and stronger inflow of warm bottom water took place in October-November, when the bottom temperature reached its maximum just as in the previous years.

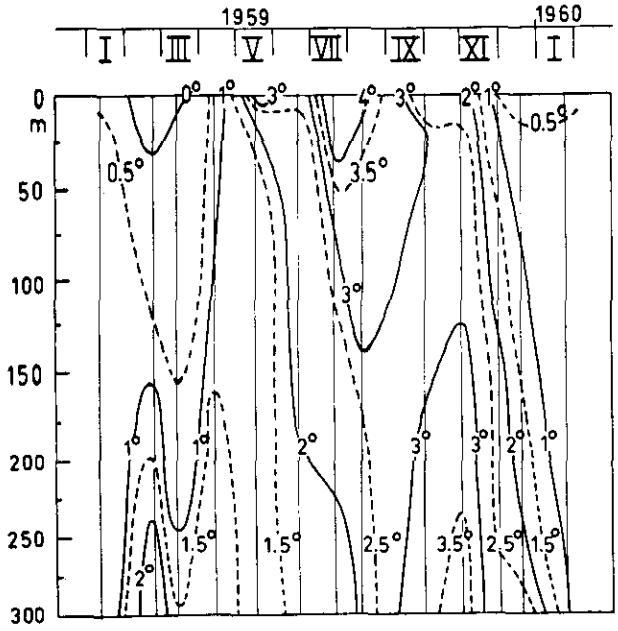

Fig. 13. Yearly variation of temperature, Jan. 1959 to Jan. 1960, at fixed station at the entrance to Godthaab Fjord.

III. French Research Report, 1959

BY J. ANCELLIN

The researches in the Convention Area have in 1959 been restricted to the working of hydrographic sections and stations in the areas fished by French trawlers in Subareas 1, 2, 3 and 4. These hydrographic data were collected by the frigate "l'Aventure"; the data from them are being published in "Bulletin du Comité Central D'Oceanographiè et D'Etude des Cotes." (Service Hydrographique de la Marine, Paris).

Statistical data from the French trawl fisheries in the Convention Area have been compiled, and a paper dealing with the results of this compilation "Note on the Catches of Cod by French Trawlers in the Northwest Atlantic, 1954-59" by J. Ancellin was distributed at the 1960 Annual Meeting.

During the next year, the new French research vessel "Thalassa" will be operating in the Convention Area.

IV. German Research Report, 1959

A. COD INVESTIGATIONS

BY ARNO MEYER

Subarea 1

a. West Greenland.

The stock of spawning cod on the western slope of Fylla Bank has become considerably younger, compared to 1958, due to the new rich year-class 1953 appearing for the first time in large quantities in the spawning shoals. This year-class constituted in March and April 72% of the German trawl catches.

The average length of the 1953 cod was only 62 cm; therefore, the average length of the total catch decreased from 76 cm in Feb.-May 1958 to 63 cm in March-April 1959, 74% of the examined cod were ripe, 26% still unripe. Of the 1953 year-class 75% were ripe. By mid-March all cod were still just ready for spawning; by mid-April the older year-classes had for the greatest part either spawned or were spawning; the 1953 cod, however, were mostly still preparing for spawning.

Considerably larger cod, average length 72 cm, were caught in June in the region of Dana Bank, where they stood quite deep, obviously due to the hydrographic situation (exceptionally much ice). But also here (Figure 1B) the 1953 year-class was the strongest with 31% followed by 1950, 23%, and 1947, 15%. The mean lengths were for 6 years old—65 cm, 9 years old —77 cm, and 12 years old—79 cm.

During a search-trip by the end of December 1959 only few cod were met on the usual fishing grounds on the western slopes of Noname and Fylla Banks. Noteworthy is a good catch (Figure 1C) on the inner slope of Fylla Bank, which confirms the view held by Rasmussen as to the cod migrations in fall and winter. 50% of this catch was made up of the 1953 year-class, which by the end of the seventh feeding period had reached a length of 72 cm. A somewhat bigger catch off Sermersut, south of Noname Bank, showed again (A. Meyer, German Res. Rept. 1958) that the 1956 year-class is well represented off the southern part of W. Greenland as well as off S. Greenland.

In the region Sermersut-Dana Bank 221 cod were tagged with a yellow, elongated plastic tag carrying the letters DHB (Germany-Hamburg) and an additional yellow plastic flap.

b. South Greenland.

Also off S. Greenland (Subdivision 1F) the stock of cod is now composed of younger individuals than in 1958. In the catches in late fall by German trawlers off Nanortalik Bank, the 1953 year-class predominated with 52% (Figure 2A).

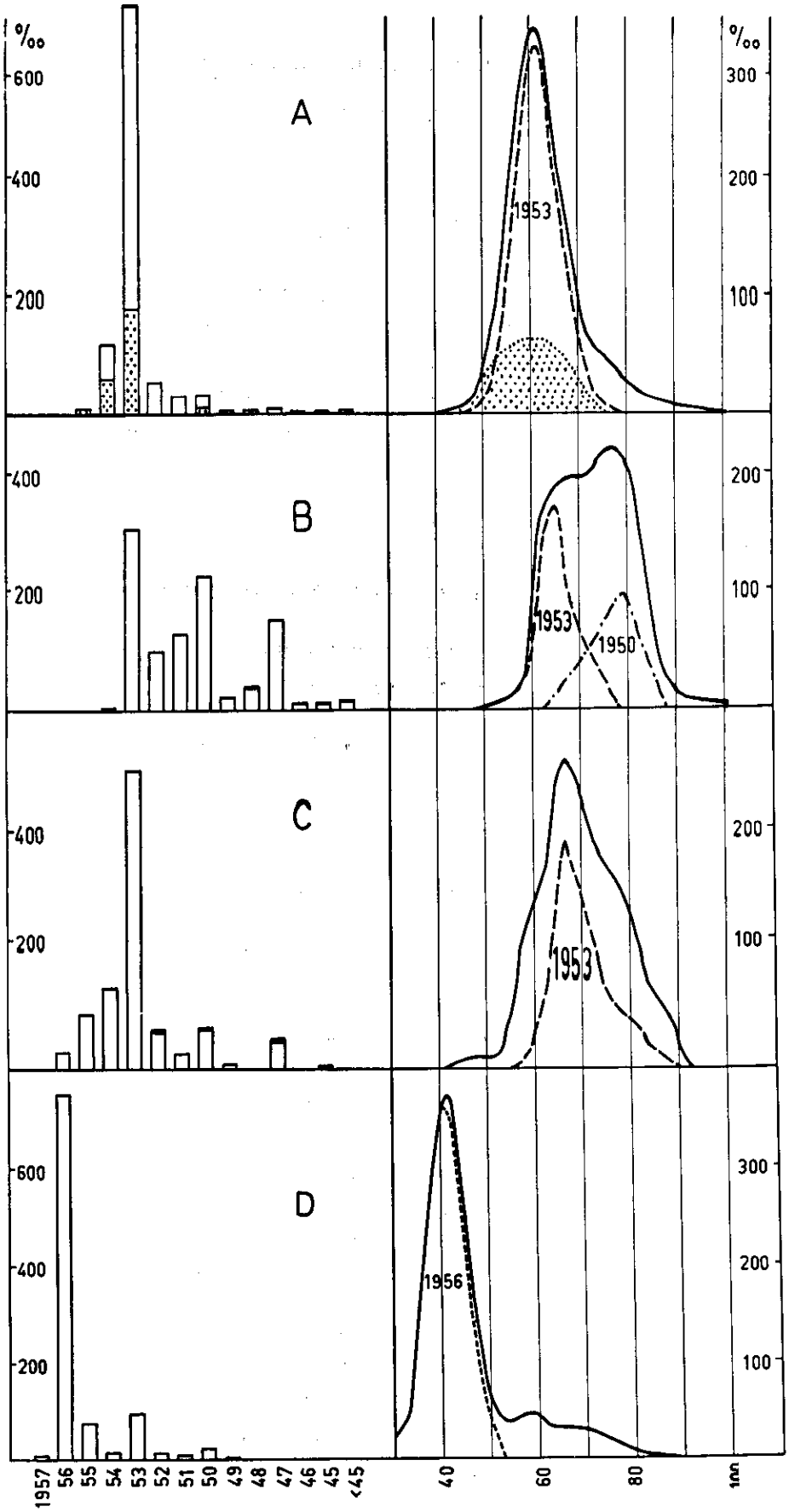

Fig. 1. Age and length distribution (‰) of cod from W. Greenland. (stipled curves—separate year-classes.)

A. from Fylla Bank (1D) landed by trawlers in March and April 1959, dotted=immature fish.

B. from Dana Bank (1D) landed by trawlers in June and July 1959.

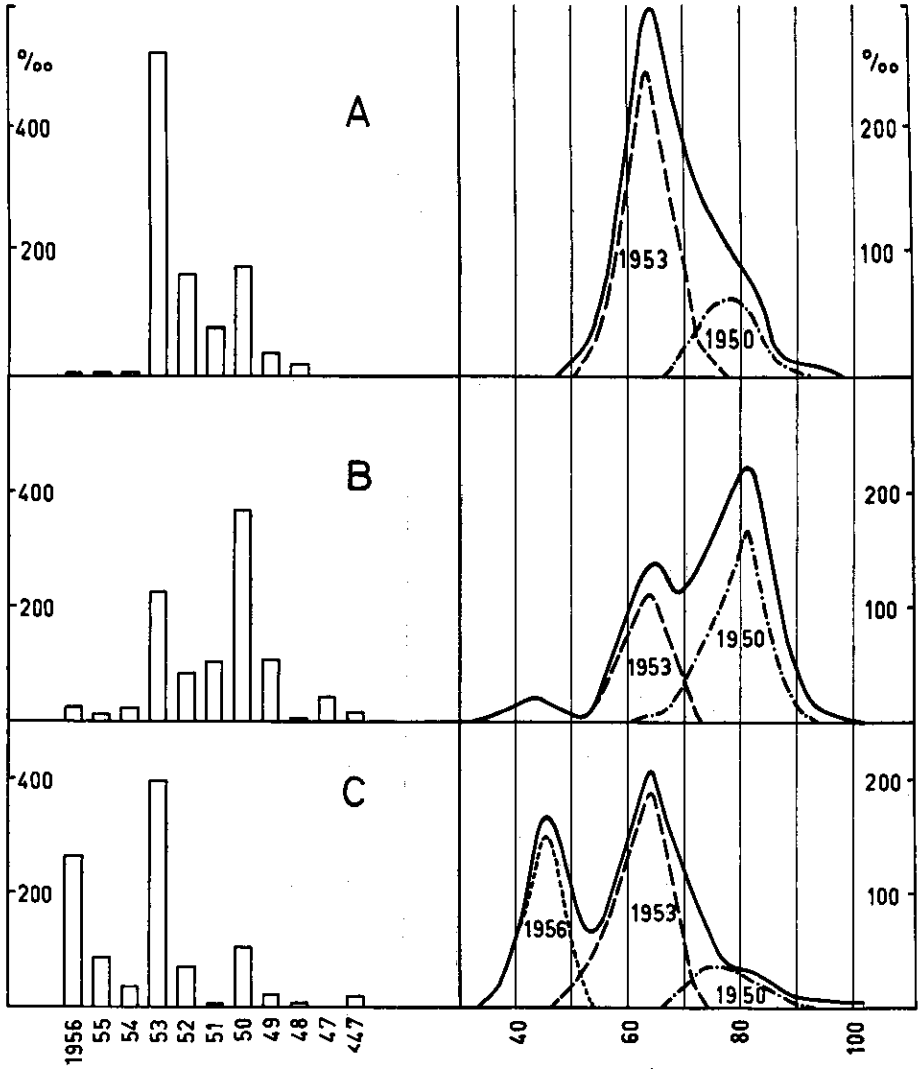

Fig. 2. Age and length distribution (°/₀₀) of cod from S. Greenland (1F)
A. from Nanortalik Bank landed by trawlers from September to December 1959.
B. off Cape Farewell fished by scouting trawler on 25/10/59.
C. off Julianehaab fished by scouting trawler on 17/12/59.

The search trips in fall and winter, however, showed that bigger and older cod occurred farther eastward, off Cape Farewell (Figure 2B), and that the 1956 year-class was richer in the catches from Julianehaab Bay west of Nanortalik (Figure 2C). Already in 1957 the 1953 year-class, at an age of 4 years, occurred in large quantities in the "Anton Dohrn" catches from that bay. As now, in its turn, the 1956 year-class is stronger (26%) in the catches in Julianehaab Bay, and strong also off Sermersut (Figure 1D), it is to be expected that this year-class 1956, which does not appear to be important off West Greenland, will become of importance for the S. Greenland fishery as from 1962. The average length of the three important year-classes by the end of 1959 were: 1956-45 cm, 1953-63 cm, and 1950-78 cm.

The two search trips offered an opportunity to tag cod off S. Greenland. The tagging included 215 cod, partly with yellow DHB tags with yellow plastic flaps, partly with blue plastic tags only with numbers and with red plastic

flaps. These taggings off S. Greenland are intended to increase our knowledge of the E. Greenland cod stock, whose feeding areas obviously are to be found off S. Greenland. Owing to exceptionally early occurrence of ice the taggings made during the second search trip in December could only be carried out to a restricted extent.

c. East Greenland.

Since the German R/V "Anton Dohrn" in September 1955 found a large stock of redfish on the Anton Dohrn Bank, the German fishery off E. Greenland has yielded the following quantities in tons:

	1955		1956		1957		1958		1959	
Total	46067	%	44683	%	21804	%	14538	%	30844	%
Cod	3001	6.5	7437	16.6	5838	26.8	4553	31.3	9691	31.4
Redfish	40948	88.9	33094	74.1	13638	62.5	8883	61.1	19186	62.2

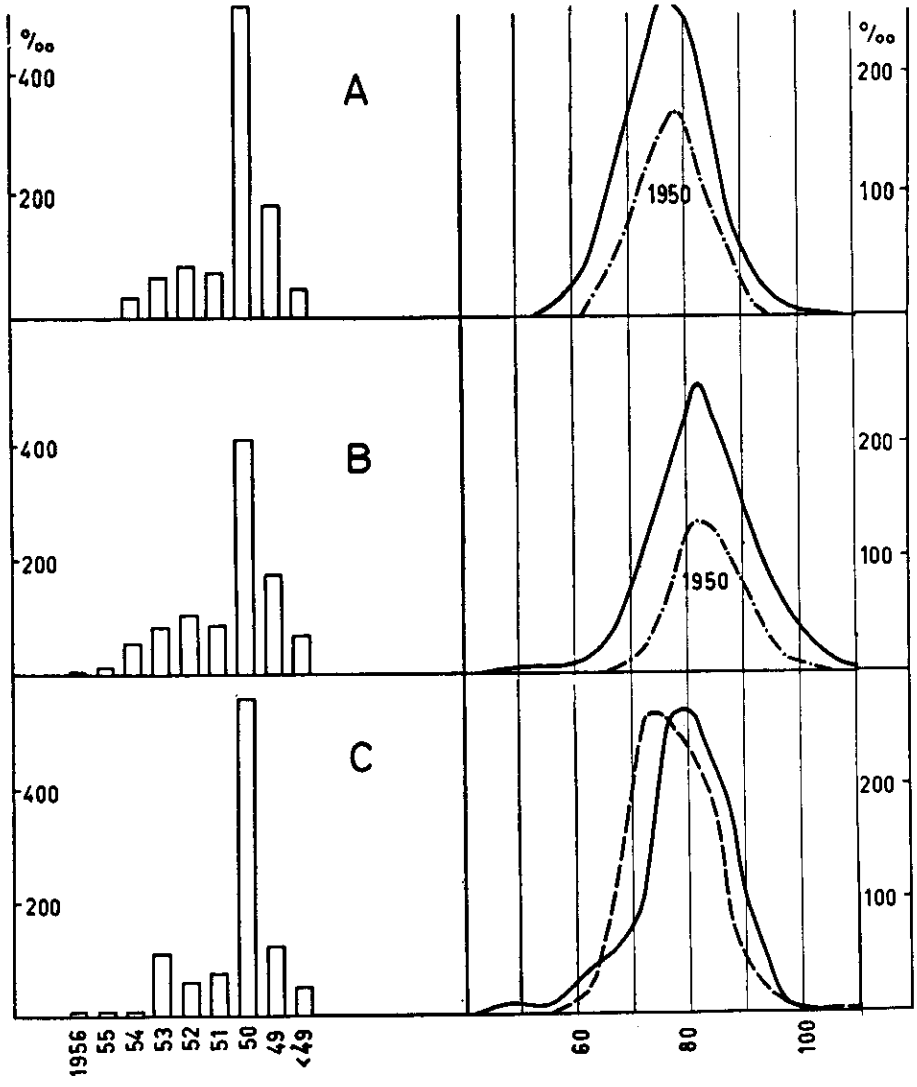

Fig. 3. **Age and length distribution (°/₀₀) of cod from E. Greenland.**
A. off Angmagssalik landed by trawlers in March and April 1959.
B. from Dohrn Bank landed by trawlers from August to December 1959.
C. from Cape Bille Bank fished by scouting trawler on 13/12/59 (full line) and from Cape Tordenskjold Bank (striated line) landed by trawlers in March and April 1960.

While up to now the main fishery was carried out on Dohrn Bank and off Angmagssalik, an increase in the fishery has occurred since 1959 on the difficult fishing grounds off S.E. Greenland. Since the fisheries started the same trend has been observed on all fishing grounds: In the beginning redfish alone were caught; thereafter comes a considerable decrease in the catch of redfish with a simultaneous increase in the proportion of cod. It is to be noted that this change only to a minor degree is the consequence of a change in fishing depth, but that the cod catches now also have increased in somewhat deeper areas, where originally only redfish were observed.

Contrary to what is the case for W. and S. Greenland, only a small change in the age-composition of the E. Greenland cod stock was observed since 1958. Now, as then, the 1950 year-class predominates with 52% and a mean length of 78 cm in the spring catches from Angmagssalik (Figure 3A), and with 41% and a mean length of 84 cm in fall catches from the Dohrn Bank (Figure 3B). The proportion of the rich 1949 year-class has, however, decreased.

A search trip in December 1959 showed surprisingly favourable ice conditions off S.E. Greenland, and an increased proportion of cod above all on the Cape Bille Bank. Figure 3C presents the age and length distribution of catches from the Cape Bille Bank (mean length 79.4 cm) and the length-distribution of trawler catches from the Tordenskjold Bank (61°15'N) in March and April. Of the cod caught 70% were ripe, 30% unripe. In the last decade of March 25% of the ripe cod were actually spawning or just beginning to spawn. In a sample from 5 April 1960 50% were spawners and 15% had almost finished spawning.

In mid-December 115 cod were tagged off S.E. Greenland with yellow DHB tags plus yellow plastic flaps.

Subarea 2.

Figure 4A and B present the length distribution of cod from two search trips by trawlers in September and November 1959 and of commercial trawl catches from December 1959 to January 1960. Only few cod, with a mean length

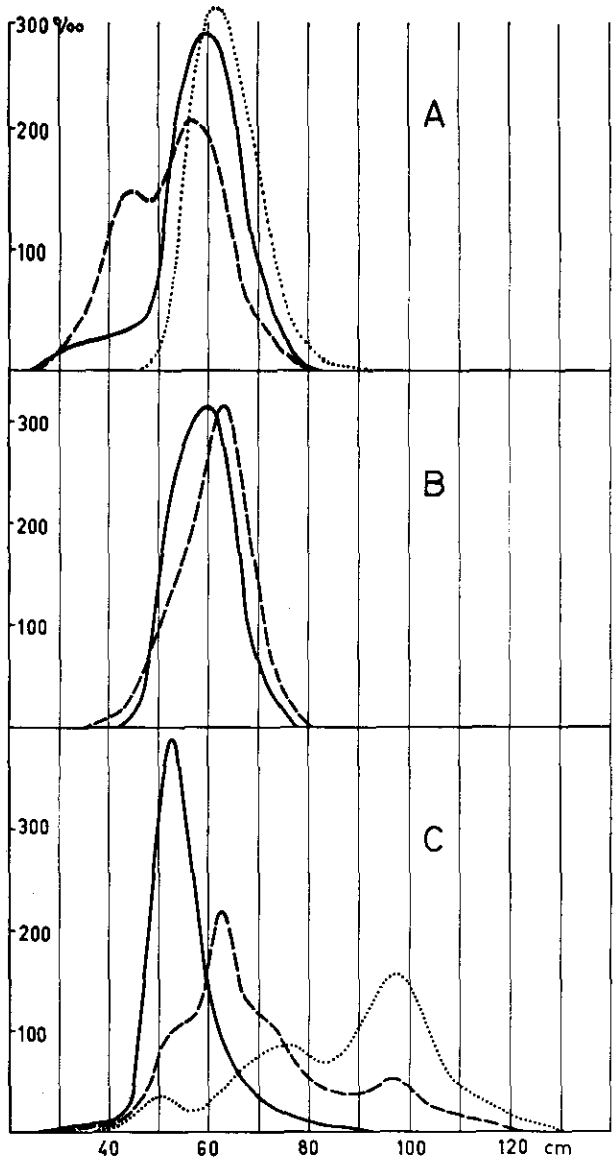

Fig. 4. **Length distribution (‰) of cod from Subareas 2 and 3.**

A. from Hamilton Bank (2J) fished by scouting trawlers in September (full line) and November (stipled line) and landed by trawlers from Sundall (2J) in December 1959 and January 1960 (dotted line).

B. from Ungava Bay (2G) on 29/10/59 (full line) and from Subdivision 2H on 2/11/59 (stipled line) fished by scouting trawler.

C. from Flemish Cap (3M) on 3/9/59 (full line) and from northeastern slope of Grand Bank of Newfoundland (3L) on 7/9/59 in 200-300m (stipled line) and in more than 300 m (dotted line), all fished by scouting trawler.

of 59.1 cm, were caught in the Hamilton Bank area in September 1959 (cfr. hydrographic report (B) by J. Messtorff). In November 1959 the catch of the salt-fish trawlers was somewhat better, although the cod were very small (54 cm). More dense cod stocks were observed in Subdivision 2H, in warmer slope water (300-340 m), where the mean length was 60.9 cm.

For the first time fishery was tried in the Ungava Bay, end of October. As the Labrador cod appear here in considerable quantities during its northward migration in late fall, this area ought to be included in the ICNAF Area (Subdivision 2G). In spite of heavy seas and damage to the trawl, the catch per one hour in the Ungava Bay was 1.5 tons. The cod—taken in -0.3° water—had a mean length of 59.1 cm, i.e. about the same as in Subdivision 2H.

From December 1959 German trawlers fished successfully in the Sundall area (2J). To be noted, compared to the previous year, is that in this—once more very satisfactory fishery—the proportion of cod was increasing, reaching a maximum in March with 37%. From many of the trips cod constituted more than 50% of the landings. Cod were even more plentiful than appears from these figures, as redfish were the fish preferred. The dotted curve in Figure 4A presents the length-distribution of the cod landings from Labrador; mean length 63.6 cm. Investigations of maturity showed, that most of the cod were on their spawning migration. Only 6% of the cod caught at Sundall in the winter were immature. By mid-January the mature cod was in Stage III, by end of March in Stage IV.

Subarea 3.

Two search trips in September and November 1959 showed poor conditions for cod fishing. Only in the area south of Flemish Cap, 280-350 m, an important occurrence of smaller cod was observed, mean length 55.2 cm. However, in November only few cod of the same size, were caught here. In redfish catches from the N.E. slope of the Grand Bank (3L) the by-catch of cod in search and commercial trawler trips amounted to 8%. These cod were very large (mean length 87.8 cm) from depths of more than 300 m, and average-sized (69 cm) from depths of 200-300 m (Figure 4C). The catches from off Cape Bauld (3K) in September 1959 were very small, the cod measured here on an average 64.5 cm.

B. GERMAN HYDROGRAPHIC OBSERVATIONS IN THE ICNAF AREA (SUBAREAS 2 AND 3) IN SEPTEMBER AND NOVEMBER 1959

BY JOACHIM MESSTORFF

During the two search trips in 1959, the opportunity was given to carry out a hydrographic survey from 2-24 Sept. (Trawler "Thunfisch") and from 28 Oct.-21 Nov. (trawler "Island"). The investigation area of the first trip was from Flemish Cap and the E. slope of the Grand Bank (3 M and 3 L), 46°24′N to off central Labrador (2 H), 56°25′N; in the second trip the area from the slope off Cape Chidley (2 G) and the Ungava Bay from 60°25′N to the S.E. edge of the Grand Bank (3N), 44°50′N, was investigated.

Figures 5 and 6 present the distribution of the hydrographic stations of the two trips; trawl stations with no hydrographic observations are not shown. As the experimental fishery was of first priority the hydrographic work had to be coordinated with the fishing experiments; thus, hydrographic stations are mainly found in the areas of fishing. For this reason the hydrographic work to a certain degree remains incomplete, and water sampling for salinity determination had to be somewhat restricted. Therefore, graphs of the salinity distribution are not presented. It was, however, possible to take short hydrographic sections across the Labrador Current in various parts of the investigated area, in order to achieve information on the present temperature distribution and on the extension of the two components of the current. These cross-sections were taken to comprise the near-coastal, less haline, polar cold-water of the Baffin Land Current flowing southward on the shelf, as well as the warmer Atlantic water of the W.-Greenland Current along the slope.

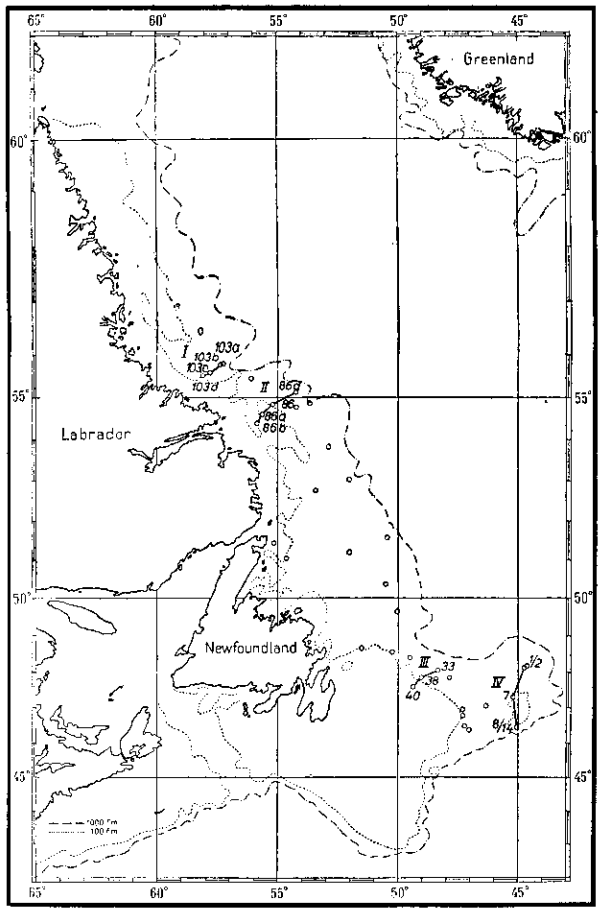

Fig. 5. **Hydrographic stations, trawler "Thunfisch," 2-24 September 1959 (I-IV = hydrographic sections.)**

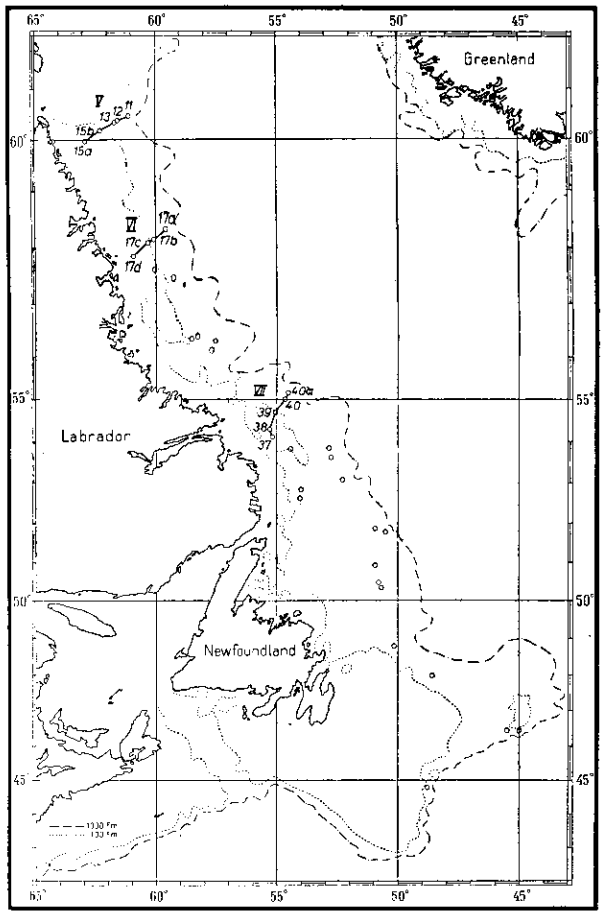

Fig. 6. **Hydrographic stations, trawler "Island," 28 October-21 November 1959 (V-VII = hydrographic sections).**

All together the distribution of the hydrographic stations of the two trips made it possible to illustrate the actual hydrographic situation in the area:

The horizontal distribution of the surface temperatures (Figure 7) shows clearly the main direction of the Labrador Current, but its composition of two different water masses does not become apparent.

The surface temperatures show a decided graduation caused by the increasing warming-up from north to south due to solar heating. The relative strength of the current appears from the more or less strong concavities of the isotherms. In the area of the main current, along the edge of the shelf, the temperatures were always lower than towards the coast and towards the open sea.

The surface temperature increased, on the whole, in September from 1°C in the North to 15°C in the South of the area. The same trend was also observed in November; however at this advanced season of the year the temperatures were considerably lower (Table 1).

As already mentioned the temperatures did not offer any information on the origin of the surface water. However, if the fresh water influx from the land is not considered, the low salinity throughout the whole area indicates that the surface water in the main belongs to the Arctic component of the Labrador Current. In September the mean salinity of the surface water was 32.4°/₀₀. (31.65-33.46) in the whole of the area. All stations with salinities above 33°/₀₀. (average: 33.3) were situated eastward of the

edge of the shelf in the area of mixed water. When these outlying stations are left unconsidered, the average salinity on the shelf was only 32.1‰ (31.65-32.69). In November a minute increase of the surface salinity was observed. The mean salinity of all samples from the shelf area was 32.6‰ (32.20-32.98). The stations beyond the edge of the shelf gave a mean salinity of 33.2‰ (33.06-33.54), i.e. about the same as in September.

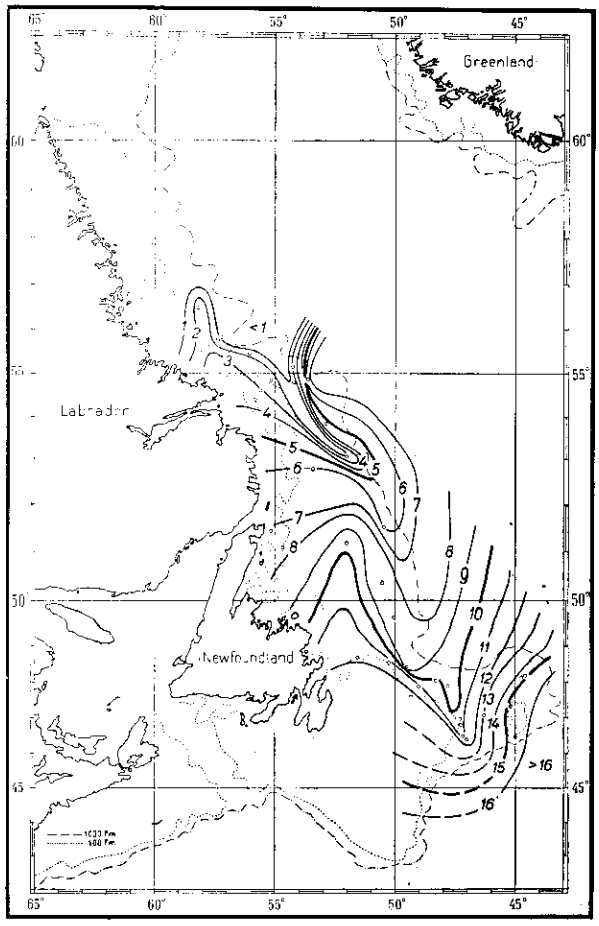

Fig. 7. Surface temperature distribution, September, 1959.

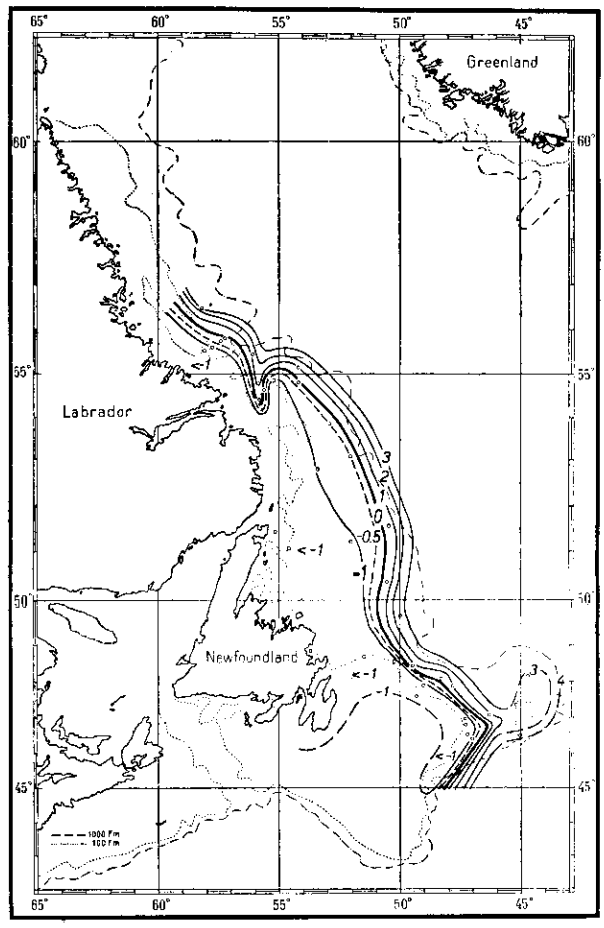

Fig. 8. Temperature distribution at 100 m, September 1959.

TABLE 1. Mean Surface Temperatures in the separate Subdivisions in September 1959 ("Thunfisch") and November 1959 ("Island") in t°C.

Subdivision	September 1959				November 1959			
	min.	max.	M	n	min.	max.	M	n
2G +Ungava Bay	—	—	—	—	-0.01	1.25	0.32	10
2H	0.70	2.76	1.96	6	0.20	0.95	0.54	6
2J	1.47	6.86	3.64	9	0.44	1.10	0.74	10
3K	5.98	9.72	7.97	6	0.90	2.51	1.61	5
3L	7.57	12.60	10.75	11	2.88	2.96	2.92	2
3M,N+	12.98	15.29	14.56	6	7.13	9.26	8.11	4

+Subdiv. 3N only in Nov. 59.

The isotherms at 100 m, running nearly parallel to the direction of the current, show the complete change of the temperature conditions compared to the surface water (Figure 8). Here, where the surface warming-up is no longer effective the temperature distribution provides better information on the origin of the water masses. The 0° -isotherm at 100 m follows fairly closely the edge of the shelf; in certain areas it is even pressed eastward over the slope. Thus at this depth the total shelf area is overflowed by Arctic water, the core of which in September 1959 showed temperatures below -1.5°C.

Figure 9 illustrates the temperature conditions of the near-bottom water in September 1959. The isotherms follow a similar parallel pattern as at a depth of 100 m. However, a certain displacement can be observed. The 0°-isotherm which at 100 m was still situated partly east of the edge of the shelf, is shifted considerably farther westwards, toward the coast. Thus the cold water masses of the Baffin Land Current at this season of the year only reached the bottom in the shelf area until 200 m depth. At greater depths the exterior part of the cold-water body is already under run by warmer and more haline Atlantic water; this appears from the position of the 3°-isotherm.

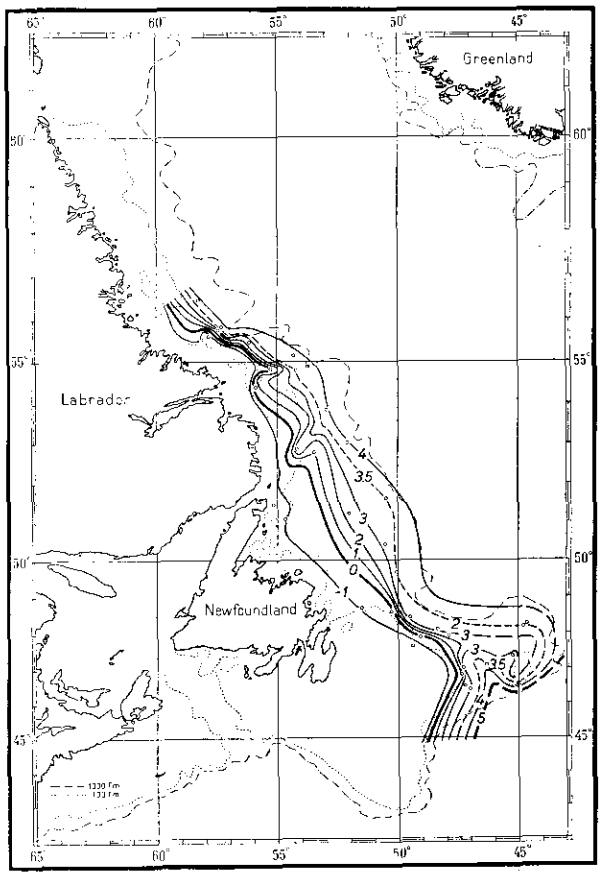

Fig. 9. Temperature distribution near bottom, September 1959.

The inflexion of the isotherms off S-Labrador towards Belle Isle illustrates the diversion of warmer and more haline Atlantic water into a deeper incision of the shelf; this causes a partial under-run of the cold-water body. A confirmation of this fact is presented by the relatively high salinity (34.4°/₀₀) of the near-bottom water in this up to 300 m deep channel, whereas the salinity of the surface water at the same position was only 32.4°/₀₀. Obviously we have here the case of a topographic-dependent under-current similar to what is observed in the Hudson Strait, the Laurentian Channel and the Fundian Channel (ICNAF Annual Proceedings Vol. 4, p. 85).

From the hydrographic section I and II (Figure 10 and 11) it is obvious that the core of the polar cold-water in September 1959, with a temperature of -1°C, was placed at a depth of 100 m. This cold water reached, in Subdivision 2H (section I), the bottom of the shallow part of the shelf. On the northern Hamilton Inlet Bank (section II) the temperature of the bottom water was still -0.3°C at a depth of 200 m. The

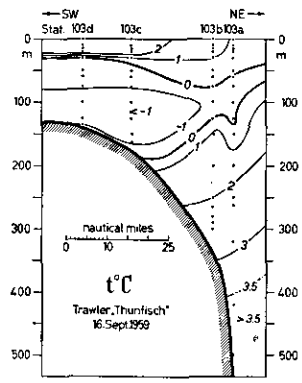

Fig. 10. Hydrographic Section I, off Hopedale, Subdivision 2H, between 55°23′ N-58°10′W (St. 103d) and 55°46′ N-57°17′W (St. 103a). Salinity in °/₀₀ - St. 103a
0 m - 32.52
420 m - 34.79

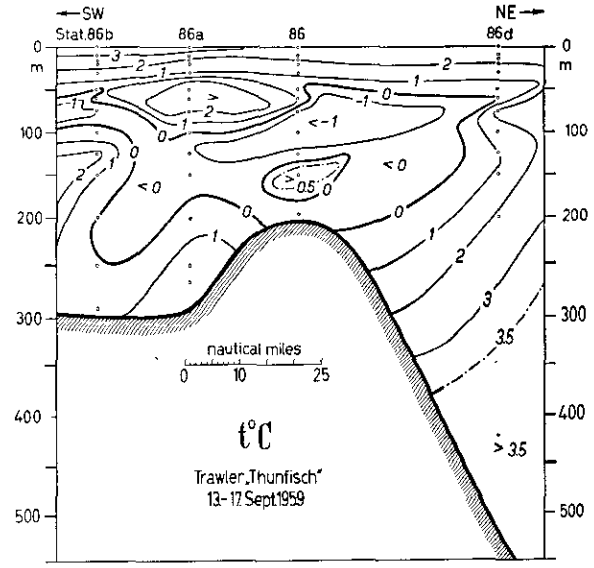

Fig. 11. **Hydrographic section II, across the north part of Hamilton Inlet Bank, Subdivision 2J, between 54°21′ N-55°52′W (St. 86b) and 55°05′ N-54°15′W (St. 86d).**

Salinity in °/₀₀ –	St. 86b	St. 86a	St. 86
0 m –	31.86	32.04	32.16
290 m –	33.95	—	—

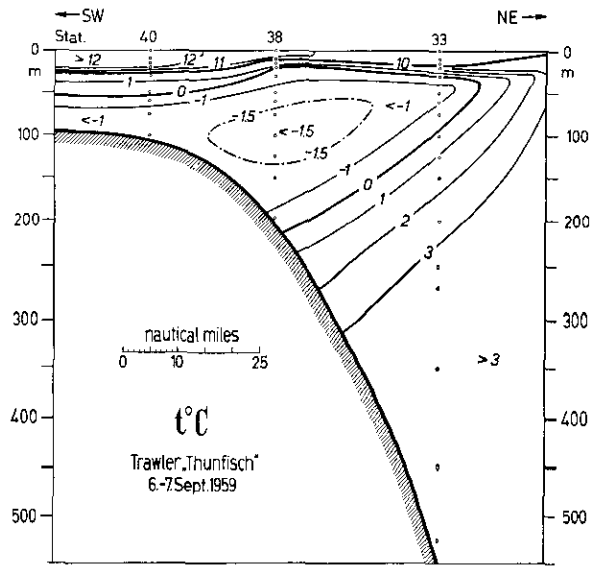

Fig. 12. **Hydrographic section III, across the NE edge of the Grand Bank, Subdivison 3L, between 47°34′ N-49°28′W (St. 40) and 48°06′ N-48°27′W (St. 33).**

Salinity in °/₀₀ - St. 33

0 m - 31.67
350 m - 34.78
450 m - 34.79

warmer, salter Atlantic water of 3°C reached the slope at a depth of 350 m. The bottom water temperature at 500 m had increased to 3.67°C in section I and to 3.81°C in section II. A comparison with the somewhat more southerly Canadian routine section off Seal Island from August 1958 (ICNAF Ann. Proc. Vol. 9, pp. 24-25) reveals that the temperature conditions in this area one year and one month later were about the same in the cold water region above the shelf as well as in the warmer water region on the slope. Only the surface temperatures were somewhat lower in September 1959 corresponding to the advanced season of the year and the more northern position. The salinity distribution in September 1959, estimated from the few available samples, also seemed to have been similar to that shown by the Canadian section in August 1958.

The very low bottom water temperatures of the shallower parts of the shelf may well explain the unsuccessful search for cod in this area in September 1959.

Over the NE-edge of the Grand Bank the temperatures in the core of the cold-water component of the Labrador Current (section III, Figure 12) were even below -1.5°C. To almost 200 m depth bottom water temperatures of below -1°C were still observed. A very distinct leap of temperature of about 10° at 20-30 m separated the relatively strongly heated thin surface layer from the cold water bulging out over the edge of the shelf. Below this bulge the about 3° warm, more saline water (34.8° /₀₀, surf. 31.7°/₀₀) of the exterior branch of the current reached the slope at 300-350 m; with increasing depth no further remarkable increase of temperature occurred. At 500 m the bottom water temperature was 3.24°C.

The Flemish Cap shelf socket presents special case as far as hydrographic conditions are concerned (section IV, Figure 13). The northern slope and the shelf part itself are still in the area of the exterior arm of the Labrador Current, whilst the Arctic water of the coastel arm no longer reaches this off-the-road region. The southern slope of the Flemish Cap, however, is already influenced by the nearness of the warmer Gulf Stream water as shown by the higher bottom water temperature and by the penetrating tongue of more than 4°C warm water between 100 and 200 m (4.75°C in 130 m).

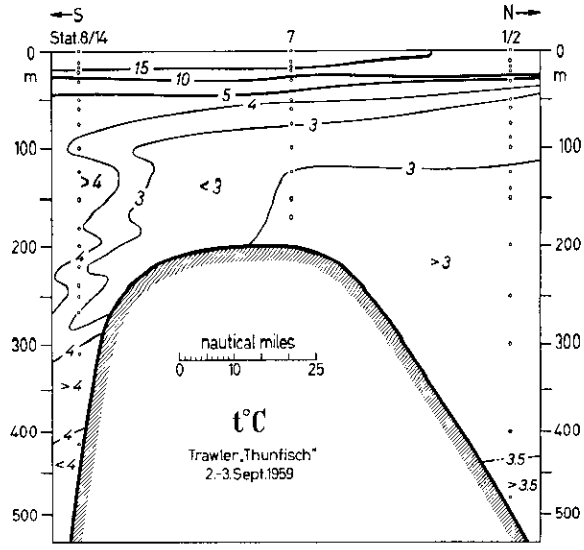

Fig. 13. Hydrographic section IV, across Flemish Cap, Subdivision 3M, from north to south, between 48°12′ N-44°46′W (St. 1/2) and 46°28′N-45°04′W (St. 8/14).

Salinity in °/₀₀ -	St. 8/14	St. 1/2
0 m -	33.36	32.56
300 m -	34.77	34.76
400 m -	34.86	34.83
480 m -	– –	34.86
560 m -	– –	34.66

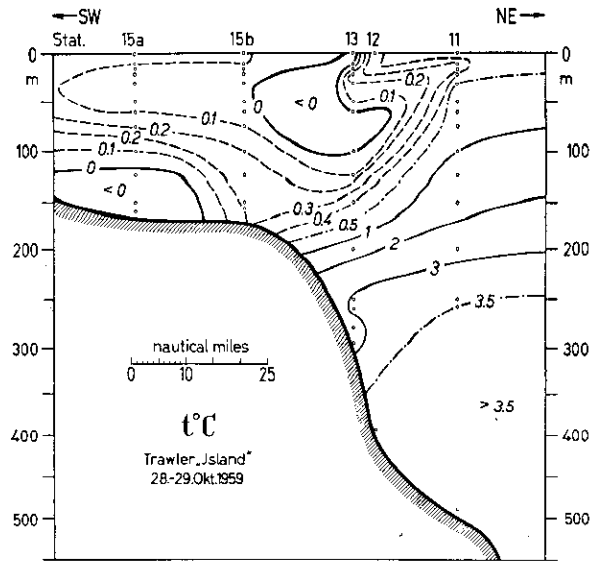

Fig. 14. Hydrographic section V, northeastwards Seven Islands Bay, N. Labrador, Subdivision 2G, between 59°38′N-63°W (St. 15a) and 60°25′N-61°12′W (St. 11).

Salinity in °/₀₀ - St. 13	
0 m -	32.29
280 m -	34.54

The hydrographic sections of the second search trip at the end of October and the beginning of November 1959 in the Labrador Area (sections V-VII, Figures 14-16) all show a remarkable change of the hydrographic conditions, especially in the region of the Arctic component of the current. The surface temperature had, corresponding to the advanced season of the year, decreased (Table 1), but the colder water masses below had become warmer so that the difference between the surface and the lower water layers down to the bottom at 150-200 m only reached 0.5°C. Only at the most northern section V a temperature of -0.1°C was observed at the bottom (150-160 m). In the Ungava Bay (Station 14, 60°16′N, 65°10′W, 200 m) the bottom water temperature was -0.3°C. Here the surface temperature was 0.24°C, and the temperatures from 50 m and deeper were just below 0°C. In the region of the southern sections VI and VII the core of cold water did not reach much deeper than 100 m. The lowest temperature was -0.2°C. Bottom water temperatures (at 150-200 m) were between 0.5° and 1.5°C. Thus the increase of the bottom water temperature since

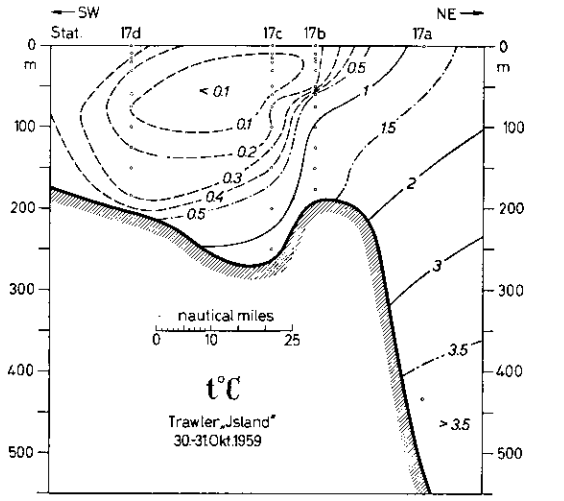

Fig. 15. Hydrographic section VI, off Cod Island, Cape Mugford, N. Labrador, Subdivision 2G, between 57°47′ N-61°03′W (St. 17d) and 58°19′N-59°43′W (St. 17a).

Salinity in °/₀₀ -	St. 17d	St. 17c	St. 17b
0 m -	32.32	32.47	33.50[1]
100 m -	–	–	33.52
200 m -	32.66	–	–
250 m -	–	33.54	–

[1] / locking of water bottle leaky

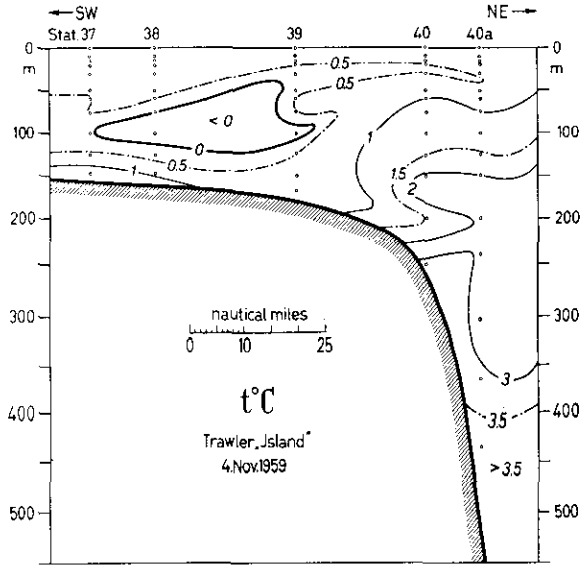

Fig. 16. Hydrographic section VII, across northern part of Hamilton Inlet Bank, Subdivision 2J, between 54°04′ N-55°16′W (St. 37) and 55°07′ N-54°37′W (St. 40a).

Salinity in °/₀₀ - St. 38	St. 40	St. 40a
0 m - 32.40	32.93	32.88
152 m - 33.24[1]	–	–
250 m - –	33.98	–
303 m - –	–	34.46
364 m - –	–	34.57

[1] / locking of water bottle leaky

September was about 1.5-2°C. The noteworthy increase in the catches of cod at this season compared to September may well be caused by this increase of the bottom water temperature.

A relatively strong increase in temperature was also observed in the slope area. In September colder water was observed in the upper water layers on all stations including the outlying stations between the sections; in November, however, no such cold water could be observed on the corresponding stations. The upward displacement of the 3°-isotherm along the slope within the region of Atlantic water may well be considered the result of the warming-up of the coastal flow of water. Bottom water temperatures of 3°C were in September only observed at depths of more than 300 m, in November, however, already at 250-300 m. On the whole also the more successful redfish catches were made in shallower water in November than in September.

Apart from this seasonal shift of the 3°-isotherm, it was observed on both trips that the bottom water temperatures at the same depth decreased considerably from north to south along the slope in the region of the seaward component of the current. The deep-water temperatures (400-500 m) off central and northern Labrador were still 3.7-3.0°C when only 3.2 and 3.4°C were observed on the N.E.- and E.-slope of the Grand Bank. This decrease is to be explained by the gradual cooling of the warm water component with increasing distance from its origin (the W-Greenland Current).

A further change in hydrographic conditions was observed on the southern and farther westward located E. -edge of the Grand Bank. The warmer exterior component of the Labrador Current hardly penetrates into this S.E. region, and the cold Arctic waters can therefore here move downwards over the steep edge of the Bank. Thus the temperature of the bottom water (300 m) was only 0.95°C on Station 73 with a relatively low salinity of only 34.0°/₀₀ (surface-32.2; 280 m -33.9). At 250 m the temperature was only 0.5°C, and until 200 m the temperatures were below zero, in the upper layers even below -1°C. It may be of interest that just at these low temperatures, in 300 m depth, an exeptionally dense concentration of redfish, however mainly small fish, was found (15 tons in a 30 min. trawl haul).

C. AMOUNTS OF FISH CAUGHT OFF LABRADOR AND CIRCULATION OF THE ATMOSPHERE OVER THE N.W. ATLANTIC

BY ARNO MEYER AND MARTIN RODEWALD

After the discovery in July 1958 and later of large concentrations of redfish at Sundall and on Ritubank, these two fishing grounds yielded large catches for a considerable period. However, by beginning of July 1959 the concentrations of redfish dissolved, for reasons unknown to us, and for several months the area gave daily catches of only 10-15 tons at the most. Two search trips by German trawlers in September and November 1959 offered opportunity for studying the reasons for this change.

All depths in Subdivisions 3K and 2J were systematically fished, however without success. Only at 51° 28′-38′N very large concentrations of redfish were observed, mainly at 300-340 m, in the first half of November. The hydrographic observations did not reveal any differences compared with the previous year, when in the same season very good catches were made in 2J and 3K. Only from December 1959 the catches off Labrador improved gradually, and right to the beginning of April when the ice conditions forced the German trawlers to discontinue the fishery the same favourable catch conditions prevailed as in the previous year.

The changing atmospheric circulation over the W. Atlantic observed through the same period may offer an indication of a relation between air circulation and catch fluctuations. Figures 17-19 present the mean atmospheric pressure departure in mb from the normal (1899-1939) in 1958 (Figure 17), during July-October 1959 (Figure 18) and in January 1960 (Figure 19). The period of rich catches is characterized by positive atmospheric pressure anomalies in the North and negative anomalies in the South, together with a corresponding onshore wind component from ENE to WSW over the E. coast of Labrador and Newfoundland. The period of poor catches, however, shows a clear change in the pattern of circulation. The atmospheric

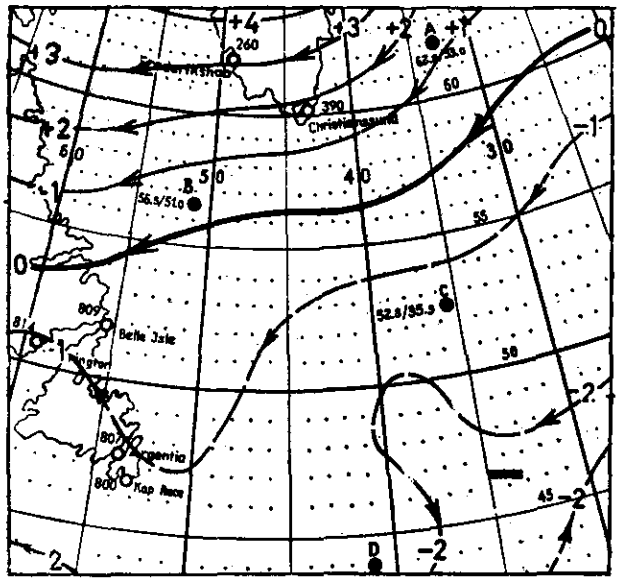

Fig. 17. Mean departure of atmospheric pressure (in mb) from normal (1899-1939) in 1958.

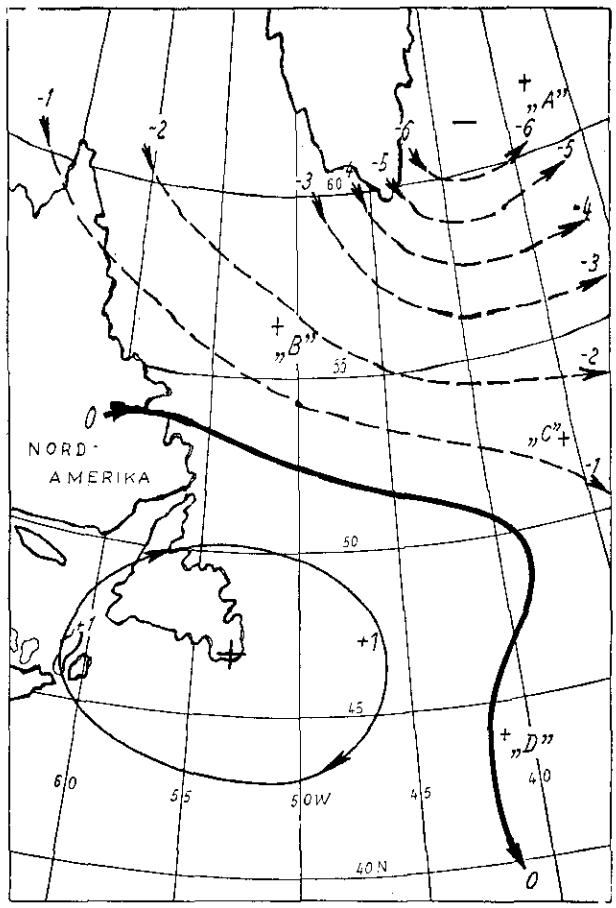

Fig. 18. Mean departure of atmospheric pressure (in mb) from normal (1899-1939) from July to October 1959.

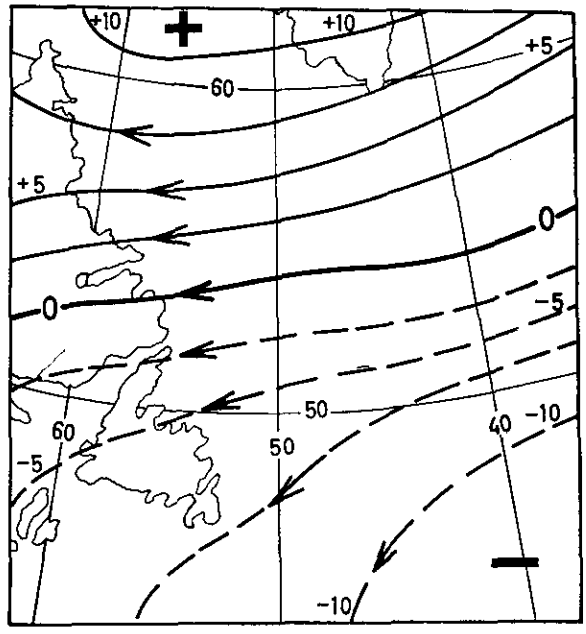

Fig. 19. Mean departure of atmospheric pressure (in mb) from normal (1899-1939) in January 1960.

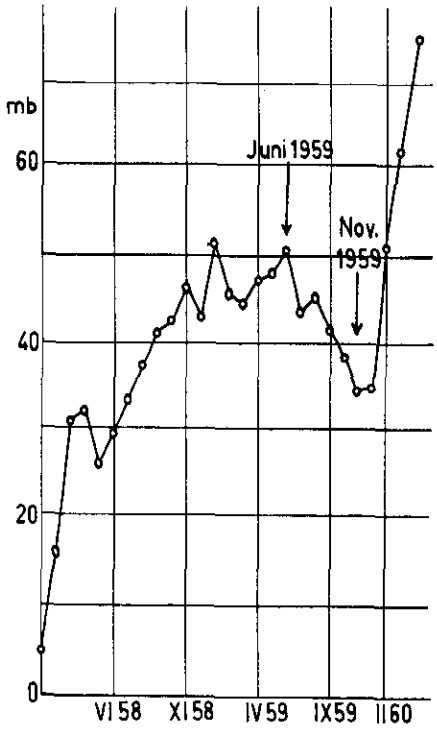

Fig. 20. The cumulative departures of the pressure gradient "North Labrador to South Newfoundland" for the period January 1958 to March 1960.

pressure is lower in the North and higher in the South, the resulting wind component off the coast of Labrador is offshore from W to WNW over the ocean. The rapid improvement of the catches in winter 1959/60 in its turn is parallel with another change in circulation over the N.W. Atlantic, resulting in onshore wind components and a decided "blocking" over the Labrador Current.

Figure 20 presents the cumulative departures of the mean monthly pressure gradient "northern point of Labrador to southern point of Newfoundland" from its 1899-1939 averages, for the period January 1958-March 1960. To compare, Figure 21 shows the daily catches, i.e. catch per day of trip, of German trawlers fishing off Labrador August 1958/March 1960. Both curves clearly follow one another. Further investigations must decide whether this agreement between changes of the atmospheric circulation and catch fluctuations is accidental or if, and to what extent, a direct connection exists between the two phenomena.

REFERENCES

RODEWALD, M. Bestandsschwankungen des Rotbarsches vor Südlabrador und die atmosphärische Zirkulation in Nordwest-Atlantik. Hansa, Jg. 97, H. 6/7, Hamburg 1960.

RODEWALD, M. and MEYER, A. Ist die Grösse der Fischfänge vor Labrador von der atmosphärischen Zirkulation abhängig? Hansa, Jg. 97, H. 12/13, Hamburg 1960.

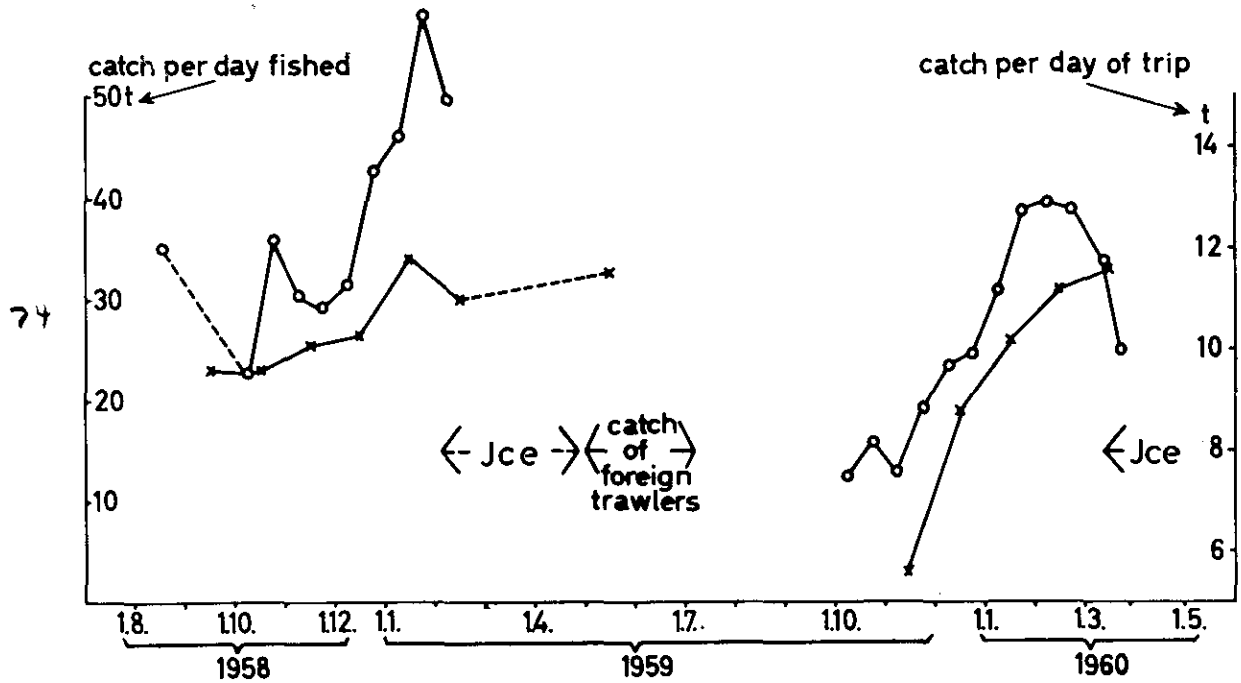

Fig. 21. Catch per day fished (circles) and catch per day of trip (crosses) of German trawlers off Labrador (Sundall) from August 1958 to March 1960.

V. Icelandic Research Report, 1959

ATVINNUDEILD HÁSKOLANS-FISKIDEILD

Introduction.

In 1959, one cruise was made to East Greenland waters and two cruises to the ICNAF area with chartered commercial trawlers. The main purpose of the cruise to East Greenland waters was to get information on the spawning stock of cod. Both cruises to the ICNAF area were made in order to search for redfish.

A. SUMMARY OF CRUISES — BY JAKOB MAGNÚSSON

I. Cruise.

The first cruise was made to East Greenland waters during April 1st to 15th. Experimental hauls were taken in different depths on the offshore banks and their slopes along the East Greenland coast from Anton Dohrn-Bank (65°35′N 29°40′W) to Fylkir Bank (62°29′N 40°30′W). Some places could not be fished as planned because of ice. In general, the catches were poor for cod as well as for redfish with the exception of the Fylkir Bank where heavy concentrations of spawning cod were found. On this bank also good catches of redfish were obtained. Cod and redfish were mixed but cod were usually in majority, but varying according to depth: In depths of 100-120 fms, redfish accounted for only about 1/4 or less of the catch, but in greater depths for 1/3-1/2 of the catch. The average catch per trawling hour was $15\frac{1}{2}$ tons for cod and redfish together.

II. Cruise.

The second cruise was made to the Newfoundland banks, July 2nd to 19th. Only 8 days were used for fishery on the banks, the remaining time for travelling. Experimental hauls were only taken in Subarea 3 (Subdivisions 3K, 3L and 3M), 76 hauls altogether. On the trawl stations temperature measurements were made. Because of lack of time and the object of the cruise no special hydrographic sections were operated. The bottom temperatures on the trawl stations in Subdivision 3K were 3.1°C to 3.4°C. The temperature conditions along the NE-slope of the Grand Bank, the SW and NE part of Flemish Cap are given in sections I-III, located as shown in fig. 1.

The conditions on the NE slope of the Grand Bank are shown in fig. 2. Under a layer of warm

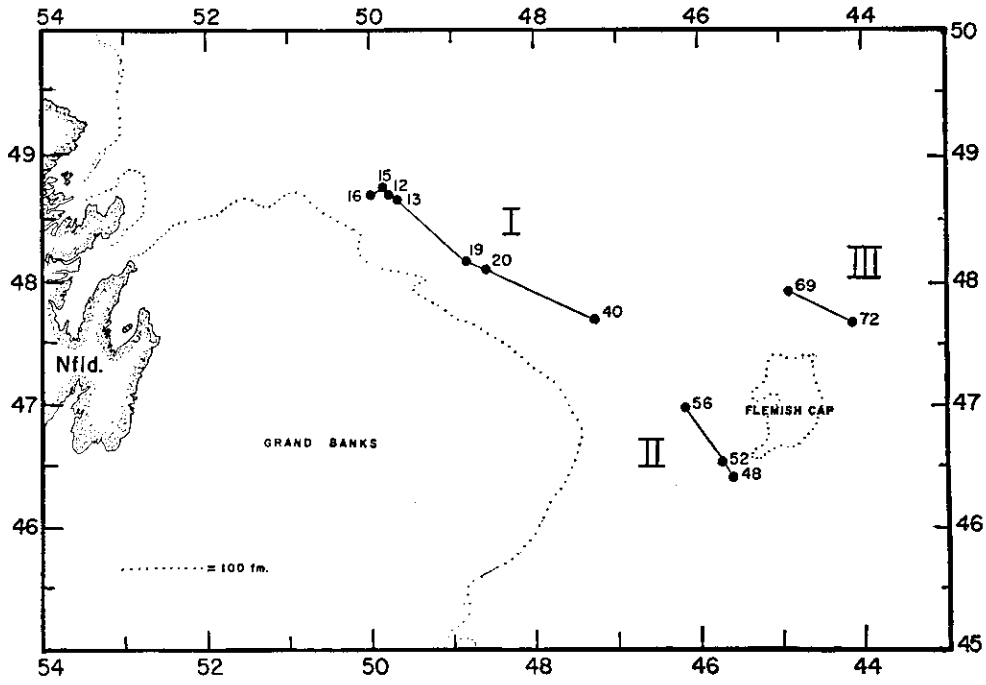

Fig. 1. Location of hydrographic sections, cruise II.

water caused by the summer heating, is a thin layer of cold water, thereafter the temperature gradually increases towards the bottom, being somewhat lower towards NW.

Fig. 3 shows temperature across the SW-corner of Flemish Cap. The bottom temperatures are very similar through the region, but in the intermediate layer we can see the influx of warm water in the southern part and of cold water in the northern part of the section.

Along the W-side of Flemish Cap, the bottom temperatures are 3.5°C to 3.9°C.

Fig. 4 presents the conditions at the NE corner of Flemish Cap.

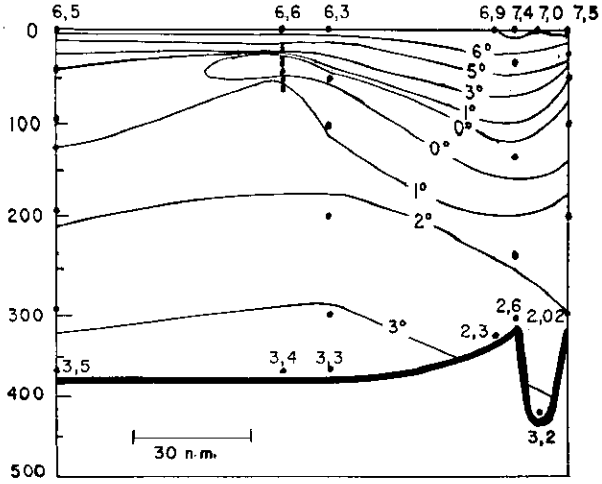

Fig. 2. **Temperature distribution, NE slope of the Grand Bank, Section I.**

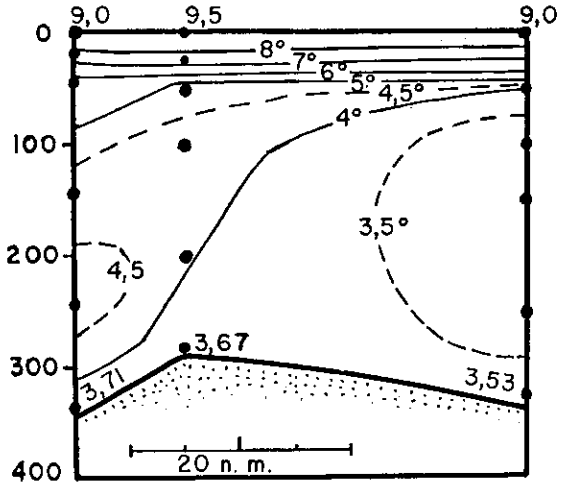

Fig. 3. **Temperature distribution, SW corner of Flemish Cap, Section II.**

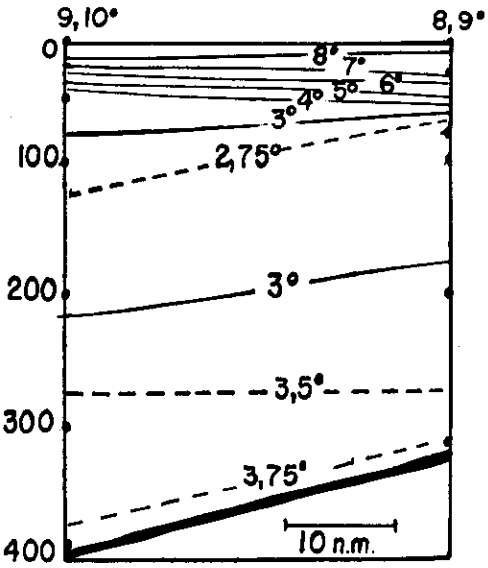

Fig. 4. **Temperature distribution, NE corner of Flemish Cap, Section III.**

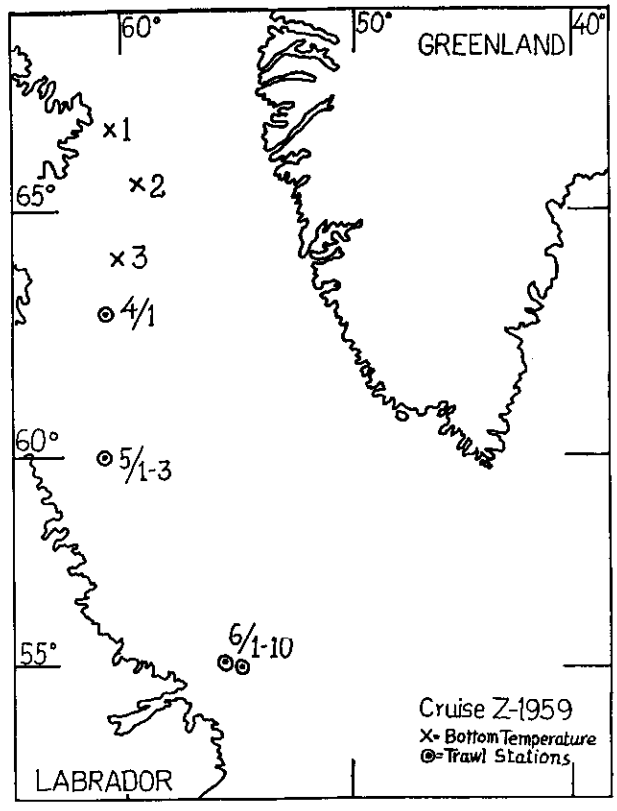

Fig. 5. **Location of stations in the western part of the Davis Strait.**

III. Cruise.

During the period August 28th to September 13th, a cruise was made to the Davis Strait. Much time was spent on searching for banks indicated on some sea-charts, but without result. Therefore, relatively few hauls were made. Some hauls were made in Subdivisions 1C and 1B. The bottom temperature was measured at different localities, the northernmost station was at 67°22'N 57°31'W where the bottom temperature was 2.8°C at 350 m.

Some temperature measurements and hauls were made in the western part of the Davis Strait (Fig. 5). Off Baffin Island, the bottom temperature was very low: At st. 1: 0.2°C in 340 m, at st. 2: 1.2°C in 460 m and st. 3: 1.6°C in 380 m.

At the trawl stations the bottom temperatures were:

st. 4: 2.4°C
st. 5: 3.0°C
st. 6: 2.9°C

B. REDFISH — By JAKOB MAGNÚSSON

I. Cruise.

As the area surveyed on this cruise does not belong to the ICNAF area and as the main purpose was cod investigations, the redfish will not be further discussed here.

II. Cruise.

In all hauls on this cruise redfish were caught, and redfish was the main species caught. Other species as cod, halibut, American plaice, were almost of no importance.

In Subdivision 3K, 11 hauls were taken at two localities in depths of 140-230 fms. (Fig. 6, hauls 1-11). All hauls were poor, the best yielded 3.5 tons redfish in one hour, but the average was only about 1 1/3 tons per hour.

In Subdivision 3L, 36 sets were made all on the NE-slope of the Grand Bank in depths of 165-230 gms. (Fig. 6). In sets 12-18, the average catch was only 1.3 tons per trawling hour.

In sets 19-39 (Fig. 6), the best hauls on the cruise were made with an average of 4 1/4 tons per trawling hour, but the maximum was about 10 tons redfish per one hour. All other hauls taken in this subdivision were poor, the best yielding 3 tons after 75 min. trawling.

At Flemish Cap (3M), 21 hauls were taken in depths in 150-225 fms. No good catch was obtained. At the V- and NE-side of the Bank some good hauls were made (3-3½ tons after 65 min.). There appears to be a rather large quantity of redfish in the surveyed area, but the fish are scattered over a vast area and no heavy concentrations were found except on the NE-slope of the Grand Bank (see above), however, by far not as dense as on Ritubanki and Sundáll in the previous year. But an average catch of 4 1/4 tons per trawling hour (in experimental hauls) gives a basis for commercial fishing in the area.

The redfish caught on this cruise were mainly of the *mentella* type. On the Ritubank *mentella* and *marinus* were mixed. But on the NE Grand Bank exclusively *mentella* was found. On the SW and NE part of Flemish Cap the *marinus* type occurred again.

The size composition of the redfish was very uniform in all areas of Subdivisions 3K and 3L with the peak at 34-36 cm (Fig. 7). At the southernmost stations some larger fish (40-45 and 46-47 cm) were also caught.

At the Flemish Cap, the redfish were somewhat smaller. At the SW part of the bank, the 34-36 cm size groups are still dominant, but in the other areas the peak was at the 31-33 cm group (Fig. 8).

The size composition of the *marinus* type differed considerably from the *mentella* type and varied in different localities (Fig. 9).

III. Cruise.

The catch of redfish on this cruise was generally very poor, though good hauls were made at the Lille Hellefiske Bank off West Greenland with a maximum of 9 tons after 40 min. trawling. In the western part of the Davis Strait, the catch was especially poor.

The size composition of the redfish in the hauls taken on the banks off West Greenland differed much from haul to haul. Thus the peaks were formed by different size groups between 25 and 62 cm. The size of the redfish caught on the west side of the Davis Strait, however, was very uniform with the 35-40 cm size group dominating. The only exception was st. 4 where only small redfish were caught with the peak at 23-25 cm.

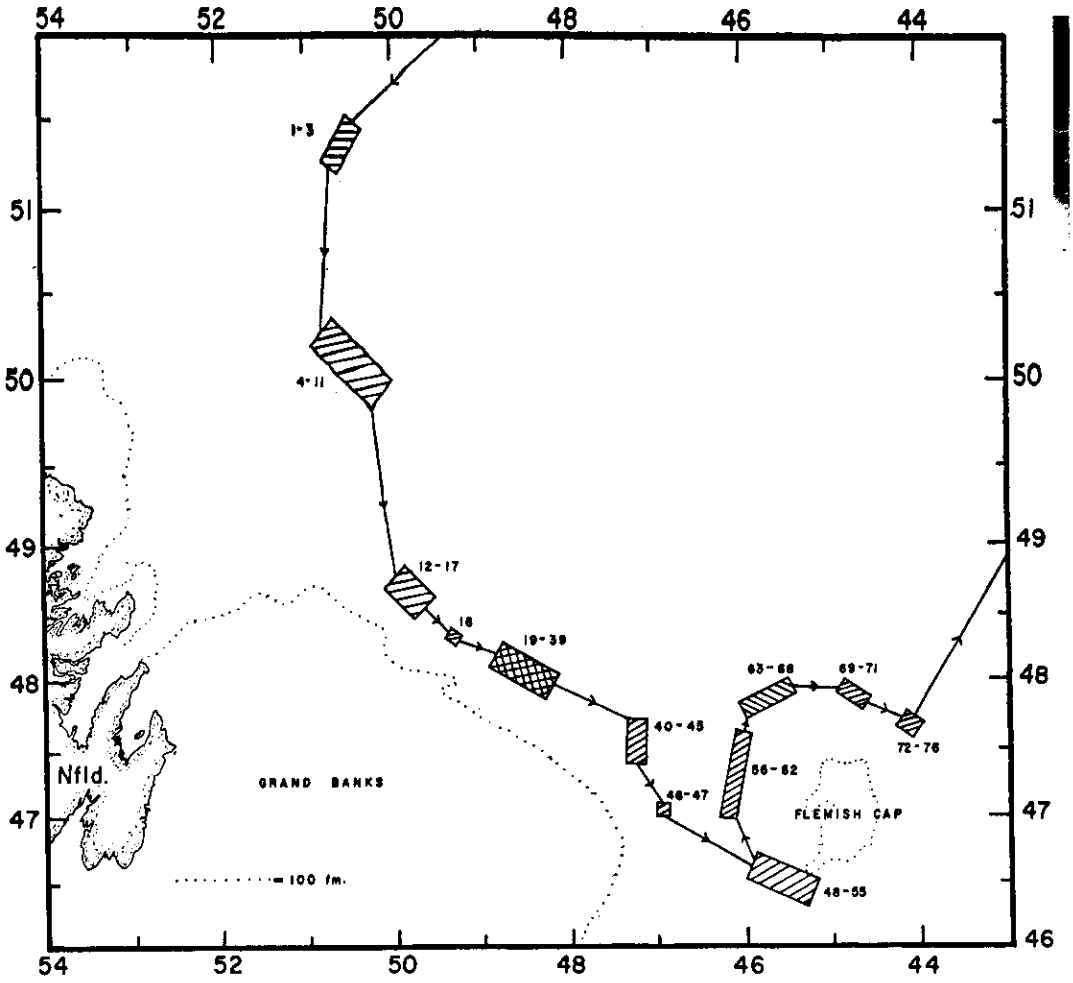

Fig. 6. Surveyed area, cruise II. Shaded rectangles indicate areas fished; double shading indicates areas with best results; the figures indicate serial numbers of hauls.

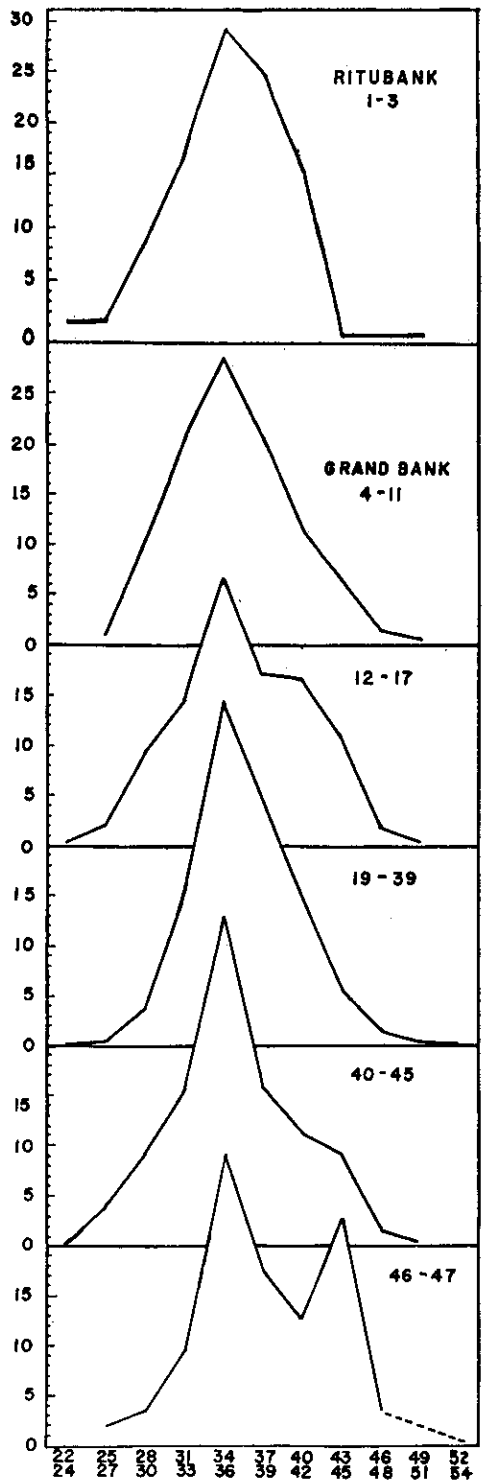

Fig. 7. Percentage length-distribution by 3 cm groups of redfish (*mentella*) at various stations (see Figure 6) in Subdivisions 3K and 3L.

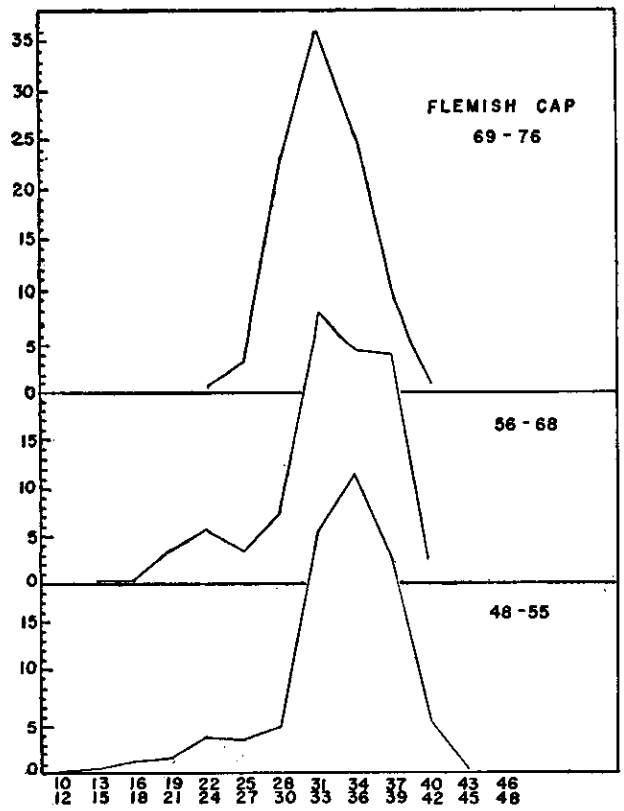

Fig. 8. Percentage length-distribution by 3 cm groups of redfish (*mentella*) at various stations (see Figure 6) in the Flemish Cap area (3M).

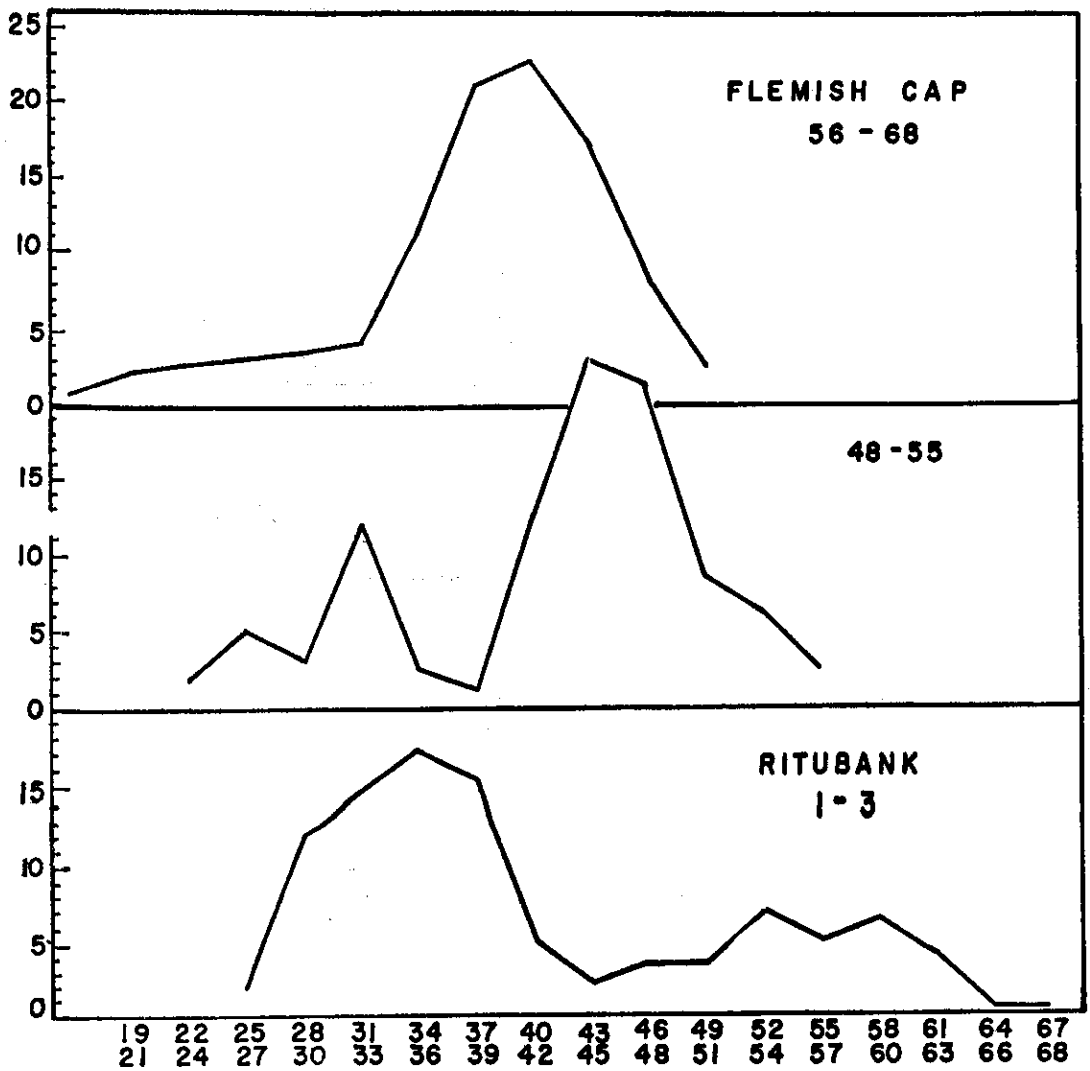

Fig. 9. Percentage length-distribution by 3 cm groups of redfish (*marinus*) in different areas (see Figure 6).

C. COD — BY JÓN JÓNSSON

In April 1959, the Icelandic trawler "Fylkir" was chartered for fisheries investigations in East Greenland waters. The purpose of this expedition was to investigate the spawning stock of cod, as our earlier observations had indicated a quite considerable spawning of cod in these waters. The trawling stations are shown on fig. 10.

Otoliths were taken from 1646 fish, a number of fish were measured and examined with regard to maturity. A total of 1050 cod were tagged, mainly with the Lea's hydrostatic tag.

Table I shows the state of maturity on the various stations off East Greenland—in April 1959.

TABLE I. State of maturity of the cod at East Greenland in April 1959, expressed in percentages of the total. For the stations see fig. 1.

No. of station	1–3	4	5–6	7	14	10	15	16
Immature	10.4	9.2	22.1	11.3	6.0	10.7	0.7	4.3
Maturing	80.4	81.6	56.5	69.1	56.1	55.3	51.3	17.1
Spawning	2.4	3.6	3.4	4.1	15.6	17.3	43.3	70.1
Spawned	6.8	5.6	17.9	15.5	22.4	16.7	4.7	8.5
Total investigated	337	250	262	291	487	150	150	234

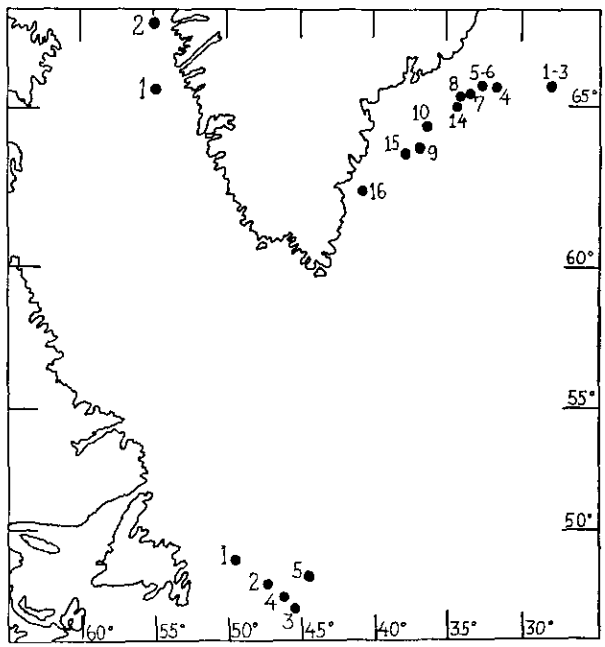

Fig. 10. Location of trawling stations from which cod samples were taken in 1959.

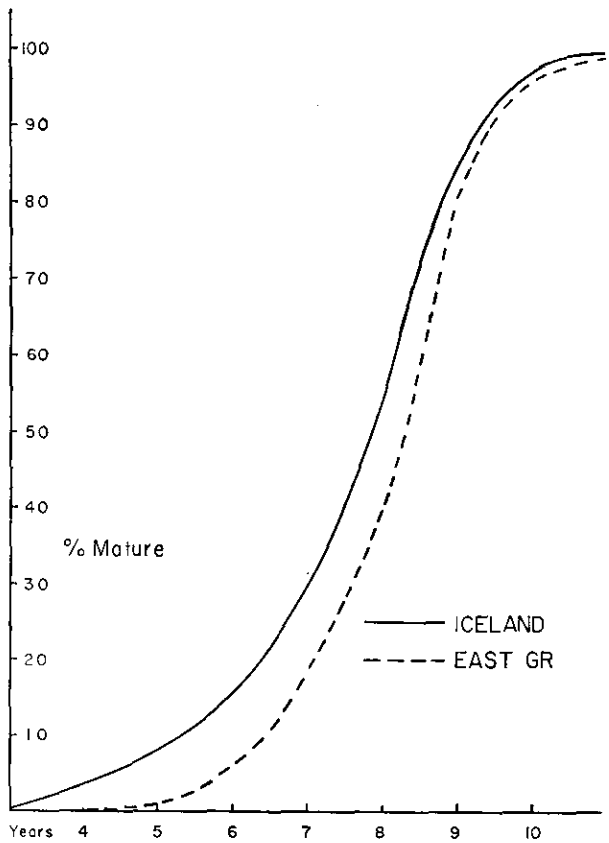

Fig. 11. Onset of maturity of the East Greenlandic and Icelandic stocks of cod; 1959 spawning season.

Spawning had hardly begun in the northern part of the area, but most of the fish had maturing gonads. The percentages of spawning fish increased southwards, with the highest figures on the southernmost stations, Fylkir Bank. Very high catches in this area indicated large concentrations of spawning cod. The bottom temperatures in 200 meters were 4.2° to 5.2°C.

Fig. 11 shows the onset of maturity of the East Greenland and Icelandic cod based on observations of the spawning zones in the otoliths of fish from the 1959 spawning season. The Icelandic cod mature as early as 3 years old and spawn for the first time as 4 years old. Only few East Greenlandic cod spawn before age 6.

The age-distribution of the cod from East-Greenland (Fig. 12) is fairly homogenous with the 1949, 1950 and 1951 year-classes predominating in all samples. On the three southernmost stations the 1947 and 1945 year-classes were still of importance.

Fig. 13 shows all the samples from East Greenland in April 1959 taken together as well as the age distribution of the spawning stock of cod on the Icelandic spawning grounds in the 1959 spawning season. The age distribution as a whole is strikingly uniform in both areas and

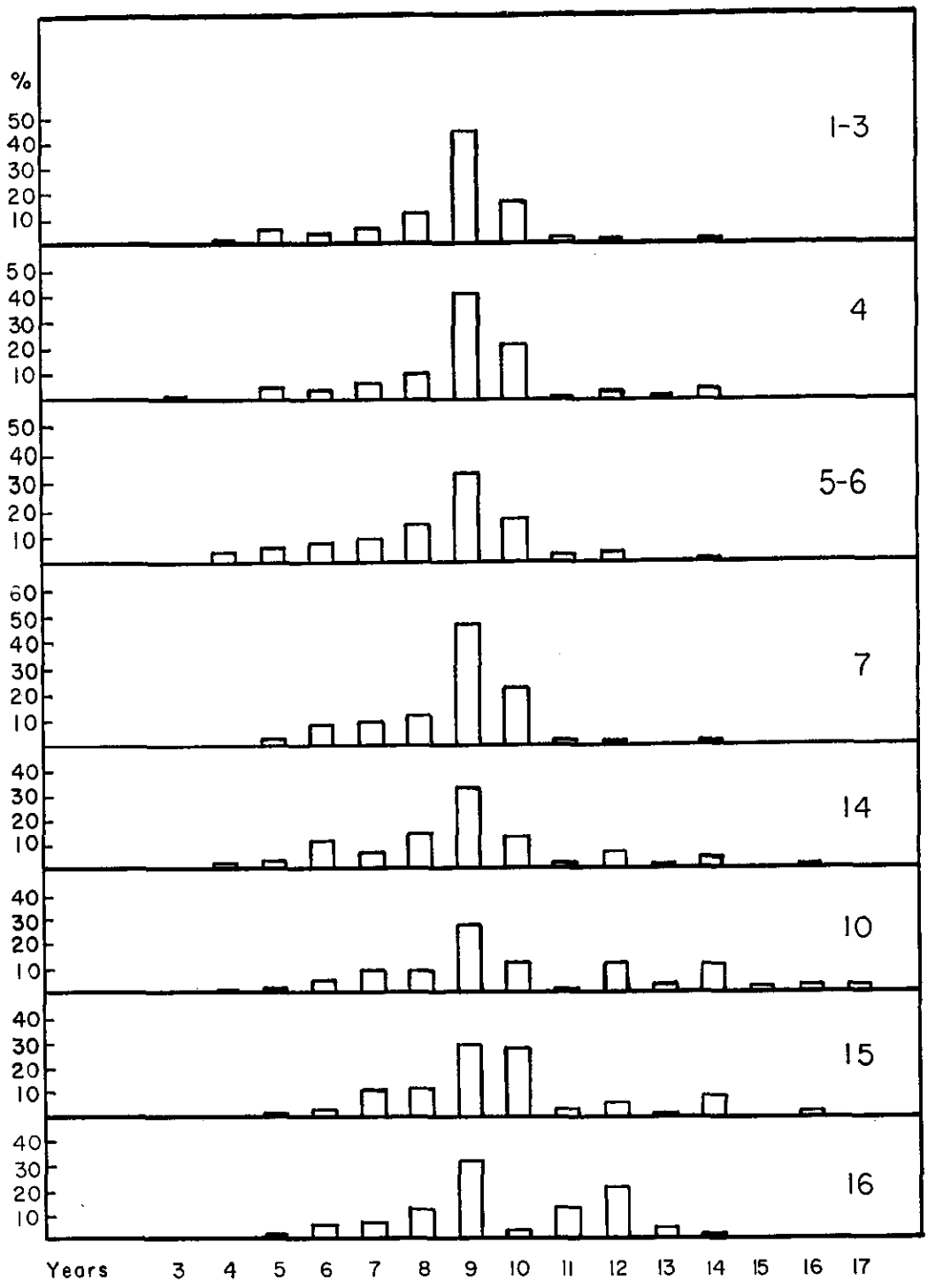

Fig. 12. Age-distribution of cod at East Greenland, April 1959. Location of stations (see Figure 1).

suggests a very close relationship between these two stocks.

A few samples of cod otoliths were collected from the cruises mentioned in dr. Magnússon's report.

Fig 14 shows the age distribution of two samples from the West-Greenland in early September 1959. Sample No. 2 from this area shows a great dominance of the 1953 year-class in conformity with our samples from this area in 1958. On the other hand sample No. 1 shows a dominance of the 1947 year-class.

The age distribution of the five samples from the Newfoundland area, 8.-14. July 1959, is shown in fig. 15. Samples 3, 4 and 5 show a clear cut dominance of the 1953 and 1954 year-classes.

Finally, the average lengths of the age-groups from these various areas are shown in Table II.

TABLE II

COD. 1959. Average sizes of the age-groups.

Age	Iceland spawn. season	East Greenland April	West Greenland Sample 2	Newfoundland Sample 3
3	55.1	44.4		
4	65.9	54.9	(58.0)	
5	75.1	63.1	67.6	53.0
6	83.5	69.1	69.8	57.6
7	86.5	74.3	74.7	62.3
8	89.7	77.8	80.0	62.8
9	90.4	80.4	79.1	64.7
10	92.5	82.8	(85.7)	68.2
11	97.4	82.8	(88.7)	
12	97.4	85.4	(87.3)	
13	100.2	78.7	(79.0)	

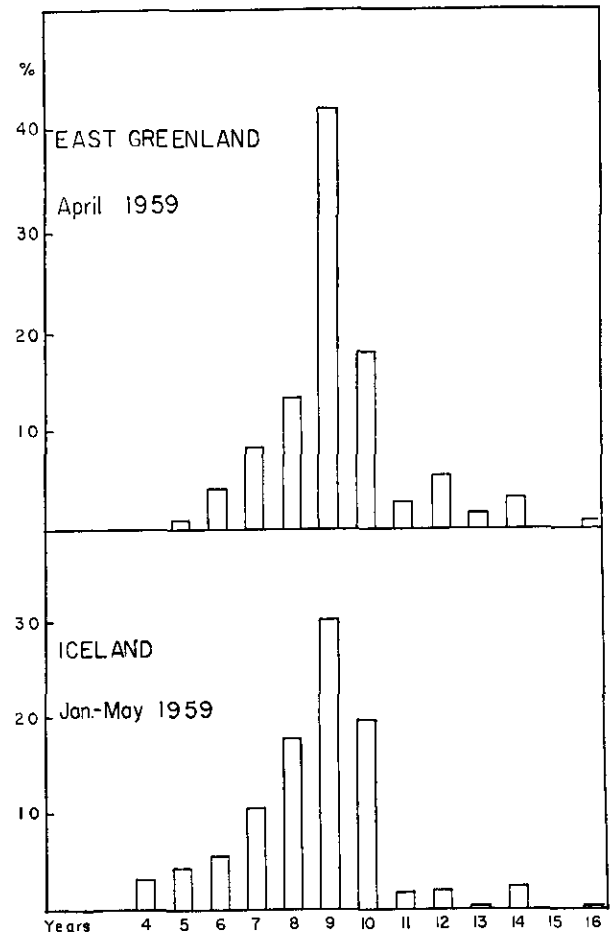

Fig. 13. Age-distribution of East Greenlandic and Icelandic spawning stocks of cod in 1959.

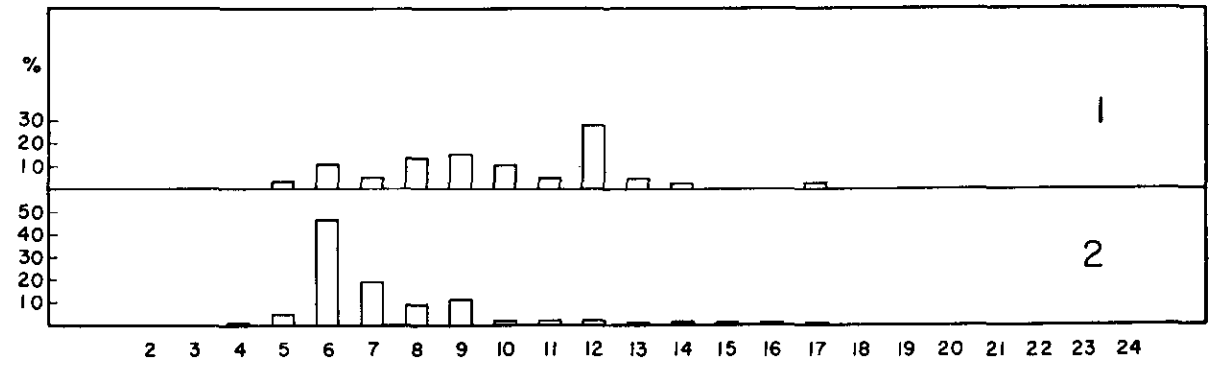

Fig. 14. Age-distribution of cod off W. Greenland. September 1959

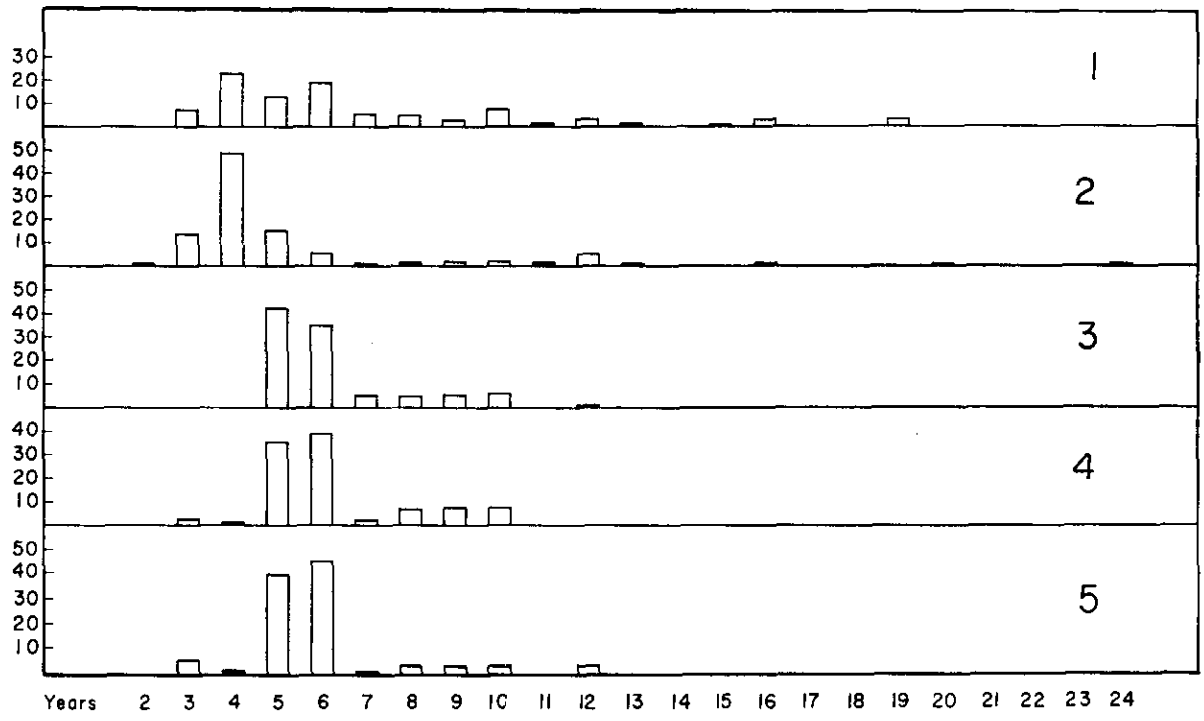

Fig. 15. Age-distribution of cod on the Newfoundland Bank. July 1959.

VI. Norway. Fisheries Investigations in Greenland Waters in 1959

BY ERLING BRATBERG

In 1959 Norwegian fishery research vessels made two cruises to Greenland waters.

The first cruise was with the research vessel "Johan Hjort" and started from Bergen March 31 and ended in Bergen April 30. The actual working days on the banks off West Greenland were between April 8 and April 22.

The second cruise took place with the research vessel "G.O. Sars" between June 26 and September 4. The main working area on this cruise was East Greenland waters from Cape Farewell to the Storfjord Deep, but between July 25 and August 15 fishery investigations also took place in West Greenland waters.

Figs. 1, 2 and 3 show the routes and stations of the two cruises.

West Greenland

Hydrography.

On the first cruise six hydrographical sections were taken between April 10 and 17 (Fig. 1). Temperature registrations were in addition made by means of a bathythermograph on all fishing stations. Figs. 4 to 9 show the isotherms in the sections.

The surface water is cold in all sections and of Arctic origin. This cold Arctic water, below 2°C, covers the bank tops and the upper slopes of the banks. On the southern banks we find the cold water deepest down, on the Noname Bank down to about 200 m. Further north, on the Banan Bank, the cold water penetrates only down to about 90 m. Below this cold layer is warmer water, more suitable for the cod.

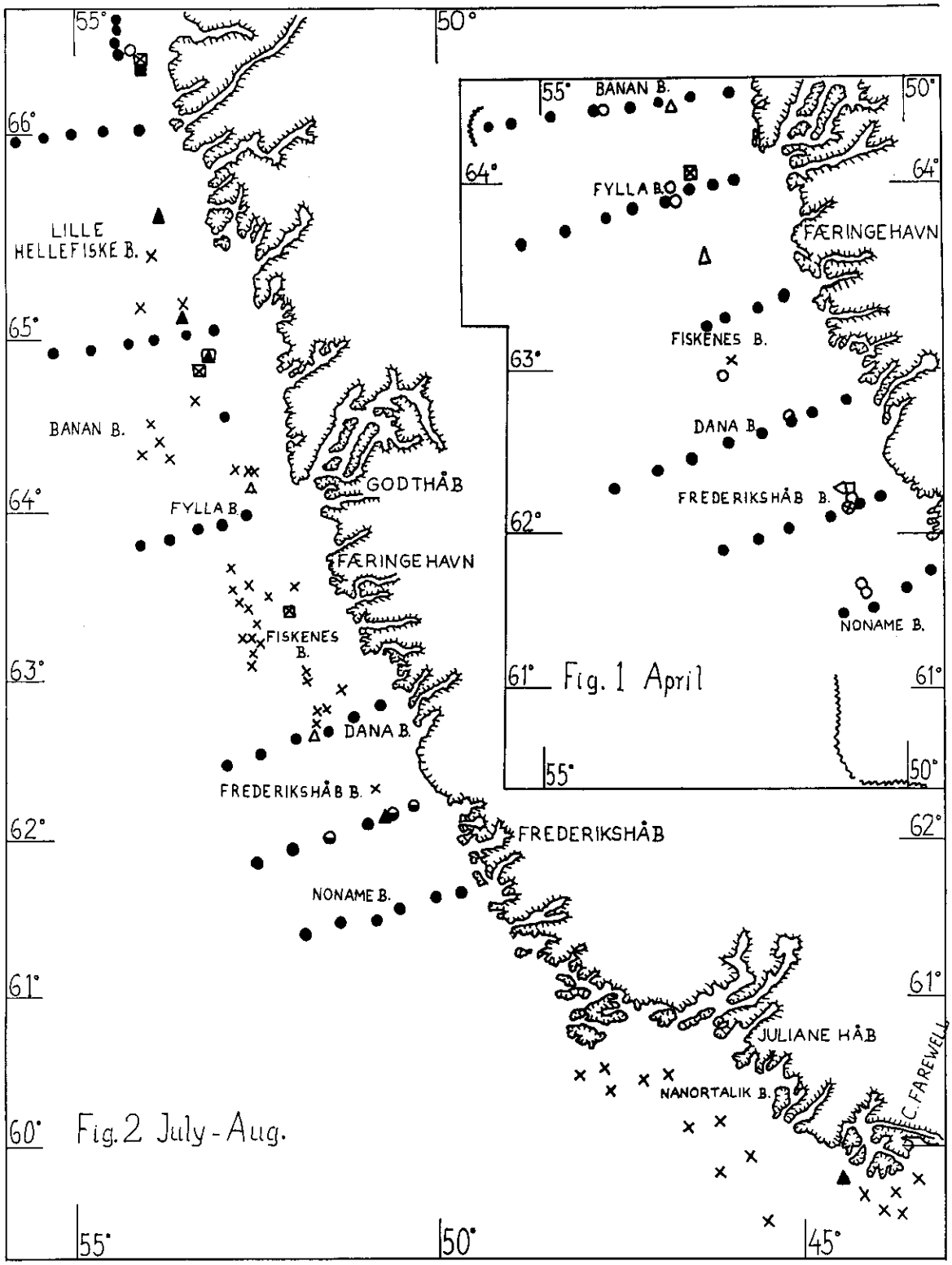

Fig. 1. "Johan Hjort", West Greenland, April 1959. Routes and stations. ● Hydrographic station, ○ Trawl st., △ Bottom long line st., × Bathy. st., □ Hand line st.

Fig. 2. "G. O. Sars", West Greenland, July-August, 1959. Routes and stations.

- ● Hydrographic st.
- ○ Trawl st.
- ◒ Hydr.-bathy. and plankton st.
- × Bathy. st.
- △ Bottom long line st.
- ▲ B.L. line and Bathy st.
- □ Hand line st.
- ■ Gill net st.
- ~~~ Pack Ice

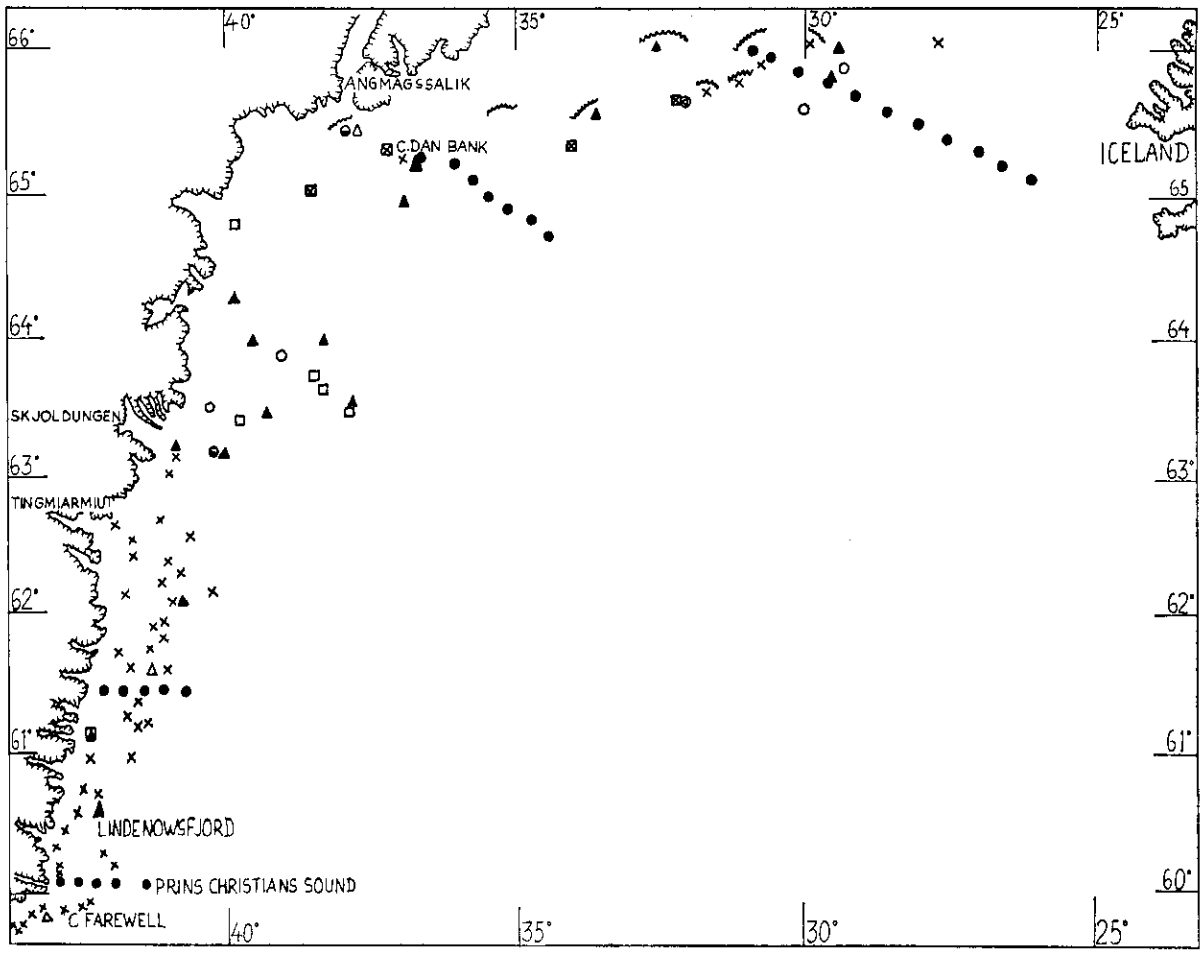

Fig. 3. "G. O. Sars", East Greenland, July-August 1959. Routes and stations.

- ● Hydrographic station
- ○ Trawl station
- ◒ Hydr. bathy. and plankton station
- × Bathy st.
- △ Bottom long line
- ▲ B. l. line and bathy st.
- □ Hand line st.
- ~~ Pack ice.

On the second cruise seven hydrographic sections were taken between July 27 and August 11 (Fig. 2). The isotherms in each section are shown in Figs. 10 to 16. The hydrographical situation at this season differs in some cases from the one in April.

The surface water is characterized in the south by two strong north-going currents, one of Arctic and one of Atlantic origin (Figs. 10-12). Here the cold water in late summer still covers the bank tops and the inshore slopes of the banks, while the deepgoing Atlantic water covers the offshore slopes of the banks. On the northern banks the situation has changed more between April and August (Figs. 13-16). Here the surface layer has not been so very much influenced by the Arctic water. Mixed water, with temperatures above 2°C, covers the tops of the banks, while on the western slopes we find a core of Arctic water with temperatures below 2°C. The origin of this water is probably the Labrador Current. Below this cold water Atlantic water again covers the bank slopes.

Cod Investigations.

In April no fish were registered with the echo sounder on the tops of the banks, except on Frederikshaab Bank and Fylla Bank where the bottom temperature was between 1° and 2°C. Samples of cod were taken here with handline. The cod were immature and comparatively small.

The mean lengths of the cod on these two banks were respectively 67.79 and 64.12 cm.

On the other hand shoals of fish, partly in heavy concentrations, were registered at the bottom on the western slopes of the banks. The depth varied from 200 to 450 m. The temperature was always 4°C or above. The catches, taken by bottom long line and trawls, consisted of cod and redfish. The redfish dominated in the trawl catches.

Nearly all the cod were sexually mature. Some were already spent but most of them were ready for spawning. A few had flowing milt or roe (just extruding).

The sampled material shows that the cod can spawn on all the banks, from the Noname Bank in the south to the Banan Bank in the north. The spawning probably starts first on the northern banks. Almost all the mature cod from the Banan Bank had completed the spawning and the percentage of spent cod decreased on the other banks from north to south. The spawning temperature seems to have a lower limit at 4°C.

Fig. 17 shows the length distribution of the cod caught with various types of gear on the different banks. The curves hardly give an exact, but at least a rough picture of the length distribution of the cod population at this time of the year. In spite of the different selectivity of the fishing gears used it seems safe to conclude that (1) relatively small fish dominate the population, and (2) the mean length of the cod decreases from south to north.

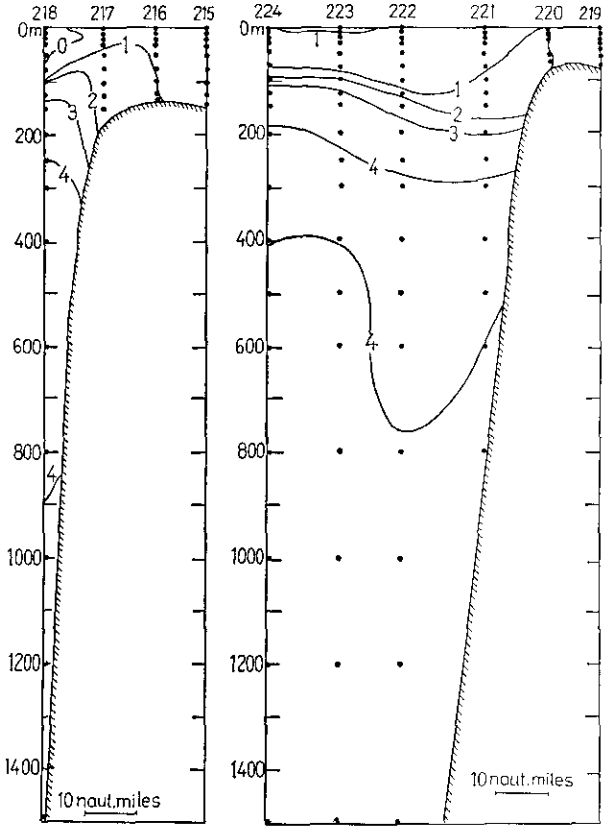

Fig. 4, left. "Johan Hjort", West Greenland, April 1959. Temperature section from Noname Bank—westward.

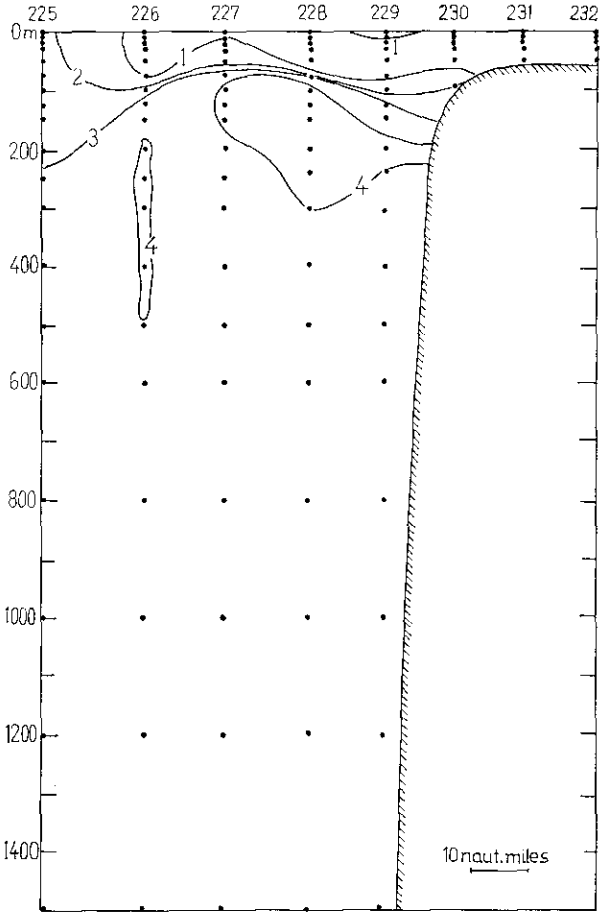

Fig. 5, right. "Johan Hjort", West Greenland. April 1959. Temperature section from Frederikshaab Bank—westward.

Fig. 6. "Johan Hjort", West Greenland, April 1959. Temperature section from Danas Bank—westward.

The length distribution of the total catch of cod taken with hand line and bottom long line is shown in Fig. 18. The mean length is relatively small, viz. 69.69 cm.

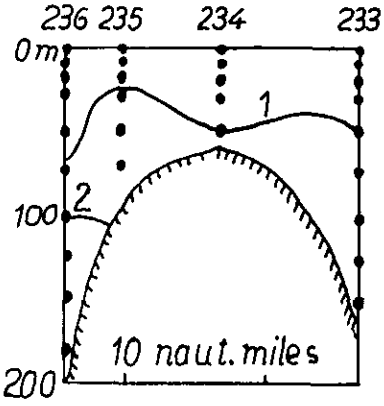

Fig. 7. "Johan Hjort". **West Greenland, April 1959. Temperature section across Fiskenes Bank—westward.**

In Fig. 19 the age composition of the cod is shown in a similar manner, based on the total catch with hand line and bottom long line. A new year-class, 1953, dominates the total catch. This year-class is, however, not as strong as indicated by the figure; the relatively large catches of immature cod from Frederikshaab Bank and Fylla Bank influence the picture too much.

The registrations with echo sounder, and the results of the fishing experiments on the cruise in July-August, showed that the distribution of cod in 1959 was almost the same as in previous years. Very few cod were found on the southern banks, even in localities with favourable temperatures.

The first good concentration was located in the middle part of Lille Hellefisk Bank. Really good concentrations were found in the northern part of Lille Hellefisk Bank, where the cod was

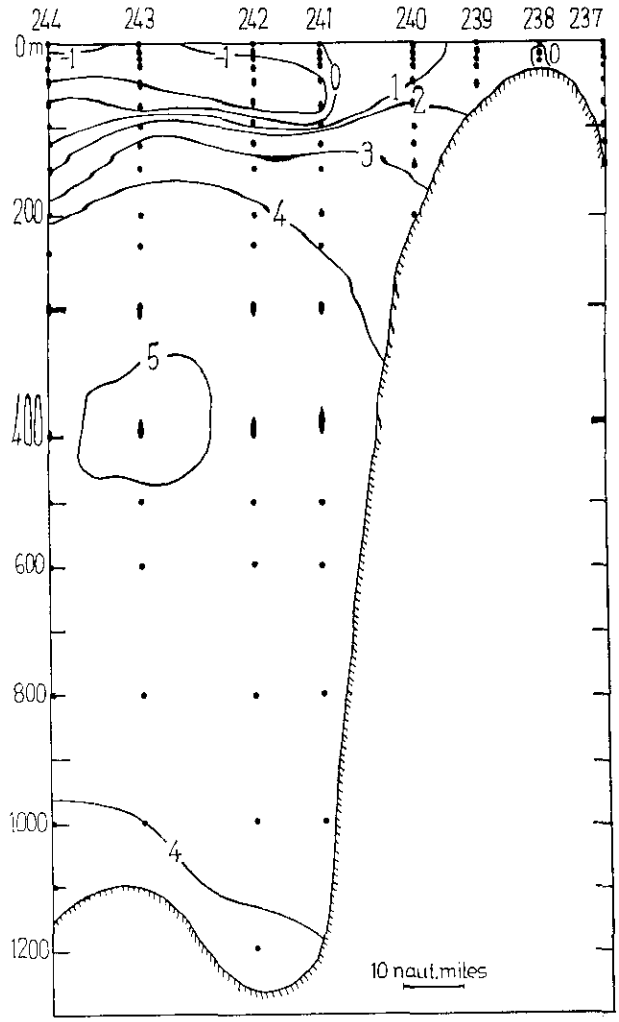

Fig. 8. "Johan Hjort," **West Greenland, April 1959. Temperature section from Fylla Bank.—westward.**

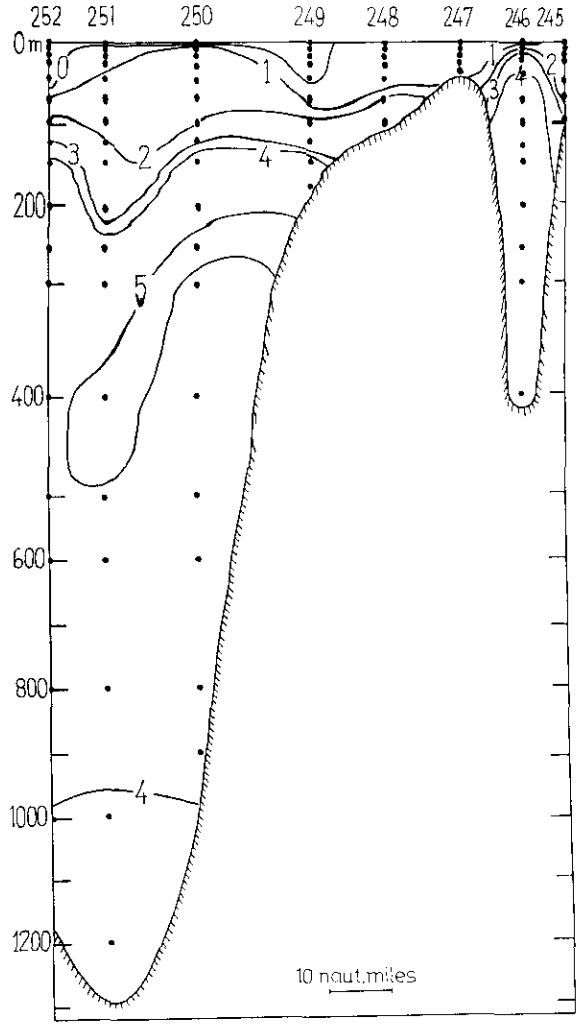

Fig. 9. "Johan Hjort", **West Greenland. April 1959. Temperature section from Banan Bank—westward.**

feeding heavily on sand eels and capelin. Here the cod were standing near the bottom. No pelagic shoals of cod were found in the Holsteinsborg Deep in spite of great concentrations of sand-eels and capelin in the intermediate water layers where also the temperature conditions were favourable.

Fig. 20 shows the length distribution of cod in the total long line and hand line catches on the banks. We still notice that to some degree the mean length of the cod shows a decrease from south to north. Exceptions are the samples from the Cape Farewell region and Fiskenes Bank. On Lille Hellefisk Bank, where the good concentrations were found, there is a very marked variation in the mean lengths. The cod in the catches from the middle part of the bank has a mean length of 74.91 cm while the mean length on the northern part of the bank is 67.30 cm. The mean length of all samples of cod off West Greenland is 72.22 cm.

The age composition of all cod taken by hand line and bottom long line in July-August is shown in Fig. 21. The picture differs from the one obtained in April and probably gives a more true impression of the factual age composition.

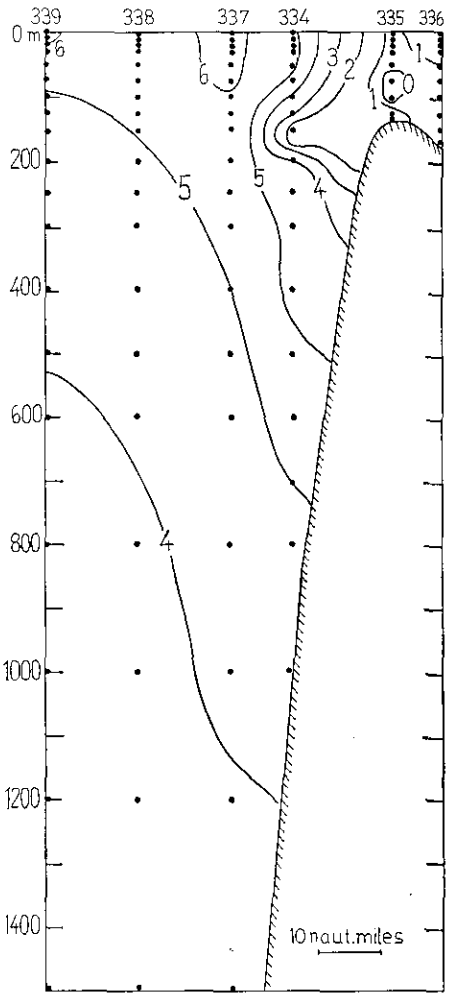

Fig. 10. "G. O. Sars", West Greenland. July 1959. Temperature section from No-name Bank—westward.

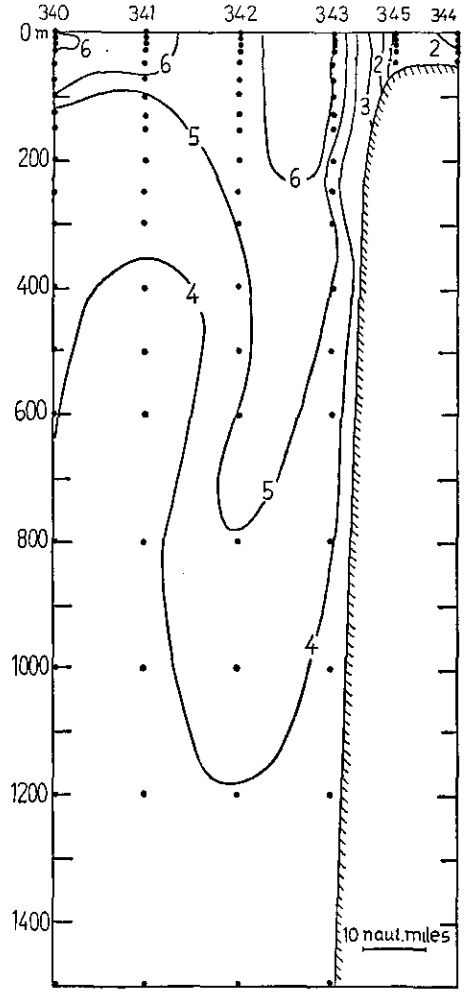

Fig. 11. "G. O. Sars", West Greenland. July 1959. Temperature section from Frederikshaab Bank—westward.

The 1953 year-class with an overall mean length of 66.17 cm is for the present not so very strong in the hook- and line catches, which are still influenced very much by the 1950 and 1957 year-classes.

Comparing with the 1958 catch, both the 1947 and the 1950 year-class have diminished in strength. The number of fish belonging to the 1953 year-class will probably increase in the hook- and line catches next year. On the other hand the mean length of the fish in the catches is expected to decrease still more due to the increase of the 1953 year-class and the decrease of the 1947 and 1950 year-classes.

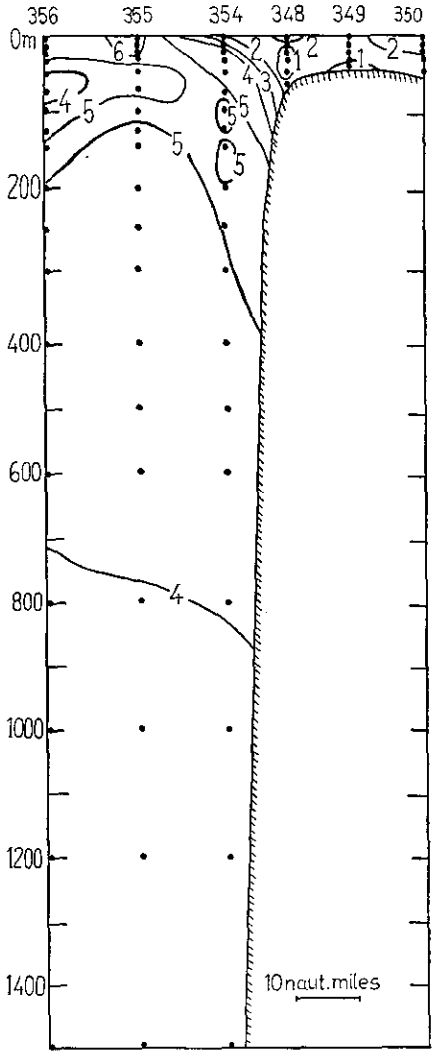

Fig. 12. "G. O. Sars", West Greenland, July 1959. Temperature section from Danas Bank—westward.

East Greenland

Hydrography.

In East Greenland waters four hydrographical sections were taken (Fig. 3). Temperature registrations were made by means of bathythermograph on all fishing stations and in other localities. Figs. 22-25 show the isotherms in the sections.

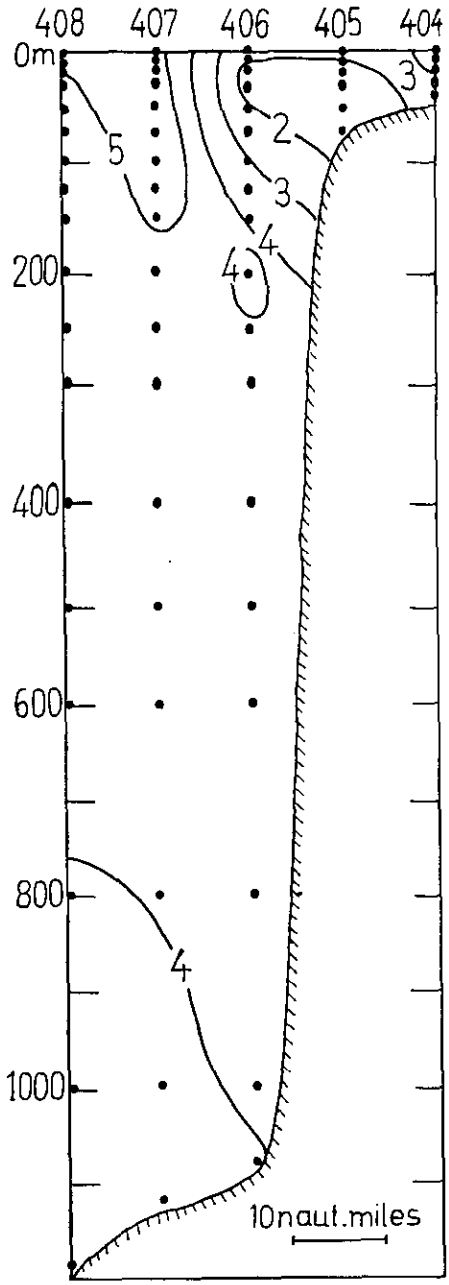

Fig. 13. "G. O. Sars," West Greenland, August 1959. Temperature section from Fylla Bank—westward.

The water masses off the coast of Southeast Greenland are marked by two parallel west- and southwestgoing currents: the western of Arctic origin (the East Greenland Polar Current), the eastern of Atlantic origin (a branch of the Irminger Current). The cold Arctic water does not, at this time of the year, penetrate to any great depth. Only in few localities we find the 2°C isotherm below 125-150 m. In other words, temperatures suitable for the occurrence of fish are found nearly all over the investigated area.

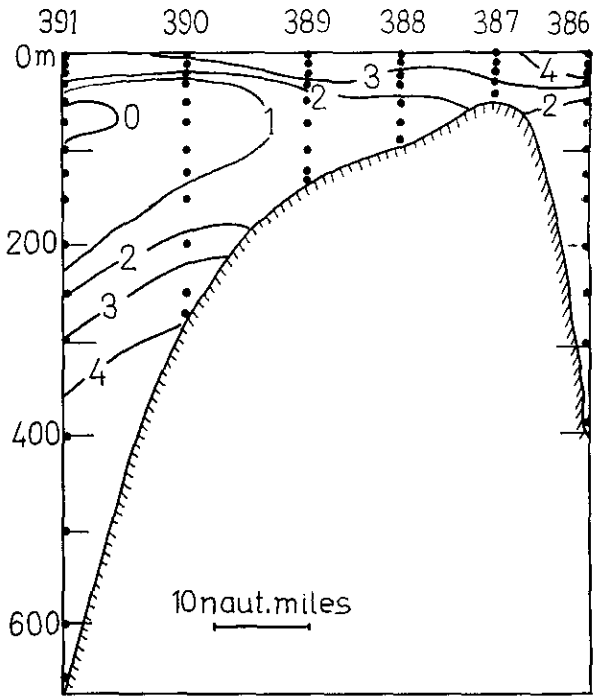

Fig. 14. "G. O. Sars", West Greenland. August 1959. Temperature section from the middle part of Lille Hellefisk Bank—westward.

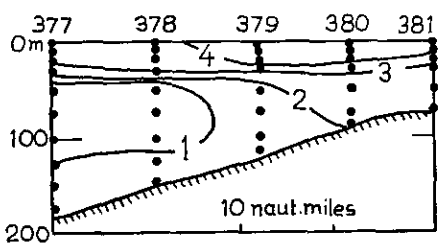

Fig. 15. "G. O. Sars", West Greenland, August 1959. Temperature section from the northern part of Lille Hellefiske Bank—westward.

Only the highest peaks of some banks, and the upper part of the slope of the coastal shelf, are covered by water with temperatures unfavourable for commercial species of fish.

Cod Investigations.

In Tables 1 and 2 are listed the bottom long line stations and the hand line stations. From the tables it will be seen that only in few localities a complete absence of cod was noted. Good concentrations of cod were found in some localities. Two areas with good concentrations of saithe (*Gadus virens* L.) were encountered during hand and line fishing, one at 63°33′N - 37°50′W, and another as far north as 65°40′N - 32°02′W. Furthermore a good concentration of haddock (*Melanogrammus aeglefinus* (L.)) was found by bottom long line fishery at 62°04′N - 40°43′W. Finally a very few haddock were taken on hand lines, one individual on a locality 63°10′N - 40°04′W, and two individuals at another, a little more northern, locality, 63°29′N - 39°18′W.

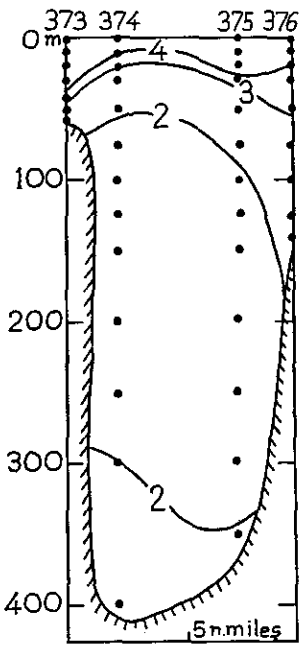

Fig. 16. "G. O. Sars", West Greenland. August 1959. Temperature section across Holsteinsborg Deep approximately from North to South.

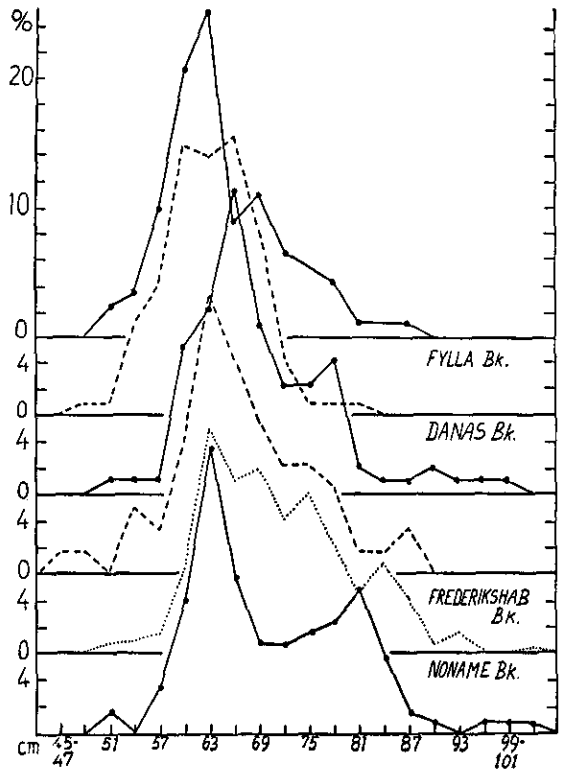

Fig. 17. "Johan Hjort", West Greenland, April 1959. Cod. Length distribution, total catch on the different banks.
———=Trawl, - - - - -=Hand line,
.....Bottom long line.

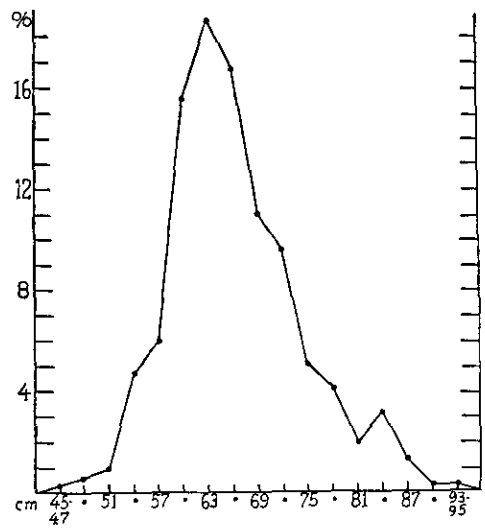

Fig. 18. "Johan Hjort", West Greenland, April 1959 Cod. Length distribution. Total catch, hand line + bottom long line.

On the Cape Dan Bank, August 26-28, the concentrations of cod were much larger than indicated by Table 1. We had the impression that the cod would not take the bait. Trawling in the same locality gave reasonably good catches.

Fig. 26 (p. 79) shows length distribution of all cod taken on bottom long lines off the coast of East Greenland. The mean length is 86.07 cm. In other words, the cod has the proper commercial size for Norwegian long line fishermen.

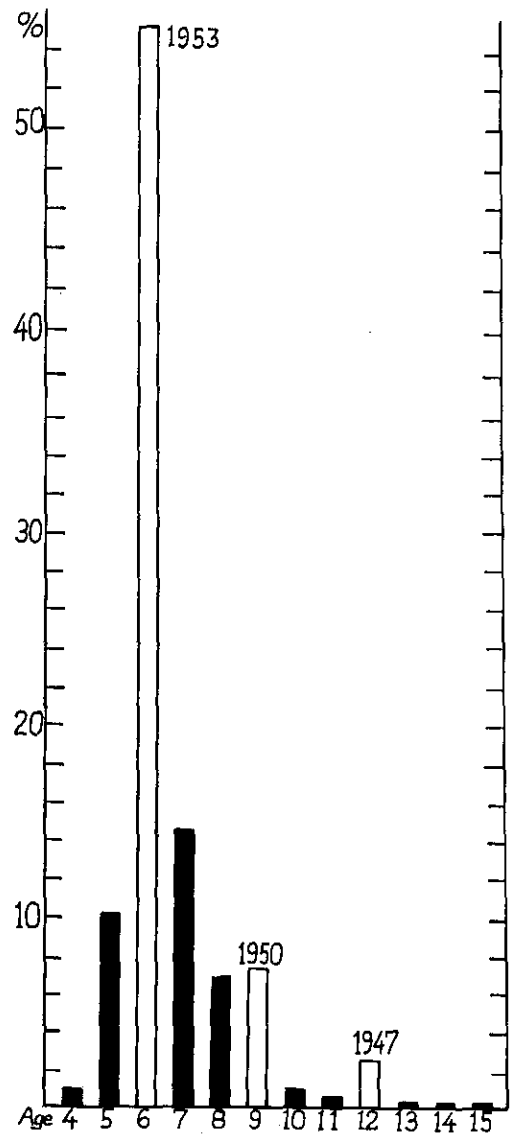

Fig. 19. "Johan Hjort", West Greenland, April 1959. Cod. Age composition. Total catch hand line and bottom long line.

Fig. 27 shows the age composition of cod taken by hand line and bottom long line, and Fig. 28 the age composition of cod taken by trawl. The 1947 and 1950 year-classes dominate the hand line and bottom long line catches. Generally all the cod are of relatively high age, between 9 and 14 years. In contrast to West Greenland the 1953 year-class does not appear to have any strength in the hand line and bottom long line catches off Southeast Greenland.

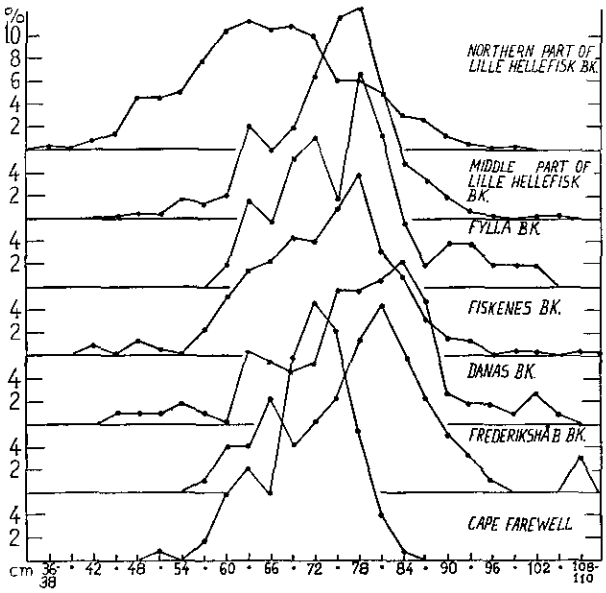

Fig. 20. "G. O. Sars", West Greenland, July-August 1959. Cod. Length distribution. Total Catch on the different banks.

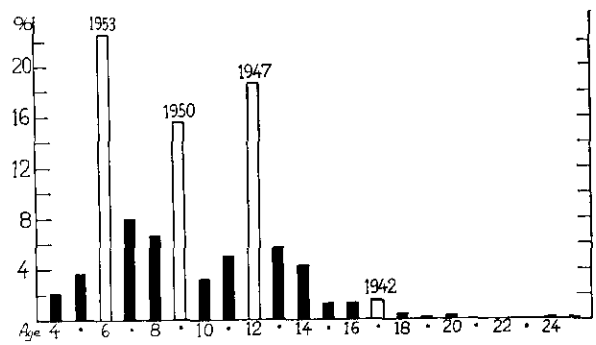

Fig. 21. "G.O. Sars", West Greenland, July-August 1959. Cod. Age composition, total catch hand line and bottom long line.

The age composition of the cod taken by trawl on the Cape Dan Bank is different. Here all the year-classes between 1949 and 1953 are relatively strong, and the 6-10 year old fish belonging to these five year-classes constitute most of the catch.

Tagging Experiments.

Tagging of cod and halibut in West Greenland waters was continued in 1959. 392 cod were tagged with Lea tags and 229 with yellow plastic disks. A total of 123 halibut were tagged off West Greenland.

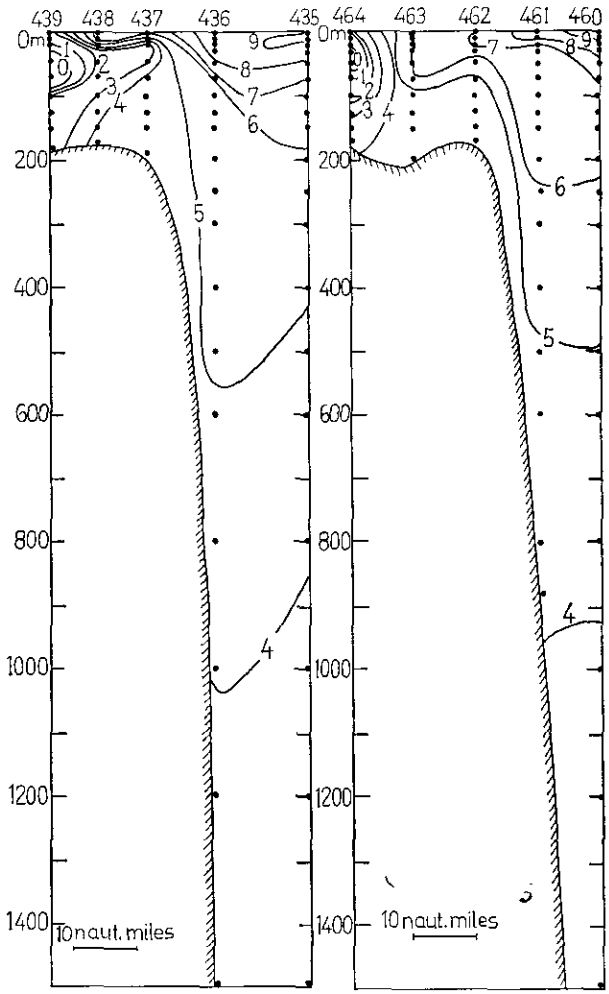

Fig. 22 left. "G. O. Sars", East Greenland. August 1959. Temperature section from Prins Christians Sound—eastward.

Fig. 23 right. "G. O. Sars", East Greenland. August 1959. Temperature section. from Cape Tordenskjold eastward.

In East Greenland waters tagging experiments were started in 1959. A total of 617 cod were tagged, 307 with Lea tags and 310 with plastic disks. Besides 99 halibut were marked with yellow plastic disks in the gill cover.

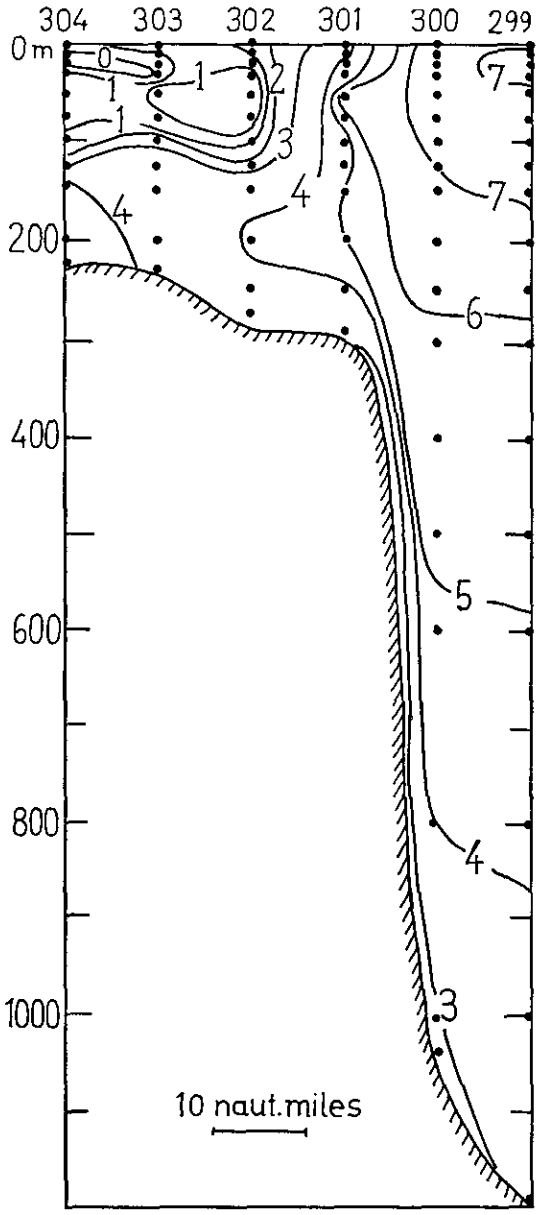

Fig. 24. "G. O. Sars", East Greenland. July 1959. Temperature section from Angmagssalik—eastward.

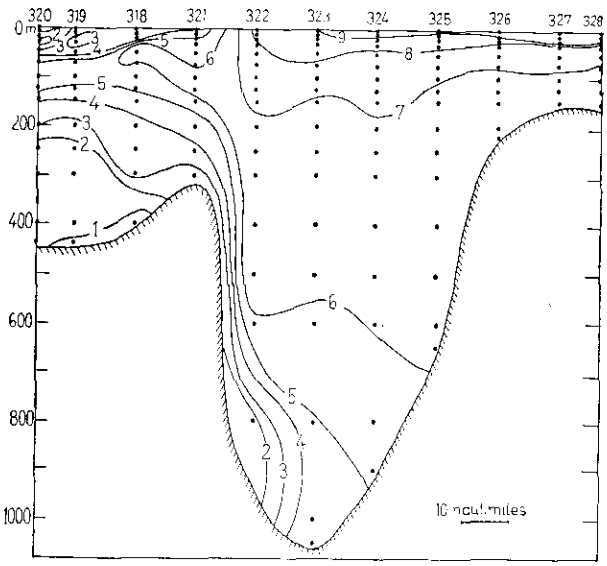

Fig. 25. "G. O. Sars", East Greenland. July 1959. Temperature section across the southern part of Denmark Strait.

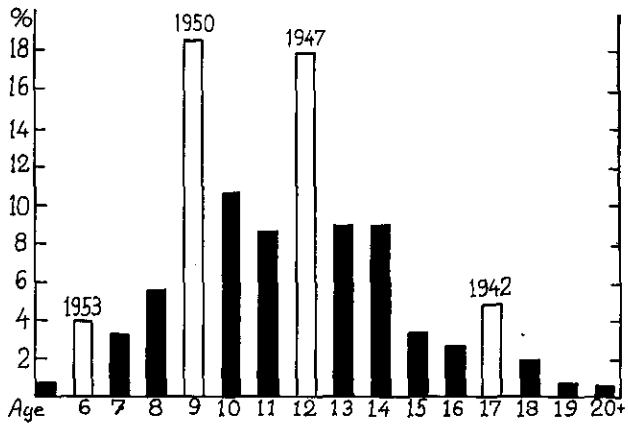

Fig. 27. "G. O. Sars", East Greenland, July-August 1959. Cod. Age composition, total catch hand line and bottom long line.

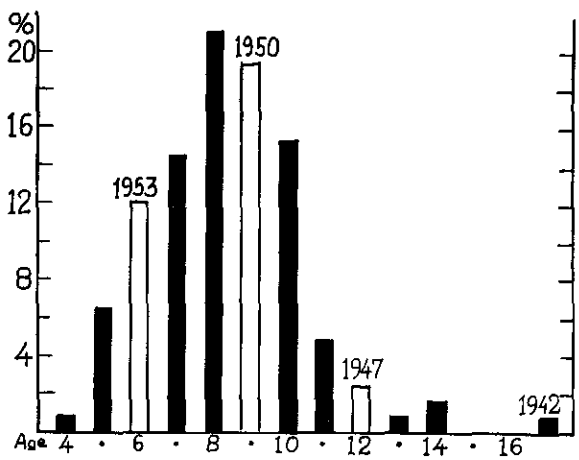

Fig. 28. "G. O. Sars", East Greenland, August 1959. Cod. Age composition, trawl. Cape Dan Bank.

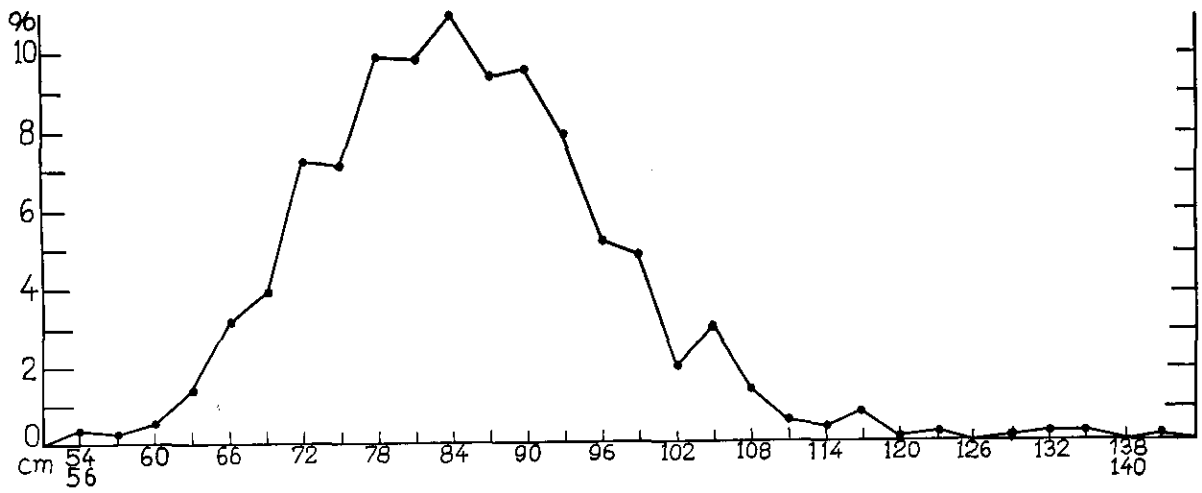

Fig. 26. "G. O. Sars", East Greenland, July-August 1959. Length distribution, total catch, bottom long line.

TABLE 1. "G. O. Sars." East Greenland, July-August 1959. Bottom long line stations.

Date	Position		Depth (m)	Number of hooks	Bottom Temp. 0°C.	Catch in number of fishes				
						Cod	Had-dock	Hali-but	Red-fish	Tusk
1/7	N63°10′	W40°04′	320	2000	4.86	16	0	2	9	78
2/7	N63°29′	W39°18′	250	2000	5.1	34	0	4	12	171
3/7	N63°33′	W37°50′	200	2000	4.5	58	0	25	5	66
4/7	N63°59′	W38°23′	250	1800	4.5	15	0	2	3	60
6/7	N64°58′	W36°58′	230	2000	4.9	49	0	0	2	64
7/7	N65°35′	W33°30′	270	2000	3.0	156	0	0	0	20
8/7	N65°40′	W31°54′	250	2000	5.0	207	0	2	1	6
9/7	N66°02′	W32°31′	285	2000	2.89	55	0	1	0	14
10/7	N66°02′	W29°27′	315	2000	0.89	Part of gear lost				
11/7	N65°50′	W29°39′	350	2000	2.77	Gear lost				
23/7	N64°18′	W39°55′	200	2000	3.6	64	0	11	0	3
23/7	N63°58′	W39°32′	240	1200	4.5	36	0	3	0	54
15/8	N59°49′	W43°11′	170	2040	2.9	87	0	7	0	0
17/8	N60°37′	W62°07′	190-200	2040	4.6	15	0	9	18	9
18/8	N61°07′	W42°20′	180	2040	3.0	86	part of	5	gear lost	
19/8	N61°35′	W41°15′	200	1600	4.5	21	0	17	33	22
20/8	N62°04′	W40°43′	165	1800	3.2	92	54	63	25	0
23/8	N63°13′	W40°48′	240	1800	4.2	82	0	2	0	0
26/8	N65°13′	W36°32′	200	1800	3.0	163	0	4	0	1
27/8	N65°13′	W36°39′	210	1800	3.1	39	0	1	0	0
28/8	N65°16′	W36°47′	190	1800	3.1	57	0	3	0	0

TABLE 2. "G. O. Sars." East Greenland, July-August 1959. Hand line stations.

Date	Position		Depth (m)	Number of hand lines	Time fished (min)	Bottom Temp. 0°C.	Catch in number of fishes				
							Cod	Had-dock	Red-fish	Saithe	Other fishes
1/7	N63°10′	W40°04′	320	4	120	4.86	0	1	20	0	1
2/7	N63°25′	W39°45′	240	4	45	5.8	5	0	0	0	0
2/7	N63°29′	W39°18′	250	4	150	5.1	2	2	9	0	4
3/7	N63°39′	W38°21′	210	3	20	4.5	1	0	1	0	0
3/7	N63°44′	W38°27′	250	4	15	4.5	0	0	1	0	0
3/7	N63°30′	W37°51′	200	2	20	4.5	0	0	0	0	0
3/7	N63°33′	W37°50′	210	4	150	4.5	5	0	0	23	0
6/7	N65°14′	W36°08′	230	4	30	4.07	15	0	1	0	0
6/7	N65°19′	W37°15′	180	4	70	4.5	5	0	0	0	0
6/7	N64°58′	W36°58′	230	4	200	4.9	3	0	20	0	0
7/7	N65°22′	W33°56′	250	3	40	2.9	0	0	1	0	0
8/7	N65°40′	W32°02′	240	4	60	5.0	2	0	0	33	0
22/7	N65°26′	W37°49′	170	4	180	3.3	45	0	0	0	0
22/7	N65°04′	W38°34′	170	4	40	3.9	38	0	0	0	0
23/7	N64°50′	W39°54′	200		25		Good catch				
25/7	N59°41′	W43°22′	200	3	15		3	0	0	0	0
18/8	N61°07′	W42°20′	180	4	120	3.0	68	0	0	0	0
19/8	N61°19′	W41°34′			30		0	0	0	0	0
19/8	N61°35′	W41°15′	200	3	120	4.5	1	0	70	0	0
26/8	N65°13′	W36°32′	200	2	60	3.0	15	0	0	0	0

VII. Portuguese Research Report, 1959

BY MARIO RUIVO AND GLICINIA QUARTIN

The present report summarizes the results of sampling carried out aboard Portuguese cod fishing vessels in Subareas 1 (Greenland), 3 (Newfoundland) and 4 (Misaine and Banquereau) during the 1959 fishing campaign.[1]

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

Further, the possibility of using the extent of parasitization of cod by copepods (*Clavella*, *Caligus* and *Lernaeocera*) as natural marks has been studied, with the purpose of identifying stocks and populations.

In May 1959, 250 drifters made of plastic were released for the study of surface currents along a line from the central part of the Grand Bank to Cape Race.

A number of preliminary data on selectivity experiments with hooks used by dories off W. Greenland have been collected for further study.

1. Observations on the Cod (*Gadus morhua*) in Subarea 1 (Greenland)

A total of 59 samples (19 from trawlers and 40 from dory-fishing vessels) were collected. The samples comprised about 10,000 individuals; otoliths for age-determinations were taken from 3,400 of these cod.

The samples are, for each subdivision, grouped according to gear and month of capture (Table 1, Figure 1); in cases where the samples differ considerably no such grouping was made.

[1]) The data from the samples considered in this report, will be published in tabular form in the Sampling Yearbook for 1959.

TABLE 1. Cod, Subarea 1, 1959. The distribution of samples within the sample groups A-Z. *—otoliths sampled.

Sample Group	No. of Samples	Subdivision	Date	Gear
A*	1,2	1D	25/26-IV-59	Trawl
B*	4,5	1D	2/3-V-59	,,
C*	7,13,15,16	1E	11/25-V-59	,,
D	3	1D	28-IV-59	,,
E	8,12,18	1E	12/27-V-59	,,
F*	20,21,22	1D	2/4-VI-59	Line
G*	23,25	1D	7/10-VI-59	,,
H*	27,28.35,36	1C	16/28-VI-59	,,
I*	30,32,34	1B	20/25-VI-59	,,
J*	37,38,40	1B	2/5-VII-59	,,
L*	41,42	1C	8/9-VII-59	,,
M*	43,44,46	1D	13/16-VII-59	,,
N*	50,52,53	1B	10/13-VIII-59	,,
O*	55,57	1C	17/20-VIII-59	,,
P*	59	1D	24/VIII-59	,,
Q	24,26	1D	8/11-VI-59	,,
R	31	1B	21-VI-59	,,
S	39	1B	4-VII-59	,,
T	45,48	1D	15/19-VII-59	,,
U	51,54,58	1B	11/21-VIII-59	,,
V	56	1C	19-VIII-59	,,
W	60.61	1C	14/15-VII-59	,,
X	62,63,64,65	1B	18/30-VII-59	,,
Y	66,67,68,69	1B	8/11-VIII-59	,,
Z	70	1D	24-VIII-59	,,

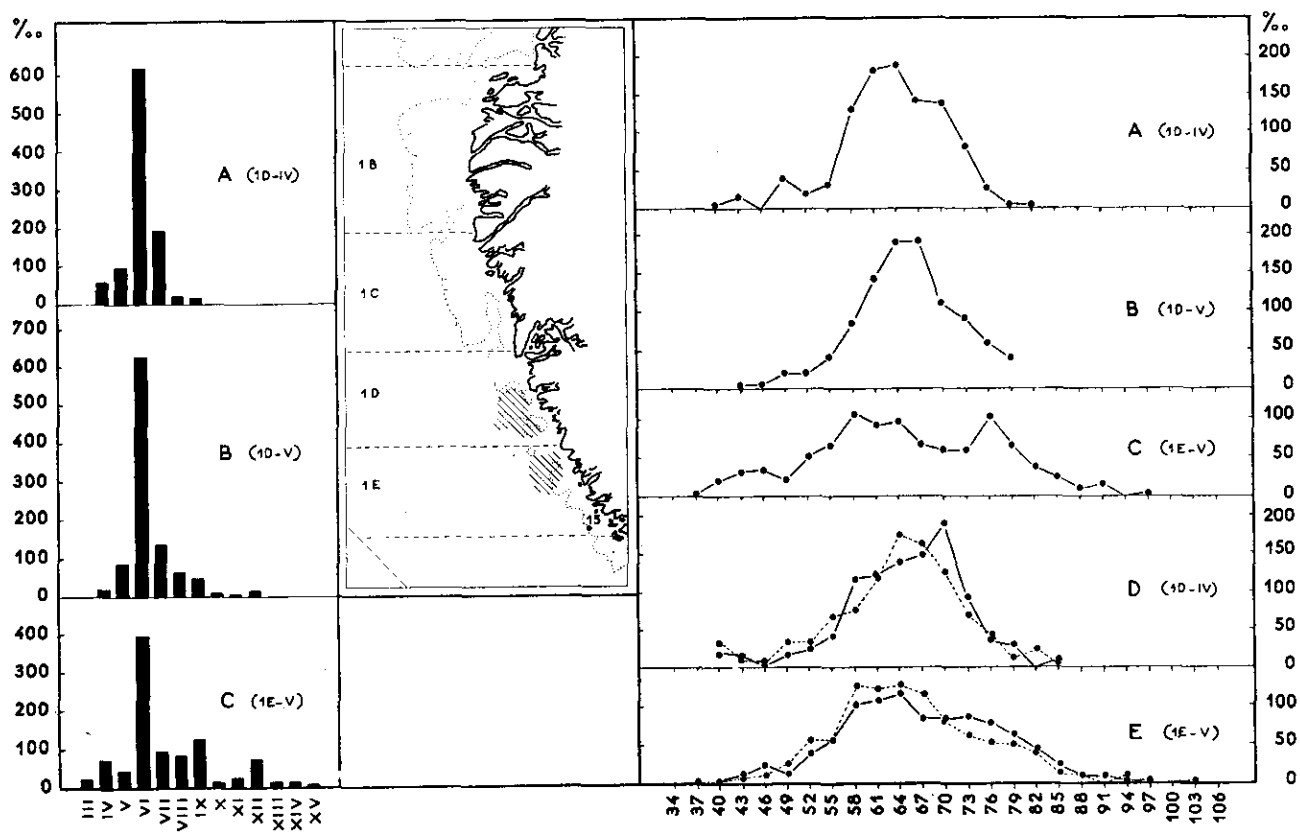

Fig. 1. Cod, Subarea 1, 1959. Age- and length-distribution (in °/₀₀) of samples from trawlers. Left—age; centre—position of samples; right—length-distribution.

1. Age Composition.

(a) **Trawlers (April-May,** Figure 1).

In Subdivision 1D (April-May, sample groups **A** and **B**) a clear predominance of age groups VI (600°/₀₀) and VII (150-200°/₀₀) was observed. The remaining age-groups were represented by less than 100°/₀₀), the V-group being the best represented (90°/₀₀).

In Subdivision 1E (May, sample group **C**) the age composition was different; the VI-group was also here the predominating (400°/₀₀), but it was followed by the Group IX (125°/₀₀) and Group VII (100°/₀₀). It should be noted that the XII-and IV- groups were represented by 70°/₀₀.

(b) **Dory Vessels (June-August,** Figure 2).

In Subdivision 1B (June-August, sample groups **I, J, N**) an absolute predominance of

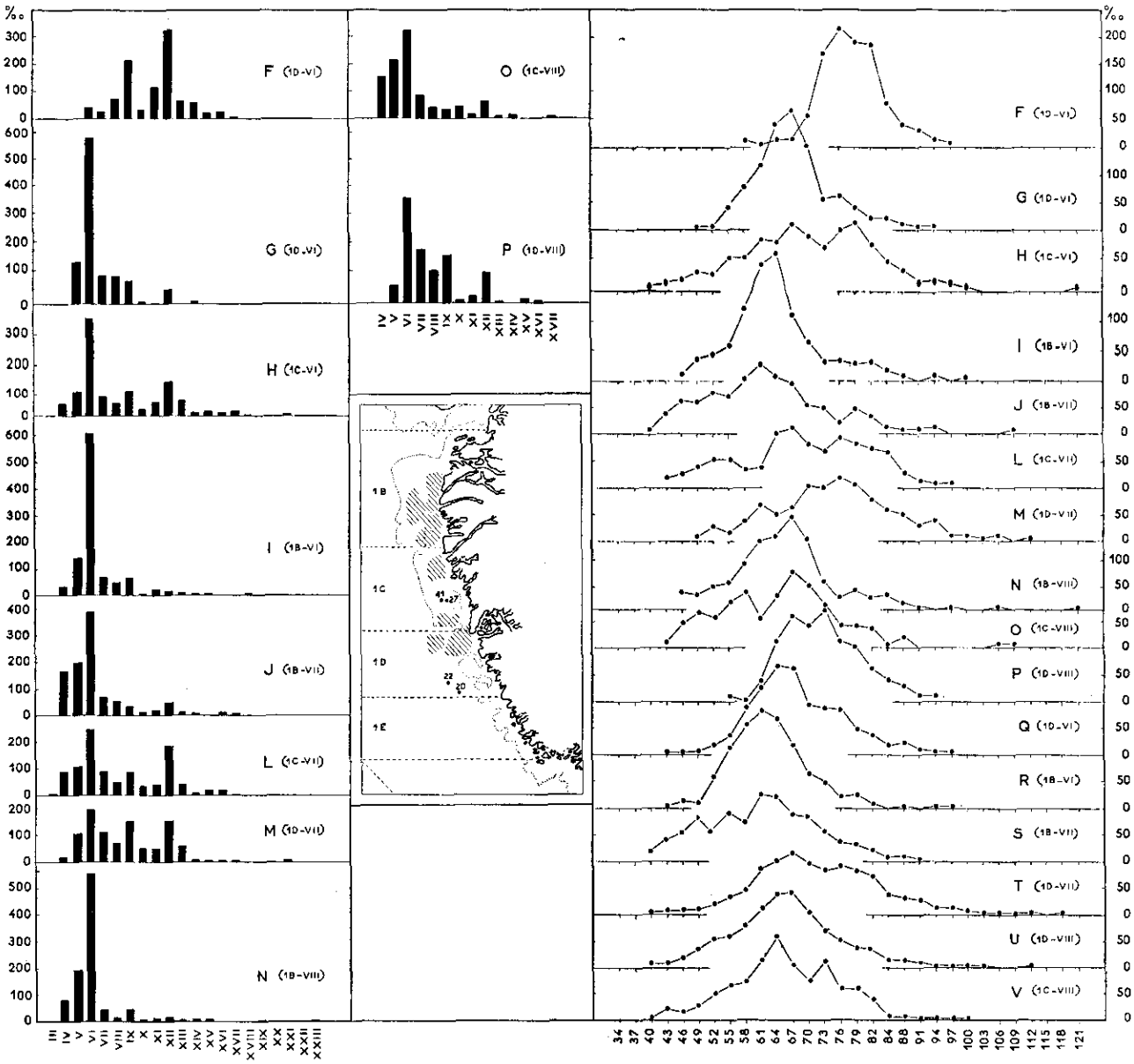

Fig. 2. **Cod, Subarea 1, 1959. Age- and length-distribution (in °/₀₀) of samples from dory vessels. Left—age; centre—position of samples; right—length-distribution.**

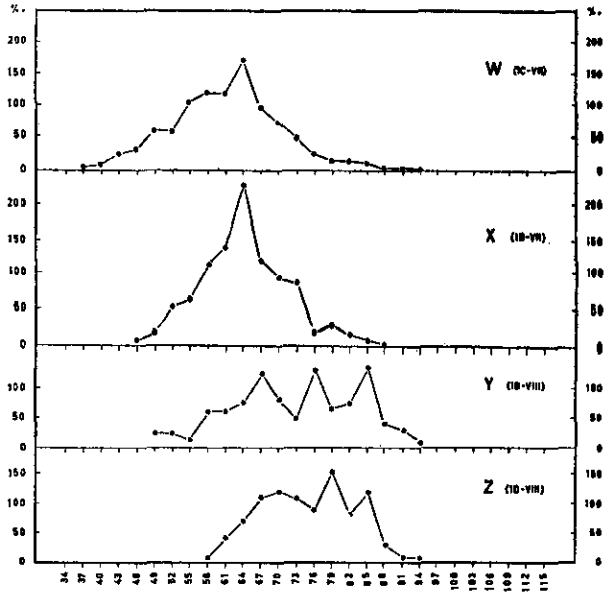

Fig. 2 app. Cod, Subarea 1, 1959. Length-distribution of sample groups W-Z, dory vessels.

age-groups VI (400-600°/₀₀) and **V** (150-200°/₀₀) was found. The IV-group, which is only little abundant in most of the samples, accounted for no less than 160°/₀₀ in the samples from July.

In Subdivision 1C (June-July, Groups **H, L**) also the VI-group is the most abundant (250-300°/₀₀), the second is the XII-group (125-180°/₀₀) The V-group accounts for about 100°/₀₀.

In August (sample group **O**) the age composition is different; the predominating age groups are: VI (300°/₀₀), V (200°/₀₀) and IV (150°/₀₀).

In Subdivision 1D (June, sample groups **F, G**) the samples show—in conformity with differences in fishing depth—a marked difference in age composition. Thus in sample group **F**—fishing depth 150 fathoms—the following age-groups predominate: XII (330°/₀₀), IX (200°/₀₀) and XI (115°/₀₀); the VI-group is almost non-existent (30°/₀₀). In sample group **G, H**-fishing depth 25 fathoms—on the contrary, the VI-group clearly predominates with 575°/₀₀, the V-group accounts for 130°/₀₀; the remaining age-groups are hardly represented.

In July (sample group **M**) the dominating age-groups are: VI (200°/₀₀), IX and XII (150°/₀₀ V and VII (110°/₀₀).

In August (sample group **P**) predominate age-groups VI (350°/₀₀), VII (170°/₀₀), IX (150°/₀₀) and VIII (100°/₀₀). Group XII is represented with 90°/₀₀.

(c) Summary.

On the whole the 1953 year-class predominates in the samples (as it did the previous year in Subdivision 1C). The 1947 year-class, which for some years has dominated the fisheries in this region, appears still as rather abundant in 1C and 1D, especially in samples from the dories. In 1B it is, however, almost non-existent and in 1E (trawl fishery) it is very scarce.

In 1B the young year-classes 1953, 1954 and 1955 are predominating.

Noteworthy is the differing age composition in 1D of dory samples from various depths: the young year-classes (1953 and 1954) dominate in shallower water (25 fathoms), the older year-classes (1947) in deeper water (150 fathoms).

2. Size Composition[1] (Figures 1-2)

The trawl samples show a size distribution ranging from the 37 to the 85 cm group, with a few specimens up to 103 cm. The peaks of the curves are around the 64 cm group, corresponding to age-group VI.

In Subdivision 1E the peaks are at 64-68 and 76 cm, corresponding to age-groups VI and IX.

In the dory vessel samples the range of variation is between 40 and 97 cm, in a few cases up to 110 cm. The peaks are generally around the classes 61-64-67 cm, in conformity with the dominating age group VI.

In Subdivision 1D (sample group **F**) the peak is, however, at 79 cm - age-group XII.

3. Growth (Table 2, Figures 3-5).

The mean length, by age groups, for the richer year-classes (trawl and line) is presented in Table 2.

The resulting growth curves show that the trawl-caught cod have a slightly slower growth

[1]) After the submission of this report to the 1960 Annual Meeting additional data have been received on the size-composition of samples from dory vessels operating in Subdivisions 1B, 1C and 1D (sample groups W-Z). The length-compositions of these samples are shown in Figure 2 app.

TABLE 2. Greenland, 1959. Mean length of males and females and annual growth of the most abundant year-classes; trawlers and dory vessels.

Year Class	Age	Trawlers ♂♂ Mean Length cm	Trawlers ♀♀ Mean Length cm	Dory Vessels ♂♂ Mean Length cm	Dory Vessels ♀♀ Mean Length cm	Trawlers + Dory Vessels ♂+♀ 1958	Trawlers + Dory Vessels ♂+♀ 1959	Annual Growth
1956	III	41.0	39.4	—	44.0	—	40.5	—
55	IV	46.1	45.6	48.3	47.4	39.8	47.4	7.6
54	V	54.4	55.9	57.0	56.9	47.7	56.7	9.0
53	VI	62.7	62.1	64.0	65.0	55.6	63.8	8.2
52	VII	68.4	68.1	68.6	70.3	62.3	69.0	6.7
51	VIII	72.4	74.0	74.5	75.3	69.4	74.0	4.6
1950	IX	76.4	76.5	77.5	78.8	72.4	77.0	4.6
49	X	75.7	79.0	78.2	80.9	73.5	78.9	5.4
48	XI	81.3	75.4	78.4	80.5	76.7	79.6	2.9
47	XII	75.8	83.4	79.7	83.2	76.9	81.3	4.4
46	XIII	80.0	82.4	81.2	85.8	78.8	83.7	4.9
1945	XIV	85.0	86.5	82.0	82.8	81.3	83.1	1.8
44	XV	—	—	80.7	87.9	—	—	—
43	XVI	—	—	86.8	90.9	—	—	—

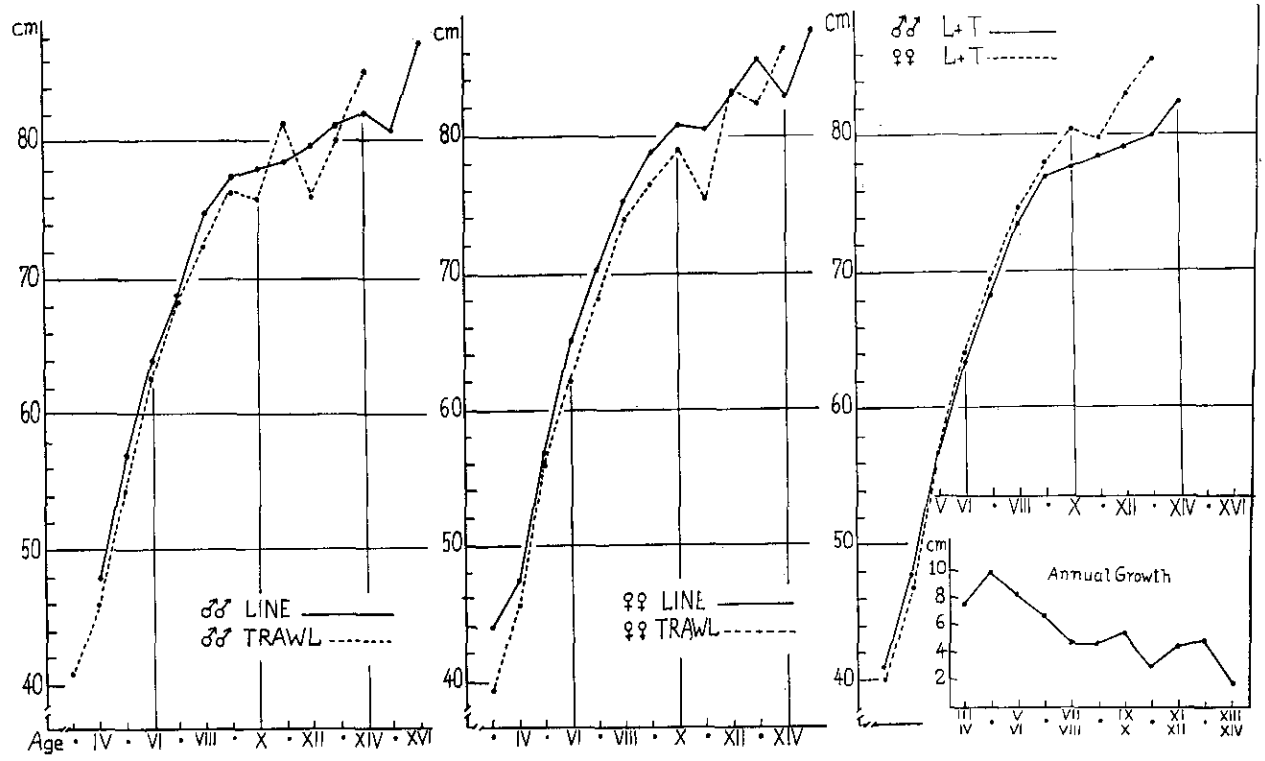

Fig. 3, 4 and 5. Cod, Subarea 1, 1959. Growth curves. Figure 3 (left)—males, line and trawl separately; Figure 4 (centre)—females, line and trawl separately; Figure 5 (right)—line + trawl for males and females separately; annual growth curve inserted.

than the cod caught on line (Figures 3-4). This fact ought to be especially studied as it may be caused by a different selectivity within each year-class after a certain length has been reached; or it may depend upon a different bathymetric distribution of the individuals due to a more or less rapid growth rate.

The growth-curve from the total of the samples (Figure 5) is in the main similar to that shown by the 1958 samples, but from age group VIII the growth appears to be a little slower.

4. Sex Ratio.

In the samples from the dory vessels the male % varies between 45 and 50, except for sample group **P** (Subdivision 1D) with 60% males. In general there seems to be a tendency of a slight dominance of females in the northern part of the Subarea 1B.

In the trawl samples males account for about 52-53.5%.

5. Stage of Maturity (Table 3, Figure 6).

Males. In April the majority are in the developing stage (73%) and in the resting stage (26%). From April to July the % in the developing stage decreases to 31 and the % in the resting stage increases to 65.

In May-June post-spawners account for 8-9%; a very few cases (2%) of spawning cod were observed.

Females. In April almost all (98%) are in the resting stage, and scarcely 2% are post-spawners. In May-June the post-spawners have increased to 33-53%. In August post-spawners account for 29%, the remaining females are in the resting stage.

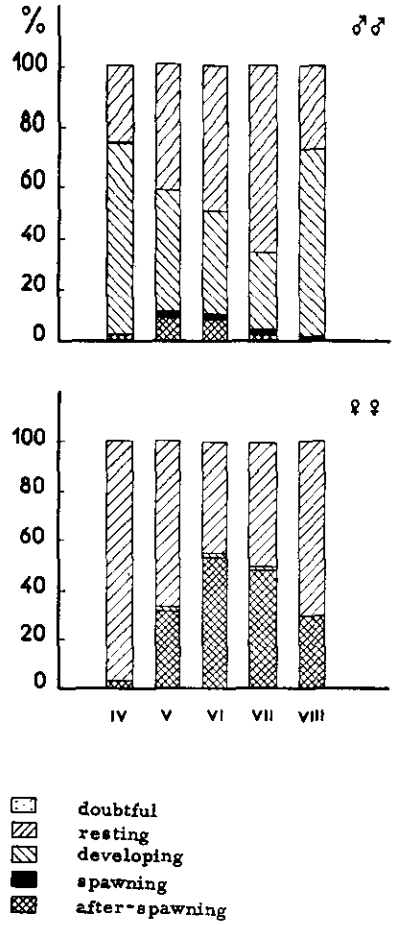

Fig. 6. **Cod, Subarea 1, 1959 Percentage numbers of males and females of different stages of maturity, April to August (IV-VIII).**

TABLE 3. Greenland 1959. Stage of maturity, from macroscopic observations of gonads, in April-August; samples from trawlers and dory-vesssels.

	April		May		June		July		August	
Stage of maturity	♂♀ %	♂♀ %	♂♀ %	♂♀ %	♂♀ %	♂♀ %	♂♀ %	♂♀ %	♂♀ %	♂♀ %
Resting	26.0	98.0	41.8	66.2	49.0	46.3	65.4	52.3	27.3	71.0
Developing	73.0	—	46.3	0.7	41.0	0.3	31.2	0.3	72.4	—
Spawning	—	—	2.6	—	2.0	—	1.7	—	0.3	—
Post-spawning	1.0	2.0	9.3	33.0	8.0	53.4	1.7	47.5	—	29.0
No. of observations	104	95	311	284	583	611	356	392	293	304

6. Age at First Maturity (Table 4, Figure 7)

The study of spawning rings, following the same method as in previous years, shows that first maturity appears normally at an age of 6-9 years, especially at 7-8 years. No noteworthy difference between males and females was found; this is in agreement with earlier observations.

7. Weight Data.

Data on weight (total weight, weight of liver, gonads and intestines) were collected for 600 cod, and are published in the Sampling Yearbook for 1959.

TABLE 4. Greenland, 1959. Age at first maturity, males and females of the more abundant age-groups (VI-XIII), samples from April-August, Subdivisions 1B-1E. ⊖ means no spawning mark.

Age-group		♂♂ Age at first maturity								
		V	VI	VII	VIII	IX	X	⊖	?	Total
VI	No.	—	16	—	—	—	—	268	403	687
	%	—	2.3	—	—	—	—	39.0	58.6	99.9
VII	No.	—	5	43	—	—	—	61	20	134
	%	—	3.7	35.8	—	—	—	45.5	14.9	99.9
VIII	No.	—	10	55	11	—	—	5	10	91
	%	—	11.0	60.4	12.1	—	—	5.5	11.0	100.0
IX	No.	—	19	85	37	—	—	1	2	144
	%	—	13.2	59.0	25.7	—	—	0.7	1.4	100.0
X	No.	—	1	23	6	1	—	—	1	32
	%	—	3.1	71.9	18.8	3.1	—	—	3.1	100.0
XI	No.	—	2	37	10	—	1	—	—	50
	%	—	4.0	74.0	20.0	—	2.0	—	—	100.0
XII	No.	—	5	91	47	7	—	—	—	150
	%	—	3.3	60.7	31.3	4.7	—	—	—	100.0
XIII	No.	—	1	29	11	2	—	—	—	43
	%	—	2.3	67.4	25.6	4.7	—	—	—	100.0

TABLE 4. continued

Age-group		♀♀ Age at first maturity								
		V	VI	VII	VIII	IX	X	⊖	?	Total
VI	No.	1	20	—	—	—	—	603	13	637
	%	0.2	3.1	—	—	—	—	94.6	2.0	99.9
VII	No.	—	3	56	—	—	—	72	21	152
	%	—	1.9	36.8	—	—	—	47.4	13.8	99.9
VIII	No.	—	6	55	14	—	—	7	13	95
	%	—	6.3	57.9	14.7	—	—	7.4	13.7	100.1
IX	No.	—	4	90	55	—	—	1	5	155
	%	—	2.6	58.1	35.5	—	—	0.6	3.2	100.0
X	No.	—	3	15	14	2	—	—	—	34
	%	—	8.8	44.1	41.2	5.9	—	—	—	100.0
XI	No.	—	1	24	28	4	—	—	—	57
	%	—	1.8	42.1	49.1	7.0	—	—	—	100.0
XII	No.	—	—	74	67	13	—	—	—	154
	%	—	—	48.1	43.5	8.4	—	—	—	100.0
XIII	No.	—	—	13	20	4	1	—	—	38
	%	—	—	34.2	52.6	10.5	2.6	—	—	99.9

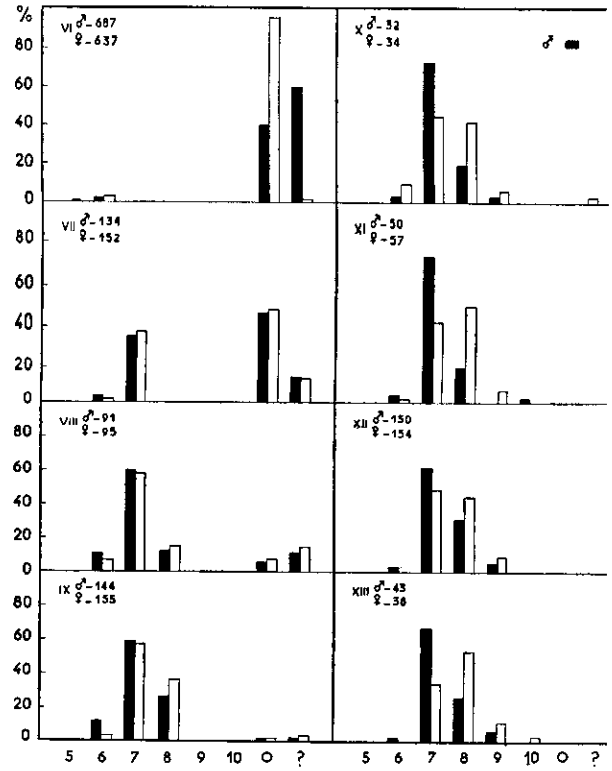

Fig. 7. **Cod, Subarea 1, 1959. Percentage numbers of males (dark columns) and females (white columns) of ages 5-10 spawning for the first time; only age-groups VI-XII shown; number of individuals investigated are indicated; O-indicates no spawning mark.**

II. Size Composition of Cod in Subarea 3 (Newfoundland)[1].

The number of samples from trawlers were 22 and from dory vessels 12, a total of 34 samples —ca. 6,000 individuals.

The material collected is being studied. At present only the following summary of length measurements from Subdivisions 3L, 3N and 3Ps is presented.

The samples were grouped by gear, subdivision and month (Table 5).

(a) **Trawlers** (Figure 8).

In Subdivision 3Ps, February-April (Sample groups **A**, **B**) the individuals caught varied in length between group 37 and 100 cm, most abundant were the groups 46-49-58.

No significant differences were observed between day and night samples.

(b) **Dory Vessels** (Figure 8).

In Subdivision 3L (October, Sample group **C**) the length varied between 37 and 91 cm; the length-groups 58 and 64 were the most abundant.

In Subdivision 3N, September (Group **D**) the range of variation was much larger; 40-142 cm, most abundant were cod of groups 64-76 cm.

Results of further observations on age-composition, growth and maturity from 1959 will be reported later.

III. Observations on the Cod, *Gadus morhua*, in Subarea 4 (Misaine and Banquereau).

A total of 14 samples, including 2,300 specimens, was collected from a trawler. 800 otoliths from these samples were aged. The detailed

TABLE 5. Cod, Subdivisions 3L, 3N and 3Ps, 1959. The distribution of samples of the sample groups A-G.

Sample Group	No. of Samples	Subdivision	Date	Gear
A	3,7	3Ps	17/26-II-59	Trawl
B	12,15,18	3Ps	3/9-IV-59	,,
C	33	3L	9-X-59	Line
D	25,27,30	3N	6/12-IX-59	,,
E	35,36,37,38,39	3Ps	6/13-V-59	,,
F	40,41,42,43	3N	4/19-IX-59	,,
G	44	3L	8-X-59	,,

[1]) After the submission of this report to the 1960 Annual Meeting data have been received on the size-composition of samples from other dory vesse operating in Subdivisions 3Ps, 3N and 3L (samples 35-44, sample groups E to G).

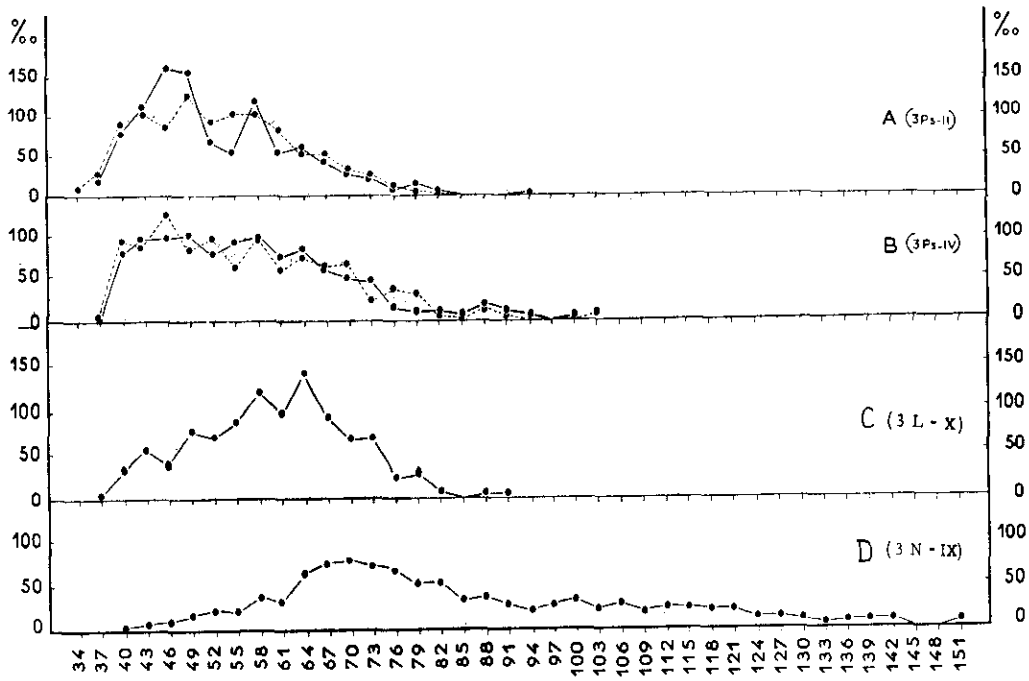

Fig. 8. Cod, Subarea 3, 1959. Length-distribution in °/₀₀. Day samples—bold lines, night samples—stipled lines, sample groups A-D; A and B—trawl; C and D—line fishery; Roman figures indicate month.

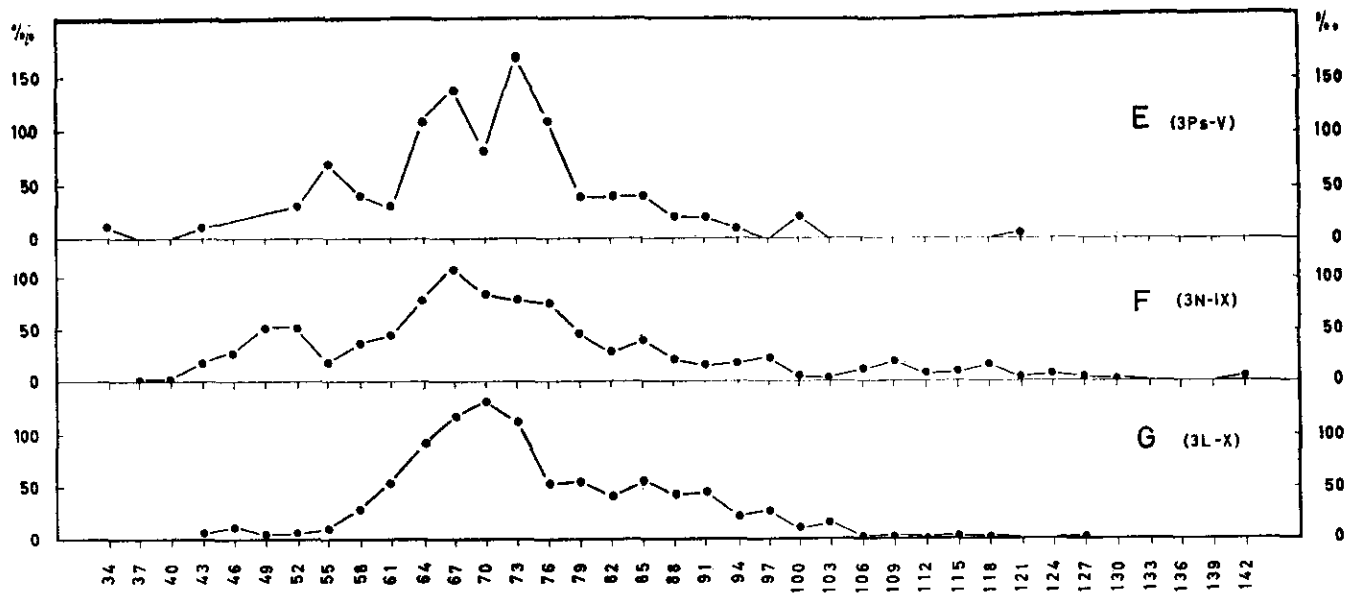

Fig. 8 app. Cod, Subarea 3, 1959. Length-distribution in °/₀₀, sample groups E-G from line fishery at day; Roman figures indicate month.

TABLE 6. Cod, Subarea 4, Misaine and Banquereau, 1959. The distribution of samples within the sample groups A-D. *—Otoliths sampled.

Sample Group	No. of Samples	Subdivision	Date
A*	1	4Vs	28-II-59
B*	3,6,8,10	4Vs	4/20-III-59
C*	12,13,14	4Vn	25/27-III-59
D	2,7,11	4Vs	1/21-III-59

data from the collections will be published in the Sampling Yearbook for 1959.

The samples were arranged by subdivisions and by months as shown in Table 6.

1. Age Composition (Fig. 9).

In Subdivision 4Vs (Feb.-March, Sample Groups **A** and **B**) the young year-classes predominated, especially age groups V (340-220°/₀₀),

VI (230-180°/₀₀), IV (210-157°/₀₀), and to a lesser degree age group VII (about 130°/₀₀).

In Subdivision 4Vn (March, Sample Group **C**), an age composition similar to that of Subdivision 4Vs was observed, with a predominance of age group VI (287°/₀₀, V (270°/₀₀) and VII (133°/₀₀). Age group IV, however, was considerably less abundant and represented only about 60°/₀₀. In general, the samples show that in Subdivision 4Vs and 4Vn, the year-classes predominating in late winter and early spring are 1953, 1954 and 1955 and, to a lesser degree, 1952.

2. Size Composition (Fig. 9).

The samples reveal a size composition with the length varying between the size classes 34 and 106 cm.

In Sample Group **A**, the mean size observed is 55.8 cm, with peaks in the 49-55-58 cm groups. In Sample Groups **B** and **C**, the mean length is about 58 cm, with peaks in the size classes 52 and 58 cm. In Sample Group **D**, the mean length of samples taken in daytime is 53.1 cm and of samples from the night 54.5 cm. The peaks were as in **B** and **C** in the size classes 52 and 58 cm.

3. Growth (Fig. 10 and Table 7).

The mean size of males and females by age groups is given for the entirety of the samples. The two length curves do not reveal significant differences up to age group IX. For the following age groups the growth of the males is stronger than that of the females.

4. Sex Ratio.

In general the number of males and females is fairly much the same—i.e. about 50%, except in Sample Group **A** in which a slight predominance of the males (57%) was observed.

5. Stage of Maturity (Table 8, Fig. 11).

Males. In February (Subdivision 4Vs) individuals in the resting stage accounted for 60% those in the developing stage for 40%. In March the number of individuals in the developing stage is greater (in 4Vs - 57%, in 4Vn - 64%), and the individuals in the resting stage are fewer (in 4Vs - 50%, in 4Vn - 36%). A very small number were spawners (0.7-3.0%).

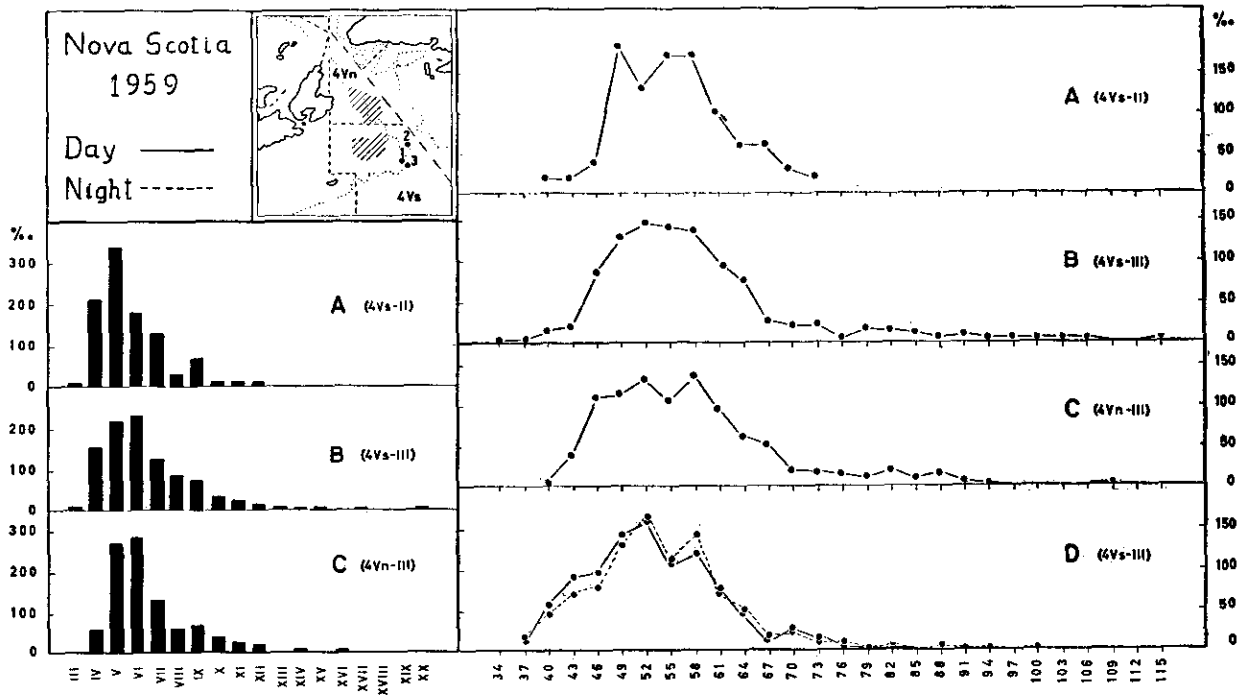

Fig. 9. **Cod, Subarea 4, 1959. Age- and length-distribution of trawl samples. Age - left, position of samples - left above; length - right. Roman figures indicate month.**

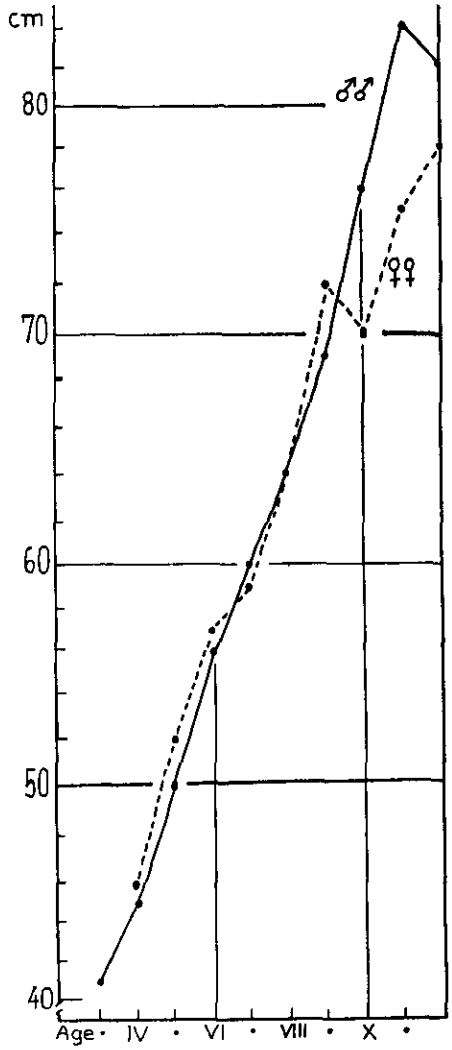

Fig. 10. Cod, Subarea 4, 1959. Growth curves for males and females; trawl samples.

TABLE 7. Cod, Subarea IV, Misaine and Banquereau, 1959. Mean length of males and females of the most abundant year-classes (sample groups A, B and C).

	Age (1959)	Mean Length cm ♂♂	♀♀
1956	III	41.6	—
55	IV	44.8	46.0
54	V	50.3	51.6
53	VI	55.7	57.4
52	VII	60.2	58.5
51	VIII	63.9	63.7
1950	IX	68.7	72.4
49	X	68.3	69.8
48	XI	75.7	75.0
47	XII	84.2	78.2
1946	XIII	81.5	100.0

Females. In February (Subdivision 4Vs) the majority are in the resting stage (72%), individuals in the developing stage are much fewer (23%), and very few (5%) are post-spawners. In March (in 4Vs and 4Vn) the resting stage is still the predominant (65%), but the number of individuals in the developing stage has increased somewhat (to about 30%). Spawners are rare (less than 1%) and the post-spawners account only for 5%.

6. Age at First Maturity (Table 9, Fig. 12).

The reading of the spawning rings shows that first maturity is reached between the 5th and 9th years, most commonly between the 6th and 7th.

TABLE 8. Cod, Subarea 4, Misaine and Banquereau, 1959. Stage of maturity from macroscopic observations of gonads, February-March. (Based on all samples.)

	February (4Vs)		March (4Vs)		March (4Vn)	
Stage of maturity	♂♂ %	♀♀ %	♂♂ %	♀♀ %	♂♂ %	♀♀ %
Resting	57.9	72.1	40.9	64.9	35.8	62.0
Developing	42.1	23.3	56.5	30.3	63.6	32.7
Spawning	—	—	2.6	0.5	0.7	0.7
Post-spawning	—	4.7	—	4.3	—	4.7
No. of observations	57	43	191	208	151	150

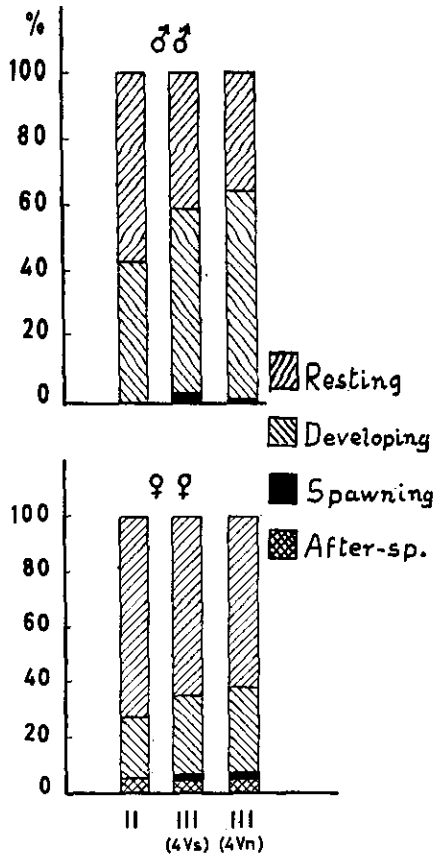

Fig. 11. Cod, Subarea 4, 1959. Percentage numbers of males and females at different stages of maturity, February-March.

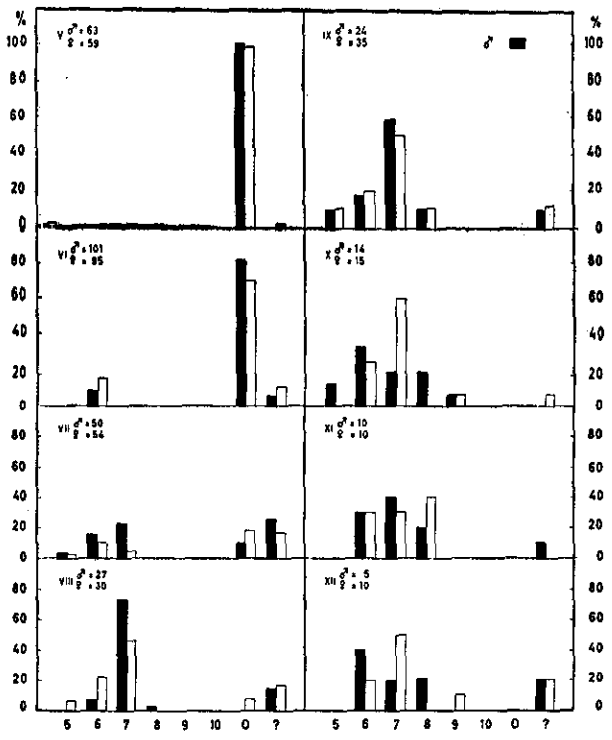

Fig. 12. Cod, Subarea 4, 1959. Percentage numbers of males (dark columns) and females (white columns) of ages 5-10 spawning for the 1st time; only age-groups V-XII considered; numbers of individuals investigated are indicated; O-indicates no spawning mark.

TABLE 9. Cod, Subarea 4, Misaine and Banquereau, 1959. Age at first maturity, males and females of the most abundant age-groups (V-XII). Samples from February and March. ⊖ - indicates no spawning mark.

		♂♂ Age at 1st spawning									
		V	VI	VII	VIII	IX	X	XI	⊖	?	Total
V	No.	—	—	—	—	—	—	—	63	—	63
	%	—	—	—	—	—	—	—	100.0	—	100.0
VI	No.	—	11	—	—	—	—	—	82	8	101
	%	—	10.9	—	—	—	—	—	81.2	7.9	100.0
VII	No.	2	8	22	—	—	—	—	5	13	50
	%	4.0	16.0	24.0	—	—	—	—	10.0	26.0	100.0
VIII	No.	—	2	20	1	—	—	—	—	4	27
	%	—	7.4	74.1	3.7	—	—	—	—	14.8	100.0
IX	No.	2	4	14	2	—	—	—	—	2	24
	%	8.3	16.7	58.4	8.3	—	—	—	—	8.3	100.0
X	No.	2	5	3	3	1	—	—	—	—	14
	%	14.3	35.7	21.4	21.4	7.1	—	—	—	—	99.9
XI	No.	—	3	4	2	—	—	—	—	1	10
	%	—	30.0	40.0	20.0	—	—	—	—	10.0	100.0
XII	No.	—	2	1	1	—	—	—	—	1	5
	%	—	40.0	20.0	20.0	—	—	—	—	20.0	100.0

TABLE 9. continued.

		♀♀ Age at 1st spawning									
		V	VI	VII	VIII	IX	X	XI	⊖	?	Total
V	No.	—	—	—	—	—	—	—	58	1	59
	%	—	—	—	—	—	—	—	98.3	1.7	100.0
VI	No.	1	16	—	—	—	—	—	66	12	95
	%	1.1	16.9	—	—	—	—	—	69.5	12.6	100.1
VII	No.	2	6	27	—	—	—	—	10	9	54
	%	3.7	11.1	5.0	—	—	—	—	18.5	16.7	100.0
VIII	No.	2	7	14	—	—	—	—	2	5	30
	%	6.7	23.3	46.7	—	—	—	—	6.7	16.6	100.0
IX	No.	3	7	18	3	—	—	—	—	4	35
	%	8.6	20.0	51.5	8.6	—	—	—	—	11.4	100.1
X	No.	—	4	9	—	1	—	—	—	1	15
	%	—	27.0	60.0	—	6.6	—	—	—	6.6	99.8
XI	No.		3	3	4	—	—	—	—	—	10
	%		30.0	30.0	40.0	—	—	—	—	—	100.0
XII	No.	—	2	5	—	1	—	—	—	2	10
	%	—	20.0	50.0	—	10.0	—	—	—	20.0	100.0

VIII. Spanish Research Report, 1959

BY OLEGARIO RODRIGUEZ MARTIN, DIRECCION GENERAL DE PESCA MARITIMA, MADRID

During 1959 the collection of data, mainly of sizes of fish caught, has been continued by means of observers working aboard Spanish trawlers.

In the various subdivisions and months, the following numbers of cod were measured (Total 41,447 specimens):

Month	III	IV	V	VI	VII	VIII	IX
1B						674	6,450
1C							811
2J					551	138	
3K				2,593	142	5,978	
3L				3,149			
3P		6,435	4,421	953			
4R				694			
4T			1,562	458			
4Vn.	2,216	3,978	244				

The measurements were made on board the trawler "Aliseo" of the company PYSBE, during the months March through September. The catches from which the samples were taken were made with a trawl with cod-end meshes of 160 mm (6 3/8") measured new and dry.

The measurements were carried out immediately after capture. Otoliths were collected from part of the fish measured, for later age determination.

Length distribution curves showing °/₀₀ frequencies for 3 cm groups (30-32 cm to 96-98 cm) are presented in Figure 1 by months and by subdivisions.

The cm group(s) of the peaks of these distribution curves are as follows by months and subdivisions:

Month	III	IV	V	VI	VII	VIII	IX
1B						63-65	60-65
1C							69-71
2J					54-56	60-65	
3K				54-62	60-65	60-65	
3L				60-65			
3P		48-50	48-62	48-56			
4R				54-56			
4T			48-50	48-50			
4Vn.	54-56	48-50	60-62				

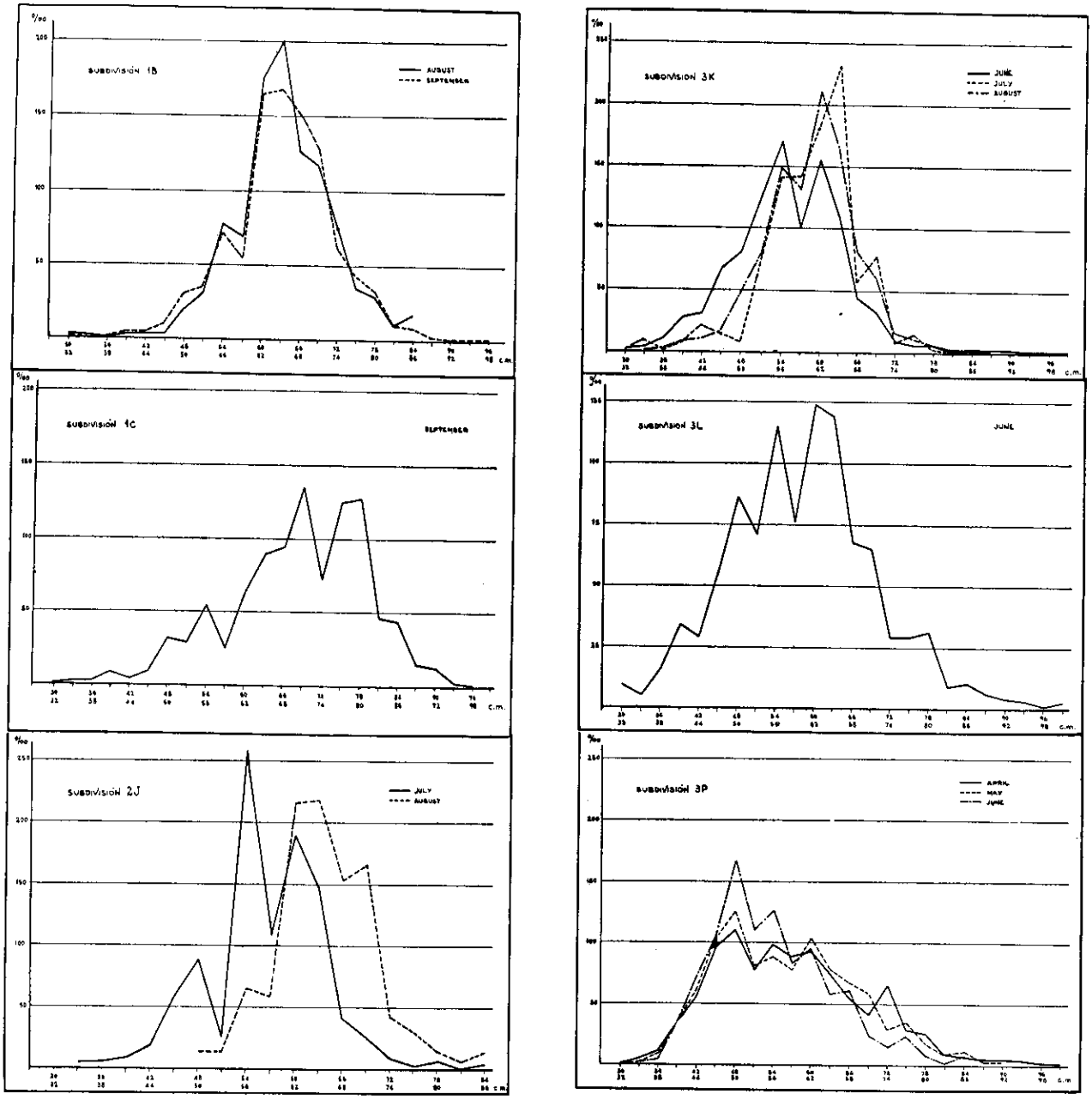

Fig. 1 Cod, length-distribution curves (°/₀₀) by 3 cm groups and by months and subdivisions.

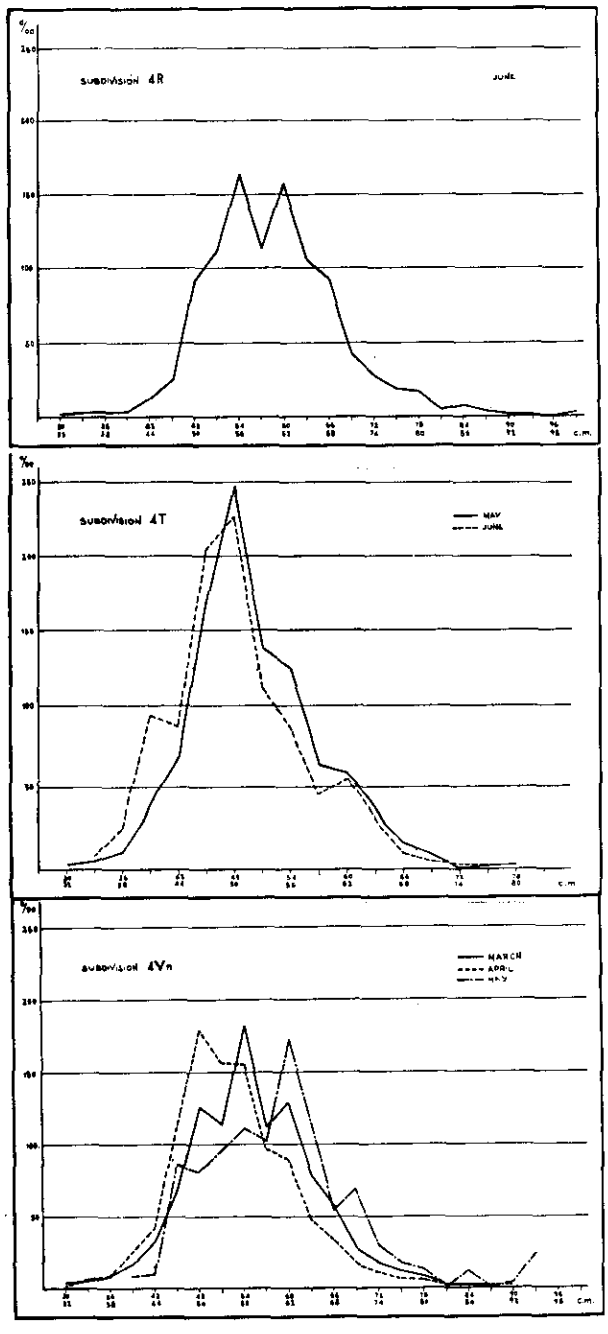

Fig. 1 (Cont'd)

The collection comprises a total of 159 samples, distributed by subareas as follows: Subarea 1—23 samples; 2—3 samples; 3—100 samples and 4—33 samples. The detailed data from these measurements will appear in the Sampling Yearbook Vol. 4 for 1959.

IX. USSR Research Report, 1959

A. OCEANOGRAPHIC INVESTIGATIONS IN THE LABRADOR AND NEWFOUNDLAND AREAS

BY A. A. ELIZAROV

A number of hydrographic sections were worked by the Soviet research vessel "Sevastopol" in the Labrador area (up to 56°N), on the northern slopes of the Newfoundland Bank, and on Flemish Cap Bank in July-August 1959. The program included measurements of temperature, salinity, content of dissolved oxygen and of some other hydro-chemical elements. Eleven sections were made from July 7 to August 20 (see figure 1), the section across the north-eastern slope of Grand Newfoundland Bank being made twice, at the beginning and at the end of the trip. Some individual stations were worked in the areas of trawl fisheries. The main object of the trip was to study the habitat of the redfish. Therefore most of the stations were located in the area of the continental slope from 300 to 500 m.

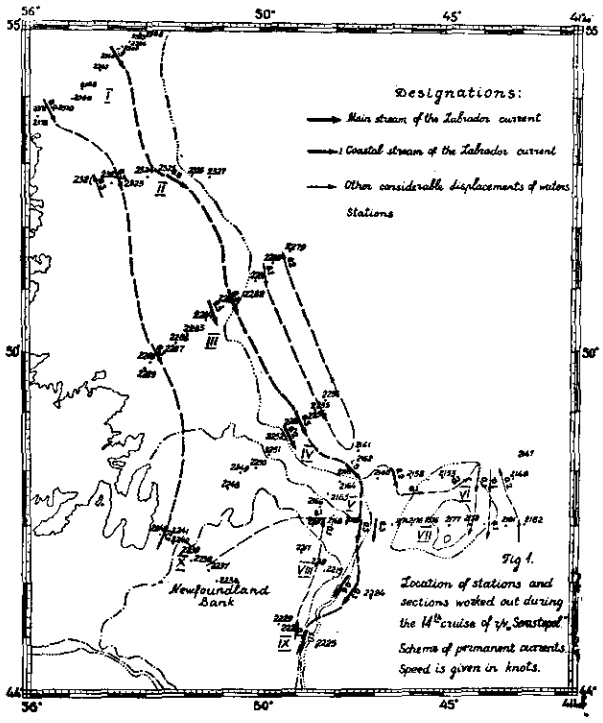

Fig. 1. Location of the sections and stations worked during the 14th trip of the R/V "Sevastopol", and a sketch of permanent currents. Velocities shown in knots.

Currents.

In order to ascertain the pattern of currents, the hydrological data were processed by a dynamic method improved by N. N. Zubov and O. I. Mamaev (1956), and a sketch of permanent currents was prepared (Figure 1), based on two dynamic maps calculated to the 500 and 200 decibar isobaric surfaces.

The 500 decibar isobaric surface was assumed to be O surface on the strength of an analysis of the data on vertical distribution of dissolved oxygen and density. However, this proved to be applicable only to the slope area (the route of the main flow of the Labrador Current). For shallow areas the 200 decibar isobaric surface proved more suitable.

The velocities observed for the Flemish Cap area seem to be somewhat on the low side because, first, the sections in this area were running mostly along the current and, second, it was difficult to establish the actual difference in specific volumes of two stations in relatively homogeneous water mass (through deficiency of the method used).

The current map does, on the whole, not differ considerably from the conventional summer-season pattern of currents for this area.

The general counter-clockwise movement of cold water masses around the Newfoundland Bank, and a slight counter-current at the western boundary of this stream were observed. The current velocities were varying from place to place within the limits of 0.1-1.5 knots. The highest velocities (up to 1.5 knots) were observed on the north-eastern slope of the Newfoundland Bank (between stations 2162 and 2163) and the continental slope, east of Hamilton Bank (stations 2365 and 2366). The velocities and directions of currents found were confirmed by navigation calculations made by A. T. Petukhov, captain of the "Sevastopol", in July 1959.

For the Labrador Shelf and the Newfoundland Bank, including Flemish Cap Bank, the cold Labrador Current is the factor determining the hydrological regime. The water masses carried by the Labrador Current (approximately 4 to 5 million cub. m/sec., according to F. Soule) interact with the local bank water and with the Gulf Stream water, which come from the south to meet the Labrador Current. Interaction of the waters of different origin causes the complex picture of water circulation over the banks and their slopes.

One of the major characteristics of the Labrador Current is that it carries water masses of different origin. Many authors divide the Labrador Current into two streams: the coastal and the off-shore stream. It is believed (Hachey, Hermann, and Bailey, 1954) that the coastal stream carries a great volume of cold water and is bound to the continental shelf, while the off-shore stream, often referred to as the main flow of the Labrador Current, carries water from the West Greenland Current.

From the data it appears that the Labrador Current south of Hudson Strait is composed of the following three independent flows:

1. The coastal flow which runs in immediate proximity to the coast. Near Belle Isle Strait it moves away from the shore for a considerable distance (Figure 1). The velocity in July 1959, according to our dynamic calculations, did not exceed 0.3 knot. The cold layer of its central part, below -1°0, ran between 25 m and the bottom.

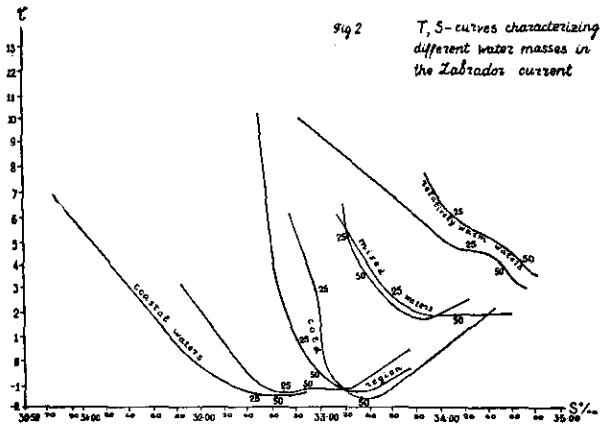

Fig. 2. Temperature—Salinity diagram characterizing various water masses in the Labrador Current system.

2. The cold part of the main flow with temperature and salinity similar to those of the coastal flow, but greatly subjected to the influence of the continental discharge and of the waters from Hudson Strait and Belle Isle Strait. Approaching the northern slope of the Newfoundland Bank, this branch of the Labrador Current divides into two independent parallel flows. Velocities of this part of the current in July-August 1959 did not exceed 0.5 knot. The thickness of the cold layer, below -1°0, was around 100 m (from 50 to 150 m).

3. The relatively warm part of the main flow, with temperatures from 3°0 to 4°0 and salinity from 34.50 to 34.80‰ in mid layers. These layers originate from the warm component of the West Greenland Current which joins the polar waters near the Cumberland Peninsula. According to our dynamic calculations, velocities of this part of the Labrador Current in the summer of 1959 were higher than those of the cold waters and reached 1.5 knots in the area of the north-eastern slope of the Grand Banks.

For characteristics of the water masses of the above-mentioned flows of the Labrador Current see the T - S diagram (Figure 2). The various parts of the curves of the 25-50 m layer have different positions, depending upon the categories of water which they represent. The lower parts indicate the increasing influence of the Atlantic water with increasing depth. The upper parts indicate the diluting effect of the river discharge on the surface layer.

Temperature and Salinity of Water Masses.

Figures 3 a-j show isotherms and isohalines of the sections from the area of the Labrador and Grand Newfoundland Bank in the summer of 1959.

Examination and comparison of the data reveal that the lowest surface temperatures (about 4°), in July-August 1959, were observed in the Labrador area at 56°N (Figure 3a), and the highest (10°-12°)—in the coastal areas of

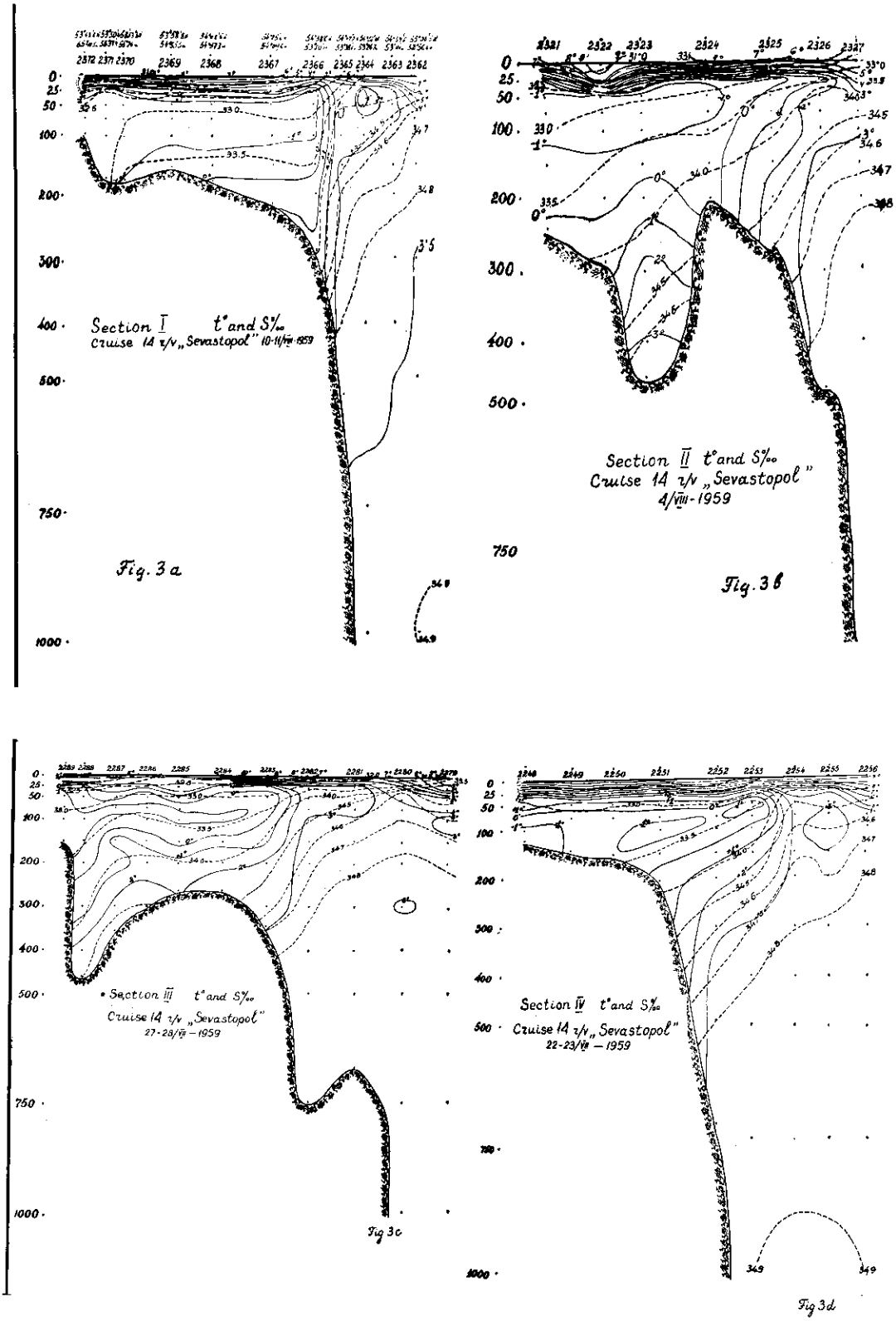

Fig. 3. a-d. Isotherms and isohalines for sections in the Labrador-Newfoundland area, July-August 1959, cruise 14, R/V "Sevastopol"; a — section I, b — section II, c — section III, d — section IV.

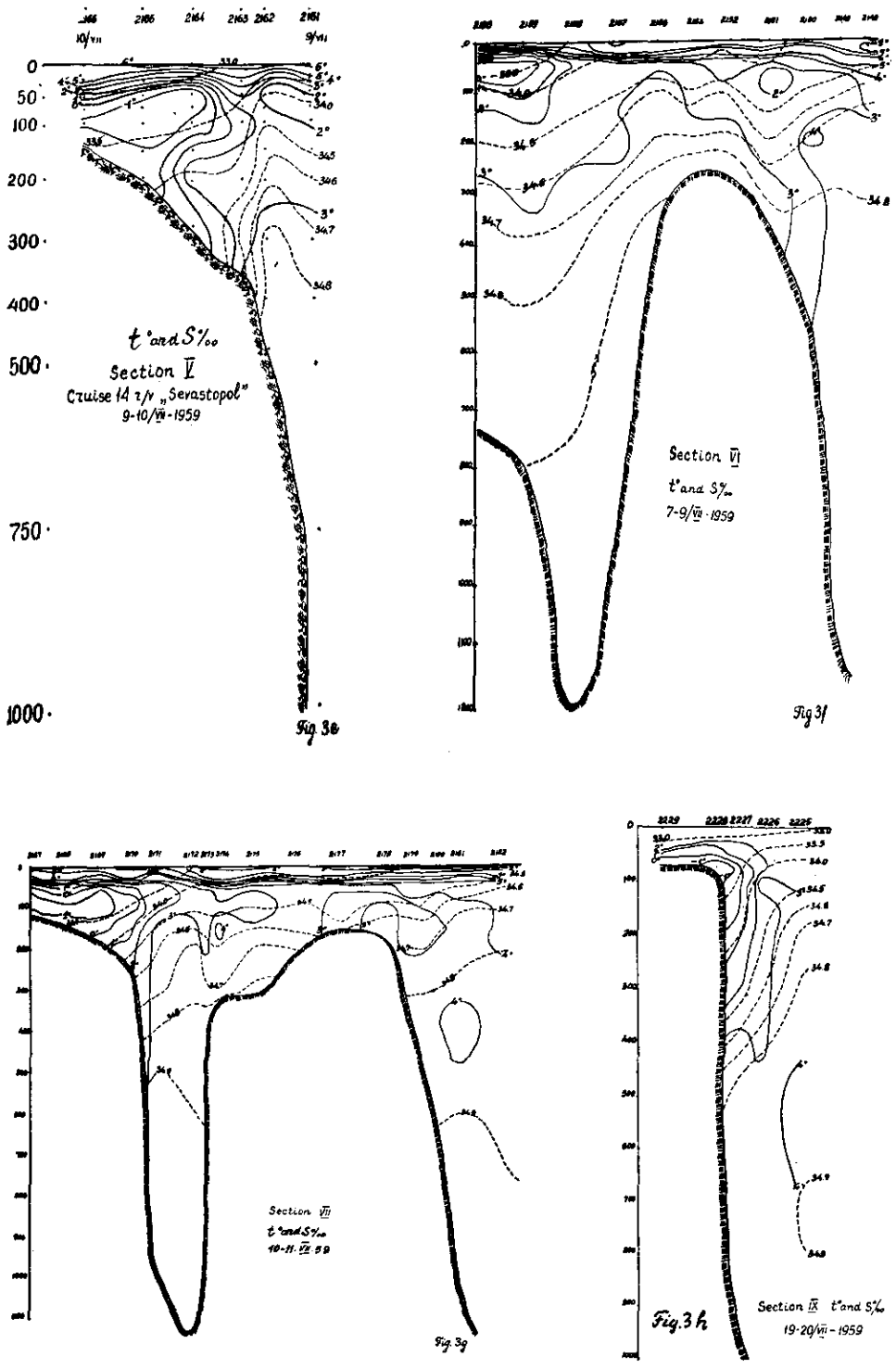

Fig. 3. e-h. Isotherms and isohalines for sections in the Labrador-Newfoundland area, July-August 1959, cruise 14, R/V "Sevastopol"; e — section V, f — section VI, g — section VII, h — section IX.

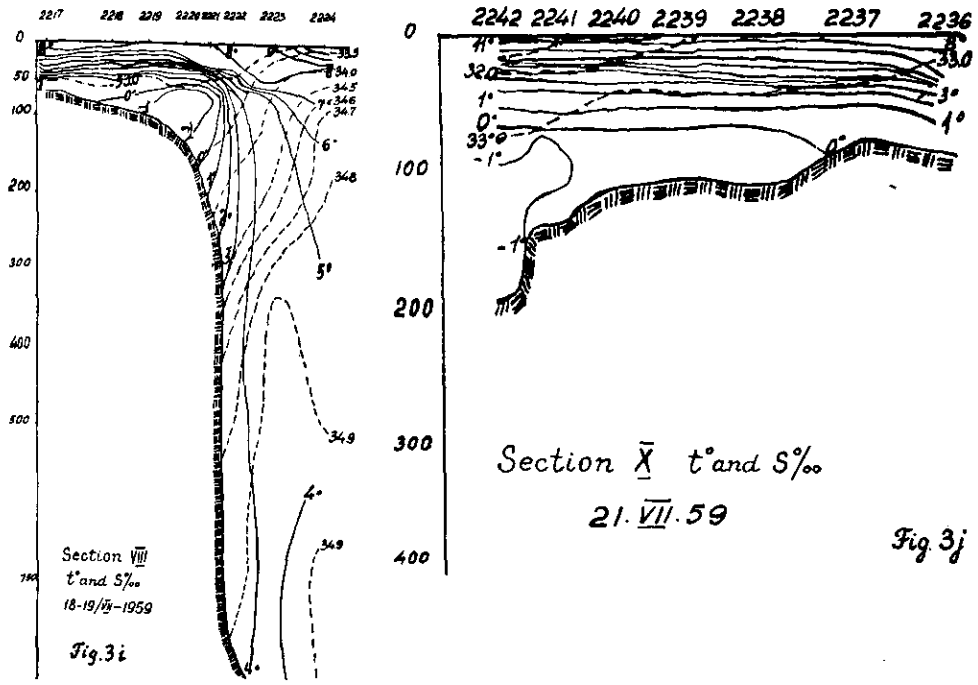

Fig. 3 i-j. Isotherms and isohalines for sections in the Labrador-Newfoundland area, July-August 1959, cruise 14, R/V "Sevastopol"; i — section VIII, j — section X.

Newfoundland (Figure 3b). The near bottom temperatures almost everywhere increased with depth, reaching the maximum at 400-500 m. The near-bottom temperatures on the slopes of the Flemish Cap Bank were, as in 1958, almost uniform, somewhat above 3° (Figures 3f, g). All large concentrations of "beaked" redfish were found just at such temperatures. The surface salinity varied in the same period from 30.64 to 34.29°/₀₀ (Figures 3a-j). The lowest values of salinity (below 31°/₀₀) were observed at the stations east and north of Belle Isle Strait, apparently caused by the outflow of water from this strait. Surface water of 34°/₀₀ was observed only on the eastern slope of Flemish Cap Bank, i.e. near the North Atlantic Current.

The salinity of the relatively warm part of the Labrador Current, in the 50 to 100 m horizons, was varying almost everywhere between 33.50 and 34.50°/₀₀, while the salinity of its coldest parts was always below 33.50°/₀₀.

Rather high salinities (above 34.7°/₀₀), in the 100 m horizon were observed on the northwestern slope of Flemish Cap Bank and in the area between 50°00′N and 51°30′N of the continental slope (Figure 3f). Apparently, upwelling was taking place in these areas. Increase in salinity was also observed in the 200 m horizon.

The salinity in the near-bottom layers varied from 32.60°/₀₀ at the Labrador coast to 34.90°/₀₀ in the underwater strait between Flemish Cap Bank and the Grand Bank, at the depth of 500 m (Figures 3f, g). The salinity in the near-bottom horizons of the Grand Banks proper, at shallow depths, did not exceed 33.50°/₀₀.

It is noteworthy that higher salinities (33.25°/₀₀) were observed at stations 2218, 2219, 2238, and 2239, than in the neighbouring areas (Figures 3h, j).

Fluctuations of the Temperature in the Course of a Day.

Observations of water temperatures and contents of dissolved oxygen were made in the course of 12 hours aboard the scouting trawler "Novorossiisk," October 9-10, 1959. A semidiurnal station was taken at 48°25′7N and 49°46′1W, in a zone of a sharp temperature drop. The diagram of the 12 hour course (Figure 4) shows that in surface horizons (0, 10 and 25 m) and in near-bottom horizons (200 and 275 m) the temperature course was even, at the depths

of 75 and 100 m fluctuations were rather considerable. For instance, at the depth of 75 m the temperature changed from 4.5° to -1.0° between 23:00 and 01:00 (i.e. in the course of two hours), and by 05:00 it rose again to 4.5°. This indicates a rather considerable lateral shifting of water masses at the conjunction line of the above mentioned components of the main flow of the Labrador Current caused both by the recurrent tidal wave and by the changes in the boundaries of the Labrador Current itself, not associated with tidal phenomena.

Seasonal Fluctuations of the Temperature.

Some authors (Hachey, Hermann and Bailey, 1954) find that it is not possible to establish the annual cycle of temperature variations of the Labrador Current because of the great inconsistencies (fluctuations) in the distribution of temperatures. We think that such a conclusion is rather premature since the available data for characterising the annual cycle are still too scanty. Oceanographic observations in this area are made as a rule in spring or summer time. Therefore the data available for other seasons are fragmentary and inadequate.

The observations made by our expedition covered the period from July 7 to August 20, 1959. This season is characterised by intensive warming up of the upper water layers. By the beginning of September surface temperatures over the greater part of the area reach their top limit. At this time the amplitude of seasonal fluctuations of surface temperatures in the area of the Grand Banks and their slopes was 11°0-14°0. This considerable heating took place in the main during the three summer months (June-August).

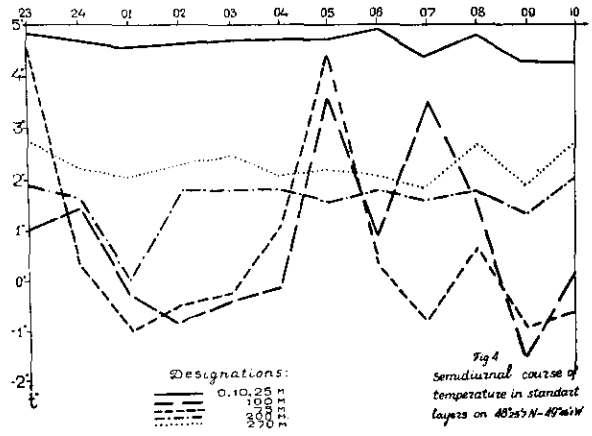

Fig. 4. **Diagram of 12 hour variations of water temperatures in various horizons at 48°25'7N and 49°46'1W. Observations made aboard the trawler RT "Novorossiisk" October 9-10.**

Repeated observations made on the north-eastern slope of the Grand Bank revealed that in 1959 the water temperature at the surface of the sea changed by 6°0-6°5 during little more than one month.

On the other hand, it was observed that despite the considerable and rapid heating at the surface, penetration of warm water downward proceeded at an extremely slow rate. High vertical density gradients caused by simultaneous dilution of the surface waters and the almost complete absence of gales in this period, accounted for this phenomenon.

No substantial change in the near-bottom layers was observed during the trip. The 3° isotherm after a month remained in the same position.

Inter-Annual Fluctuations of the Temperature.

In our earlier studies were established some interdependencies which permitted an approximate assessment of the annual temperature conditions in the area of the Newfoundland Banks, on the basis of average temperatures of two sections. It was then established that 1958 was an abnormally warm year. This was confirmed by direct observations of hydrometeorological conditions (ice situation, etc.) made aboard scouting boats, as well as by the data from investigations by Canadian scientists (ICNAF Collected Works, 1959). The data obtained can hardly be used, however, for evaluation of the temperature regime of 1959, because we have no data on hydrological sections crossing the eastern slope of the Grand Banks for April.

It is, however, evident that 1959 was characterised by somewhat lower temperatures than 1958, which was also confirmed by the volume

and condition of cold water. The average temperature of the O-bottom layer of section 6A running along the 47°N and within 46°56′-43°53′W, was 4°05′ on March 10-11, 1958, and 3°96′ on July 10-11, 1959, i.e. the latter temperature was a little lower despite the high degree of seasonal heating. On the other hand, other data from the 14th trip of the R/V "Sevastopol" led to the conclusion that 1959 should be regarded as an almost average year from the point of view of thermal conditions.

REFERENCES

ADROV, M. M. The Newfoundland Fishing Area. A Hydrological Essay. Sc. and Techn. Bull. of the Polar Research Inst. of Oceanography (PINRO), No. 4, 1957. Murmansk. Pp. 36-44.

ELIZAROV, A. A. Hydrological Regime in the Area of the Newfoundland Banks in 1957-1958. Sc. and Techn. Bull of PINRO, No. 1(9), 1959. Murmansk, Book Publ. House. Pp. 9-15.

ELIZAROV, A. A. and ZOTOV, L. A. Fluctuations of the Water Temperature of the Labrador Current in the Grand Bank Area. (In print).

ELIZAROV, A. A. and PROKHOROV, V. S. Hydrological Regime and Fisheries on Flemish Cap Bank in March and May 1958. Sc. and Techn. Bull. of PINRO, No. 3(7). Murmansk. Book Publ. House. Pp. 57-60.

ZUBOV, N. N. and MAMAEV, O. I. A Dynamic Method of Calculating Elements of Sea Currents. Hydrometeoizdat 1956, Leningrad.

ZUBOV, N. N. and SABININ, K. L. Calculation of Condensation at the Time of Mixing of Sea Waters. Hydrometeoizdat, M., 1958.

KHARITONOV, D. G. Hydrometeorological Characteristics of the North Atlantic. Works of the State Oceanogr. Inst. 1948, No. 9 (21).

HACHEY, H. B. HERMANN, F. and BAILEY, W. B. The Waters of the ICNAF Convention Area. Int. Comm. for the N. W. Atlantic Fisheries, Ann. Proc. Vol. 4, 1954.

ISELIN, C. A Study of the Northern Part of the Labrador Current. Bull. Nat. Comm. No. 61, 1927.

ISELIN, C. A Study of the Circulation of the Western North Atlantic. Papers on Phys. Oceanog. and Meteor., No. 4(4), 1936.

SMITH, E. H., SOULE, F. M. and MOSBY, O. The Marion and General Green Expedition to Davis Strait and the Labrador Sea. U. S. Coast Guard Bull. No. 19, Sc. Res., Part 2, Phys. Oceanogr., 1937.

SOULE, F. M. Oceanography of the Grand Banks Regions and the Labrador Sea and Davis Strait in 1938. U.S. Coast Guard Bull. No. 28, 1940.

SOULE, F. M. Physical Oceanography of the Grand Banks Region, the Labrador Sea and Davis Strait in 1949. U. S. Treasury Dept. Coast Guard Bull., No. 35.

B. INVESTIGATIONS INTO THE CHEMICAL BASE OF PRIMARY PRODUCTION IN THE AREA OF LABRADOR - NEWFOUNDLAND BANKS IN SUMMER 1959

BY M. V. FEDOSOV AND M. S. GORYACHEVA

Surveys (see Fig. 5) made in the course of environmental studies from the R/V "Sevastopol" in July-August 1959 in the Labrador-Newfoundland areas of commercial fisheries permit to characterize the process of formation of new organic substance of phytoplankton and the intensity of oxidation of organic matter.

The intensity of photosynthesis of organic substance of phytoplankton in the upper 25-meter layer was determined as the difference between the diurnal minimum and maximum oxygen content in the overoxygenated sea water as compared with their mean oxygen content during the non-vegetative winter period. The influence of temperature and salinity was taken into account and corresponding corrections introduced when the actual data on the content of water absorbed were compared.

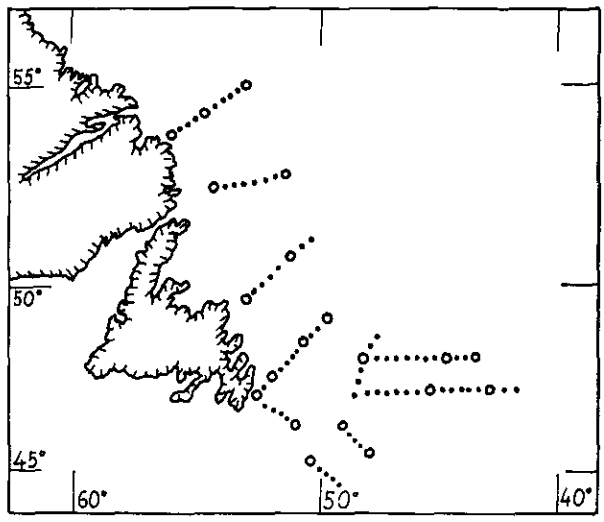

Fig. 5. Position of stations for hydrochemical observations in summer 1959.

Values characterizing the intensity of formation of new organic matter were calculated on the basis of the material collected and have proved to be rather large. North of 50°N the difference between the pre-morning minimum and afternoon maximum averaged from 24 to 79 mkg-at O_2/1; north-east of Belle-Isle Channel in the region of 57°W $\triangle O_2$ maximum within the 500 m isobath equalled 169 mkg-at/1. The same region was characterized by a very great value of biochemical oxidation of organic matter reaching on the average 22 mkg-at/1 per 24 hours, whereas in the other parts of this area the average diurnal oxygen demand was 4 mkg-at/1 and sometimes only 2 mkg-at/1. The average over-oxygenation in waters of the photic layer in this area reached 108% - 105% of the full oxygenation value.

Intensive photosynthesis in these waters resulted in considerable decrease of phosphates in the photic layer (0.97 mkg.at/1) in comparison with their content in the subsurface layer. South of 50°N oxygenation of the photic layer also averaged 104% - 107%; $\triangle O_2$ maximum value varied from 22 to 72 mkg-at/1. Only for the eastern part of Flemish Cap Bank $\triangle O_2$ maximum was registered at 103 mkg-at/1.

With the exception of two extremely high values the intensity of production of oxygen reached on the average 44 mkg-at/1. This is one and a half times higher than the value observed in the earlier season of the year (May-June 1958) in the Davis Strait.

Phosphate consumption in the photic layer reached here 0.17 mkg-at/1, if estimate is made in comparison with the content of phosphates in the subsurface layer of sea water.

The intensity of biochemical oxidation of organic matter characterizing its relative content in waters east and southeast of Newfoundland, was considerably lower and averaged 4 mkg-at/1 per 24 hours. At the same time this process was more intensive in the Flemish Cap area reaching 6 mkg-at/1.

The above data indicate a rather high primary productivity of the water masses in this Atlantic area.

C. FISHING ACTIVITIES AND COMPOSITION OF CATCHES BY AREAS

BY V. A. TRAVIN, E. I. SURKOVA, AND E. M. MANKEVICH

Soviet commercial trawlers were engaged in fishing activities in the ICNAF zone all year round. The intensity of the fishery was somewhat lower in the first and fourth quarters, when some of the large refrigerator ships of the "Pushkin" type were fishing herring in the Norwegian Sea. Trawlers of the following three types were engaged in fishing in the ICNAF zone: 151-500, 501-900 and over 1800 tons displacement. The latter produced the bulk of the total harvest.

Average catches per hour of hauling of common trawlers (from 501 to 900 tons) were twice, and those of medium-size trawlers (151 to 500 tons) four times lower than catches by vessels like the "Pushkin."

The total harvest of Soviet trawlers from the ICNAF area in 1959 was 181,937 tons, of which 138,276 tons were obtained by the Murmansk trawling fleet. The bulk of the harvest (95.3%) was taken from Subarea 3 (Newfoundland). In the Labrador area concentrations of fish last year were thin and inconsistent, and produced only 0.7% of the total yield. In the West Greenland area, where only occasional short fishing trips were made, only 0.4% of the total yield was obtained. Scouting vessels produced 3.6% of the total yield, but their catch cannot be classified by subareas.

Like in previous years, redfish, primarily *Sebastes mentella*, made the bulk of the catches of Soviet trawlers (82.4%). Cod made 9.5% of the annual catch, and other groundfish - 7.5%; flatfish and halibut together only 1%.

In 1959 observations of the composition of catches and of certain hydrographic conditions were organised more systematically than in previous years, covering the areas of West Greenland, Labrador, and Newfoundland. Scouting and research vessels made occasional trips to the subdivisions off Nova Scotia (4V and 4W).

The r/v "Sevastopol" made one trip to the North West Atlantic (Newfoundland Bank and Labrador), and the scouting vessels "Rossiya," "Odessa," "Stalingrad," and "Zapad," with groups of scientific workers on board, made nine trips to all areas.

The total of 820 hydrological stations in a series of standard sections were made, about 314,000 specimens of fish (62,000 cod, 11,000 haddock, and 241,000 redfish) were examined; and material for determining age was collected from 17,000 specimens (including 12,000 redfish and 5,000 cod).

Subarea 1.

Material was collected from West Greenland waters from April to November. Commercial trawlers made only occasional trips—never very successfully—to this area, and therefore returned to the main fishing grounds, i.e., to the Newfoundland Bank. Scouting trawlers fished on redfish and cod, depending upon the depth of the areas being investigated, their redfish catches consisted practically of *S. marinus* only. The largest catches of redfish were taken in subdivision 1C.

In all the subdivisions investigated (1C, 1D, and 1E), the average size of redfish exceeded 40 cm, and the numbers of males and females were almost equal, males somewhat prevailing. The maximum sizes of redfish in 1C were 37-44 cm, and in 1D and 1E, 39-46 cm. The length of females, as a rule, somewhat exceeded that of males. The age data obtained indicated that younger fish were captured in 1C than in 1D and 1E. In the former area most of the redfish captured were from 15 to 18 years old, and in the two latter areas from 17 to 20 years old. The maximum average weight per one specimen (about 1.5 kilos) was observed in 1D.

Cod occurred in all subdivisions, prevailing in the catches from 1B. In most cases average size of cod exceeded 60 cm. In 1D larger cod were encountered all year round than in the other subdivisions. In the samples taken from 1B, 1C, and 1D, for determining age, 6 and 5 years old specimens prevailed (1953 and 1954 year-classes). In 1E older fish were captured in May and June, when the share of 12 years old specimens was quite large.

Subarea 2.

In the Labrador coastal area, primarily on Hamilton Bank (2J), good concentrations of redfish and cod were observed early in the year, but fishing was hampered by unfavourable ice conditions. In the subsequent months, and until the end of the year, when there was no ice to prevent fishing, the concentrations became small and inconsistent. Therefore the Soviet trawlers spent very little time in this subarea and the fishing yielded only about 1000 tons, 70% of which were redfish.

Scouting and research work was conducted in March and in June-August, mainly in 2J. In July and August several trips were also made to 2H.

In the catches of redfish females were somewhat prevailing, most so in June when females accounted for 2/3. In this area the male and female size compositions were much different. On the average, the maximum sizes observed were from 31 to 38 cm for males, and from 35 to 42 cm for females. A corresponding difference was observed in the average weight and age composition. In 2J the average weight of a female was 956 and of a male 618 grams. The oldest males were 24 years old, females 27 years old.

The cod captured in the Labrador coastal area were much smaller than those caught off West Greenland. In 2H the average size was about 54 cm, on Hamilton Bank (2J) about 50 cm. The maximum sizes in 2H were between 41 and 65 cm, in 2J between 36 and 60 cm. The sample of cod taken for determining age in April 1959 showed that fish from 5 to 8 years old, i.e. of 1954-1951 year-classes, prevailed in the catches.

Subarea 3.

The Newfoundland region, particularly its northern part (3K, 3L, and 3M), was the main fishing ground of Soviet trawlers. Redfish were being fished all year round. Redistribution of trawlers took place quite frequently depending upon the density of concentrations found in the

above mentioned subdivisions. The Murmansk fleet was engaged mainly in 3K, where it obtained 42% of the annual catch; the next important fishing ground was 3M (30.9%) and then 3L (14.5%). Just a few trawlers, from 501 to 900 tons, were fishing in 3N, where only 0.1% of the total yield was caught.

The composition of the redfish (*Sebastes mentella*) stocks fished in 3K and 3L proved to be very similar. On the average the catches taken all year round contained 58% females and 42% males; the average size of females was from 37.5 to 38 cm., of males from 34.20 to 35.20 cm (the respective weight of one specimen being 600 and 1000 grams). The peak of the size curve for males was between 31 and 38 cm, and for females between 35 and 42 cm. The prevailing ages of males were from 12 to 18 years, of females from 16 to 20 years. The redfish from 3M (Flemish Cap Bank) were on the average considerably smaller, males by 2 cm and females by 3 cm. The maximum length of males was from 29 to 36 cm, of females from 31 to 40 cm, the prevailing ages being respectively 11 to 16 years and 12 to 17 years. The average weight of males from Flemish Cap Bank was 560 of females 707 grams.

The available data for 3N and 3O on the southern slope of the Newfoundland Bank, obtained by scouting trawlers which operated there at different times, mainly in the first half of the year, indicated that *Sebastes mentella* were very small, of no commercial importance for Soviet trawlers. For instance, in 3N the average size of males was 29.59 cm, and of females 31.56 cm; in 3O, 26.07 cm and 27.65 cm, respectively, in both subdivisions females made about 2/3 of the catch.

Cod were certainly of commercial sizes in all the Newfoundland subdivisions investigated by the scouting trawlers. In most cases their average size exceeded 50 cm, the average weight being about 1.5 kilos. The largest cod (average length about 60 cm) were encountered in 3L and 3N, especially early in the year.

Subarea 4.

A scouting trawler which cruised in the southern areas of the Newfoundland Bank in April 1959, took samples of cod from the adjacent subdivisions 4V and 4W. More than 1000 specimens of cod from 4V, and more than 700 from 4W were examined. The average sizes of fish from these samples were respectively 55.25 cm and 73.15 cm. The peak of the size curve for 4V was between 46 and 65 cm, for 4W between 56 cm and 70 cm. A rather high percentage of the specimens from 4W were up to 100 cm or longer.

D. FISHING CONDITIONS IN THE AREA OF THE GRAND NEWFOUNDLAND BANK IN 1959, AS REPORTED BY THE SOVIET TRAWLER FLEET

By M. A. PAVLOV

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In 1959, like in previous years, the Soviet trawler fleet in the North-West Atlantic fished primarily for redfish.

The fishing activities were concentrated mainly on the northern and north-eastern slopes of the Newfoundland Bank and off the southern part of Labrador.

The following three periods of fishing are distinguished: The first period, from January through May, characterised by the highest yields; the second period, from June through November characterised by a change of fishing conditions for the worse and considerable reduction of yields; and the third period, beginning December, characterised again by increased yields.

From January through May the Soviet trawl fleet was engaged in redfish fishery on the northern and north-eastern slopes of the Newfoundland Bank. The concentrations of redfish were sluggish and very thick. The catches contained mainly *Sebastes mentella*, from 36 to 42 cm long, with *Sebastes marinus* in the by-catch. The by-catches taken at the depth up to 300 meters contained large-size cod.

Redfish were feeding at that time on lantern fish (*Maurolicus*).

The fleet moved in March to the eastern slope of the Newfoundland Bank and to the north-western slope of Flemish Cap Bank because of the ice conditions in the main fishing areas.

The month of May was a kind of turning point in the progress of fishing. By the end of May the conditions on the northern slopes of the Newfoundland Bank became much worse. It can be explained both by the retreat of spent females to the greater depths, and by the migration of redfish concentrations to the south necessitated by the fall of water temperature in northern regions.

The scattering of redfish was accompanied by sharp changes in yields in the course of 24 hours which, certainly, must be accounted for by vertical migrations of redfish who turned to feeding on planktonic organisms.

In the period from September through November the concentrations of redfish were the thinnest and most mobile, which could not but affect the methods of fishing. In contrast to the practice of the winter-spring season, the boats had to move frequently from one fishing area to another and to disperse.

By the end of November the fishing conditions improved. Adequate concentrations of redfish were found in the northern part of the Newfoundland Bank and in the southern areas of Labrador, where they stayed through December. Large concentrations were confined to the areas of sharp temperature gradients at the line of junction of cold and warm waters extending along the eastern slope of the zone of shallow waters.

Thus, the following picture of migrations of redfish stocks in the Newfoundland Bank area in 1959, can be given on the basis of the areas fished by the trawler fleet in various seasons. During the pre-spawning and spawning periods (January through May), the concentrations of redfish were confined to the northern slopes of the Newfoundland Bank. In May spent females retreated to greater depths. During the feeding period, the redfish concentrations, scattered and very mobile, kept close to the eastern slope of the Newfoundland Bank and in the area of Flemish Cap. The concentrations became denser toward the end of November and in December.

The following table shows the changes in the catches, metric tons per one hour haul, of large stern trawlers in the area of the Newfoundland Bank, off Labrador, and in the area of Flemish Cap, during 1959.

Months:	1	2	3	4	5	6	7	8	9	10	11	12
Tons:	2.22	2.57	2.86	2.41	2.81	1.49	1.68	1.37	1.55	1.32	1.40	2.10

The average catch per hour of haul of large stern trawlers was 2.01 ton, as against 2.17 in 1958.

In 1959 scouting boats investigated the southern slopes of the Newfoundland Bank. Concentrations of haddock were discovered in this area in January, at a depth from 50 to 70 m. These concentrations produced catches amounting to 1.5 tons per haul.

Scientific scouting was conducted also in the area off West Greenland, April-September. It should be mentioned that during the entire period high yields of both cod and redfish, were never steady. For instance, large catches of redfish in the area south-west of Lille Hellefiske Bank, in June 1959, kept for five days only. On the Fylla Bank concentrations of cod in April and May were small, and only in the period from May 11-16 large catches were taken, quite unexpectedly. On Store Hellefiske Bank catches varied greatly, from 300 to 3000 kg per haul.

Appendix to the U.S.S.R. Research Report

ZOOPLANKTON OF THE FRONTAL ZONE OF THE NORTH ATLANTIC IN SPRING 1958

BY A. P. KUSMORSKAYA, VNIRO, U.S.S.R.

During the International Geophysical Year (1957-1958) planktonic studies were conducted by Soviet scientists in the Atlantic and Pacific Oceans, similar methods of research being used in both regions.

In the spring 1958 plankton collections in the North Atlantic were made by the R/V "M. Lomonosov" in the area from 55°N to the Azores and from Newfoundland to Spain (Fig. 1). The material collected permitted the study of the distribution of zooplankton in the North Atlantic and the locating of areas most abundant with food for fishes.

Zooplankton was sampled mainly with a No. 38 (38 threads per cm) Juday net of 36 cm diameter and with No. 140 (14 threads per cm) Juday net of 80 cm diameter from the following depths: 500-200 m; 200-100 m; 100-50 m; 50-25 m and 10-0 m; phytoplankton was sampled horizontally with Nansen bottles at 0.5 m, 10 m, 25 m, 50 m, and 100 m.

Numerous data of various research expeditions in the Atlantic Ocean, published by Hensen (1911), Lohman (1919), Hentschel (1932), Jespersen (1935), Wilson (1942), and others, were used first by Hentschel (1942), and then by Friedrich (1950) to compile a chart of the distribution of the relative density of pelagic population of the Atlantic. Hentschel, however, limited himself to establishing the oligotrophic and eutrophic regions and did not try to provide quantitative indices.

The data on the distribution of zooplankton biomass are given here as calculated by converting the number of planktonic organisms to their raw weight. Estimation of organisms was carried out in Bogorov's counting chamber by means of a stamp-pipette.

The North Atlantic area under investigation is heterogeneous with regard to its hydrologic regime and the distribution of water masses.

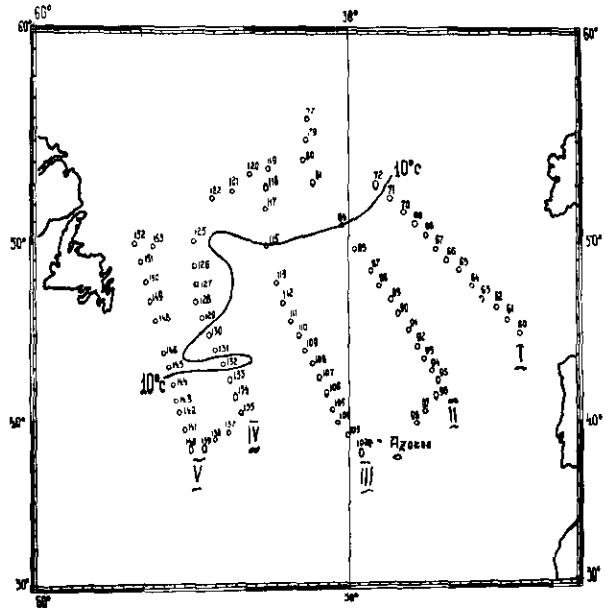

Fig. 1. Stations worked in spring 1958 in line with IGY program. The 10°C isotherm for surface water is shown.

Equally heterogeneous are the composition and distribution of the plankton.

The suborder *Calanoida*, whose specific determination was given special attention, is represented by 160 forms. The group of warm water organisms was represented by the largest number of species. Boreal species were considerably scarcer, and arctic species were only represented by single individuals. The 10°C isotherm of the surface appeared as the southern border of mass distribution of boreal fauna and as the northern limit for the warm water species (Fig. 1). South of this isotherm lies a zone of mixing, where representatives of both faunas are found together. This mixing zone extends as a wide belt from the southwest to the northeast in the area of the North Atlantic current.

The number of boreal species of *Calanoida* in the zone of mixing south to Stations 140, 135, 109, 87, 69 incl. only decreased slightly—as compared with the boreal zone—north of the 10°S isotherm. South of the above stations boreal species occurred in the plankton with only

few individuals, and they were entirely absent from the area of the Azores. Similar individual occurrence of warm water species was registered north of the 10°C isotherm.

The following representatives of the boreal fauna were observed most frequently north of the 10°C isotherm: *Calanus finmarchicus, Microcalanus pygmaeus, Pareuchaeta norvegica, Limacina retroversa, Thysanoessa longicaudata.*

Metridia lucens and *Pleuromamma robusta* were also observed at most stations, whereas *Scolecithricella minor* was somewhat more scarce.

In the area of the Newfoundland Bank the boreal fauna could be found together with arctic organisms in relatively low numbers. The most frequent were *Calanus hyperboreus, Calanus glacialis;* more rarely occured *Limacina helicina, Clione limacina* juv.

The following representatives of the boreal fauna were most frequently observed in the zone of mixing: *Calanus finmarchicus, Microcalanus pygmaeus, Pareuchaeta norvegica, Metridia lucens, Pleuromamma robusta, Limacina retroversa.*

Warm water species were represented here by *Calanus tenuicornis, Neocalanus gracilis, Nannocalanus minor, Mecynocera clausi, Calocalanus styliremis, C. tenuis, Paracalanus parvis, Ctenocalanus vanus, Clausocalanus arcuicornis, Euchirella rostrata, Euchaeta acuta, Pleuromamma gracilis, P. borealis, P. xiphias, P. abdominalis, Lucocicutia flavicornis, Heterorhabdus papilliger, H. spinifrons, Heterostylites longicornis, Haloptilas longicornis.*

The zone of mixing was also abundant with salps, mainly represented by *Salpa fusiformis. Calanus helgolandicus*, found in plankton south of the 10°C surface isotherm, occurred at all stations right to the Azores.

The quantitative development of plankton in the area of investigations was not uniform; the reason for this is not only the specific conditions of the regime, but also the long period of observation (from March 2 to May 1).

Studies on Sections I and II were conducted in March prior to the vernal development of phytoplankton and the reproduction of Calanus, on Section III in the beginning, and on Sections IV and V at the height of the biological spring. Spring development of phytoplankton proceeded in the area of Newfoundland Bank (Stations 148, 149, 150, 151).

Among the most numerous diatoms were *Chaetoceros atlanticus, Ch. convolutus, Rhizosolenia hebetata, Thalassiosira Nordensköldii.* Diatom bloom at Station 126 was caused by mass development of *Thalassiothrix longissima* which also occurred in smaller quantities at Stations 127 and 128.

At Stations 144, 132 and, to a lesser extent, at Station 145 the warm water diatom *Thalassiothrix delicatula* occurred in considerable quantity in the 50-0 m layer. At Station 142 in the 25-170 m layer the moderate-warm water species *Thalassiosira subtilis* was found in great numbers. No development of this species was observed in the 25-0 m layer.

The distribution of food zooplankton in the central part of the North Atlantic agrees well with the regime of this area (Fig. 2). When compiling the chart of zooplankton biomass salps, doliforms, siphonophores and meduses were not taken into account because they are considered as non-food organisms for fishes.

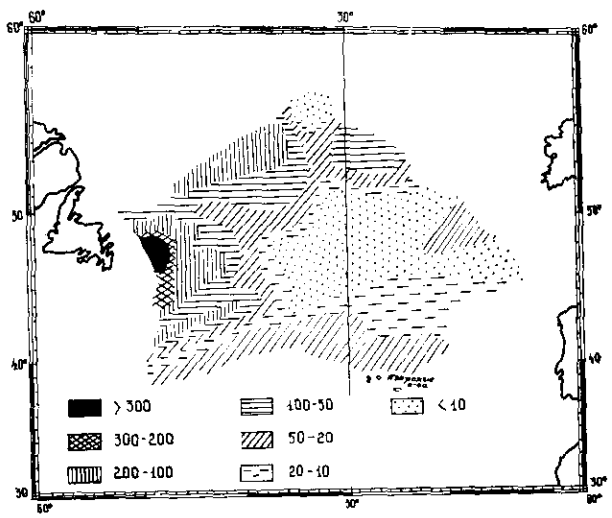

Fig. 2. Distribution of food zooplankton in the 200-0 m layer in spring 1958, in mg per m^3.

The water masses most abundant with food plankton were situated north and northwest of the 10°C surface isotherm. South of it the biomass of zooplankton is greatly decreased. Minimum values of food zooplankton biomass were registered in the central part of the investigated area, i.e. the area where the North Atlantic current fans out. South of this impoverished area, particularly around the Azores, the quantity of food zooplankton had slightly increased; this confirms information in the existing literature.

The average biomass value of food zooplankton for the boreal waters north of the 10°C surface isotherm was for the 100-0 m layer - 204 mg/m^3, and for the 200-0 m layer - 138 mg/m^3.

The average value of food zooplankton biomass for the area south of the above isotherm for the 100-0 m layer was 30 mg/m^3, and for the 200-0 m layer - 24 mg/m^3.

Zooplankton of the boreal zone (north of the 10°C isotherm) was mainly represented by *Calanus finmarchicus* which constituted 32% of the food zooplankton biomass, *Limacina retroversa* (24%) and *Euphausiacea* (12%). In the plankton biomass of the upper 200 m of water south of the 10°C isotherm various species of the genera *Pleuromamma*, *Clausocalanus*, *Calocalanus*, and *Ctenocalanus vanus* had the greatest weight.

Calanus finmarchicus, the main food organism for pelagic fishes, occurred only in large numbers north of the 10°C isotherm in conformity with the increase in biomass from northeast to southwest (Fig. 3). This was caused by the local differences on one hand, and by the seasonal changes on the other, since plankton was sampled in the northern parts of sections II and I in the middle of March, from sections III and IV in the middle of April and on section V in late April. This also affected the abundance and composition of the population of *Calanus finmarchicus*, the main representative of zooplankton in the boreal zone.

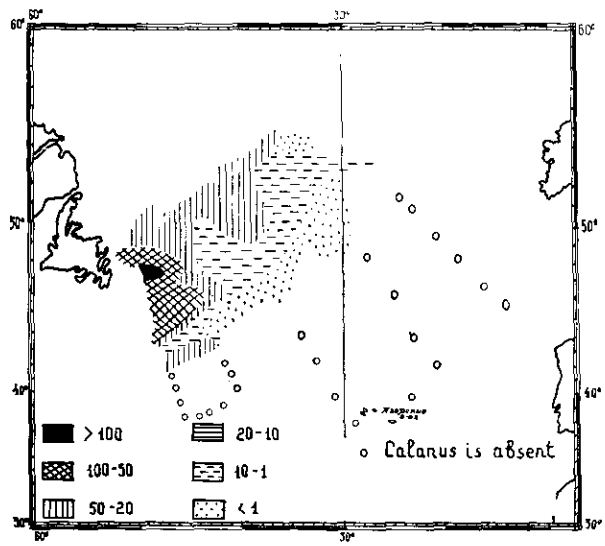

Fig. 3. Distribution of biomass of *Calanus finmarchicus* in the 200-0 m layer in spring 1958, in mg per m^3.

TABLE 1. The numerical strength and age-composition of the population of *Calanus finmarchicus* in the North Atlantic in Spring 1958 (average number in the 500-0 m layer; sampled with a Juday net, 36 cm in diameter).

Area	Stations 77, 79, 80, 81 March 13-20		Stations 115, 117, 118, 119, 120, 121 April 10-15		Stations 148, 149, 150, 151 April 28-May 1	
Stages of Development	Number	%	Number	%	Number	%
I	—		8	0.8	1011	30.8
II	—		23	2.2	466	14.3
III	—		25	2.4	247	7.5
IV	29	10.9	80	7.7	237	7.2
V	198	74.0	189	18.5	290	8.9
VI	12	4.5	500	48.8	966	29.6
VII	28	10.6	200	19.6	55	1.7
Total	267	100.0	1025	100.0	3274	100.0

At stations 77, 79, 80 and 81 *Calanus finmarchicus* was found in the lower water layers, 500-200 m. Since the deeper layers were not investigated, it can not be stated whether *Calanus* occurred below 500 m. In spite of rather high temperature of the upper water layers (7-9°C) the population kept all the time below 200 m, never ascending to the surface, not even in the evening or at night time.

At stations 115, 117, 118, 119, 120 and 121 all age-groups were present in the population, the females dominated in number. *Calanus* was caught in all water layers from 500 m to the surface, i.e. the population was in the stage of ascending after the winter and just entering the period of spring reproduction. Water temperature was somewhat lower than in the area just discussed, though at most stations the beginning of the warm-up of the surface layer and the stratification of the water were observed. At some stations spring diatoms appeared in small numbers.

Intensive propagation of *Calanus finmarchicus* was observed in the Newfoundland Bank area. The young were dominating. The eggs and nauplii numbered tens of thousands in one cubic meter of water throughout the whole water layer, but especially in the upper 50 m layer.

Calanus hyperboreus, the arctic representative of plankton was most abundant in the Newfoundland Bank area (Fig. 4). Its distribution is determined apparently by the transport of water from the Labrador Sea to the more southern areas of the North Atlantic as well as by the deflection of the Labrador current roughly along the 50°N Lat. to about 30°W Long.

The population of *Calanus hyperboreus* was not numerous and was composed principally of stages IV and V and of adult females. The eggs and nauplii were only found in the plankton of the Newfoundland Bank, where the lowest temperatures were recorded.

The quantitative distribution of salps in the North Atlantic is indicative of the supply of water of the North Atlantic current (Fig. 5).

The greatest numbers of salps, especially *Salpa fusiformis*, were found in plankton of the southern stations of section V and in the central part of the area, characterized by the minimum biomass of food zooplankton (Fig. 2). Salps were almost absent from the southern part of the first three sections; here doliforms, especially *Doliolum mülleri*, were found in mass numbers.

When comparing the composition and quantitative distribution of zooplankton in the in-

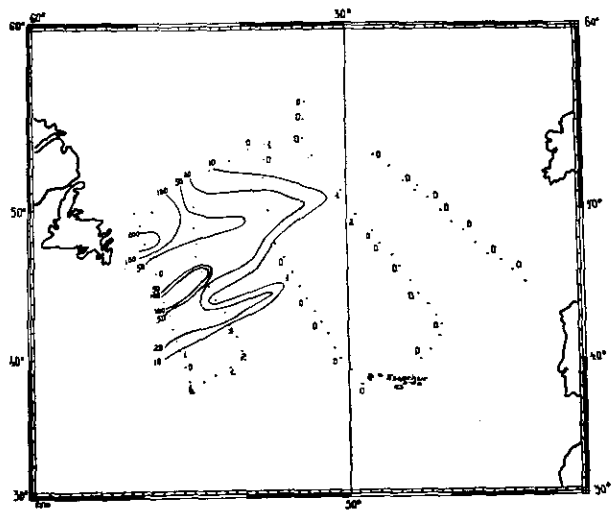

Fig. 4. Distribution of *Calanus hyperboreus* in the N. Atlantic in spring 1958; numbers of individuals caught with a Juday net (38 cm in diameter) in the 500-0 m layer.

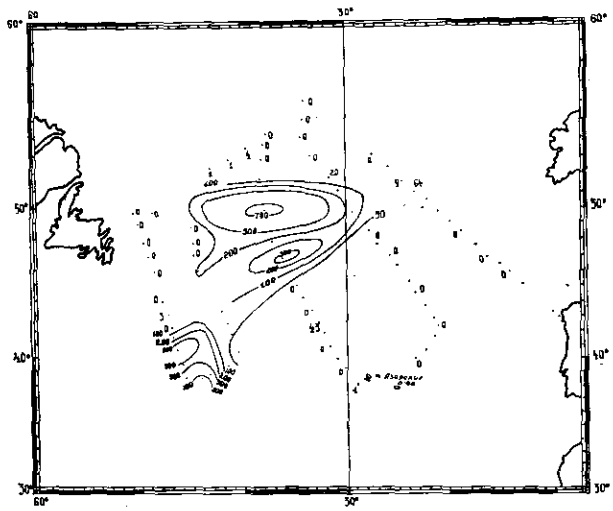

Fig. 5. Distribution of salps in the N. Atlantic in spring 1958; numbers of individuals caught by a Juday net (38 cm in diameter) in the 500-0 m layer.

vestigated area of the North Atlantic, it appears that in the spring of 1958 the zone of mixture of boreal and tropical fauna showed the lowest quantities of food plankton. The analysis of the material showed that zooplankton biomass in the investigated area decreases with increasing numbers of warm water species of *Calanoida*.

Let us consider the distribution of food zooplankton by species and biomass on sections III, IV and V (Fig. 6). The numbers of boreal species of *Calanoida* in the northern half of section III up to station 111 incl. remained unchanged; then their number gradually decreased until they entirely disappeared in the area of Azores. The number of warm water species began to increase from station 115 (the 10°C isotherm at the surface). At station 113 there is a sharp increase and the number remains at the high level with small variations up to the end of the section. The biomass of food zooplankton sharply decreases in proportion with the increase of warm water species in the plankton, reaching its minimum at stations 113-109 despite almost unchanged number of boreal species. The latter inhabit the zone of mixture mainly at the depth below 100 meters, though their number here is not very large.

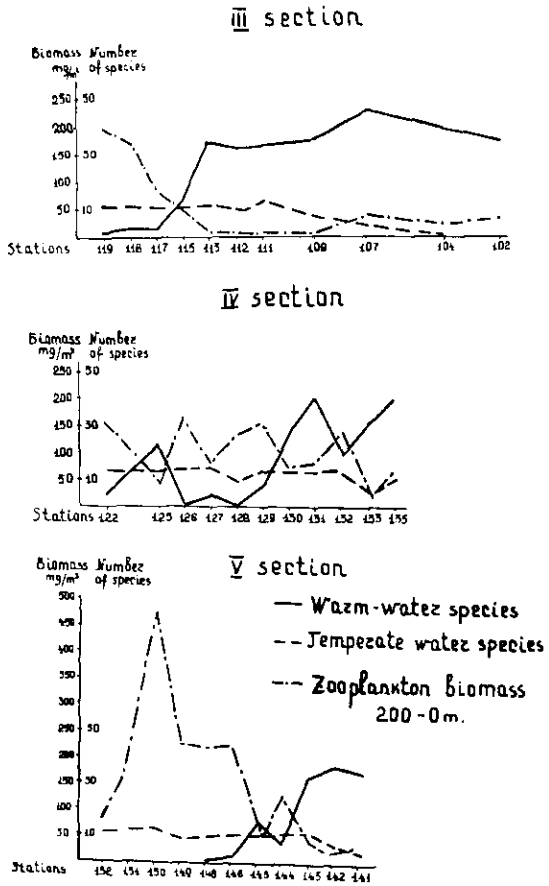

Fig. 6. Variations in the number of species of *Calanoida* and biomass of food zooplankton by latitudes in the N. Atlantic.

On Section IV the ratio between the number of warm water species and the biomass of food zooplankton is the same as in Section III. Plankton at station 125 is characterized by the presence of a considerable number of warm water species and a large number of salps. At station 126 the boreal species dominated with an admixture of arctic organisms; no warm water species were observed. The number of warm water species in the Flemish Cap area (station 127, 128) was insignificant; more southerly they occurred in great numbers. A marked decrease in the number of warm water species was observed only at station 132 where warm water mixed with cold water flowing at different levels. Thus, *Calanus finmarchicus* was found in large quantities in the 50-0 m layer. This species was not observed between 50 and 200 m, but below 200 m it could be found in considerable numbers together with *Calanus hyperboreus*. At the same time many salps were found in the 50 to 200 m layer which is indicative of a supply of water from a warm current. The number of boreal species at the stations in this section was very stable, but their numerical strength and, consequently, their biomass fluctuated greatly.

Distribution of warm water species on Section V was somewhat different from that on the two preceding sections. In the northern half of the section (Newfoundland Bank) warm water species were not observed. They appeared only at station 146 and reached the maximum number in the southern part of the section (stations 143, 142, 141) characterized by a very small quantity of food zooplankton and a mass development of salps, indicating a supply of warm water from the Gulf Stream.

From the consideration of the composition and distribution of zooplankton of the frontal

zone of the North Atlantic in spring 1958 it can be concluded that the areas south and east of the 10°C surface isotherm were poor in abundance of food plankton. These areas were distinguished by the presence of a great number of warm water species with low numerical strength and biomass. The areas situated to the north of the 10°C surface isotherm showed the presence of a limited number of boreal species in the plankton, however with great numerical strength and, thus, of much greater biomass.

As the 10°C surface isotherm appears to be the northern border of distribution of salps, it may be assumed also to be the northern limit for the spread of the North Atlantic current whose waters in spring 1958 were distinguished by a poor development of food zooplankton.

LITERATURE USED

1. BRODSKY, K. A. On the phylogenetic interrelations of some *Calanus* (Copepoda) species of the North and South Hemispheres. Zoological Journal, vol. XXXVIII No. 10, 1959.
2. YASHNOV, V. A. The origin of species *Calanus finbrehicus*, S. L. Zoological Journal, vol. XXXVII, No. 6, 1958.
3. FRIEDRICH, G. Versuch einer Darstellung der relativen Besiedlungsdichte in den Oberflächenschichten des Atlantischen Ozeans. Kieler Meersforsch. VII, Heft 1-2, 1950.
4. HANSEN, V. Das Leben im Ozean nach Zählungen seiner Bewohner. Ergeb. Plankton. Exped. d. Humbold-Stiftg. Bd. 5, 1911.
5. HENTSCHEL, E. Die Biologischen Methoden und das biologische Beobachtungsmaterial der "Meteor" - Expedition. Wiss. Ergebn. Deutsch. Atlant. Exped. "Meteor". Bd. 10, 1932.
6. HENTSCHEL, E. Eine biologische Karte des Atlantischen Ozeans. Zoolog. Anz. Bd. 137, 1942.
7. JESPERSEN, P. Quantitative Investigations on the Distribution of Macroplankton in different Oceanic Regions. "Dana" - Reports, Nr. 7 1935
8. LOHMANN, H. Die Bevölkerung des Ozeans mit Plankton nach den Ergebnissen der Zentrifugenfänge während der Ausreise der "Deutschland" 1911. Arch. f. Biontologie, Bd. IV, 3, 1919.
9. WILSON, Ch. The Copepods of the Plankton gathered during the last cruise of the "Carnegie." Sc. Res. Cruise VII of the "Carnegie" 1928-29. Biology 1, 1942.

X. United Kingdom Research Report for 1959

BY C. E. LUCAS AND R. J. H. BEVERTON

Commercial Fishing.

Effort and landings in 1959 were both slightly higher than in 1958. In all 64 trips were made to Subarea 1, from which 9,951 tons of cod were landed. The catch per unit effort increased, from 0.14 to 0.18 tons per 100 ton-hours.

Market Sampling.

During 1959 regular measurement was made of cod landed from Subarea 1 at Hull and Grimsby (Figure 1). In all 4,569 fish were measured. The measurements will be presented in tabular form in the Sampling Yearbook vol. 4. 153 otoliths were collected for age determination.

Fish Stock Assessments.

Members of the population teams of the Lowestoft and Aberdeen Laboratories have, as requested, been reviewing the fish stock data available for the Commission's Areas 1 and 2, in conjunction with representatives of Denmark and Portugal; the results have been communicated to the ICNAF special population dynamics meeting at Lowestoft in March 1960.

Comparative Fishing.

Although no comparative fishing experiments were conducted in the ICNAF area in 1959, experiments undertaken elsewhere are relevant to the Commission's programme. In particular, further work was done on the cod-end topside chafer problem, particularly with a different kind of chafer which may have opened the way towards a more satisfactory solution to this problem; preliminary results were communicated to the ICES meeting in October 1959. The Scottish spring-load mesh measuring gauge has

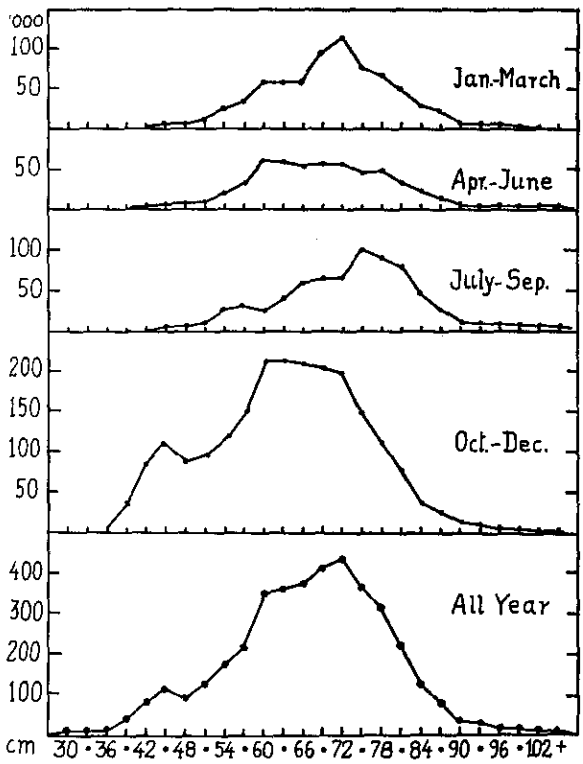

Fig. 1. Length measurements of cod, 3 cm groups, by quarters of 1959 and whole year, caught by U.K. trawlers in Subarea 1. Raised figures ('000 ind.); 4,569 cod measured.

been slightly modified in accordance with Dutch suggestions and has been recommended by ICES for international adoption by its scientists.

Plankton.

The continuous plankton recorder survey conducted from the Oceanographic Laboratory in Edinburgh was extended during 1959 to the western boundary of the ICES area and into the ICNAF area, by means of records taken between Iceland and Newfoundland with the invaluable assistance of Icelandic scientists. Preliminary results show the potential value of a series of such continuous records, both in terms of plankton in general and *Sebastes* larvae in particular; an interim report on records of young *Sebastes* obtained by this method was presented to the ICES/ICNAF Redfish Symposium in Copenhagen.

XI. United States Research in the Convention Area during 1959

A. BY HERBERT W. GRAHAM

LABORATORY DIRECTOR, BUREAU OF COMMERCIAL FISHERIES

BIOLOGICAL LABORATORY, WOODS HOLE, MASS.

SUBAREA 5[1]

Haddock (*Melanogrammus aeglefinus* (L.))

The Fishery. U. S. haddock landings were lower again this year, continuing the trend begun in 1957 (see Table 1). There was an increase in effort but a slight decrease in the catch per unit of effort. As had been anticipated, there was not a strong recruitment of 1956 year-class fish (about 29% of the total catch) and the large 1954 year-class was still contributing significantly (about 13% of the total catch).

Evaluation of the Mesh Regulation. The 1952 year-class of haddock has now virtually passed through the fishery, making possible a new evaluation of the Subarea 5 mesh regulation. The 1952 year-class was fished almost entirely with the regulation ($4\frac{1}{2}$-inch) cod-end mesh. Through age 5, the 1948 year-class (fished with small mesh nets) and the 1952 year-class yielded nearly equal numbers of fish. However, landings from the 1952 year-class weighed almost 20% more than landings from the 1948 year-class. This difference is considered to be the result of mesh regulation.

[1]) Most of U.S. research was restricted to Subarea 5. Studies conducted in other subareas are included in this report with appropriate reference to region concerned.

TABLE 1. Trends in the Subarea 5 Haddock Fishery[1].

Year	Large	Scrod	Total	Days fished	Catch/Day
1956	55.6	52.3	107.9	7763	13.9
1957	51.4	49.5	100.9	9090	11.1
1958	43.1	38.4	81.5	9261	8.8
1959[2]	42.2	36.0	78.2	8455	8.3

1) Landings in millions of pounds.
2) Based on a preliminary analysis.

Young-of-the-Year Survey. Surveys of young-of-the-year (or pre-recruit haddock) have been made for several years now. These surveys are concerned with Subarea 5 and Subdivision 4X. Approximately one month of sea time is devoted to surveying the banks to assess the strength of young-of-the-year and 1-year-old haddock. In general these surveys have yielded data on pre-recruit abundance that has subsequently been verified, in magnitude at least, by the landings of the commercial fleet. Although no unusually large year-class has yet been detected, some amelioration of the downward trend of the past few years is expected on the basis of the surveys made in 1958 and 1959.

Age Determination. The techniques and validity of aging haddock, using scales, have been carefully re-examined and a report on this study will soon be ready for publication. The validity of the scale aging method through the first years of life for Georges Bank haddock is now regarded as being established beyond a reasonable doubt. Further studies on the aging problem using techniques other than the scale method are progressing satisfactorily.

Ecology. The study of the haddock's ecology on particular grounds, mentioned in last year's research report (1958), is progressing satisfactorily. Studies of the seasonal changes in gonads and other organs are also under way. Of particular interest is the seasonal change in liver weight and its inverse relationship to gonad weight. There is evidence that the developing gonads depend largely on reserves held in the liver, as well as material from other parts of the body.

Cod (*Gadus morhua* L.)

The Fishery. Total U. S. landings for 1959 were up about 2 million pounds over the 1958 total of 27 million pounds. This was principally due to an increase in the abundance of market cod (fish from $2\frac{1}{2}$ to 10 pounds). The 1958 increase was due to the presence of unusually large numbers of scrod fish (fish of less than $2\frac{1}{2}$ pounds).

Research. In collaboration with the Woods Hole Biological Laboratory, two U. S. Navy airships (blimps) dropped drift bottles over an area of more than 10,000 square miles of ocean surface in one night (February 1959). The resulting drift data will help to clarify the nature of surface currents off the coast of New Jersey and the effect of these currents on the fate of eggs and larvae of the codfish that spawn here.

Further analysis of tag returns has yielded some valuable comparative data on the types of tags that have been used. Petersen disc tags with the pin applied through the dorsal musculature give better results in terms of returns than the modified Lea tags previously used, regardless of the time at large.

A study of the emigration of the larger cod to colder waters in Subarea 4 and 5 has been completed.

Redfish (*Sebastes marinus* (L.))

The U. S. redfish landings in 1959 were about 137 million pounds, 10 million pounds less than 1958 and the second lowest amount since 1946. This continues the trend of gradual decline in redfish landings since reaching a peak in 1951. About 29 million pounds of this year's total were

caught in the Gulf of Maine, 50 million on the Nova Scotian banks, 38 million on the Grand Bank, and 20 million in the Gulf of St. Lawrence. The Labrador coast fishery that was opened in 1958 did not develop as anticipated this year.

The Gulf of Maine redfish fishery remains fairly constant in abundance with an average catch of close to 10 thousand pounds per day in 1959. On the Grand Bank and Nova Scotian banks fishing effort increased slightly while catch-per-day decreased about 10% from the 1958 values, ranging between 21 and 33 thousand pounds per day on different grounds. Fishing effort decreased in the Gulf of St. Lawrence while the catch-per-day rose slightly to 21 thousand pounds.

Research. Field work was concentrated on the inshore stock of redfish at Eastport, Maine. Routine sampling of the commercial landings at the four major redfish ports was continued for length, age and abundance analyses, and for spawning, racial, and parasite studies.

Kelly reported on three aspects of his work at the Redfish Symposium at Copenhagen in October.

The measurement of a long series of meristic and morphometric characteristics designed to clarify the status of subspecies of *Sebastes marinus* did not show a clear separation between *marinus*-type and *mentella*-type redfish. Diameter of orbit was the most variable morphometric characteristic, but the measurements did not separate the fish into two groups of large-eyed and small-eyed fish. Instead, at least four modal peaks of eye size were present in the combined sample from all areas studied, suggesting that more comprehensive sampling may disclose a normal distribution of eye size for the whole *Sebastes* population.

There was a wide range in the average length of redfish sampled from different areas. Despite the differences in length range and eye size, there was very little difference in meristic characteristics, the differences suggesting a possible clinal distribution of meristic characteristics in the whole North Atlantic population.

Mid-winter sampling of young redfish (10 to 60 mm) in the Gulf of Maine has revealed some important information on the duration of the pelagic period and the growth and vertical distribution of the larvae during that time. Newly spawned young (5 to 6 mm) appear at the surface in the spring. As they grow to 10-15 mm the larvae move down into the thermocline, remaining there until about 25 mm in length. Beyond this size they move even deeper into cooler water where they live until they reach an average length of 50 mm and then move to the bottom. The pelagic period is about 5½ months in duration, long enough to permit the young fish to drift long distances with the water currents.

Study of the inshore stock of redfish at Eastport, Maine, has provided observation of the live fish in its natural environment. Recapture of a great many tagged fish at the tagging site reveals a rather strong territorial instinct and little tendency to migrate. Otolith studies show the growth of tagged fish to be much slower than the growth rate before tagging. Tagging altered the pattern of zone formation in the otolith so that virtually no opaque material was deposited for as long as 3 years after tagging.

Flounder Studies.

The Fishery. Landings of yellowtail in 1959 were again high, about 28 million pounds, though slightly lower than in 1958 when about 32 million pounds were landed. Apparently the strong year-classes from 1955 and 1956 are now passing out of the fishery. Approximately 24 million pounds of other species of flounders were also landed in 1959.

Research. An analysis of relative abundance (catch per unit of effort) of yellowtail flounder, *Limanda ferruginea*, has been completed for the three principal New England fishing grounds.

In addition, 3000 yellowtail were tagged in 1959 to further define movements and estimate fishing mortality.

Silver Hake.

The Fishery. Total annual landings of silver hake from New England grounds was 85

million pounds, approximately the same as the previous year. The occurrence of smaller fish on the offshore grounds focused the fishing effort on to the larger silver hake located inshore.

Research. Data collected on cruises increased our knowledge of the seasonal distribution of this species. The deep water between 100 and 200 fathoms appears to be the wintering area for some if not most of the silver hake. Cruises made in Subarea 5Z show that the silver hake intermingle with the deep-water species *Merluccius albidus* during the winter, but separate and move inshore during the summer months. Specific collections are being made of both species to determine the biological and ecological relationship of the two species.

Industrial Fishery.

The landings of non-food species of trawl fishes for reduction to meal stopped in September 1959 due to economic factors. As a result, a 4-year continum of fishery data on certain mixed groundfish populations also came to an end. These data are now being analyzed.

Sea Scallops (*Placopecten magellanicus* Gmelin)

The Fishery. U. S. landings from the Convention Area in 1959 were 18.7 million pounds, an increase of 11% over the 1954-1958 average and an increase of 25% over 1958. Fishing effort was 8480 days, down 19 percent from the 1954-1958 average and down 3% from 1958. The newly recruited year-class made up over 60% of the catch. The catch per tow was very high. Either the new year-class was unusually abundant or was more densely aggregated than in previous years.

Research. Growth and mortality rates calculated during the year all reinforce the previous conclusion that postponement of first capture would result in a substantial increase in the yield of a year-class.

Benthos Investigations.

A report describing the Georges Bank groundfish food resources is now being prepared, the quantitative as well as the qualitative aspects being considered. Bottom sediments, which strongly influence many groundfish foods, are also being studied. A survey of Georges Bank bottom sediments has been completed, and this work is now being extended to include the southern Gulf of Maine and Browns Bank. Field work for part of this extended coverage was completed last August.

B. BY LIONEL A. WALFORD

THE WASHINGTON BIOLOGICAL LABORATORY

RESEARCH PROGRAM RELATING TO THE ICNAF AREA

The Washington Biological Laboratory is making an analysis by 5-day periods and one-half degree squares of surface temperature observations of commercial vessels as reported to the U. S. National Weather Records Center. Comparative studies are being made of bathythermograph records as reported to the Navy Hydrographic Office and classical hydrographic data obtained from various laboratories in Canada and the United States. A series of maps is being prepared showing in various ways that are likely to have significance to fishery problems, temperature characteristics of the western North Atlantic during 1953 and 1954. The study, begun as a pilot project, demonstrates how this extraordinary volume of material may be utilized to show, in detail, features of the annual temperature regime. These features vary greatly and irregularly from year to year and will be compared over a series of years in order to understand the significance of any one year's anomalies.

A similar analysis is being made of the distribution in time and space of catches per unit of fishing effort of several species of fishes. Maps will be prepared for study in conjunction with those showing temperature fields.

Past and present environmental researches on the continental shelf of eastern North America are being assessed in relation to commercial fishery problems. This study includes an analysis of fishery problems that must be

attacked by environmental research; a statement of the necessities of an environmental research program, i.e., the kinds of data needed, their temporal and spacial distribution; a critique on the usefulness or adequacy of such data collected currently or in the past; alternate minimal and optimal plans of systematic field programs to collect adequate data in the future.

The American Geographical Society has made considerable progress in its preparation for launching the Journal of North Atlantic Biogeography, which was described at the last annual meeting of ICNAF. It is hoped that the first issue will be published within a few months. A working base map covering most of the ICNAF area is ready for distribution to scientists for use in preparing manuscripts reporting on geographic studies pertaining to species and their environments. It may be obtained by writing directly to the American Geographical Society, Broadway at 156th Street, New York 32, New York.

B. Compilation of Research Reports by Subareas, 1959

BY ERIK M. POULSEN

Summaries of researches carried out in 1959 are reported by Canada, Denmark, France, Germany, Iceland, Norway, Portugal, Spain, USSR, United Kingdom and United States of America.

The table below shows the distribution of field researches (++ denotes investigations from special research vessels, + from other vessels):

Subarea	1	2	3	4	5
Canada		++	++	++	+
Denmark	++				
France	+	+	+	+	
Germany	+	+	+		
Iceland	+		+		
Norway	++				
Portugal	+		+	+	
Spain	+	+	+	+	
USSR	+	++	++	+	
United Kingdom	+		+		
United States	+	+	+	++	++

Canada and Germany also reports researches in Ungava Bay, Canada alone off Baffin Island, and Denmark, Germany, Iceland and Norway report researches in E. Greenland waters.

SUBAREA 1.

A. Hydrography.

Danish observations show that the temperature was considerably below normal on Fyllas Bank and Lille Hellefiske Bank, indicating that the Arctic component of the W. Greenland Current is very strong and that the Baffin Island Current extended farther eastwards than normally. In the region of St. Hellefiske Bank the temperatures were about normal. Also the Norwegian sections show a core of Arctic water on the western slope of the banks.

Figure 1 presents a comparison of the temperature on and west of Fyllas Bank in 1957, 1958 and 1959. It is apparent that a considerable cooling of the water has occurred through these years. Patches of water below +1°C did not appear in 1957. In 1958 narrow patches occurred along the 100 m depth contour, and in 1959 the patches were much larger and in the westernmost part of the section water below 0°C was present.

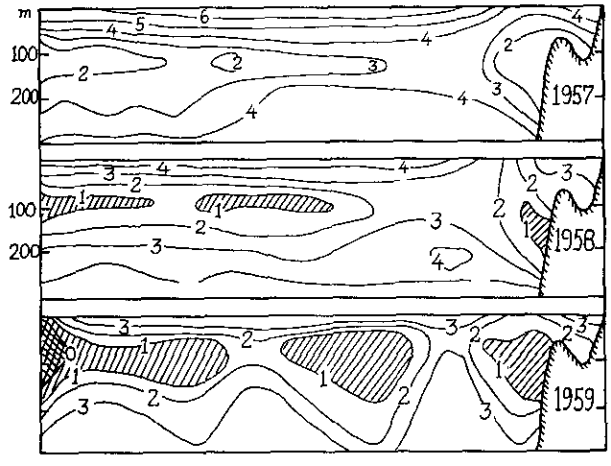

Fig. 1. Comparison of temperature on and off Fylla Bank, 1957, 1958 and 1959. Water masses below + 1°C are hatched, below 0°C double-hatched (Danish sections).

Slightly to the west and north of the westernmost part of the section shown in Fig. 1, Icelandic observations about a month later (Aug.-Sept.) gave temperatures between -0.2 and +1.2° at 340-460 m.

B. Cod.

The mean number of larvae taken per 30 minutes haul with ringtrawl ("Dana") was 4.2, or little less than in 1958. The mean figures for the period 1950-1959 are as follows:

Year	1950	1952	1953	1954	1955	1956	1957	1958	1959
No.	8.0	1.6	4.1	1.3	1.3	1.2	87.8	4.6	4.2

The following summary of the catches of larvae in the years 1957-1959 shows that in each year the largest catches per 30 minutes haul are made in the central area, Subdivision C and D, which includes Lille Hellefiske Bank, Fyllas Bank and Fiskenaes Bank:

	1957	1958	1959
A + B	41.0	238.3	2.2
C + D	2.9	8.0	0.1
E + F	2.3	5.9	0.8

The fact that the frequency of larvae is much lower in the southern area (E+F) than in the central area (C+D) conforms well with the conception, based mainly on marking experiments, that in the central area we have the home of the actual, indigenous W. Greenland cod stock, whereas the southern area houses a stock, of which a large part is connected with the stock of Iceland, and of which a great emigration of larger, probably maturing, cod occurs.

Another interesting fact in the distribution of larva is that the largest concentrations of larvae are not found on the banks or even on their western slopes, but farther westwards in the Davis Strait as close to Baffin Island as to Greenland. This is illustrated in Fig. 2 which shows the catch of larvae by "Dana" (per 30 minutes haul with 2 m ringtrawl, means of hauls at various depths) on stations in two sections on and west of Lille Hellefiske Bank and Fylla Bank in the years 1957, 1958 and 1959, i.e. in a year with an exceptionally rich occurrence of larvae (1957), and in two years with a more normal frequency. In all three years by far the largest numbers are caught over deep waters in the middle of the Davis Strait. The concentrations over deeper waters are about 12-15 times as large as those of the banks and their slopes. What is the fate of these larvae, representing more than 90% of the "result" of the cod spawning on the W. Greenland banks?

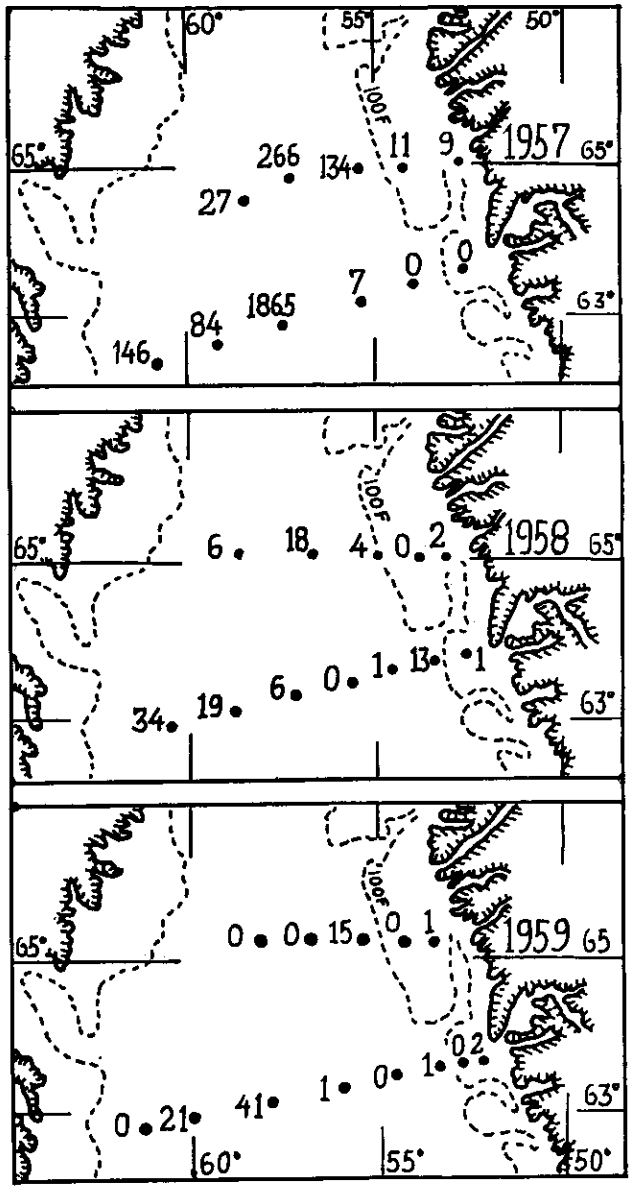

Fig. 2. No. of larvae of cod (means of hauls per 30' with a 2 metres ringtrawl at various depths) on stations of sections across and westward of Lille Hellefiske Bank and Fylla Bank (R/V "Dana"); 1957, 1958 and 1959.

Results of age analyses of commercial-size cod have been reported by Denmark (including the fishery by the Faroes), Germany, Iceland, Norway, Portugal and USSR; the 1953 year-class is reported by all these countries as predominating; the 1955 and 1956 year-classes are fairly well represented in some samples; of the older-year-classes, 1950, 1947 and 1945 are still of some importance. Off E. Greenland the 1950 year-class predominates.

SUBAREA 2.

Hydrography.

A Canadian section across Hamilton Inlet Bank in August showed that inshore the cold water was nearer the surface than in 1958. In deeper water east of the bank, temperatures were somewhat higher than in 1958.

A German section in the same region in September showed about the same conditions as the Canadian section in August: a large volume of water below zero°C between ca.30 to 40 m and ca.200 m. (rather near the bottom). In deeper water east of the bank, the temperature was 3.5-4.0°.

Cod

Canada and Germany made a survey in Ungava Bay. The Canadian survey in August-September showed only small quantities, up to 200 kg per trawl-hour, 27-200 fms, -0.6 to +2.0°C. The German survey at the end of October resulted in 1.5 tons per trawl-hour (commercial trawl) at a temperature around -0.3°C, mean length of cod 59 cm, or the same as in 2H.

Canadian research showed that the 1950 and 1952 year-classes were the most abundant. In German, Spanish and USSR commercial catches, about the same length-groups prevailed: German, 54-61 cm; Spanish, 54-65 cm; and USSR, 50-54 cm.

Redfish.

Canadian researches off N. Labrador and S. Baffin Island revealed a northerly distribution of young redfish in the Labrador Current region, indicating a drift of larvae from W. Greenland.

Others.

USSR reported on studies of productivity (amounts of organic matter).

SUBAREA 3.

Hydrography.

Sections were taken or observations made by Canada, Germany, Iceland and USSR.

The Canadian sections showed that, in the northern regions, the temperatures resembled those of 1958; on the south-west slope of the Grand Bank, the deep-water temperatures were lower than usual.

German sections and Icelandic observations gave evidence of a large tongue of water below -1°C, at a depth between 70-150 m, resting on the Grand Bank and extending to the north-east, with warm water (above +3°C) above and below.

Both Canadian and German sections showed that the bottom water of the Flemish Cap had a temperature of about +3°, on the slopes 3-4°C.

Cod.

Canadian observations in inshore and near-shore waters northeast of Newfoundland revealed decreases in the size of stock due to intensive local and foreign fisheries in recent years.

Observations on lengths of commercially caught cod were reported by Germany, Iceland, Portugal, Spain and USSR. The average lengths or peaks were given as follows:

Germany, NE slope of Grand Bank, 88 cm; S of Flemish Cap, 55 cm.

Iceland, Grand Bank, 53-62 cm.

Portugal, SE slope of Grand Bank, 64-76 cm; Grand Bank, 58-64 cm; St. Pierre Bank, 46-58 cm.

USSR, Grand Bank, 50-60 cm.

In the Grand Bank area, Germany, Iceland and USSR report the cod as somewhat smaller than does Portugal (both trawl and line), obviously due to the fact that the Portuguese fleet fish for cod exclusively, the other three fleets mainly for redfish.

Haddock.

Canadian observations showed the 1955 year-class, with a mean length of 33 cm, as the most abundant; the rich 1949 year-class is now rapidly vanishing; the 1957 and 1958 broods are complete failures.

Redfish.

Explorations for commercial concentrations were carried out, with highly varying results in different regions and seasons, by Canada, Germany, Iceland and USSR. The peaks of length-distribution observed were as follows:

	Canada	Iceland	USSR
3KL		34-36	34-38
3M		31-36	
3NO			26-32
3P	?-38		

Others.

Canada reports researches on American plaice and USSR studies of productivity.

SUBAREA 4.

Hydrography.

Canadian sections and other data show that the cooling of the water, observed in recent years, continues and is apparent for the surface, the intermediate and the bottom layers.

Cod.

Canada carried out extensive studies mainly on size-composition, growth and migrations. The 1954, 1956 and 1957 year-classes were dominant in the Gulf of St. Lawrence, whereas the 1955 year-class was poor. The growth researches revealed that in certain areas the average size of 5-10 year old cod has increased substantially between 1949-1952 and 1955-1958.

Portuguese researches showed a predominance mainly of the 1953, 1954 and 1955 year-classes in 4V; the mean sizes of samples varied between 53 and 58 cm.

Spanish measurements showed peaks of length curves between 48 and 62 cm in 4R and 4T, and USSR measurements showed peaks between 46 and 65 cm in 4V and between 56-70 cm in 4W.

Others.

Canada carried out extensive studies on discards especially of haddock and cod, and conducted a series of fishing experiments with otter

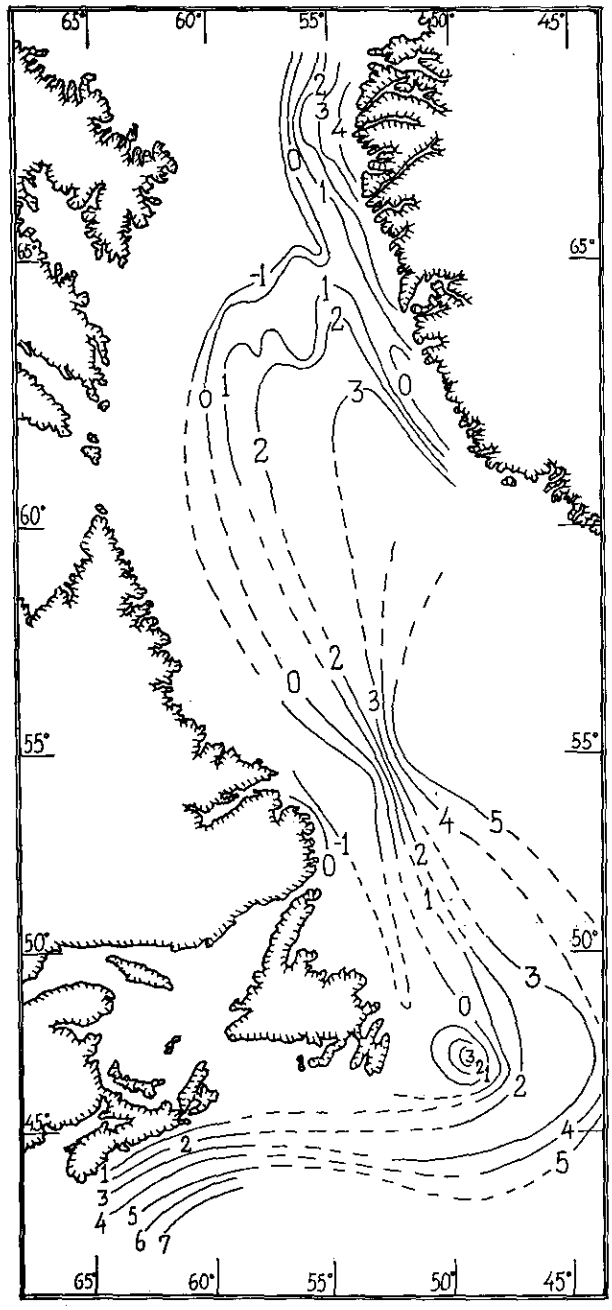

Fig. 3. **Isotherms (°C) in 50 m depth in the Convention Area, July-August 1959. From observations reported by Canada, Denmark, Germany, Iceland, Norway and USSR.**

trawl and Danish seine, and with scallop drags of various ring-sizes.

A large number of samples from Subarea 4, not considered in the various research reports, have been collected (cod, haddock and redfish) and will be published in the Sampling Yearbook.

SUBAREA 5.

For this subarea Canada reports investigations as to abundance and mortality of scallops, and on the amount of discards.

Aside from this, the United States is the only country carrying out researches in this subarea (see U.S.A. Research Report).

Whole Convention Area.

Hydrography.

Figure 3 shows isotherms (°C) in 50 metres depth, for July-August 1959, based on sections and other observations reported by Canada, Denmark, Germany, Iceland, Norway and USSR. Compared with 1958, a small decrease in temperature is observed off W. Greenland and in the region of the Labrador Current.

PART 4

I. ICNAF Mesh Regulations, Operation of 10% Annual Exemption

October 1, 1957, through September 30, 1959

BY LAWRENCE H. COUTURE, F.R.B.

The United States Bureau of Commercial Fisheries, Fish and Wildlife Service, issued 23 exemption certificates during the first year, and 23 additional certificates during 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
April		1
May		2
June		2
August		1
September		1
	Total—2nd year	23

At the completion of the first year, eight certificates expired and were not renewed by the vessel owners. Two certificates were revoked for failure to submit required reports.

During the second year, three certificates expired and were not renewed by the vessel owners. One certificate was cancelled when the vessel was sold. On October 1, 1959, there remained 322 certificates in effect.

Tonnage classes of exempted vessels:

Gross tons	Class	Number of Certificates: As of Sept. 30, 1958	Number of Certificates: As of Sept. 30, 1959
0-25	OTS	1	0
26-50	OTS	5	9
51-100	OTM	7	12
101-150	OTM	2	4
151-200	OTL	7	6
Over 200	OTL	1	1
		23	32

The landings of these vessels are presented in the attached table 1.

TABLE 1 - Summary of the Operation of the 10% Annual Exemption.

SUBAREA 3

		1st Year		2nd Year	
		No.	%	No.	%
Exempted vessels[1]					
Fishing trips		9		27	
All species	000 lb.	2,107	100.0	5,724	100.0
Haddock	" "	0	0	28	0.5
Cod	" "	0	0	9	0.2
Redfish	" "	2,106	99.9	5,599	97.8
Other species[2]	" "	1	0.1	88	1.5
No. of trips with haddock		0		3	
No. of trips with cod		0		3	
No. of trips with redfish		9		27	
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

		1st Year		2nd Year	
		No.	%	No.	%
Exempted vessels[1]					
Fishing trips		70		102	
All species	000 lb.	11,840	100.0	14,864	100.0
Haddock	" "	374	3.2	1,136	7.6
Cod	" "	34	0.3	171	1.1
Redfish	" "	11,247	95.0	12,761	85.9
Other species[2]	" "	185	1.5	796	5.4
No. of trips with haddock		24		61	
No. of trips with cod		21		61	
No. of trips with redfish		68		89	
Range of haddock landings per trip, lb.		200-89,300		200-100,200	
Range of cod landings per trip, lb.		35-6,550		80-11,700	
Excess trips[3]		4		19	
Pounds excess haddock[4]	000 lb.	108		865	
Pounds excess cod[4]	" "	0		4	

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

		1st Year		2nd Year	
		No.	%	No.	%
Exempted vessels[1]					
Fishing trips		628		1,304	
All species	000 lb.	23,178	100.0	41,206	100.0
Haddock	,, ,,	2,453	10.6	2,404	5.8
Cod	,, ,,	471	2.0	670	1.6
Redfish	,, ,,	7,333	31.6	12,552	30.5
Other species[2]	,, ,,	12,921	55.8	25,580	62.1
No. of trips with haddock		534		841	
No. of trips with cod		539		784	
No. of trips with redfish		265		454	
Range of haddock landings per trip, lb.		15-113,000		10- 63,800	
Range of cod landings per trip, lb.		10- 20,650		10- 23,035	
Excess trips[3]		154		101	
Pounds excess haddock[4]	000 lb.	1,146		1,012	
Pounds excess cod[4]	,, ,,	68		84	

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.

ALL SUBAREAS

Subarea		1st Year		2nd Year	
		No.	%	No.	%
Exempted vessels[1]		23		32	
Fishing trips		707		1,433	
All species	000 lb.	37,125	100.0	61,794	100.0
Haddock	,, ,,	2,827	7.6	3,568	5.8
Cod	,, ,,	505	1.4	850	1.4
Redfish	,, ,,	20,686	55.7	30,912	50.0
Other species[2]	,, ,,	13,107	35.3	26,464	42.8
No. of trips with haddock	,, ,,	558		905	
No. of trips with cod		560		848	
No. of trips with redfish		342		570	
Range of haddock landings per trip, lb.		15-113,000		10-100,200	
Range of cod landings per trip, lb.		10- 20,650		10- 23,035	
Excess trips[3]		158		120	
Pounds excess haddock[4]	000 lb.	1,254		1,877	
Pounds excess cod[4]	,, ,,	68		88	

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