INTERNATIONAL COMMISSION

FOR THE

NORTHWEST ATLANTIC FISHERIES

ANNUAL PROCEEDINGS

Vol. 8

for the year

1957-58

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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 papers from the Commission may be published separately.

The Annual Proceedings contains the Commission's reports for the year in question: Administrative Report, Report of the Annual Meeting, Summaries of Research by the participating countries, scientific papers especially prepared for Meetings, and occasionally lists of scientists engaged in the various branches of the Commission's work, and of main laboratories concerned with this work (newest revised list in Ann. Proc. Vol. 7).

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 Statistical Bulletin for the year 1957 will be published in the beginning of 1959.

The "Sampling Yearbook" includes in tabular form length measurements, age determinations and possibly other data relating to the stocks of commercial fish species, and collected by the member countries in ports or on board fishing vessels or research vessels. The first volume of the "Yearbook" including data from 1955 and 1956 was printed (by an off-set method) in June 1958. The next volume including mainly data from 1957 will be published early in 1959. The distribution of the "Sampling Yearbook" is restricted to directly interested institutions or persons.

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

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

Erik M. Poulsen,
Executive Secretary.

Halifax, 31 October, 1958

PART 1

Administrative Report for the Year ending 30 June 1958

BY THE EXECUTIVE SECRETARY, ERIK M. POULSEN

1. U.S.S.R. Becomes a Member of the Commission.

The Union of Soviet Socialist Republics notified the Depositary Government on April 10, 1958 of its adherence to the International Convention for the Northwest Atlantic Fisheries, and on that date the Convention entered into force with respect to U.S.S.R. By this action U.S.S.R. has, as of that date, become a member of the International Commission for the Northwest Atlantic Fisheries.

U.S.S.R. fishing vessels have in recent years been working in parts of the Convention Area, and researches have been carried out in connection with the fishery. Co-operation between U.S.S.R. and ICNAF had already been in existence for some years. U.S.S.R. observers participated in the recent annual meetings and reported on the U.S.S.R. research work in the Area. This co-operation can now be extended to the mutual benefit of all twelve member countries.

2. Officers during the Year.

Chairman of Commission—Mr. Klaus Sunnanå, Norway

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

Chairman Panel 1: Captain Tavares de Almeida Portugal
,, Panel 2: Mr. A. Carusi, Italy
,, Panel 3: Dr. J. Ancellin, France
,, Panel 4: Mr. F. W. Sargent, U.S.A.
,, Panel 5: Mr. G. R. Clark, Canada

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

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

Chairman of Standing Committee on Research and Statistics—
Dr. L. A. Walford, U.S.A.

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

3. Changes in the Secretariat.

At the 1957 Annual Meeting it was decided to establish from 1st July, 1957 a new position of typist. Miss Else Poulsen, Halifax, was appointed to this position. Miss Jean Maclellan, who had served as Clerk-Stenographer since November 1954, resigned on 7th February, 1958. Miss Joan Edwards, Halifax, was appointed to the vacant position.

4. Newsletters

Newsletters were distributed from headquarters in order to circulate information relevant to the Commission's activities and interests on 7 October 1957, 16 December 1957, 14 March 1958, and 2 June 1958.

5. Panel Memberships 1957-58

Country	Panel No. 1	2	3	4	5	Total
Canada		+	+	+	+	4
Denmark	+					1
France	+	+	+	+		4
Germany	+					1
Iceland	+					1
Italy	+	+	+	+		4
Norway	+					1
Portugal	+	+	+	+		4
Spain	+	+	+	+		4
United Kingdom	+		+			2
United States			+	+	+	3
TOTAL	9	5	7	6	2	29

6. Commission's Publications

The Annual Proceedings, vol. 7, for the year 1956-57, was issued in October 1957.

The Statistical Bulletin, vol. 6, for the year 1956, was issued in June 1958.

The Sampling Yearbook, vol. 1, for the years 1955 and 1956, was issued in April 1958. This new publication includes in tabular form, length measurements, age determinations and other data relating to the stocks of commercial species, collected by member countries in ports or on board fishing vessels or research vessels. Part of this material has up to now been published in the Research Reports in the Annual Proceedings. The Sampling Yearbook was reproduced in the Secretariat by an off-set method.

A report on the meeting of the Standing Committee on Research and Statistics in Biarritz, France in March 1956, including a series of contributions from this meeting, which was concerned in the main with methods to be used in fishery research, has been prepared and edited by the Chairman of that Committee. The final typescript and arrangements for publication were made in the Secretariat and the report was reproduced by an off-set method by a Halifax firm. It was distributed in June 1958.

7. Co-operation with other International Organizations.

This co-operation by means of exchange of observers and of reports and publications has been continued along the same lines and with the same organizations as in recent years (vide Ann. Proc. vol. 7, p. 6).

In May-June 1957 a joint Workshop on Population Dynamics and Gear Selection was held by FAO, ICES and ICNAF in Lisbon, Portugal, immediately following the Annual ICNAF Meeting. A report of this meeting will be edited by F.A.O.

8. Co-operation with Non-member Countries.

Co-operation with U.S.S.R. on the collection of fishery statistics and on researches was continued through the fiscal year.

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

9. Research Programs

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

Particulars regarding the hydrographic work were forwarded by the Secretariat to the CSAGI (International Geophysical Year 1957-58) through the special committee appointed by ICES.

Following a request by the Commission, Mr. John Corlett, Lowestoft, England, has prepared a paper dealing with the requirements for plankton researches in the Convention Area. The paper, which was distributed for the 1958 Annual Meeting (Serial No. 529, Document No. 4), forms a basis for consideration of a Plankton Research Program for the ICNAF Area.

10. Research Summaries.

Summaries of research in 1957 were received from a number of member countries during the first months of 1958 and distributed as documents for the 1958 Annual Meeting. They are printed in this Proceedings as Part 3A, together with a compilation of them by Subareas (Part 3B).

11. Sampling.

Following a decision of the 1956 Annual Meeting, data from samples of fish taken both by commercial vessels and research vessels were reported to the Commission and after being edited and converted to the Commission's standard form, were published in the ICNAF Sampling Yearbook Vol. 1, Age, length and weight data on the cod, haddock and redfish from 1955 and 1956 were included.

12. Collection of Statistics.

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

After this year's experience, the use of I.B.M. cards in processing the statistics for the Bulletin has become routine. This has permitted more time to be spent on other urgent statistical matters, especially the Sampling Yearbook.

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

13. List of Vessels Fishing in the Convention Area.

A detailed list of all the vessels of 50 gross tons and over fishing in the Convention Area has been prepared for publication as an ICNAF Meeting Document (Serial No. 526, Document No. 3).

A summary of the numbers of all vessels and boats fishing in the Convention Area was included in the Statistical Bulletin Vol. 6 and it is intended that such a summary will have a permanent place in the Statistical Bulletin, whereas the detailed list will be published as a circular every three years.

14. Eighth Annual Meeting.

The Eighth Annual Meeting was convened in Halifax at Dalhousie University during the week 9-14 June, 1958. It was preceded by meetings of the Research Committee and of groups of Advisers on 4-7 June. (see Chairman's Report, Part 2).

15. Other Matters.

In December 1957 meetings of groups of Advisers to Panels 3, 4, and 5 were held in Quebec, Canada. Biologists from various member countries represented in the respective panels participated, as did also the Executive Secretary and the Biologist-Statistician.

Following invitations, the Executive Secretary attended a fishery meeting sponsored by the Fisheries Research Board of Canada in Ottawa in January and a meeting of the Fisheries Council of Canada in Halifax in April 1958.

Canadian and U.S.A. experts participated in the spring of 1958 in fishing cruises by two French trawlers in the Convention Area. This followed the visit by a French expert on board Canadian and U.S.A. vessels the previous year.

As in previous years data from a hydrographic section across the Labrador Sea taken by the International Ice Patrol, U.S.A. Coast Guard, were placed at the disposal of the Commission and circulated to member countries.

A list of annotated papers relevant to the Commission's work was circulated on 6 December. 1957 (Serial No. 508).

The annual addition to the Guide to ICNAF Papers covering the period 1956-57 was circulated on 1 October, 1957 (Serial No. 505).

Following a request by several persons working with the Commission for a record of earlier ICNAF resolutions, proposals, programs, and of descriptions of methods and terminology, a Guide to ICNAF Proposals and Resolutions has been prepared and distributed within the Commission (Serial No. 533).

16. Financial Statements for the Fiscal Year ending 30 June, 1958.

The accounts of the Commission for the year ending 30 June, 1958 show an appropriation of $ Can. 45,175.00 and a total expenditure of $45,175.00.

The audit of the Commission's finances for the fiscal year ending 30 June, 1958, was made by the Auditor General's Office of the Government of Canada in August, 1958.

The report from the Auditor General's Office, of 19 September, 1958 says:

"The statement of budget appropriations, etc., points to transfers beween appropriation sections made without authorization by the Commission. The action is contrary to the direction of Financial Regulation 4.5, but I have been advised that it was taken with your consent, subject to approval at the next meeting of the Commission, to meet a situation which developed at the close of the financial year.

"Subject to the foregoing, in accordance with the requirement of Financial Regulation 11.2 of the Commission, I certify that:

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

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

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

"Free access was given to all books of account and records necessary for the performance of the audit. Such additional information as was required was readily provided. The cooperation 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 1958

Purposes of Appropriations	Appropriated by Commission	Transfers	Amended Appropriations	Obligations incurred	Unobligated Balance of Appropriations
Personal Services —					
Salaries	$25,070	$ 120.78*	$25,190.78	$25,190.78	—
Superannuation	2,255	672.81*	1,582.19	1,582.19	—
Travelling	2,600	1,420.25 407.97*	771.78	771.78	—
Transportation of things	200	33.15*	166.85	166.85	—
Communication Services	1,200	307.50*	892.50	892.50	—
Rent and Utility Services	1,800	—	1,800.00	1,800.00	—
Other Contractual Services, including printing	8,000	1,064.41 987.58*	10,051.99	10,051.99	—
Supplies and materials	1,800	355.84 60.53*	2,095.31	2,095.31	—
Equipment	1,800	24.00*	1,776.00	1,776.00	—
Annual Meeting	450	397.60*	847.60	847.60	—
	$45,175		$45,175.00	$45,175.00	—

*Transfers subject to approval by Commission.

Statement 2

Statement of income and expenditure for the year ended 30 June 1958.

Income:		
Members' contributions assessed —		
Canada	$ 5,002.53	
Denmark	1,582.01	
France	5,485.67	
Iceland	1,745.09	
Italy	5,739.70	
Norway	1,582.01	
Portugal	5,165.70	
Spain	5,165.70	
United Kingdom	2,722.17	
United States	3,862.43	
		$ 38,053.01
Unobligated balances of 1956-57 appropriations		2,917.26
Add: Italian contribution, 1952-53		3,704.86
Miscellaneous income—		
Proceeds from sales of Commission publications:		
1956-57	499.87	
1957-58	260.00	759.87
		$ 45,435.00
Deduct: Obligations incurred (Statement 1)		45,175.00
Excess of income over obligations carried to Surplus Account		260.00

Statement 3

Statement of assets and liabilities as at 30 June 1958

Assets				Liabilities		
GENERAL FUND						
Cash at bank			$ 1,094.25	Accounts payable (printing)		$ 6,510.61
Contributions receivable:				Credits due to Member States:—		
Iceland 1957-58		$ 1,745.09		From Germany's contribution:		
Italy:				1956-57		
1956-57	$ 5,221.72			½ year	$ 263.33	
1957-58	5,739.70			1957-58	1,766.82	
		10,961.42				2,030.15
			12,706.51			
				Due to Working Capital Fund		5,000.00
				Surplus Account		260.00
			$ 13,800.76			$ 13,800.76
WORKING CAPITAL FUND						
Cash at bank			$ 1,218.67	Principal of Fund		$ 5,266.60
Due from General Fund			5,000.00	Credits due to Member States:		
				From Germany's contribution	$ 478.78	
				Denmark advance		
				1958-59	430.31	
				Bank interest	42.98	
						952.07
			$ 6,218.67			6,218.67

PART 2

Report of the Eighth Annual Meeting

9 - 14 June, 1958

BY THE CHAIRMAN — KLAUS SUNNANÅ

1. Time and Place of Meeting.

The Eighth Annual Meeting of the Commission was convened in Halifax, Canada on 9th June, 1958 and continued through to 14th June. The Annual Meeting was preceded, 4th to 7th June, by meetings of the Standing Committee on Research and Statistics and of Groups of Advisers to Panels.

2. Participants (Appendix I)

Commissioners, most of them accompanied by advisers and experts, were present from the twelve member countries: Canada, Denmark, France, Federal Republic of Germany, Iceland, Italy, Norway, Portugal, Spain, Union of Soviet Socialist Republics, United Kingdom, and United States.

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

3. Opening of the Meeting (Agenda item 1)

The opening session was convened at Dalhousie University. Present were: the Minister of Fisheries for Canada, the Honourable Mr. MacLean; the Mayor of Halifax, his Worship Mr. Charles A. Vaughan; and representatives from Dalhousie University, governmental institutions in Nova Scotia and fisheries organizations in the Maritimes. Also present were representatives of the consular agencies of member countries and observers from other international organizations and delegates from the member countries.

The Chairman opened the meeting, welcoming guests, observers and delegates.

The Hon. Mr. MacLean welcomed the delegates to Canada and expressed his best wishes for the meeting.

His Worship Mr. Vaughan welcomed the meeting participants to Nova Scotia and stressed the great interest of this province in fisheries and in the work of the Commission.

The Chairman thanked for the welcome extended to the Commission, and the opening meeting was adjourned.

In the first Plenary session following the opening meeting the Chairman extended a hearty welcome to the two new member countries: the Federal Republic of Germany and the Union of Soviet Socialist Republics. Mr. Pirkmayr, Germany and Mr. Ishkov, U.S.S.R. thanked the Chairman for the welcome.

4. The Agenda (Agenda item 2) Appendix II

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

5. Publicity for the Meeting (Agenda item 3)

The Chairman informed the meeting that the Canadian Government had provided the services of Mr. G. Gillespie to act as press officer for the Commission in keeping the public informed. A Committee consisting of K. Sunnanå (Norway), J. H. MacKichan (Canada), T. de Almeida (Portugal) and L. A. Walford (United States), was appointed to work with the press officer and approve press releases.

6. Review of Panel Memberships (Agenda item 4)

A request by U.S.S.R. for memberships in Panels 1, 2 and 3 was considered by the Standing Committee on Finance and Administration and by the panels concerned. Upon recommendation by these agencies the Commission agreed that U.S.S.R. be admitted to membership in Panels 1, 2, and 3.

There were no other changes in panel memberships, and the distribution of panel memberships for 1958-59 will be as follows:

Panel Memberships 1958-59

Panel	1	2	3	4	5	Total
Canada		+	+	+	+	4
Denmark	+					1
France	+	+	+	+		4
Germany	+					1
Iceland	+					1
Italy	+	+	+	+		4
Norway	+					1
Portugal	+	+	+	+		4
Spain	+	+	+	+		4
U.S.S.R.	+	+	+			3
U.K.	+		+			2
U.S.A.			+	+	+	3
TOTAL	10	6	8	6	2	32

7. Report on Staff Matters, etc.
(Agenda item 5 and 6)

Upon recommendation by the Standing Committee on Finance and Administration the Commission approved the Auditor's Report for 1956/57, and expressed its gratitude to the Auditor General of Canada for services rendered by his office in carrying out the audit of the Commission's accounts. The Commission also, on the recommendation of the Standing Committee on Finance and Administration, approved the Administrative Report for 1957/58 (up to 31st May), and the provisional financial statements for 1957/58 (up to 31st May), including transfers of $1,420.25 from "Travel, including subsistence" to defray deficits of $1,064.41 in the "Other contractual services, including printing" account and $355.84 in the "Supplies and Materials" account.

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

The Commission approved the recommendation of the Committee on Finance and Administration to appropriate $50,000 for the year 1958/59 for the following purposes:

Personal services	
(a) Salaries	$26,300
(b Superannuation	2,100
Travelling	5,400
Transportation of things	300
Communication services	1,000
Rent and utility services	1,800
Other contractual services, including printing	7,100
Supplies and materials	1,800
Equipment	3,000
Annual Meeting	1,200
	$50,000

The Commission noted that the Committee on Finance and Administration had adopted a budget estimate for the year 1959/60 of $53,000 for the following purposes:

Personal services	
(a) Salaries	$26,300
(b Superannuation	2,100
Travelling	5,500
Transportation of things	300
Communication services	1,000
Rent and utility services	1,800
Other contractual services, including printing	12,000
Supplies and materials	2,000
Equipment	500
Annual Meeting	1,500
	$53,000

9. The Commission further adopted the following recommendations by the Standing Committee on Finance and Administration
(Agenda item 18)

(a) That the date of billing be 1st July, 1958.

(b) That consideration of a plan for medical care for staff members be deferred until the next annual meeting, pending more specific information.

(c) That the 1958/59 Annual Meeting be held at Montreal, Canada, opening on 1st June, 1959.

(d) That the Executive Secretary, while on home leave, attend the 1958 Meeting of the International Council for the Exploration of the Sea as observer, and that the Commission's Chairman and the Executive Secretary appoint one of the Commissioners, who has been delegated by his own country to attend the ICES Meeting, as observer.

(e) That an invitation to the Second World Fishing Boat Congress of the Fisheries Division of FAO in April be declined, as the member countries would be directly represented.

(f) That the Executive Secretary extend to the same international fisheries organizations as in the past, invitations to send observers to annual meetings of ICNAF, without further reference to all Commissioners.

Mr. A. J. Suomela (United States) was elected Chairman of the Standing Committee on Finance and Administration for the ensuing year

10. A Special Meeting of Commissioners considered items 10, 11, 13, and 14 of the Plenary Agenda:

Regarding item 10 the following draft resolution from the Special Meeting was adopted by the Plenary:

> "The Commission having been informed on the one hand of the difficulty felt by the United Kingdom, in relation to stern trawlers, in accepting the revised wording of Paragraph IV (b) of Trawl Regulations in Subareas 3, 4 and 5, agreed by the Commission in 1957, and on the other hand of the difficulty felt by several other countries in considering at this stage any further amendment in the Regulation, agrees that in implementing the Regulation the United Kingdom should be allowed to make such modifications in its terms as may be necessary to suit the condition of operation of stern trawlers and requests the United Kingdom to consider accepting the Regulation for Subarea 3 on this understanding."

The Plenary further recommended, on proposal by the Special Meeting, that information on the technical aspects of the trawl regulations or modification thereof as applied to the stern trawler type of operations be reported by the countries concerned at the 1959 Annual Meeting.

Under item 11 the Special Meeting agreed that since full information on the implementation of trawl regulations was not yet given by all countries, the collection of this information should continue, and that an *ad hoc* committee should be appointed at future annual meetings to consider the information available.

Under item 13 the Special Meeting considered the problem of the preparation and drafting of fishery regulations to ensure that they are of a practical nature from the point of view of fishing operations, and agreed that such matters should be dealt with by the individual panels or, if applicable to more than one panel, by the panels concerned jointly.

Under item 14 the Special Meeting, after a very thorough discussion, agreed to invite the Commission to adopt the following resolution:

> "The Commission believes that the words 'fish' and 'fisheries', as used in the Convention, should be understood to include molluscs".

Under "Other Business" the Special Meeting discussed how a closer liaison between administrators and scientists could be ensured. It was agreed that this problem was of the greatest importance, and that it should be the subject of fuller consideration and review by the Commissioners at each annual meeting, and that at the next annual meeting a meeting of Commissioners, together with the Chairman of the Standing Committee on Research and Statistics, should be arranged.

The Commission adopted these proposals by the Special Meeting, with some minor amendments which are incorporated in the above text.

The Commission agreed that the text of the resolution under item 14 be sent to the Depositary Government with the request that it take the appropriate action.

11. Report of the Standing Committee on Research and Statistics (Agenda items 12, 16 and 17)

This Committee, with several ad hoc subcommittees, met during the period 4th to 13th June.

Based mainly on the reports of these subcommittees the Committee made the following recommendations:

Statistics Collection and Analysis.

It was agreed that the biologist/statistician should undertake an analysis of the statistics now provided by the Commission to assess more precisely their value for current research needs, especially in population studies. The Committee recommended that he begin this work in the coming year, which will necessitate visits to the countries concerned, both in North America and Europe. He should also attend the FAO meeting on North Atlantic Fishery Statistics, which will be held in northern Europe in 1959.

Sampling.

That all countries should engage sea observers to accompany commercial vessels fishing in the ICNAF area to provide age and length data of the entire catches, including the fish discarded as well as the fish retained, for each of the statistical regions fished.

Redfish Biology.

That the symposium on Redfish Systematics and Biology approved at the Commission meeting in 1957 should be held in Copenhagen in the week commencing September 21st, 1959, immediately preceding the ICES Annual Meeting, and that ICES should be invited to co-sponsor the symposium.

Gear Selection.

That the summary report of the result of Gear Selection research in the ICNAF area prepared by Mr. J. R. Clark, Dr. F. D. McCracken and Dr. W. Templeman, suitably edited, be published in the Annual Proceedings of the 1958 Meeting.

That Gear Selection research should be placed on the agenda of the next meeting of the Committee to consider means for filling gaps in this field.

That the Secretariat be instructed to enquire whether FAO is able to undertake the preparation of a general document on Gear Selection.

Marking Techniques.

That a symposium on marking should be held at the time of the next annual meeting in Europe. This symposium will be devoted to a detailed survey of all aspects of marking techniques, including parasite infestation studies, as applied to North Atlantic fishery investigations.

Assessment of Current and Possible Future Mesh Regulations

(i) Subarea 5 Regulation

That U.S. scientists should continue to pursue the measurement of the benefit from the Subarea 5 regulation, using hitherto untried methods; that the licensing of small mesh study boats should be held in abeyance and that the U.S. should consider increasing the size of mesh used in the Georges Bank haddock fishery to allow release of haddock to age 3.

(ii) Possible use of 5½ inch mesh in Subarea 4

That France, Portugal and Spain should send observers to sea to sample and measure amounts of the fish discarded and retained; that Canada should institute sampling of cod caught by trap in Subdivision 4S, and that France and Portugal should submit to the Secretariat sampling data collected in this area since 1952.

That Subdivision 3P and 4V should be further subdivided into northern and southern sections respectively to assist in the measurement of the catch and effort for fisheries exploiting the Gulf of St. Lawrence stock. The proposed new boundaries are to be as follows:

1. **Subdivision 3P**:

   (a) Northwestern portion—that portion of Subdivision 3P lying northwest of a line extending from Burgeo Island, Newfoundland, approximately southwest to a point 46° 50′ Lat. North and 58° 50′ Long. West.

   (b) Southeastern portion—that portion of Subdivision 3P lying southeast of the line defined in paragraph 1 (a).

2. **Subdivision 4V**:

   (a) Northern portion—that portion of Subdivision 4V lying north of parallel 45° 40′ North.

   (b) Southern portion—that portion of Subdivision 4V lying south of parallel 45° 40′ North.

Research on Sea Scallops in Subarea 5.

That investigations of the population dynamics of the exploited scallop stocks, now in progress in the United States and Canada, be continued and expanded. In particular that: (1) catch and improved effort statistics for the Canadian and United States vessels fishing in the area be collected for as small time and area subdivisions as practicable; (2) consideration be given to measuring catch and effort of a selected portion of the commercial fleet and to the use of a special research vessel to improve our understanding of factors influencing the catch per unit effort; (3) tagging experiments be undertaken for estimating mortality; (4) experimental fishing, including underwater photography and television, be conducted to measure catching efficiency of the gear and to estimate fishing mortality; (5) research on the biology of the sea scallop and on its environment to determine elements influencing occurrence, behaviour and survival be instituted.

Environmental Studies.

That: (i) a survey should be made by Dr. L. A. Walford of present information on plankton in the Convention Area; (ii) that participating countries bring plankton specialists to the next annual meeting to plan a co-ordinated ICNAF plankton programme; (iii) that present programmes of environmental studies should be continued, and if possible intensified, in anticipation of the development of a fully co-ordinated Commission programme.

Publications.

The Committee approved the recommendations of the *ad hoc* subcommittee set up to consider current publication problems. These recommendations are set out in Appendix XII of the Report of the Committee on Research and Statistics (not cited here).

Special Meeting.

At a special meeting held 10 June Dr. Carl Sindermann, of the U.S. Bureau of Commercial Fisheries delivered lectures on "The Place of Serology in Fishery Research" and on "The Significance of Diseases of Marine Organisms"; and Dr. Ju. Ju. Marti, Polar Ins. of Mar. Fish. and Oceanography, Murmansk, spoke on "Research in the N. Atlantic by U.S.S.R."

It was agreed that the Committee should meet in the week preceding the 1959 Annual Meeting. Dr. Mario Ruivo, Portugal, was elected Chairman of the Committee for the ensuing year.

12. Reports of Meetings of Panels 1 to 5 (Agenda item 19)

The Commission approved the reports of Panels 1 to 5. Panels 1, 2 and 3 recommended that the request by U.S.S.R. for membership in these three panels be adopted.

Panel 1 considered the research reports by member countries. The existing programmes were elaborated and it was noted that Norway would be able to increase its research work; that Spain had commenced research work in Subarea 1 and that France planned to send observers on board its fishing vessels operating in Subarea 1. Denmark urged the fullest reporting on recaptured tagged fish and at such an early date that the recaptures could be considered in the year's research report.

Panel 2 considered reports on the fisheries and researches of Canada, France, Portugal, and Spain. The few U.S.S.R. researches in this area were incorporated in the report for Subarea 3. The advisers to the Panel had met, their report was read, and the Panel noted that increases in research work were planned by several countries. It was agreed that the Group of Advisers should meet in the week preceding the 1959 Annual Meeting.

Panel 3 reviewed the reports on fisheries and researches by the member countries. The Panel noted that matters concerning regulations would be discussed in a special meeting of Commissioners and reported to the Plenary. The Panel accepted a division of Subdivision 3P into northern and southern sections. The plans for researches in the subarea were reviewed. A report by the Group of Advisers was read and the Panel noted that an increase of research work could be expected, and that the Group of Advisers would meet again the week preceding the 1959 Annual Meeting.

Panel 4 reviewed the status of the fisheries and the progress of research. It accepted a division of Subdivision 4V into northern and southern sections. It noted that the questions of enforcement of regulations and methods of attaching chafing gear were dealt with by the Commissioners. It was recognized as advisable that the Group of Advisers should continue to have mid-year meetings.

Panel 5: Each country presented a review of its fishing and researches. A report by the Group of Advisers was read and its recommendations of newly-proposed methods for assessing effects of regulations were endorsed by the Panel. The Panel took no action on a rewording of Paragraph IV (b) of the Trawl Regulations because the matter had been referred to a meeting of Commissioners. Consideration was also given to further reports by the Group of Advisers on expected effects of a $5\frac{1}{2}$ inch mesh on cod and haddock catches, on the value of study boat programmes, and on the Georges Bank sea scallop fishery. The question of whether sea scallops fall within the terms of jurisdiction of the Commission was deferred, since the matter had been referred to a meeting of Commissioners. It was noted that the Group of Advisers would hold a joint mid-year meeting with the Advisers to Panel 4. A report on the 10% annual exemption for trawl regulations was read; it was noted that the total catches in the exempted categories was lower than anticipated.

13. Acknowledgements and Adjournment

(Agenda items 20 and 21)

In the final Plenary the Chairman and various Commissioners expressed the Commission's gratitude to the resigning chairmen of the two Standing Committees, Mr. MacKichan and Dr. Walford, stressing the outstanding work carried out by them in the service of ICNAF.

The Chairman expressed the Commission's gratitude to governmental and other institutions for the hospitality shown during this Annual Meeting. Expressions of gratitude were also extended to Mr. G. Gillespie for the excellent press coverage, to Dalhousie University for the very suitable accommodations offered to the Meeting, and further to Commissioners, observers and guests, as well as to the Secretariat. All these institutions and persons had contributed to the success of the Eighth Annual Meeting, which was adjourned on 14th June, 1958.

APPENDIX I

LIST OF PARTICIPANTS

CANADA:

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Mr. W. M. Terry, Office of International Activities, Department of the Interior, Washington.

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Mr. Sapanadze

Advisers:

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Mr. Tsvetkov

Mr. Volkov

Mr. Timinskiy, Interpreter.

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INTERNATIONAL FISHERIES CONVENTION 1946

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INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

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PRESS

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Miss Joan Edwards, Clerk/Stenographer, ICNAF, Halifax.

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Miss T. Sharpe, Department of Fisheries, Halifax.

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 1957/58 and financial statements for 1957/58.
6. Presentation of Auditor's Report for the financial year 1956/57 (vide Ann. Proc. Vol. 7, pp. 7-9).
7. Consideration of budget estimate for 1958/59.
8. Consideration of advance budget estimate for 1959/60.
9. Report on the coming into effect of the plan for superannuation for staff members.
10. Review of the wording of the Paragraph IV(b) of the proposals for trawl mesh regulations for Subareas 3, 4, and 5 (vide Chairman's Report of 1957 Ann. Meet.—Ann. Proc. Vol. 7, p. 17).
11. Information on enforcement of trawl regulations, and consideration of "Annual Returns" showing inspections carried out. Further the appointment of an ad hoc committee to consider the collected information (vide Chairman's Report, Item 13, 1957 Ann. Meet.—Ann. Proc. Vol. 7, p. 12).
12. Review of progress in the study of the feasibility of the use of the 10% annual exemption to the haddock-cod regulation in Subarea 5 (vide Recommendations 1 and 2 of Panel 5, Chairman's Report of 1956 Annual Meeting—Ann. Proc. Vol. 6, p. 15).
13. Consideration of the setting up of a permanent committee for studying the technical and practical aspects of the mesh regulations and any other conservation measures proposed (vide Chairman's Rep. item 13, 1957 Ann. Meet.—Ann. Proc. Vol. 7, p. 12).
14. Consideration of the Sea Scallop fishery in Subareas 4 and 5 and its inclusion in the terms of jurisdiction of the Commission.
15. Date and place of Annual Meeting, 1959.
16. Report on plans for the Redfish Workshop in Copenhagen, 1959.
17. Report on the meetings of the Standing Committee on Research and Statistics.
18. Report on the meetings of Standing Committee on Finance and Administration.
19. Reports on meetings of Panels 1-5, June 1958.
20. Other business.
21. Adjournment.

PART 3
Summaries of Research 1957
A. Summaries by Countries
I. Canadian Researches, 1957

1. SUBAREAS 2 AND 3
BY W. TEMPLEMAN

SUBAREA 2

Redfish were examined from various depths east of Hamilton Inlet Bank. At 158 fathoms, of 12 redfish 9 were *Sebastes marinus marinus* (L.), one doubtful, and 2 *Sebastes marinus mentella* Travin. At 170-172 fathoms 3 very large redfish were *marinus* type and 17 smaller redfish were *mentella* type, at 182-186 fathoms all 49 redfish were *mentella*. At 200, 250 and 300 fathoms all were *mentella*. Redfish were most abundant at 250-300 fathoms.

In the hydrographic section off Seal Islands, Labrador, (Fig. 1) taken on August 6 to 7, 1957, offshore temperatures in the deep water of the continental slope east of the Hamilton Inlet Bank were above 4°C. This hydrographic section has been taken yearly since 1950 and the 1957 cruise was the first occasion when temperatures as high as 4°C have been found in the deep offshore water of the area. In 1950 these offshore deep-water temperatures were 3.6 to 3.9°C.; in 1951, 3.3 to 3.5°C.; in 1952, 3.4°C.; in 1953, 3.5°C.; in 1954, 3.5 to 3.7°C.; in 1955, 3.3 to 3.6°C.; in 1956, 3.6 to 3.9°C.; and in 1957, 3.9 to 4.7°C. Salinities and inshore temperatures were generally similar to those encountered during the past few years. Some water below -1.5°C. was present near shore. This was absent in 1956 but present in 1955 and 1954. The lowest temperature encountered in 1957 was -1.67°C. and in 1956 -1.41°C.

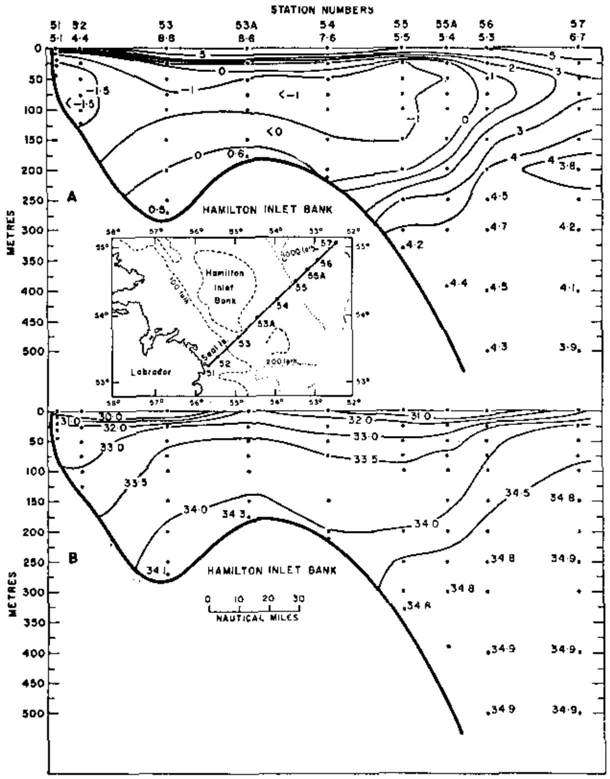

Fig. 1. **Hydrographic section off Seal Islands, across Hamilton Inlet Bank, Labrador, 6-7 Aug. 1957. A—Temperature °C; B—Salinity ‰.**

SUBAREA 3

Data were collected on location of catches and catch per unit of effort of the offshore groundfish fleet. A beginning was made at gathering catch per unit of effort data in several localities for different fishing gears of the inshore cod fleet. Offshore commercial landings of groundfish were well sampled for size and age and similarly the inshore catches were sampled at Burin, St. John's and Bonavista.

Haddock, *Melanogrammus aeglefinus* (L.). During the May and June haddock otter-trawling surveys by the *Investigator II* the haddock had spread northward from their winter concentrations in the deeper water of the southwest slope of the Grand Bank to occupy most of the southern half of the bank and thus were not very abundant in any one area. On the Grand Bank as a whole fair quantities of haddock appeared to be present. The 1949 year-class still made up a very significant part of the catch and the 1952 year-class, with some additions from the 1953 year-class and from year-classes older than 1949, made up the remainder of the haddock of commercial size. The 1950, 1951 and 1954 year-classes were completely insignificant; there was evidence of a modestly large 1955 year-class and of moderate survival of the 1956 year-class.

In the St. Pierre Bank bottom survey no significant quantities of the once very large 1949 year-class or of other haddock of commercial size were obtained. There was evidence that the survival of the 1955 year-class was only small and no evidence was found of significant survival of other year-classes from 1950 to 1954. There has been no immigration to St. Pierre Bank of the successful 1952 and 1953 Grand Bank haddock broods. There was some indication of good survival of the 1956 year-class in deep water at the western edge of St. Pierre Bank but this year-class cannot be properly assessed before it is two years old. Assuming no immigration from the Grand Bank there is at present no evidence that there will be a haddock population available for sustained commercial fishing on St. Pierre Bank for the next three years.

A study of the sound-producing muscles of the swim-bladder of the haddock has been proceeding since 1953 and is now completed. The volume of these muscles in mature male haddock at spawning time in May-June is nearly twice as great as in October-November, whereas in the mature females and in immature males and females these so-called "drumming" muscles are much smaller and there is no seasonal difference in size. Presumably these drumming muscles are used for sound production in male haddock, mainly during the spawning season, and these organs may provide a rallying sound for spawning schools. It is possible that, with suitable equipment, the sounds of these male haddock at spawning time could be an aid to identifying schools of adult haddock. These drumming muscles can be used also in sexing sexually-mature, gutted haddock, but this is not a great problem in Newfoundland where most of the haddock are landed round.

Redfish, *Sebastes marinus mentella* Travin and *Sebastes marinus marinus* (L.). The *Investigator II* carried out deep-water explorations for redfish between 100-150 and 400 fathoms northeast of the Grand Bank and south of Green Bank. In each of these areas a few *marinus*-type redfish were found at the shallower depths while almost all the redfish, including all at the greatest depths were of the deep-water *mentella* type. The greatest redfish abundance was at 200 fathoms northeast of the Grand Bank and at 170-200 fathoms south of Green Bank. Occasional redfish were recorded to 380 fathoms. From a small commercial catch of 3000 pounds of redfish during a cod trip by the otter trawler *Blue Spray* in the southern part of the Halibut Channel between St. Pierre Bank and Green Bank in 88-90 fathoms 543 redfish were examined, of which 14% were of the *marinus* type and the remainder of the *mentella* type.

Other researches in redfish biology have been continued on age and growth, the reproductive cycle, and on a study of body proportions and meristic characters of redfish from various areas and depths. The occasional occurrence of red flesh in redfish was investigated and the pigment responsible was found to be astaxanthin.

Cod, *Gadus callarias* L. Cod investigations were chiefly on size, age, growth and year-class abundance. Sampling has been improved. A study of pre-commercial year-classes of cod was begun through the gathering of data on their abundance and the collection of material for growth studies.

Flatfishes. Age and growth studies have been continued on the American plaice, *Hippoglossoides platessoides* (Fabr.), and on the witch flounder, *Glyptocephalus cynoglossus* (L.).

Male American plaice from both St. Mary's Bay and Southern Grand Bank areas mature sexually at 5 to 11 years and females from 11 to 17 years, but, at comparable ages, for both males and females the Southern Grand Bank plaice are much larger. Male plaice are much slower growing than females, reaching 40 cm. in length in St. Mary's Bay in 19 to 20 years compared with 15 years for the females.

On both the Southern Grand Bank and St. Pierre Bank the 1951 and 1952 year-classes of American plaice were dominant. This is interesting because both of these year-classes of haddock were failures on St. Pierre Bank, and on the Southern Grand Bank haddock survival was good for the 1952 year-class but very poor for the 1951 year-class. Plaice spawn earlier than haddock and thus their eggs and larvae encounter lower surface temperatures and different upper-water currents. Plaice also have a much more wide-spread distribution in the Newfoundland area than haddock and are much more unlikely than haddock to lose a complete year's brood over depths too great for them to survive at the bottom-seeking stage.

Hydrography. Five regular hydrographic sections usually extending from shore and across the banks to the 500-metre depth beyond the edge of the continental shelf were taken during July and August. These sections extended from off Cape Bonavista to the southern slope of the Grand Bank. Once or twice each month temperatures and salinities were taken at a station 5 miles off Cape Spear in 176 metres. Daily surface temperatures were obtained in St. John's Harbour.

In the section off Cape Bonavista there was an abundant supply of water over 4°C. in the deep water at the edge of the continental shelf.

As in Labrador this is very unusual and has not previously occurred in our records at this station where the deep-water temperatures at the continental slope are generally below 4°C., similar to those we have described for the deep-water continental slope area east of Hamilton Inlet Bank. There was a considerably greater volume of water below 2°C. in 1957 than in 1956. Otherwise, temperatures in this section were little different from those of 1956 escept that the 0°C. isotherm lay closer to the surface in 1957.

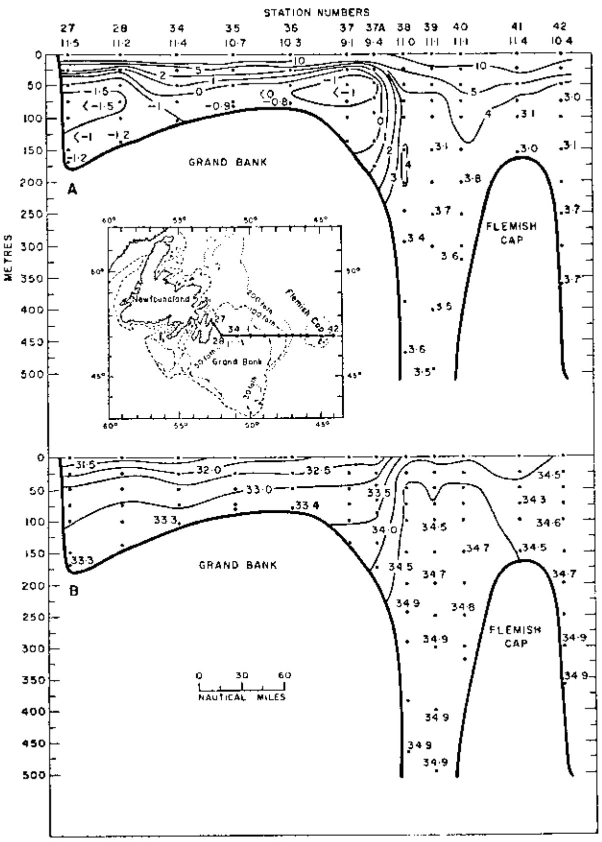

Fig. 2. **Hydrographic section St. John's-Grand Bank-Flemish Cap, 29 July-1 Aug. 1957. A — Temperature °C; B — Salinity°/₀₀.**

In the St. John's-Grand Bank-Flemish Cap section (Fig. 2) some water below -1.5°C. was present near shore. Here the lowest temperature was -1.57°C. whereas in 1956 the lowest temperature in the same area was -1.34°C. In agreement also with the very low air temperatures of the 1957 winter in the Newfoundland area, bottom water temperatures on this northern section of the Grand Bank were all between -0.8°C. and -1.1°C. whereas in 1956 bottom temperatures of 0.2°C. were to be found in this area. Temperatures east of the Grand Bank and around Flemish Cap were little different from those of 1956. The large supply of water over 4°C. which existed at the edge of the continental slope from Labrador to the northern slope of the Grand Bank did not occur in this section. The salinities of the upper layers in the shoreward part of the section were slightly lower than in 1956.

Bottom temperatures on the southern Grand Bank in the section across the Southeast Shoal were unusually low and lower than in 1956. Bottom temperatures in the shallowest water near and on the Southeast Shoal were 0.8 and 0.1°C. in 1957 compared with 3.4 and 4.7°C. in 1956.

In the section close to and paralleling the southwest slope of the Grand Bank water below -1°C. filled most of the Haddock Channel between Green Bank and Grand Bank whereas in 1956 only a trace and in 1955 no water with this low temperature was present in this channel. Otherwise the bottom temperatures at the edge of the south-western slope of the bank in this section were very similar to those in 1956.

More warm water and water of a higher temperature than in 1956 or in 1955 was present in 1957 in the 275-metre section paralleling the southwest slope of the Grand Bank. In this section there was less water below 0°C. and considerably less water below 2°C. in 1957 than in 1956. The lowest temperatures in the Labrador Current water which occurs in the eastern part of this section were -0.7 in 1957 and -0.9 in 1956.

2. SUBAREA 4

BY W. R. MARTIN

Canadian research in the offshore waters of Subarea 4 is carried out by the Fisheries Research Board of Canada and the Quebec Department of Fisheries. The Board's Station at St. John's Newfoundland, did redfish work in Subdivision 4R. The Quebec group studied redfish in Sub-Division 4S and cod in the northern part of Subdivision 4T. The Board's Station at St. Andrews, New Brunswick, investigated cod and haddock in Subdivisions 4T to 4X, and the Atlantic Oceanographic Group at St. Andrews continued hydrographic work throughout the subarea. This report summarizes the various Canadian researches in Subarea 4 which are considered to be of interest to the Commission.

Statistics and sampling of commercial landings are reported separately. During post-war years the numbers of offshore otter trawlers and longliners have steadily increased. This has increased the work involved in relating landings to area of capture and fishing effort. Sampling of commercial landings included approximately 15 thousand cod and 14 thousand haddock measurements, and age determinations for about one fifth of these. Another 14 thousand cod were measured on commercial draggers in order to determine the proportion and sizes of cod discarded at sea.

Haddock, *Melanogrammus aeglefinus* (L.). The haddock program has been carried out in co-operation with the United States laboratory at Woods Hole. In 1957 this research included tagging, exchange of statistics and wharf sampling data, and development of the otolith method of age determination for all Subarea 4 haddock.

In March and April, haddock were caught by otter trawl from depths of 45 to 80 fathoms in the LaHave-Browns region of Subdivision 4X by the M.V. *J. J. Cowie*, and 1123 of these were tagged. In November and December, 1085 haddock were tagged at the mouth of the Bay of Fundy in Subdivision 4X. Most of these were tagged from the same research vessel in Passamaquoddy Bay and Grand Manan Channel over depths of 20 to 60 fathoms. Early returns are consistent with results of earlier taggings which show a southern movement of haddock to offshore grounds in winter, and a northern movement to inshore grounds in summer months. The success of tagging experiments is shown by the high returns from earlier taggings. Over 40% of the disk-tagged haddock released off Lockeport, N. S., (Subdivision 4X) were recovered by the end of 1957. Recaptures in 1957 were still 6% of the possible number of tagged fish remaining in the water at the end of 1956, without any allowance for natural mortality since tagging.

Haddock statistics and sampling data for Subdivision 4X were sent to Woods Hole for analysis. United States statistics and sampling data for Subdivision 4V and 4W were examined at St. Andrews. A large 1952 year-class was largely responsible for increased landings of haddock from Subdivision 4W in 1956, and this year-class continued to be dominant in 1957 catches from Subarea 4. Growth of this year-class appeared to be normal for the Western Bank region of Subdivision 4W.

As a result of an earlier conclusion that otoliths were more satisfactory than scales for age determination of Subarea 4 haddock, all age analyses are now based on otolith readings.

Cod, *Gadus callarias* L. Cod research, in 1957, was concentrated in Subdivision 4T. Investigations included tagging, parasite incidence, growth experiments, models of the fishery, effects of mesh regulation, mesh selection, and a new census program.

In late July and early August, 1202 cod were tagged at the Magdalen Islands at depths of 12 to 26 fathoms. Most of these cod were caught by handline from the M.V. *J. J. Cowie*. First-year recaptures showed a seasonal pattern of migrations similar to that observed earlier for cod tagged farther north off Shippegan Island. Summer recaptures were mainly taken near the Magdalen Islands. Winter recaptures were taken farther south in deeper water, outside the Gulf of St. Lawrence. Percentage recaptures have been smaller than the high returns from earlier taggings (Table I).

Studies of parasite incidence contribute to definition of cod populations. The proportion of cod infected with *Porrocaecum decipiens* (Krabbe), *Lernaeocera branchialis* (L.), and *Clavella uncinata* (O.F. Muller) varied with the size of fish and with the area of capture.

Returns of fish lengths with recaptured tags from 1955 and 1956 cod tagging experiments have provided direct measurements of growth. Results from the 1955 tagging show that the average growth increased from 0.6 cm in July to 3.7 cm in November of the year of tagging, from 5.3 to 7.7 cm during the summer of 1956, and from 9.3 to 11.3 cm in the summer of 1957. There was considerable growth during winter months. The results from the 1956 tagging showed similar changes, but it was evident that there was more growth from 1955 to 1956 than from 1956 to 1957. This difference between years was also observed from otolith studies of commercial samples.

Data on growth, mortalities, fishing intensity, and size at first capture have been used to construct models of the Subdivision 4T cod fishery. The models provide information on fishing conditions required to make best use of the resource. On the basis of present models it is predicted that the sustained yield can be increased by increasing fish size at first capture with a minimum mesh size of at least $5\frac{1}{2}$ inches, and by limiting the total amount of fishing effort to a level approaching the present intensity. The evidence was presented to the Commission in 1957.

As a first step in management of Subarea 4 groundfish the $4\frac{1}{2}$-inch minimum mesh size recommended by the Commission for cod and haddock dragging entered into force for all countries on January 1, 1958. This $4\frac{1}{2}$-inch mesh became effective for Canada in March, 1957. The year, accordingly, was one of transition from small- to large-mesh nets, and there was a good opportunity to compare the effects of different mesh sizes on the quantities landed and the sizes of fish caught.

The relative efficiencies of small- and large-mesh draggers have been compared from statistics of landings per trip by various size classes of New Brunswick draggers. The comparisons give no evidence of decreased landings for draggers which increased their mesh size in 1957.

There is convincing evidence that many fish are released through the larger meshes. The proportion and sizes of cod discarded at sea in Subdivision 4T were examined on 10 commercial dragger trips. As an example, three small-mesh (3-inch) trips to Bonaventure Island grounds were compared with three large-mesh ($4\frac{3}{4}$-inch) trips in 1957. Discards were reduced from 31% to 12% by numbers, and from 10% to 5% by weight on large-mesh trips.

TABLE 1. Subarea 4 Cod Tagging Experiments 1953-57.

Year tagged	Place	Type of tag	Method of Capture	No. tagged	Percentage Recaptured: Calendar year of tagging	2nd year	3rd year	4th year	5th year	Total re-coverie
1953	Lockeport 4X	Disk	Handline	608	34	27	5	3	2	62
1954	Louisbourg 4V	Disk	Handline	492	21	21	17	5	—	51
1954	Canso 4W	Disk	Handline	299	25	29	20	3	—	59
1955	Northern N. B. 4T	Disk	Handline	2650	7	14	8	—	—	27
1956	Northern N. B. 4T	Disk	Handline	482	9	24	—	—	—	30
1956	Northern N. B. 4T	Disk	Otter Trawl	922	7	9	—	—	—	16
1956	Cape Breton 4T	Disk	Otter trawl	733	10	6	—	—	—	16
1957	Magdalens 4T	Disk	Handline and otter trawl	602	2	—	—	—	—	
1953	Lockeport 4X	Hydrostatic	Handline	933	24	13	0.7	0.2	0.2	35
1954	Louisbourg 4V	Hydrostatic	Handline	318	13	14	7	2	—	32
1954	Canso 4W	Hydrostatic	Handline	175	26	14	3	—	—	38
1955	Northern N. B. 4T	Hydrostatic	Handline	1208	7	10	7	—	—	22
1956	Northern N. B. 4T	Hydrostatic (wire)	Otter trawl	150	10	7	—	—	—	17
1956	Northern N. B. 4T	Hydrostatic (nylon)	Otter trawl	448	8	10	—	—	—	18
1957	Magdalens 4T	Hydrostatic	Handline and otter trawl	600	3	—	—	—	—	

(Annual percentages are based on the maximum possible number of tags in the water at the beginning of the year. No allowance ha been made for probable natural mortalities.)

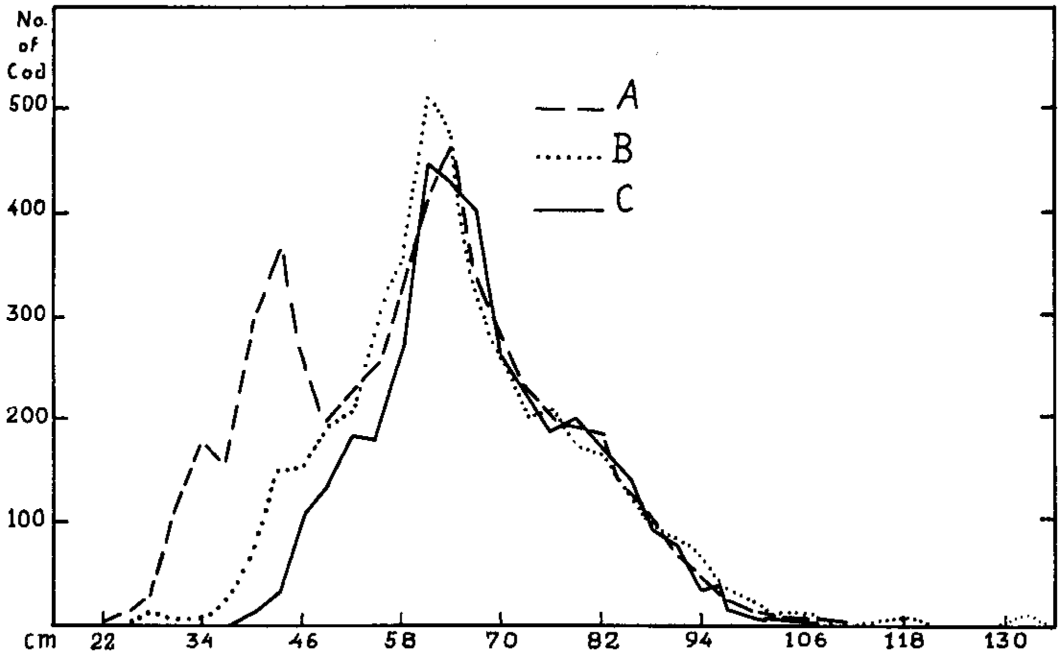

Fig. 1. Length composition of cod caught in 1957 on Bonaventura Island grounds: A — by small — (3-inch) mesh draggers (5136 spec.); B — by large — (4 ¾-inch) mesh draggers (3314 spec.); and C — landings by fishermen (2541 spec.).

Sizes of cod caught by 3- and 4¾-inch mesh codends are compared with sizes landed by fishermen in Figure 1. It is noted that even in the larger-meshed nets the proportion of cod caught and discarded is still significant. Examination of the data indicates that a minimum mesh size of about 5½ inches would be required to eliminate waste.

New information was obtained on equivalent mesh sizes for twines other than manila. The selective properties of two twines, No. 400/3 ply twisted nylon and braided parachute cord nylon were compared with manila during covered codend studies of cod and plaice in subdivision 4T. The results confirmed earlier conclusions that nylon meshes release larger fish than manila meshes of the same size. This justifies special provisions in the Canadian regulations for nylon twine. The results are incorporated in a gear selection review for the Commission (see page 83).

A systematic census of cod and plaice, *Hippoglossoides platessoides* (Fabr.), populations in Subdivision 4T was started in 1957 to determine recruitment, and to assess the effects of environmental factors on abundance, distribution, and movements of these fish. In May to October, 245 tows were made, 16,210 cod and 21,554 plaice were measured, and detailed observations of age, sex, maturity, parasites, and food were recorded for 3,136 cod and 771 plaice. The results should lead to short-term predictions of the relative abundance of stocks available to the fishery. Preliminary results show four well defined size groups of cod. These groups changed in length during the summer, indicating growth of 3 to 6 cm. Small cod moved into Chaleur Bay at the end of June and offshore again in August.

Redfish, *Sebastes marinus* (L.). Two subspecies of redfish have been found in the central part of the Convention Area. No *marinus* -type redfish were found in an exploratory otter trawling cruise in Subdivision 4R between 100 and 180 fathoms off Port Saunders and Cape St. George; all were *mentella*. On a later cruise farther south off Cape Anguille, between 100 and 250 fathoms, of 1900 redfish only two at 120 fathoms were *marinus* type, the remainder being of the *mentella* variety.

Exploratory dragging for redfish was carried out along the south coast of Anticosti Island in

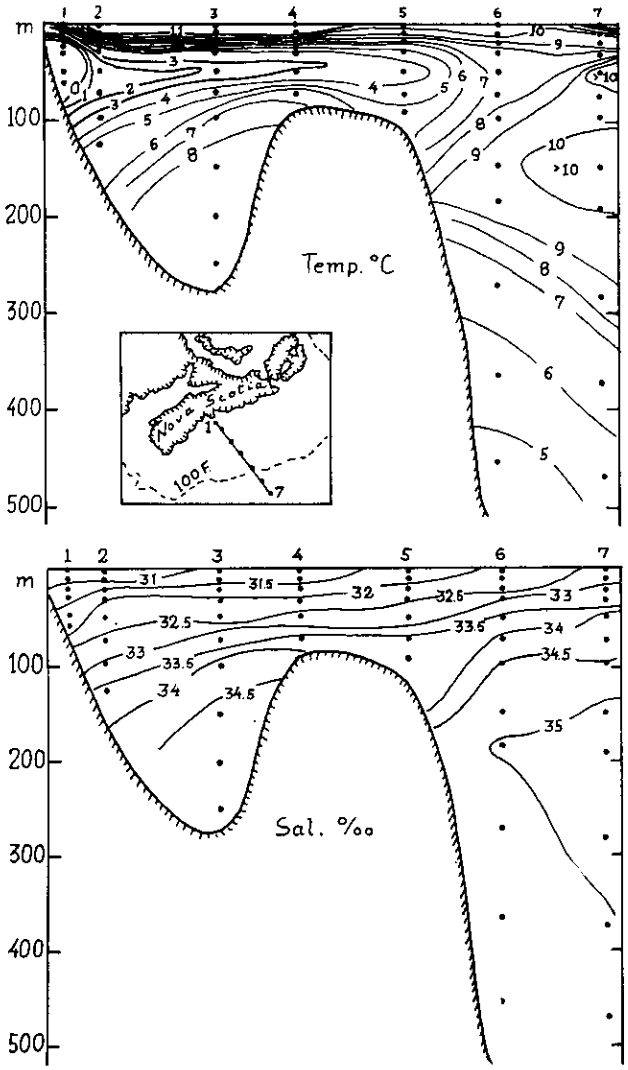

Fig. 2. **Hydrographic section across the Scotian Shelf off Halifax. 25-26 June, 1957. Above — Temperature; below — Salinity.**

Subdivision 4S, at depths of 100 to 200 fathoms. Good catches were usually taken between 140 and 150 fathoms. Over 90% of the redfish sampled were large, over 30 cm in length.

Hydrography. For the second consecutive year a winter hydrographic survey was made in the Gulf of St. Lawrence. Ice conditions were heavy in 1957 as compared to those of 1956. The production of the cold-water layer in the Gulf seems to be related to the cooling of the upper layers during the winter as well as to the oceanographic conditions of the deeper layers.

A survey of the Bay of Fundy, Scotian Shelf, and the Gulf of St. Lawrence areas was carried out in June. The hydrographic section off Halifax is described in Figure 2. In June, the cold-water layer was more developed in 1957 than in 1955. The inshore banks were presumably covered with water of sub-zero temperature. The Scotian Gulf was filled with warm water, above 8°C., and the bottom temperature on Emerald Bank varied between 5.5 and 7.5°C.

Analysis of oceanographic conditions in the Strait of Belle Isle-Esquiman Channel area indicates the development of an eddy in Esquiman Channel as a result of the dominant westward flow in the Strait and of the bottom configuration. Analysis of the properties of the deep waters in the Laurentian Channel indicates warming of the deep layer from the 1920's to the 1950's. The upward trend of temperature was accompanied by an increase in the volume of the deep layer.

Analysis of surface water along the coast revealed that the cooling observed during the previous three years was followed in 1957 by a slight warming in the Bay of Fundy area and the southwestern Gulf of St. Lawrence. The Halifax area showed a decrease from the previous year.

In June drift bottles were released over the Scotian Shelf for studies of surface drift.

II. Danish Research Report, 1957

1. BIOLOGY

BY PAUL M. HANSEN

I. Cod in Coastal Waters and on the Offshore Banks of West Greenland.

1. Occurrence of Cod Eggs and Fry.

Table 1 shows the number of cod eggs and larvae caught in Godthåb Fjord. Figure 1 shows the position of the stations. Fishing was carried out with a 1 m stramin net and, from the 1st of May, also with a 1 m nylon net of the same mesh size. The catches with the nylon net are shown in brackets in Table 1. The nets were hauled with a 100-50 m wire for 30 minutes. The nylon net yielded in most cases larger catches than the stramin net. The table only shows hauls taken in the months February to July. On the 9th, 22nd, and 24th of January the stramin net was used on Station 4, 6, and 7 respectively. Cod eggs were not caught in any of these hauls.

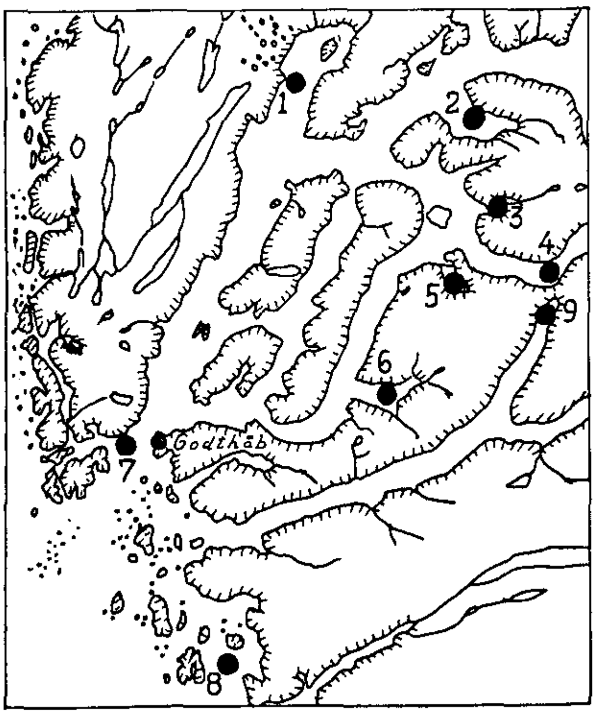

Fig. 1. Stations in Godthåb Fjord, where hauls for cod eggs and cod larvae were made in February-July 1957.

At the largest spawning place for cod in Godthåb Fjord, Station 4, twenty cod eggs were caught on 21 February in a haul with stramin net with 100-50 m wire. At the same station and date 88 cod eggs were caught in a haul with a 400 m wire (this haul is not shown in the table). In March there were considerably more eggs in the hauls on Station 4 than on the neighbouring stations. In April less eggs were caught on Station 4 than in March.

It is apparent that on an average the eggs were scarcer in Godthåb Fjord in 1957 than in 1956.

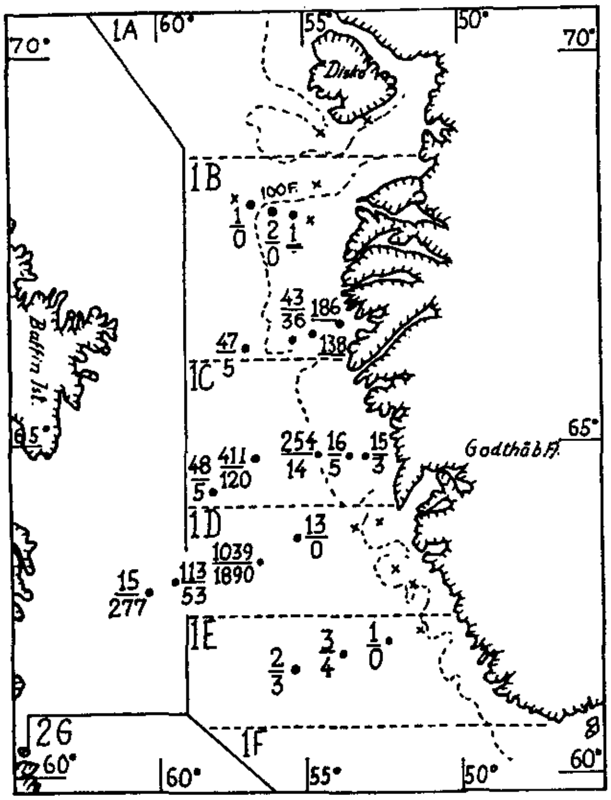

Fig. 2. Catches of cod larvae per 30 minutes haul with two m. stramin net in West-Greenland waters in July 1957. Above the line—upper water layers; below—lower water layers.

TABLE 1. Number of cod eggs and larvae caught in the Godthab Fjord area. Figures in ( ) indicate nylon net catches.

STATION		February		March		April		May		June		July	
		1-15	15-28	1-15	15-31	1-15	15-30	1-15	15-31	1-15	15-30	1-15	15-31
1	Eggs			4									
	Fry			0									
2	Eggs					4							
	Fry					0							
3	Eggs				134			7500 (9240)					
	Fry				0			0 (0)					
4	Eggs		20		9950		834				0 (0)		
	Fry		0		0		0				0 (1)		
5	Eggs				18			1239 (2804)					
	Fry				0			0 (0)					
6	Eggs			4	4			77 (353)	290 (519)		0 (0)		
	Fry			0	0			0 (0)	0 (0)		5 (1)		
7	Eggs	0						30 (18)			0 (0)		
	Fry	0						6 (2)			128 (139)		
8	Eggs	0		0			0		24 (7)			0 (0)	0 (0)
	Fry	0		0			0		23 (9)			20 (55)	0 (0)
9	Eggs								328 (1000)				
	Fry								0 (0)				

The first larvae were caught in the beginning of May at Station 7 in the mouth of the fjord, and at the same station the largest number of larvae were caught in the last half of June.

Figure 2 shows the catches with 2 m stramin net taken on the "Dana" stations in the Davis Strait in July. The numbers of larvae were on a whole much greater than in earlier years. The distribution of the larvae in the south part of the Strait was far more westerly than usual. Thus no larvae at all were caught over Fylla, Fiskenaes, and Dana Banks, but large numbers on the stations farther west. On Lille Hellefiske Bank a few larvae were found, but west of the bank the quantities caught were far greater. On the contrary more larvae were caught on the southern part of Store Hellefiske Bank than on the stations west of the bank. At the northern stations on this bank only few larvae were caught.

It is difficult to estimate from the distribution and frequency of the cod fry in 1957, whether this year-class will be rich or poor. The western distribution of larvae indicates that the current carried large quantities out over greater depths where they, when reaching the stage when they seek the bottom, may either perish or be carried to Labrador. In both cases they will be lost to the Greenland stock. However, the fairly good occurrence of larvae along the coast and over Store Hellefiske Bank indicates that a sufficiently great number will develop and form a good 1957 year-class which in 1962 for the first time will be of importance to the fishery.

2. Occurrence of Small cod of Age-Groups I-III.

Small cod were very scarce in the coastal and fjord areas. Except for one case where 1,139 cod of 7 to 15 cm. were caught (in seine, Sukkertoppen district, 64°48'N, 52°12'W.) The modal length was 11 cm. These small cod belonged to the I-Group.

3. Commercial Fish. The Age Composition

a. Offshore Banks.

Age determinations were made on 1546 otoliths: 941 from "Dana" catches with handlines in July and August (no. 1, 2, 4, 6 and 7), and 605 from longline catches by "Adolf Jensen" (no. 3, 5, 8 and 9).

Figure 3 (left) shows the age distribution of nine catches from the Banks (the material will appear in tabular form in the 1957 "Sampling Yearbook"). Age analyses from Store Hellefiske Bank (nos. 1 and 2) show a surprising dominance of the 1953 year-class with about 50% of the catch. Even if the 1953 year-class, based on the investigations from 1956, was estimated to be a rich year-class it was not expected to appear already at an age of four years in such large quantities on the banks. On the banks south of Store Hellefiske Bank it only made up a rather small percentage. It was without importance for the fishery in 1957 owing to the small size of the individuals, about 46 cm (0.9 kg).

The rich 1947 year-class predominated in most of the samples from the other banks; however, it appears somewhat reduced since 1956. The 1947 year-class is probably about to migrate southwards and then via E. Greenland to Iceland, as was the case in earlier years with the 1945 year-class.

The 1950 year-class is well represented and has obviously played a great role in the yield of the fishery. Year-classes older than 1947 were scarce.

The length distribution (Figure 3—right) shows good conformity with the age distribution. In the two samples from Store Hellefiske Bank (nos. 1 and 2) and in the longline catch in April from Fylla Bank (no. 9) mainly small and young cod occur. In the other samples most cod measure between 70 and 80 cm which agrees with the fact that these samples mainly consist of the rich 1950 and 1947 year-classes, with mean lengths of 70 and 77 cm, respectively.

b. Inshore Waters and Fjords.

Age determinations were carried out for 5,172 cod sampled from coastal and fjord areas (see Fig. 4). Most of the cod were caught on longline with cod hooks. No. 15 is from pound net, no. 21a, 21b and 21d are from prawn trawl and no. 21g and 27 from handline. No. 25 is composed by equal numbers from handline, longline and pound net. (The data will appear in tabular form in the "Sampling Yearbook, 1957").

In no. 10, 11 and 12 from Subdivision 1A the 1942 year-class is strongly represented, in 10 and 12 it predominates with 41 and 29%, in 11 it is the next largest with 26%. The 1947 year-class is the largest (34%) in no. 11, it amounts to between 15 and 20% in the two other samples.

In Subdivision 1B a completely different age distribution is found. The 1942 year-class is here quite unimportant. In the northern part of the area, no. 13, the 1947 year-class predominates (40%), while the 1950 year-class is next with between 25 and 30%. In sample no. 14 the 1950 year-class is the strongest with over 30%, the 1951 year-class comes second and the 1947 year-class third.

In sample no. 15, pound net in Amerdloq Fjord, the younger year-classes are more frequent than in the northern samples. 1950 is dominating 1951 the next largest. The 1953 year-class which was very dominant in the handline catches on the Store Hellefiske Bank was of no importance

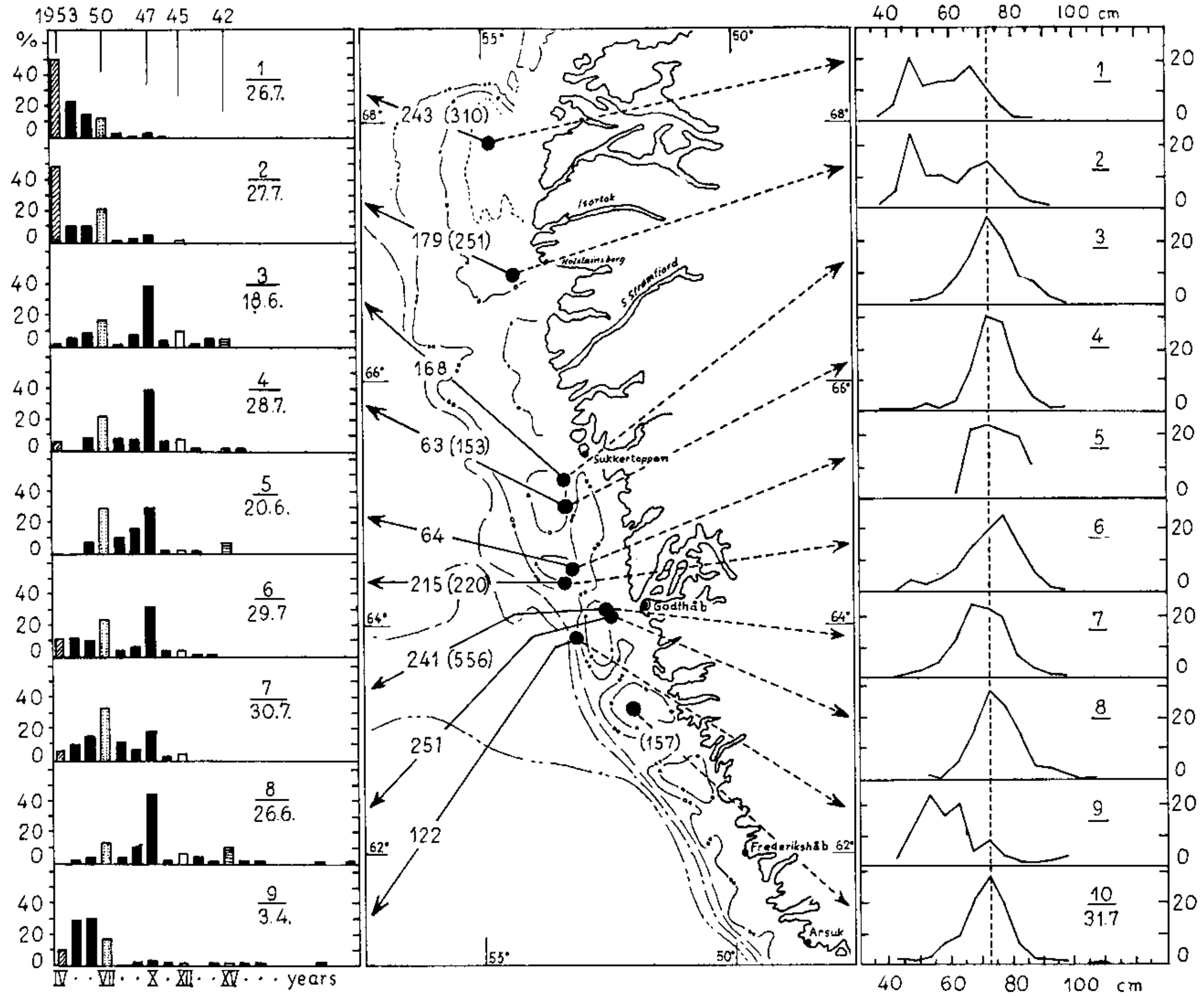

Fig. 3. Cod Percentage age distribution (left) and length distribution by 5 cm groups (right) of cod caught on the Greenland Banks in 1957. The numbers of cod examined and cod tagged (in brackets) are given for each station on the map (center).

in the samples from the coastal regions. Only in the sample from Amerdloq Fjord it constituted between 10 and 15%.

In Subdivision 1C the year-classes 1950, 1953 and 1947 dominated in samples no. 16, 17 and 18, respectively. In no. 17 the 1953 year-class constituted as much as 32%.

In Subdivision 1D two samples were taken at the mouth of the Godthåb Fjord (no. 19 and 20). Both samples contain nearly exclusively young year-classes, 1950-1953. In no. 20 from the autumn, the 1953 year-class amounted to over 50%.

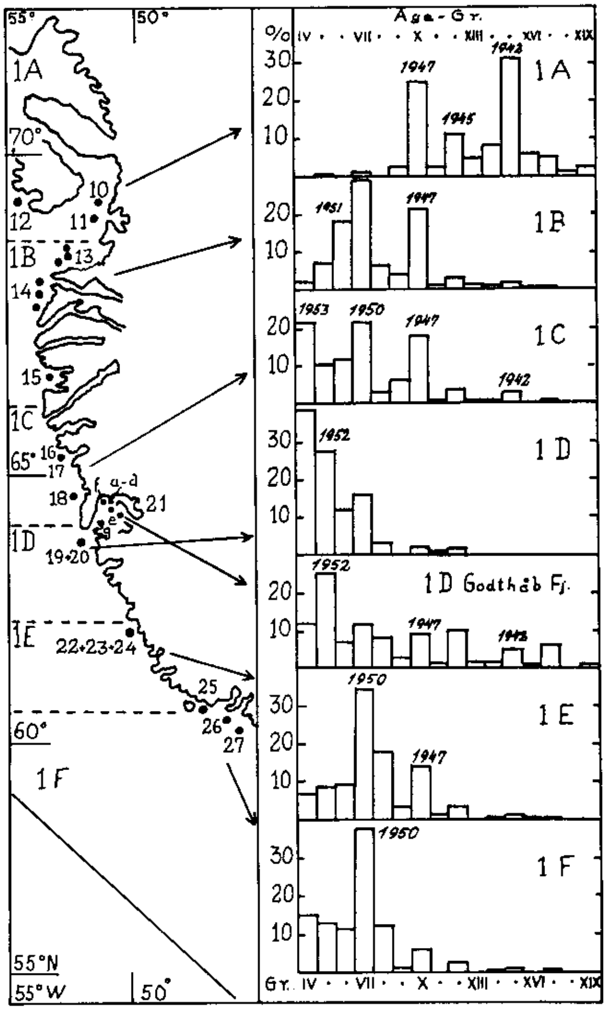

Fig. 4. Position of samples of cod from inshore waters and fjords, 1957, and (right) age distribution of samples.

In Godthab Fjord seven samples were collected from January to May. These are shown in Figure 4, as 21a-g. The samples a, b, c, d are from the same locality, but from various gears. Samples a, b and d are from prawn trawl and caught at a depth of about 240 m; c and f from longlines; and e and g from handlines. No. 21e is taken right in the bottom of the fjord where the greatest spawning ground is found. A rather even distribution of the rich year-classes was as usual found in several of the samples from Godthåb Fjord.

Of the young year-classes the 1952 year-class was exceedingly well represented, dominating in four of the samples.

Many old, mature cod were found in samples a, b and c from January and February, both in catches with prawn trawl (a and b) and with longline (c). In March, however, a catch from prawn trawl (d) from the same locality as a and b contained almost exclusively the age-groups IV and V (1952 and 1953 year-classes). The older, mature cod had by now migrated to the innermost part of the fjord for spawning. Sample e was taken in April on this spawning place and showed an age distribution very much the same as that found in February a little farther out in the fjord. In this sample there were not many cod younger than the VII-Group. The two samples f and g corresponded fairly well to c and d, showing also that far into the fjord are found mainly old, mature cod, farther out mainly young, not yet mature, fish.

The three samples from Subdivision 1E, nos. 22, 23 and 24, were taken in the same region, in May, August-September and October respectively. Common for these samples was that the 1950 and 1949 year-classes played a rather considerable role. In no. 24, however, the 1947 year-class dominated with more than 30%, in the two other samples it was without importance.

In Subdivision 1F, samples no. 25, 26 and 27, the 1950 year-class dominated, in no. 26 with 57.5%, in the other samples with a little more than 30%. The 1947 year-class constituted only between 5 and 10%. The 1949 and 1950 year-classes together made up not less than 88%

Age Group	III-VI	VII-X	XI-XVI	No.	Mean Length cm
Year-class	1954-51	1950-47	1946-41		
Longline	40.4	47.1	12.4	121	60.3
Handline	44.3	53.9	1.8	113	58.0
Pound net	61.5	38.5	—	192	54.5

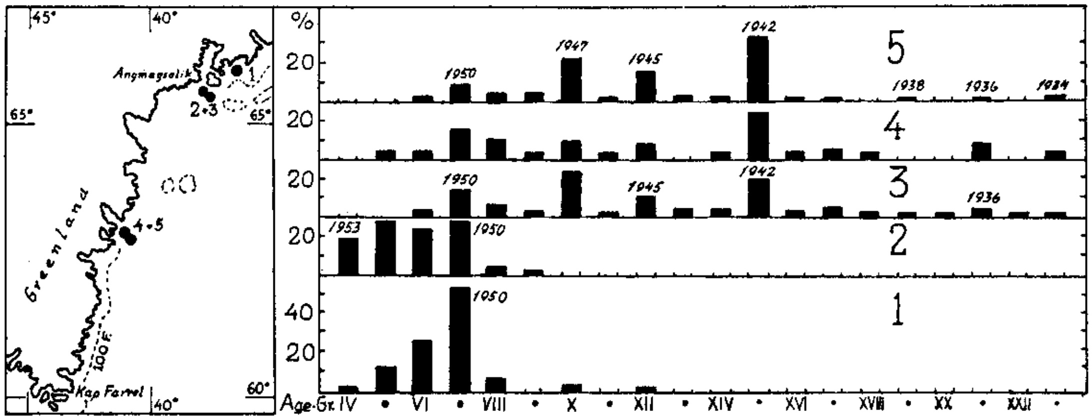

Fig. 5. **Position of samples of cod from East-Greenland waters, 1957, and percentage age distribution of the five samples.**

of sample no. 26. Sample no. 25 consists of three catches taken with longline, handline and pound net. In the table above is shown the percentage age distribution for the age-groups III-VI, VII-X and XI-XVI of the catches of these gears. It appears that the longlines take more old cod than the handlines and the pound nets. Pound nets yield more young cod than the two other gears.

II. East Greenland.

From 9 August to 24 September researches were carried out in SE Greenland waters from "Adolf Jensen". The work was concentrated mainly between 63 and 66°N. Lat.

Off Angmagssalik (65°35'N, 37°35'W) large concentrations of cod were found. At Kungmiut in the Angmagssalik Fjord the concentrations were somewhat smaller. In all 681 cod were aged, of these 589 were collected by "Adolf Jensen" and 92 by the leader of the fisheries at Skjoldungen. The material includes five samples (Figure 5). The data will be presented in the "Sampling Yearbook, 1957".

No. 1 is from handline with the exception of a few specimens from long line. No. 2 is taken exclusively by handline. Both samples contain mainly the age-groups IV-VII (1953-1950 year-classes). No. 2 includes rather more of the young year-classes than no. 1. In no. 1 the 1950 year-class dominates with 52.5% whilst this and the 1952 year-class are of about the same size in no. 2; 25.5% and 27.0% respectively. No. 2 was taken in quite shallow water where great shoals of cod were chasing the capelin (I and II-Groups), which occurred here in very great quantities.

Based on information from Angmagssalik, a migration of very great cod into coastal waters occurred in October. A similar migration had also been observed in earlier years.

Sample no. 3 was taken with longline in deep waters, about 200-300 m, partly on an offshore bank off Angmagssalik and partly on localities in the coastal area south of Angmagssalik. No. 4 was taken in about the same depth as no. 3; partly on the bank in the Denmark Strait off Skjoldunge Sound and partly in the Sound at Skjoldungen. These two samples were completely different from nos. 1 and 2 as they include

TABLE 2. Age at first maturity for the three year-classes 1942, 1945 and 1947 from otolith observations made in 1957, Greenland.

	Sex	1942 year-class Males		1942 year-class Females		1945 year-class Males		1945 year-class Females		1947 year-class Males		1947 year-class Females	
	Age	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
	Imm	—	—	—	—	—	—	—	—	2	1.1	2	1.2
	6	5	20.8	2	15.4	1	5.3	1	3.8	9	5.2	1	0.6
Banks,	7	11	**45.8**	6	**46.2**	7	36.8	8	30.8	90	**51.7**	53	32.1
Subdiv.	8	8	33.3	3	23.1	8	**42.1**	13	**50.0**	57	32.8	82	**49.7**
1 A	9	—	—	2	15.4	1	5.3	4	15.4	16	9.2	26	15.8
to	10	—	—	—	—	1	5.3	—	—	—	—	1	0.6
1 D	11	—	—	—	—	1	5.3	—	—	—	—	—	—
	Total	24	—	13		19		26		174		165	
	mean age	7.1		7.4		7.8		7.8		7.4		7.7	
	Imm	—	—	—	—	2	4.0	—	—	3	1.2	22	6.0
	6	16	25.0	9	13.2	4	8.0	3	5.4	8	3.3	1	0.3
North,	7	31	**48.4**	29	**42.6**	12	24.0	18	32.1	74	30.1	82	22.2
Subdiv.	8	9	14.1	17	25.0	25	**50.0**	27	**48.2**	110	**44.7**	162	**43.9**
1 A	9	7	10.9	12	17.6	7	14.0	8	14.3	49	19.9	93	25.2
to	10	1	1.6	1	1.5	—	—	—	—	2	0.8	9	2.4
1 D													
	Total	64		68		50		56		246		369	
	mean age	7.2		7.5		7.4		7.7		7.8		7.6	
	Imm	—	—	—	—	—	—	1	6.7	—	—	3	5.8
	6	—	—	—	—	2	10.0	1	6.7	5	8.6	2	3.8
South,	7	6	**100.0**	1	**50.0**	7	35.0	4	**26.7**	27	**46.6**	18	34.6
Subdiv.	8	—	—	1	**50.0**	8	**40.0**	4	**26.7**	24	41.4	24	**46.2**
1 E	9	—	—	—	—	2	10.0	2	13.3	2	3.4	5	9.6
to	10	—	—	—	—	—	—	3	20.0	—	—	—	—
1 F	11	—	—	—	—	1	5.0	—	—	—	—	—	—
	Total	6		2		20		15		58		52	
	mean age	7.0		7.5		7.7		7.6		7.4		7.7	
	6	7	22.6	3	13.6	18	24.3	14	30.4	5	20.0	4	15.4
Godt-	7	18	**58.1**	8	**36.4**	36	**48.6**	18	**39.1**	10	**40.0**	6	23.1
håb	8	5	16.1	7	31.8	17	23.0	12	26.1	7	28.0	12	**46.2**
Fjord	9	—	—	3	13.6	3	4.1	2	4.3	3	12.0	3	11.5
	10	1	3.2	1	4.5	—	—	—	—	—	—	1	3.8
	Total	31		22		74		46		25		26	
	mean age	7.0		7.6		7.1		7.0		7.3		7.7	
	Imm	—	—	—	—	—	—	—	—	3	12.5	5	11.6
	6	—	—	4	8.2	—	—	2	8.3	—	—	—	—
	7	14	**60.9**	23	**46.9**	4	40.0	4	16.7	7	29.2	4	9.3
East	8	8	34.8	19	38.8	6	**60.0**	9	**37.5**	11	**45.8**	22	**51.2**
Coast	9	1	4.3	2	4.1	—	—	6	25.0	3	12.5	11	25.6
	10	—	—	1	2.0	—	—	2	8.3	—	—	1	2.3
	11	—	—	—	—	—	—	1	4.1	—	—	—	—
	Total	23		49		10		24		24		43	
	mean age	7.4		7.4		7.6		8.2		7.8		8.2	

mainly cod older than the X-Group (1947). In nos. 3 and 4 these old cod constitute 75 and 66% The 1942 year-class made up about 20% in both samples. The old 1936 and 1934 year-classes were, however, represented by few specimens only.

Sample no. 5 is from Greenlanders' catches with handline from the end of September. Also this sample contained mainly old cod, 81% of the 1947 and older year-classes. The 1942 year-class was the largest with 32.6%. During the investigations in August most of the cod were found on the offshore banks. In the end of September cod appeared in the Skjoldunge Sound in larger quantities.

Two ripening cod with ovaries containing rather large eggs were caught on the 16th of September off Angmagssalik. Possibly these cod would have spawned in October or November.

III. Age at First Maturity—West and East Greenland.

Table 2 gives a survey of the age at first maturity as estimated from otoliths of the 1942, 45 and 47 year-classes from various regions of West and East Greenland. The 1942 year-class was the year-class with the largest number of cod reaching maturity at age seven. Of the two other year-classes the majority reached maturity at age eight.

IV. Redfish.

In Godthåb Fjord ten hauls with ring trawl for redfish (*Sebastes*) were made at various times during eight months of the 1957 season. The catch included a total of 14,282 redfish, all of which were measured. Otoliths were collected from part of the redfish. Measurements of redfish taken in prawn trawl in this locality have been made regularly since 1952. From Tunugdliarfikfjord (60°56'N, 45°47'W), 1,293 redfish caught with prawn trawl in seven hauls during January, February and March were measured. Otoliths were collected.

The data will appear in the 1957 Sampling Yearbook.

V. Spotted Wolffish.

The following measurements of spotted wolffish (*Anarhichas minor* Olafsen) caught on longlines were made:

Søndre Upernavik (72°08'N, 55°28'W), July; 2,694 specimens

Diskofjord (69°28'N, 54°07'W), 2 August; 746 specimens

The length frequency curves of these two samples are shown in Figure 6 together with a length curve for 786 spotted wolffish caught in more southern fishing places off West Greenland in 1956.

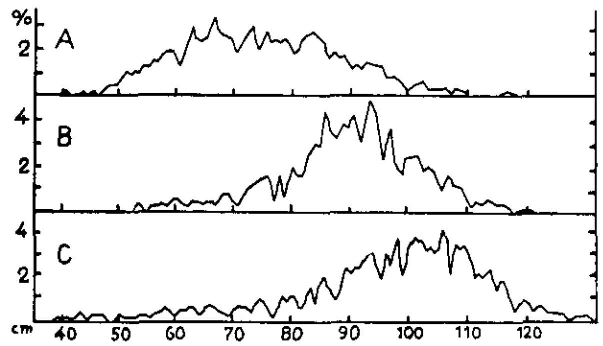

Fig. 6. Spotted wolffish. Percentage length distribution. A — Sdr. Upernavik, July 1957, 2694 spec.; B — Diskofjord, 2 August, 1957, 746 spec. and C — Holsteinsborg, Sukkertoppen, Godthåb, St. Hellefiske Bank, Aug.-Sept. 1956, 786 spec.

The smallest wolffish are caught in the most northern fishing place, Søndre Upernavik. At Diskofjord the wolffish are considerably larger; however, still well below those from the most southern fishing places. At Søndre Upernavik 59 wolffish were tagged and at Diskofjord 56.

VI. Cod Tagging Experiments.

In 1957, 5,228 cod were tagged at West Greenland and 567 at East Greenland.

A total of 715 tagged cod were recaptured in 1957. Table 3 shows the recaptures of cod of various ages from several years' tagging experiments. 697 tagged cod were recaptured in West Greenland waters; 13 at Iceland, 3 in East Greenland and 2 on the Grand Bank of Newfoundland. Of the three recaptures from

East Greenland one was from Anton Dohrn Bank, one from off Angmagssalik and one from north of Angmagssalik (66°48'N, 24°57'W).

The recapture of a cod tagged with hydrostatic (Lea) tag is of special interest. This cod was recaptured 12 June on Fylla Bank (63°56'N, 52°32'W) and measured then 75 cm. It was tagged 5 August 1949 in Umanak Harbour (70°40'N, 52°05'W) with a length of only 20 cm. It is the fifth recapture from this tagging experiment which included 130 small cod (16-29 cm.), all apparently belonging to the 1947 year-class, which as I-and II Gr. had an unusual northern distribution. The five recaptures are from 1950, 1952, 1953, 1954 and 1957. The recapture in 1950 was made close to the place of liberation, the other four were from St. Hellefiske Bank 30-Aug.-1952 and 26-Jul.-1954, and from Fylla Bank 11-Aug.-1953 and 12-June-1957. Two of the recaptured cod from Store Hellefiske Bank belonged to the V-and VII- Gr., those recaptured on Fylla Bank to the VI- and X- Gr. When tagged they measured 20, 19, 24 and 20 cm respectively. For three of these the reported lengths at recapture are not sufficiently reliable. The recapture from 1957 is reported as 75 cm, which appears reasonable for a X-Gr. cod. The distances between place of liberation and of recapture were for the cod recaptured on Store Hellefiske Bank 200-250 miles; for those recaptured on Fylla Bank around 450 miles.

This experiment is of interest partly because it shows that cod as small as only 20 cm can be tagged with hydrostatic tags, and partly because it gives evidence to the effect that the cod stock that is the basis for the fishery on the banks in the Davis Strait in certain years is recruited to a great extent from areas north of the banks.

A cod tagged with a hydrostatic tag 21 July 1950 in the harbour of Christianshåb (68°50'N, 51°00'W) was recaptured 9 July on Store Hellefiske Bank; when tagged it measured 27 cm, when recaptured 75 cm. The distance between liberation and recapture was ca. 120 miles. Another cod tagged 18 August 1949 with hydrostatic tag at Qutdligssat (70°N, 53°W) was recaptured 5 May 1957 in trawl off Frederikshåb (61°50'N, 50°30'W). The distance between the two posi-

TABLE 3. Marked Cod recaptured at Greenland (Gr.) and at Iceland (Ic.) in 1957, tabulated according to Age and Year of Liberation.

Year-class	Age-group	1948		1949		1950		1951		1952		1953		1954		1955		1956		1957		Total		
		Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	%	Ic.
939	XVIII	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	0.3	
940	XVII	2	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	—	—	1	—	7	1.9	
941	XVI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
942	XV	—	—	—	—	—	—	1	—	—	—	—	—	6	—	4	—	3	—	1	—	15	4.0	
943	XIV	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	2	—	4	1.1	
944	XIII	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	—	—	—	—	3	0.8	
945	XII	—	—	—	1	—	—	—	1	—	1	2	—	4	4[2]	9	—	9	—	3	—	27	7.2	7[2]
946	XI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	1	—	5	1.3	
947	X	—	—	1	—	—	—	-1	—	6	—	4	—	30	2	14	—	50	—	11	—	117	31.3	2
948	IX	—	—	—	—	—	—	—	—	—	—	—	—	2	—	4	—	14	—	4	—	24	6.4	
949	VIII	—	—	—	—	—	—	—	1[1]	—	—	—	—	4	—	5	1	7	—	—	—	16	4.3	2[1]
950	VII	—	—	—	—	—	—	—	—	—	—	1	—	7	—	20	—	41	1	8	—	77	20.6	1
951	VI	—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	13	—	5	—	22	5.9	
952	V	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	5	—	10	—	22	5.9	
953	IV	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	25	—	27	7.2	
954	III	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	5	1.3	
955	II	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	0.5	
??		1	—	2	—	1	—	3	1	10	2	8	—	32	—	46	2[3]	148	1	72	—	324		6[3]
Total number		3	—	3	1	1	—	5	3[1]	16	3	15	—	88	6[2]	119	3[3]	297	2	150	—	697		18[1,2,3]

(1) One cod recaptured at Angmagssalik.
(2) One cod recaptured on the Dohrn Bank and one cod recaptured in the Denmark Strait.
(3) Two cod recaptured on the Grand Bank.

tions is ca. 480 miles. When tagged the cod measured 47 cm, at the recapture 83 cm (probably 1945 year-class).

Otoliths of 385 recaptured cod were collected.

Of 12 tagged cod recaptured outside Subarea 1, and whose age could be ascertained, seven belonged to the XII-Gr. (1945 year-class), two the X-Gr. (1947), two to the VIII-Gr. (1949), and one to the VII-Gr. (1950).

Otoliths were collected from 373 cod recaptured in Subarea 1. The 1947 year-class still predominated (31.3%), the 1950 year-class was next (20.6%).

Table 4 shows the number of recaptures by the various countries. As in previous years Portugal reports the highest number (73%), next come the Greenlanders' (19%); recaptures by other nations total to ca. 8%.

TABLE 4. Cod recaptured in 1957.

	W. Green-land	Iceland	E. Green-land	Grand Banks
Denmark	3			
Greenland	132			
Faroe Islands	4			
Norway	4			
Iceland	8	13		
United Kingdom	6			
France	5			
Germany	6		3	
U.S.S.R.	1			
Spain	19			
Portugal	509			2
Total	697	13	3	2

2. HYDROGRAPHIC CONDITIONS IN THE EASTERN PART OF LABRADOR SEA AND DAVIS STRAIT 1957.

BY F. HERMANN

During July and the beginning of August the sections shown in Figure 1 were worked by the Danish R/V "Dana".

The ice conditions were favourable off West Greenland and practically no "storis" was met. The temperature distribution at 50 m is shown in Figure 1. The sharp front between the arctic and the atlantic component of the West Greenland Current is clearly seen especially off the southern part of West Greenland. Off Fylla Bank a branch of the West Greenland Current turns westwards where it meets the cold water masses of the Labrador Current. The temperatures were about normal at 50 m, probably a trifle below normal in the southernmost and northernmost part of the area.

The hydrographic conditions are further illustrated by the Sections I to VI (Figures 2 to 7). The sections show that the arctic component of the West Greenland Current was weak except in the Cape Farewell section and the warm atlantic component of this current was well developed, especially in the area south of Fylla Bank.

The Fylla Bank section had been worked by M/C "Adolf Jensen" earlier in the year in the beginning of April and in late June. Over the shallow part of the bank the temperature at 40m was in April 0.15°C. and in June 1.35°C. The winter cooling seems not to have been very severe.

As in previous years a fixed station was worked in the entrance of Godthåb Fjord (64°07'N - 51°53'W) as often as possible throughout the year from the ships M/S "Adolf Jensen" and M/C "Tornaq".

The variation of the temperature from November 1956 to February 1958 is shown in Figure 8. In March and April 1957 the temperature was as usual nearly uniform from surface to bottom. The winter cooling appeared, however, to have been less severe than usual as the bottom temperature was positive all the year. In November a strong inflow of warm bottom water took place. This is about a month earlier than usual.

In January 1958 the winter cooling was already very strong and negative temperatures were found from surface to bottom.

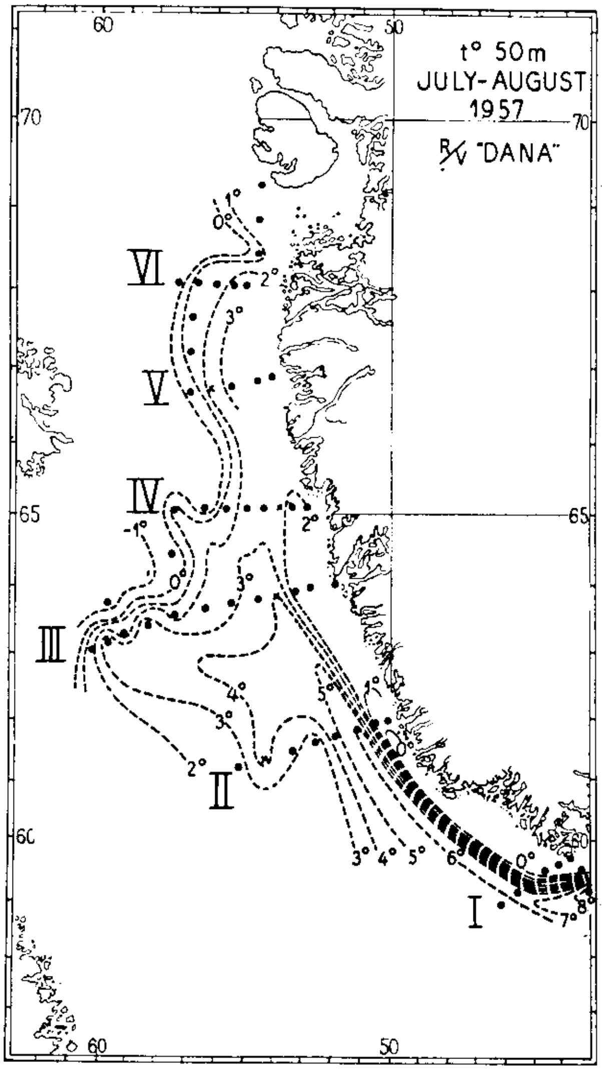

Fig. 1. Location of sections (I-VI) taken from R/V "Dana", July-Aug. 1957, and distribution of temperature °C at 50 metres depth.

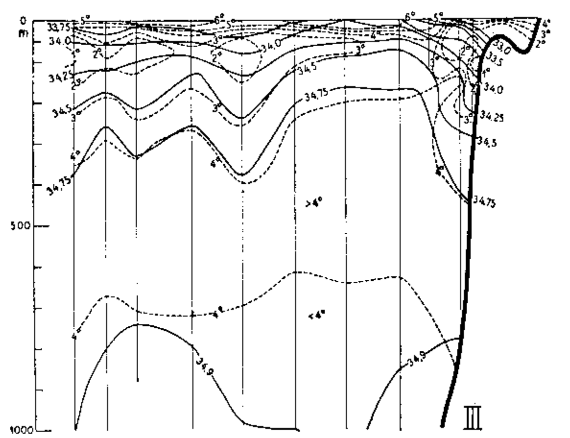

Fig. 4. Section III across Fylla Bank 15-17 July 1957.

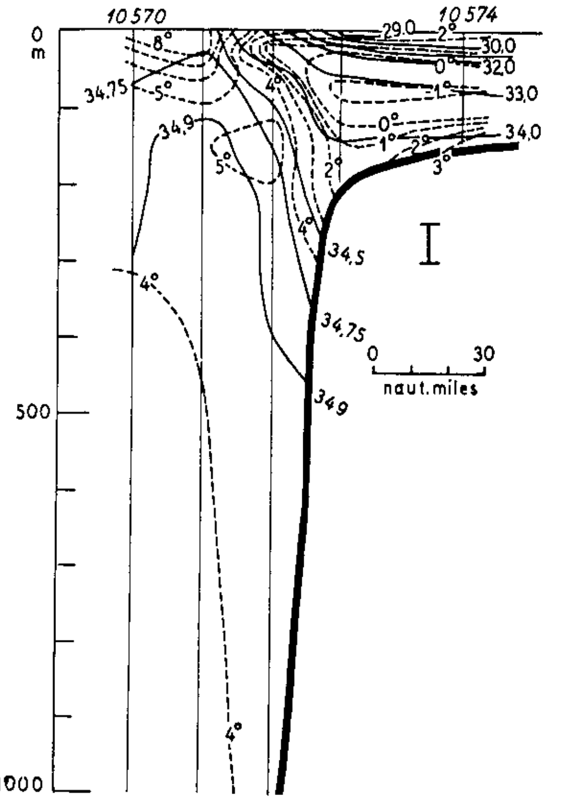

Fig. 2. Section I off Cape Farewell 8-9 Aug. 1957.

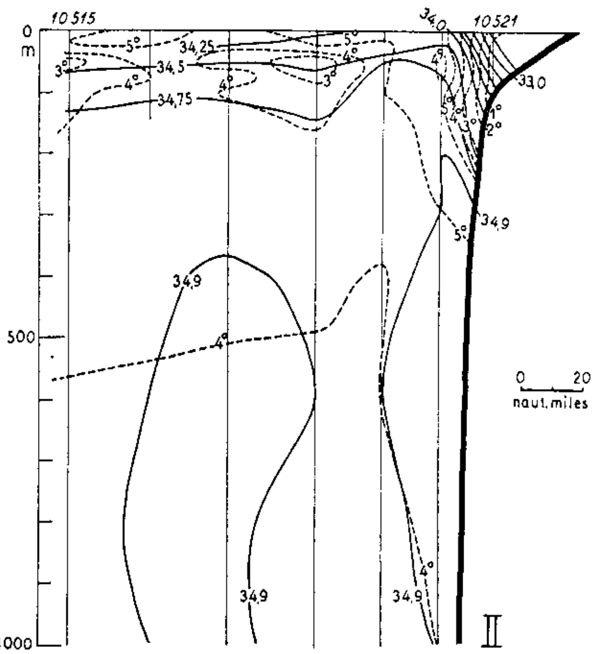

Fig. 3. Section II off Frederikshaab 7-8 July 1957.

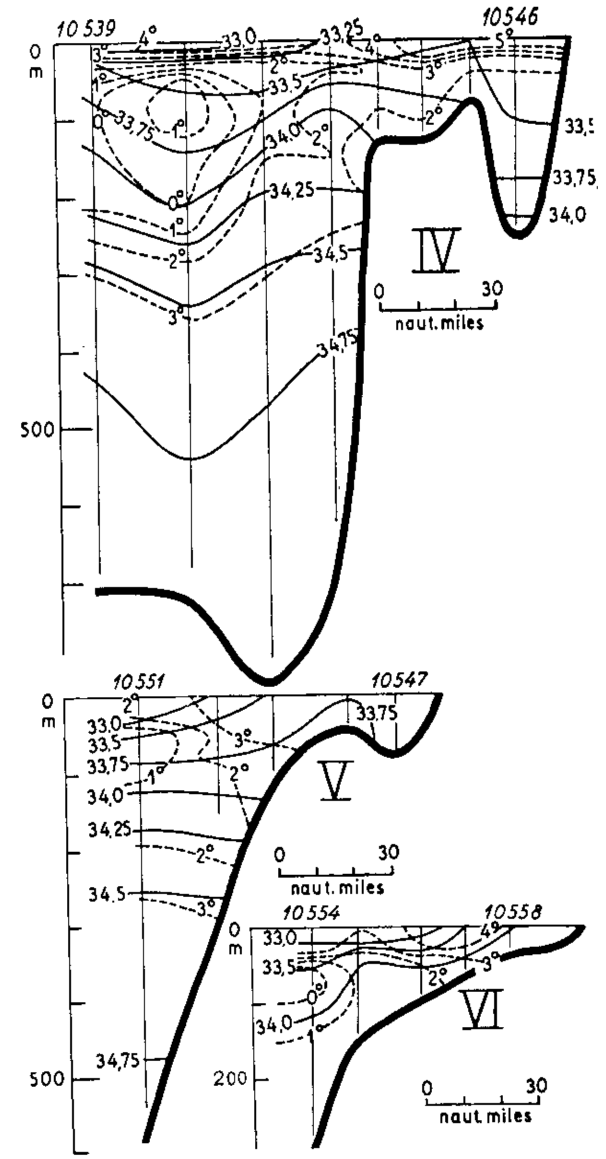

Fig. 5, 6, and 7. Section IV (above) across Lille Hellefiske Bank 18-19 July 1957. Section V (below left) across Store Hellefiske Bank 20-21 July 1957. Section VI (below right) off Egedesminde 21-22 July 1957.

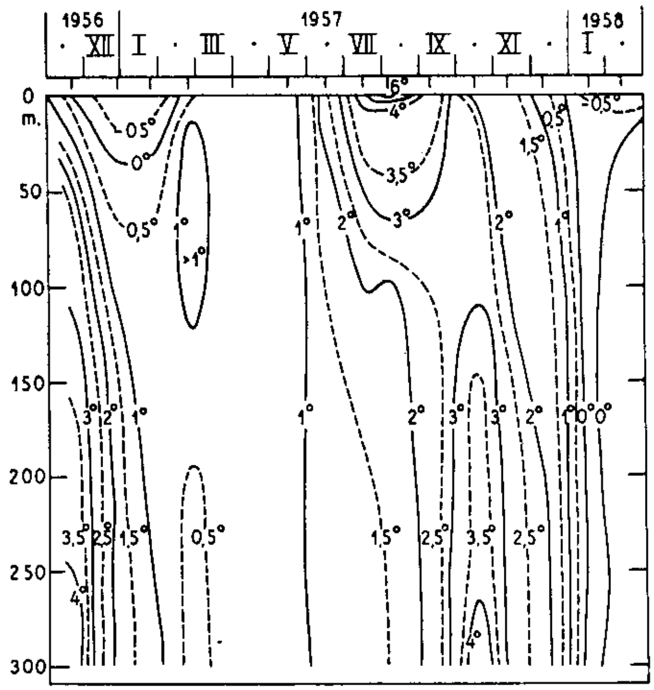

Fig. 8. Variation of temperature at the entrance to Godthaab Fjord, Nov. 1956 to February 1958.

III. French Research Report, 1957

BY J. ANCELLIN

The frigate "l'Aventure" has carried out researches on the Polar Front in the North Atlantic in 1957; A hydrographic section of 9 stations was worked in the Davis Strait in August, and another of 22 stations in October, 1957, between Newfoundland and Brest (France) down to 3,000 metres.

The results of these researches will be published in "Le Bulletin d'Information du Comité Central d'Océanographie et d'Étude des Côtes, Service Central Hydrographique, 13 rue de l'Université Paris VIIe".

IV. German Research Report, 1957

BY J. LUNDBECK

Work at Sea

The fishery research vessel "Anton Dohrn" was engaged in various investigations in the area between Greenland and Iceland 27 March-26 April; 47 trawl catches in depths of 130-500 m dealt with the distribution of the "marinus" and "mentella" types of redfish. 163 redfish were tagged.

The only trip of the vessel within the ICNAF area itself was made 1 - 30 Aug. '57. Experimental trawl hauls were carried out as follows:

Serial No.	Position and Depth
1 -12.	Nanortalik Bank (Kap Egede) Subdivision 1F 59°55'N, 45°50'W to 60°8'N, 46° 4'W, 92-130 m
13-49.	South of Cape Desolation, Subdivision 1F 60°21'N, 47°20'W to 60°23'N, 47°18'W, 94-140 m
50-53.	SW of Noname Bank, Subdivision 1E 61°38'N, 50°35'W to 61°40'N, 50°52'W, 120-130 m
54-58.	Fylla Bank, Subdivision 1D 64°0'N, 52°8'W, 50-60 m
59-68.	Fiskenaes Bank, Subdivision 1D 63°20'N, 52°15'W to 63°25'N, 52°40'W, 100-240 m

The main purpose was technological investigations such as net selection (see below), and methods of mesh measurement; but the material obtained was also evaluated in a biological sense.

Net Selection (by Prof. v. Brandt)

The fishery research vessel "Anton Dohrn" carried out selection tests for cod in Subarea 1 in August, 1957. A white fish trawl of manila with cod-ends of different materials as usually used in the Federal Republic was applied. Cod-ends of manila, "Perlon", and Trevira were tested according to the covered net method. Trevira is a material with a small extensibility and is approximately equivalent to the English Terylene and the American Dacron. The synthetic fibre material was plaited. In each case the cod-ends were double-braided of materials equivalent as regards strength. The resulting selection factors for manila and Trevira showed smaller differences than between manila and Trevira on the one hand and "Perlon" on the other. The load elongation curves of manila and Trevira did not differ much. This supports the theory that for the fixation of mesh-sizes not the fibre kinds (manila, "Perlon", Trevira, etc.) should be referred to, but the properties of the netting twines. At any rate, fibre groups as for instance "synthetic fibres" must not be regarded as equivalent at all.

Net Material No.	Manila 3 (Nt 500/3 double)	Perlon I 6	Perlon II 9	Trevira 12
Mesh depth mm	127	129	129	122
Number of hauls	12	14	9	9
Cod selection;				
Number of cod in net	3232	2627	2150	2505
In cover net	596	3794	2192	1394
Total	3828	6421	4342	3899
50% escapement size, cm	47	52	50	46
Selection factor	3.7	4.0	3.9	3.8
Redfish selection;				
Number of redfish in net			354	
In cover net			327	
Total			681	
50% escapement size, cm			42	
Selection factor			3.3	

Market Investigations

Subarea 1, Western and southern Greenland (data from eastern Greenland in brackets):

	Cod (Institut für Seefischerei, Hamburg; A. Meyer)	Redfish (Biologische Anstalt Bremerhaven; A. Kotthaus)
Length measurements	26017 (9457)	3452 (6820)
Age determinations	2201 (3567)	517 (1292)
Sex and maturity	839 from 9 samples of ungutted cod	
Individual weights	220	

Subarea 3, Newfoundland area:

	Cod	Haddock
Length measurements	450	243
Age determinations	206	117

The routine work was continued. Including those of the fore-mentioned research trips the samples contained the above numbers of fishes.

Similar to the preceding years most of the work was done on catches from eastern Greenland in order to clear the relationships to the West Greenland as well as to the Icelandic stocks.

Cod Investigations[1] (By Dr. A. Meyer).

Fig. 1A shows the age and length composition of the cod fished commercially on the slopes of Fylla and Banana Banks (Subdivisions 1C and 1D) in May and June. As in the preceding year the year-classes 1947 (31.9%) and 1950 (30.2%) were dominating. 33% of all cod were immature, 27% had spawned in spring 1957 for the first time, and 40% had spawned twice or more. The distribution of maturity on the different year-classes is shown in Figure 1A. Of the rich 1950 year-class 53% were still immature, 45% were first time spawners and 2% had spawned for the second time. Of the 1947 year-class 10% were immature, 14% were first time spawners and 76% had spawned 2, 3 or 4 times. It is interesting to note that 14% of the 12 year old cod were immature.

In 1957 no rich young year-class joined the marketable stock. Therefore, the average age and length rose above normal, 68.7 cm in 1955 to 69.1 cm in 1956 and to 73.3 cm in 1957. The 7 year old cod measured 67.1 cm, those 10 years old 72.8 cm.

In Subdivision 1F, (Figure 1B) South Greenland, the age composition resembles more that of East Greenland than that of West Greenland. As in 1956 the 1950 year-class was dominating with 51.7% (1956: 53.1%). Next in strength followed that of 1949 with 18.3%, which during all the preceding years was found to be stronger in the South than in the West. The 1947 year-class was only of small commercial value in Subdivision 1F, and the 1945 year-class, up to 1955 of great importance in South Greenland, was only present in small numbers. The average length of all cod (66.5 cm) was considerably smaller than in West Greenland. But the quality of the South Greenland cod in winter is far above that of the lean cod of West Greenland in early summer. The average length of the 1950 year-class in South Greenland was 65.8 cm and the cod spawned in 1949 measured 70.6 cm at the end of the feeding period.

The experimental fishing of "Anton Dohrn" with covered codend, mostly in the area of Sermersok and in the Bay of Julianehåb, 25 miles SE of Cape Thorvaldsen, enables us to calculate the real length and age composition of all cod living in those localities.

In the area 20 miles SW of the southern tip of Sermersok in a depth of 125 m the age and length composition of the total stocks of cod

[1] The report deals only with researches in Subarea 1. Similar researches were carried out in E-Greenland waters (outside the Convention Area); these latter researches are being reported in ICES, Annales Biologiques.

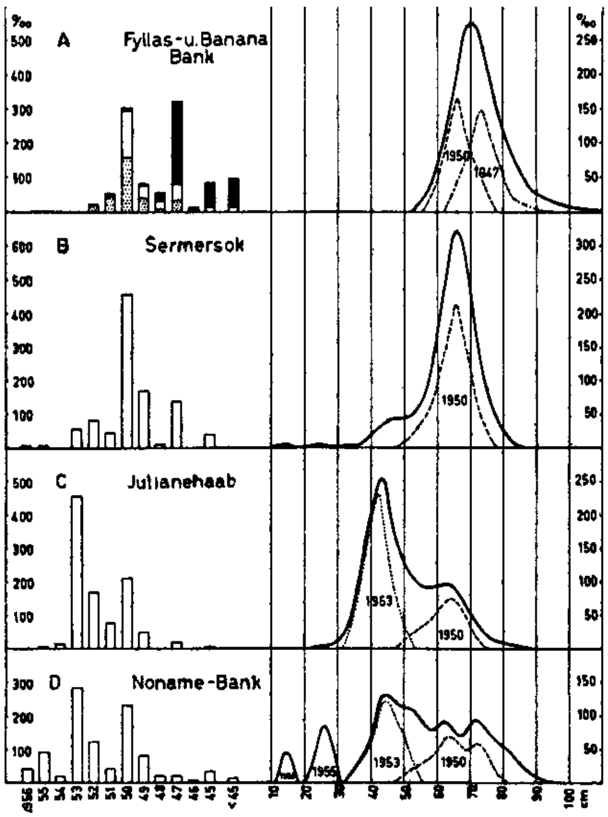

Fig. 1. **Age and length composition of cod from West and South Greenland waters, 1957. A — samples from fresh-fish trawlers in May and June, Fylla and Banana Bank; immature — dotted, first time spawners — white, and cod spawned several times — black. B — samples from "Anton Dohrn" off Sermersok, covered codend. C — samples from "Anton Dohrn" Julianehaab Bay, covered codend. D — samples from "Anton Dohrn" Noname Bank, covered codend.**

fished with narrow meshes was rather equal to that of the cod fished by the commercial trawlers using 110 mm meshes in the Cape Farvel-Sermersok-Nanortalik Bank area. Thus in these fishing places almost all the cod present are of marketable size. When fishing with meshes of 110 mm, only 5% were smaller than 50 cm and were discarded. In the Bay of Julianehåb (Fig. 1C), however, the stock of cod was composed of much younger fish. Here the new strong year-class of 1953, which will enter the fishery in 1958 for the first time, was found in large shoals. These 4 year old cod made up 45.6% and had in August an average length of 41.8 cm. The second strongest year-class was that of 1950 (20.7%) with an average length of 60.8 cm. As the stock of cod in this part of Subdivision 1F is composed of smaller fish, the trawlers here are only trawling for redfish.

"Anton Dohrn" was fishing with covered codend also on the western edge of Noname Bank in 120-130 m. Fig. 1D shows that also here a lot of younger cod, especially those of the rich 1953 year-class were present. But as a whole the catch in this locality was poor.

Redfish Research.

From the results of investigations made by Dr. Kotthaus on the research trip to eastern Greenland in March-April may be mentioned some few points. Whereas in the region of the Dohrnbank the small quantities of redfish captured contained only about 50% of ripening females, (and to the E and NE none at all,) a typical spawning concentration was met more southerly on the edge of the shelf off Angmagssalik.

Here both sexes were present in almost equal numbers and among the females, most of which were in the ripening stage VI (a-) c about 40% were still juvenile in contrast to the region SW of Iceland with 90% ripening and no juvenile females. These spawning concentrations were formed of the *marinus*-type only, but were located in 420-450 m depths, which after former experiences are inhabited only by the *mentella*-type. Therefore it seems, that for spawning purposes the redfish seek deeper water than that in which the type lives in other seasons.

Fishing Activity (By Dr. A. Meyer).

43 German trawlers, of between 454 and 763 gross tons, carried out 91 trips to the West- and Southcoast of Greenland (against 123 in 1956) and 2 trips to Newfoundland; they landed 24,169 t (1956: 31,996 t) and 386 t gutted weight respectively.

The customary fishery off Western Greenland began in the middle of April with full loads of redfish from west of Fylla- and Banana Bank. The proportion of cod here amounted to 4.7% on the average and only exceptionally rose to 20%. Thus in contrast to the preceding year, but similar to 1955, the redfish strongly predominated during this season. This fishery came to an end about the middle of July.

Nine trawlers began a little later, in the first part of May, and continued until 10th of August, to fish cod for green salting. In the beginning, these trawlers were fishing on the West coast banks (Subdivision 1E 5-19 May; 1D 20 May-20 June; 1B until 30 July), but since the end of July mainly in the more southern area off Nanortalik (Subdivision 1F). 13 shiploads of green salted cod, 6 of which were landed in Portugal directly, between 144 and 303 tons each, totalled to 2,861 t, equal to 6,694 t fresh gutted weight.

During the second half of the year the fishery continued, for landing of fresh fish only, off both the western and the southern Greenland coast. It was devoted to the redfish as well as to the cod, the average share of the latter being 53%. A rather successful cod fishery with a daily output rising to 36.0 tons developed in the Farewell-Sermersok-Nanortalik area from November until mid-February 1958, similar to 1952. Following this real cod fishery in South Greenland waters, which was stopped by advancing ice, the trawlers started a new redfish season beginning as early as in March 1958 in Subdivision 1D, so that for the first time the German Greenland fishery was proceeding all the year round without interruption.

In February two trawlers fished, for trial only, in the vicinity of St. Pierre Bank and Green Bank (Subdivision 3P). These trips lasted 28 days each, 9½ and 7½ days respectively being devoted to fishing. The catches amounted to 142 and 244 tons and consisted predominantly of cod (80%) with smaller percentages of haddock (13%), coalfish (pollock), redfish and halibut. The small size of cod and haddock however (average lengths: cod 62.2 cm, haddock 48.0 cm) was hardly acceptable for the German market, and for this reason one of the two ships landed its catch in England, and the enterprises were discontinued.

V. Icelandic Research Report, 1957

BY JÓN JÓNSSON

1. Introduction

This report deals with material collected by mag. scient. Adalsteinn Sigurdsson from Atvinnudeild Háskdlans Fiskideild on board the Icelandic trawler "Hallveig Fródadóttir" on an ordinary fishing trip to the West Greenland banks from 17th April to 9th May 1957 with the purpose to fish in these waters at an earlier date than Icelandic trawlers did before.

The following material of cod *Gadus callarias* L. was collected:

Area	Otoliths	Measured	Tagged
Fylla Bank, 1D	298	575	
Fiskenaes Bank, 1D	302	781	
Dana Bank, 1E	295	620	
Frederikshaab Bank, 1E	150	508	
Noname Bank, 1E	300	1325	124
Total	1345	3809	124

Although no hydrographical sections could be worked numerous measurements of the bottom temperature were taken on the various banks.

2. Length Distribution.

Figure 1 shows the length distribution of the fish on the various fishing banks, and from Figure 2, where the total length distribution on Fylla Bank and Noname Bank has been broken down to the length distribution of the various age groups, we can distinguish between the year-classes which made up the main bulk of the catches.

For Fylla Bank the curve shows two well-defined peaks of about 45 and 65 cm respectively. These peaks represent the 1953 and 1950 year-classes. These two year-classes were found in rather varying quantities from one day to another, as is evident from Figure 1.

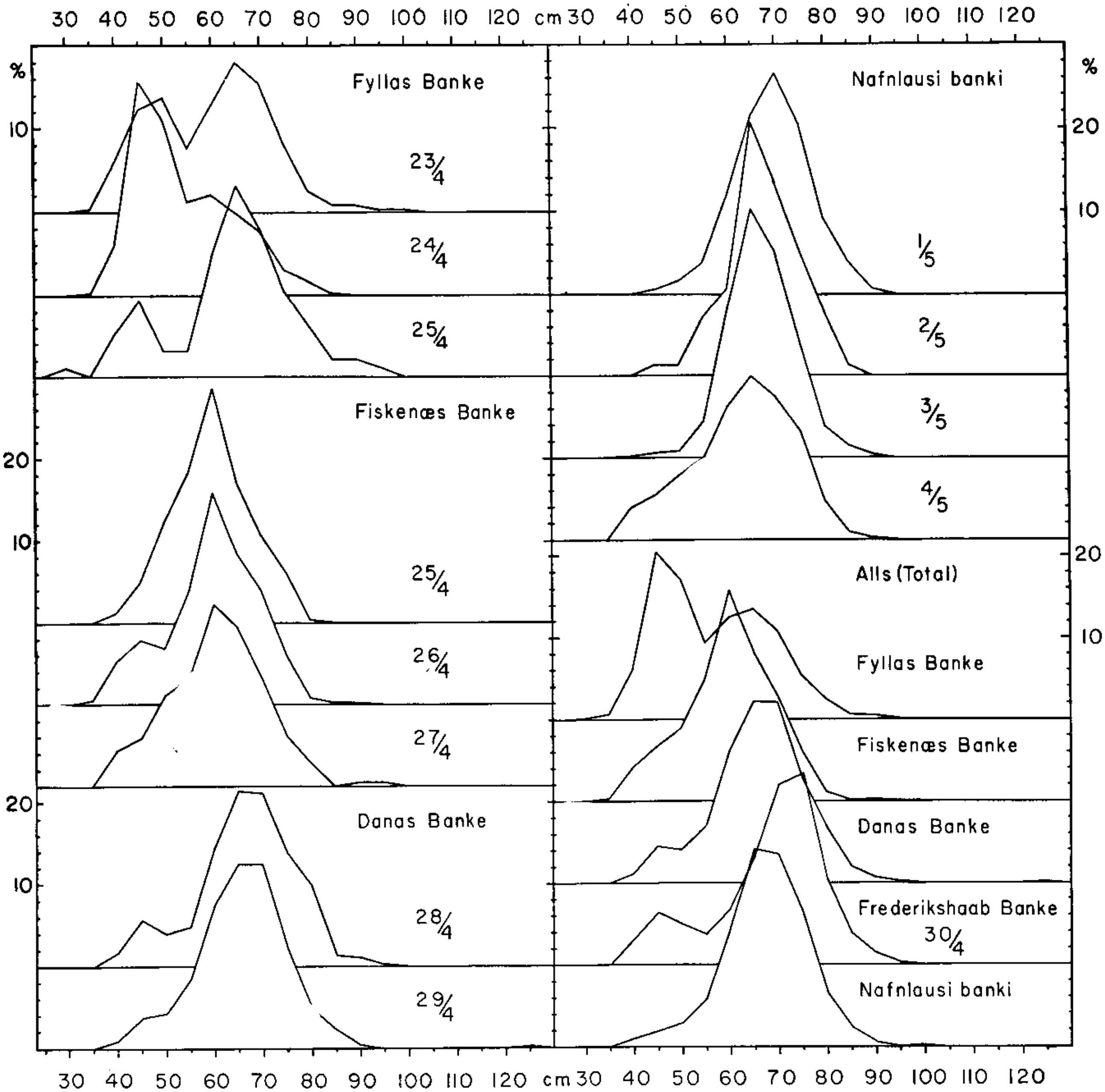

Fig. 1. **Daily variations in the length distribution of cod from, Fylla, Fiskenaes, Dana and Noname (Nafnlausi) Bank, and totals for the various banks.**

On Fiskenaes Bank the 1950 year-class is more prominent, with a little admixture of the 1953 year-class in some of the hauls. The peak of the curve is at 60 cm and indicates thus a certain admixture of five and six year old fish.

The length distribution of the fish from Dana Bank indicates a strong dominance of the 1950 year-class; this year-class was also very numerous on Noname Bank, except in the last sample, from the shallow part of the bank.

The right-hand corner below in Fig. 1 shows the total length distribution from each bank, and it appears that the 1950 year-class has made up the main part of the catches except on Fylla Bank.

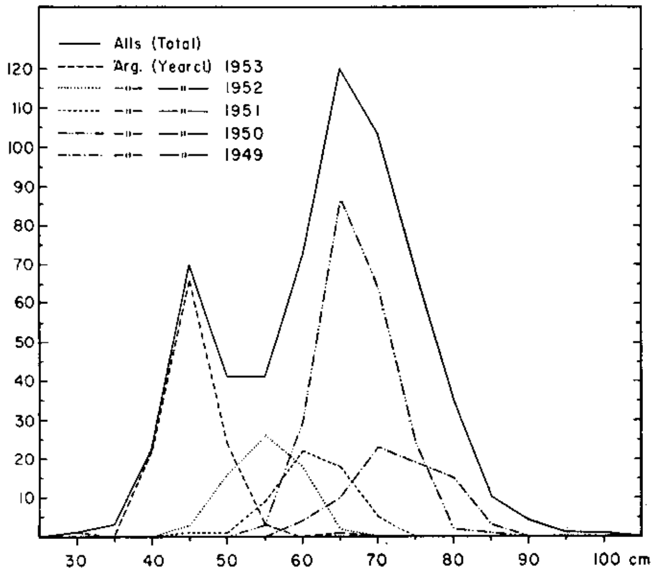

Fig. 2. **Cod. Length distribution (numbers) of the 1949 to 1953 year classes on Fylla Bank and Noname Bank together.**

3. Age Distribution and Sexual Maturity.

The data on age distribution and on age at first spawning on Fylla Bank and Noname Bank will be published in the 1957 Sampling Yearbook. The age groups of the mature fish have been divided according to age at first spawning; the number of immature fish in each age group is also stated. In both samples all cod under 5 years are immature. As mentioned, there is a strong dominance of the 1953 year-class on Fylla Bank, but the 1950 year-class is predominating on Noname Bank. In both samples the recruit spawners make up more than 80% of the mature fish. The 1950 year-class constituted the greatest part of the recruits, about 59% on Fylla Bank and 51% on Noname Bank (see Fig. 3).

The stage of maturity was the following in these two samples:

	Immature	Maturing	Spawning	Spawned
Fylla Bank	171	14	55	43
Noname Bank	131	3	6	157

It is clear that we are not dealing with a pure spawning population, as there are 40-60% immature fish in the samples.

The spawning seems to be far more advanced on Noname Bank than on Fylla Bank. This difference may be caused by the difference in temperature, as the bottom temperature on Fylla Bank was only 1.49°C (120 m), as compared to 3.28°C (175 m) on Noname Bank.

The average lengths of the various age groups are listed in Table 1.

TABLE 1. **Average lengths of the various age groups of cod in 1957.**

Area	**FYLLA BANK**				**NONAME BANK**			
Position	64°00'N — 53°00'W				61°47'N — 50°37'W			
Depth	150 — 250m				150 — 200m			
Date	23rd - 25th April				1st - 2nd May			
Age groups	♀ **No.**	♀ **cm**	♂ **No.**	♂ **cm**	♀ **No.**	♀ **cm**	♂ **No.**	♂ **cm**
3	2	34.5	2	37.5				
4	56	45.6	57	45.1	3	46.0	1	50.1
5	21	52.3	29	56.4	9	56.9	6	56.3
6	11	59.5	16	62.4	11	58.6	18	62.9
7	34	68.6	35	65.9	83	67.4	58	66.0
8	5	78.4	2	78.5	40	73.5	27	70.5
9	5	74.2	5	75.4	9	76.4	1	75.0
10	7	76.6	3	77.3	15	77.9	5	76.2
11	1	83.0	1	71.0	2	77.5	2	76.0
12	1	93.0	1	78.0	4	77.7	4	80.7
16					1	100.0		
17	1	91.0						

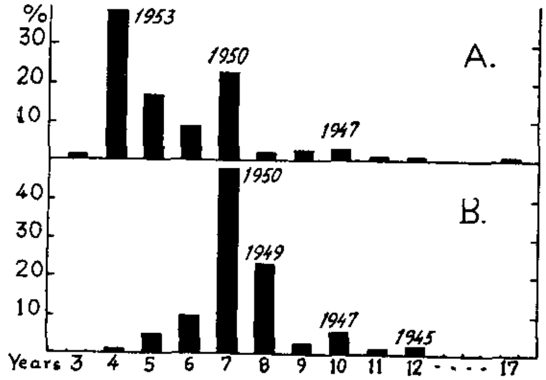

Fig. 3. **Age distribution of trawl-caught cod. A—Fylla Bank, 23-25 April 1957, 292 spec. B—Noname Bank, 1-2 May 1957, 290 spec.**

4. The Fishery and the Bottom Temperature.

The following table gives the bottom temperatures and catches per one hour trawling on the various banks:—

Locality	Depth fished	Temp./depth	Hours fished	Catch in tons per hour
Fylla Bank	150-250	1.49/120-1.89/205	21	1.33
Fiskenaes Bank	75-100	1.30/145-1.78/165	25¼	2.23
Dana Bank	150-230	1.60/215	14	2.39
Frederikshaab Bank	135-245	0.25/165-0.29/100	3	1.50
Noname Bank	150-200	3.28/175-3.56/175	36¼	3.02

The catches were highest on Noname Bank where the bottom temperature was about 3.5°C, but the material is too limited to allow general conclusions.

VI. Norwegian Research Report, 1957

THE HANDLINE-FISHERY OFF WEST GREENLAND, 1957

BY BIRGER RASMUSSEN

The Fishery.

In 1957 a Norwegian fleet of 51 long-liners fished partly on the Newfoundland banks and partly off West Greenland. The reason for this shifting of fishing grounds was that on the Grand Banks the cod was larger and of a better quality than off West Greenland. The Grand Banks were visited for the first time by Norwegian vessels in 1956 when two ships tried the fishery. In 1957 most of the ships went to the Grand Banks, and therefore the Norwegian catch of cod taken off West Greenland naturally declined in that year. It is estimated that about 6,000 tons of salted cod and 400 tons of halibut were landed from Subarea 1 as compared with 14,000 tons of salted cod and 700 tons of halibut in 1956.

The West Greenland fishery started in 1957 in early May on the southern banks between Juliannehåb and Fiskenaes. During the early part of the season the fishing was good and the cod was of large size. Satisfactory fishing for the long-liners on Fylla Bank and Banan Bank did not occur before the latter half of July. From the beginning of August shoals of cod were registered by means of echo-sounder both on Fylla Bank and off Holsteinsborg, where excellent catches were made with handlines in the upper water-layers. During the early part of the season the quality of the fish was rather poor with small liver content. Towards the end of August the liver content increased considerably, and the quality of the fish improved. When towards the autumn the pelagic shoals of cod were formed, the fish were feeding heavily on sand eels, young fish and small squid.

As in earlier years an observer was sent to West Greenland by the Norwegian Institute of Marine Research. The observer worked on board a commercial fishing vessel. Material was collected for the study of the age- and size-composition of the commercial cod catches and for the study of the temperature conditions on the banks in relation to the fishery. The temperature registrations were made by means of a bathythermograph. Three temperature sections westwards from the banks were taken on August 24-25. They showed no exceptional features compared with earlier years (Figures 1, 2, 3).

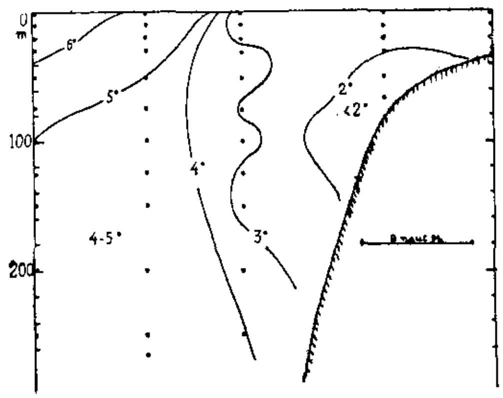

Fig. 1. Temperature section from Fylla Bank westwards. Bathythermograph. 25 Aug. 1957.

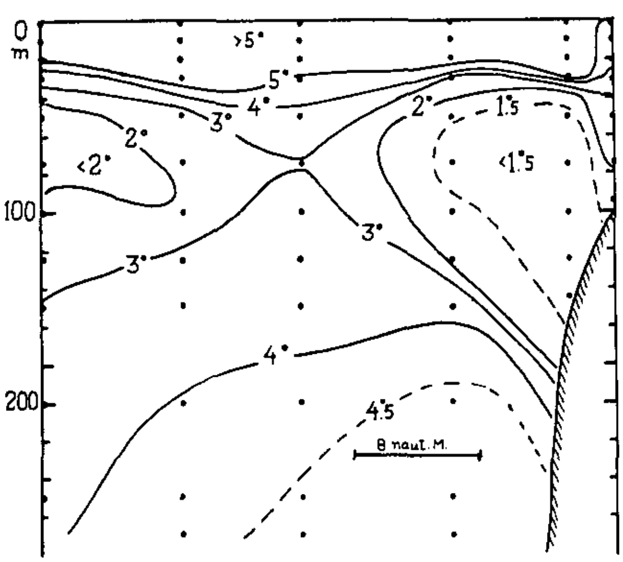

Fig. 2. Temperature section, eastwards towards Southern part of Lille Hellefiske Bank-. Bathythermograph. 24 Aug. 1957.

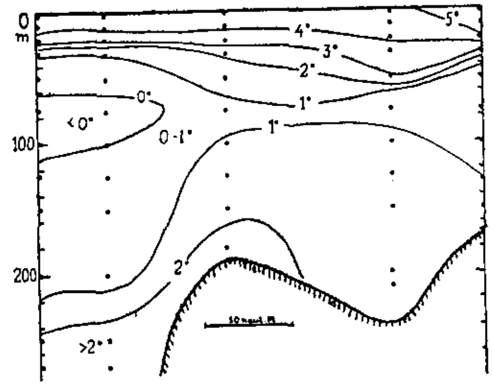

Fig. 3. Temperature section from Northern part of Lille Hellefiske Bank westwards. Bathythermograph. 23-24 Aug. 1957.

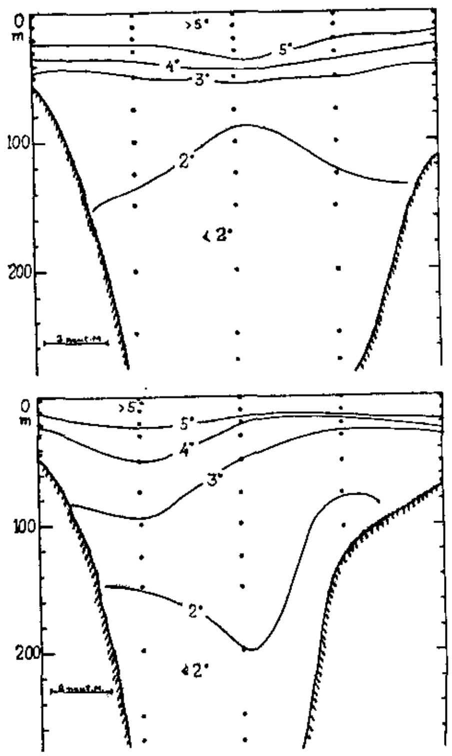

Fig. 4. Two temperature sections across Holsteinsborg Deep from S. to N. Above —19 Aug. 1957; below 23 Aug. 1957.

On Fylla Bank and southern part of Lille Hellefiske Bank, a core of cold arctic water, 1.5 - 2°C was lying along the upper part of the bank slope. On Fylla Bank this cold core of arctic water was lying between 25 and 100 m, and on the southern part of Lille Hellefiske Bank between 50 and 150 m. On the northern part of

Lille Hellefiske Bank the bottom water on the bank-plateau was somewhat colder. In the particular depths along the slope where long-liners usually worked (150-200 m) the temperatures were all above 2°C. and thus satisfactory for fishing. The temperature conditions for long-line fishing seem to have been somewhat more favourable in 1957 than in the two preceding years.

Holsteinsborg Deep is of relatively great importance to the Norwegian fishing fleet. Here the cod usually concentrate in large pelagic shoals in early August. The surface water usually is warm in August while the deeper water is colder, with a sharp thermo-cline dividing the cold and warm water masses. Earlier investigations have shown that the cod usually concentrate pelagically against the ceiling of warm surface water.

In 1957 two sections were taken across the Holsteinsborg Deep on August 19 and 23. The temperature observations in these sections are shown in Figure 4. The surface water in the Deep had a temperature above 5° C. Between 25 and 50 m a sharp thermocline was found where the temperature dropped to 3° C. with colder water below. Heavy concentrations of cod were recorded by echo-sounder in depths between 25 and 50 m, especially in the southern part of the Deep. The handline fishing was excellent in this locality in August.

Cod Investigations.

In 1957 samples of cod caught on handlines were collected in Holsteinsborg Deep and on the northern slope of Lille Hellefiske Bank. A few Norwegian vessels fished here with

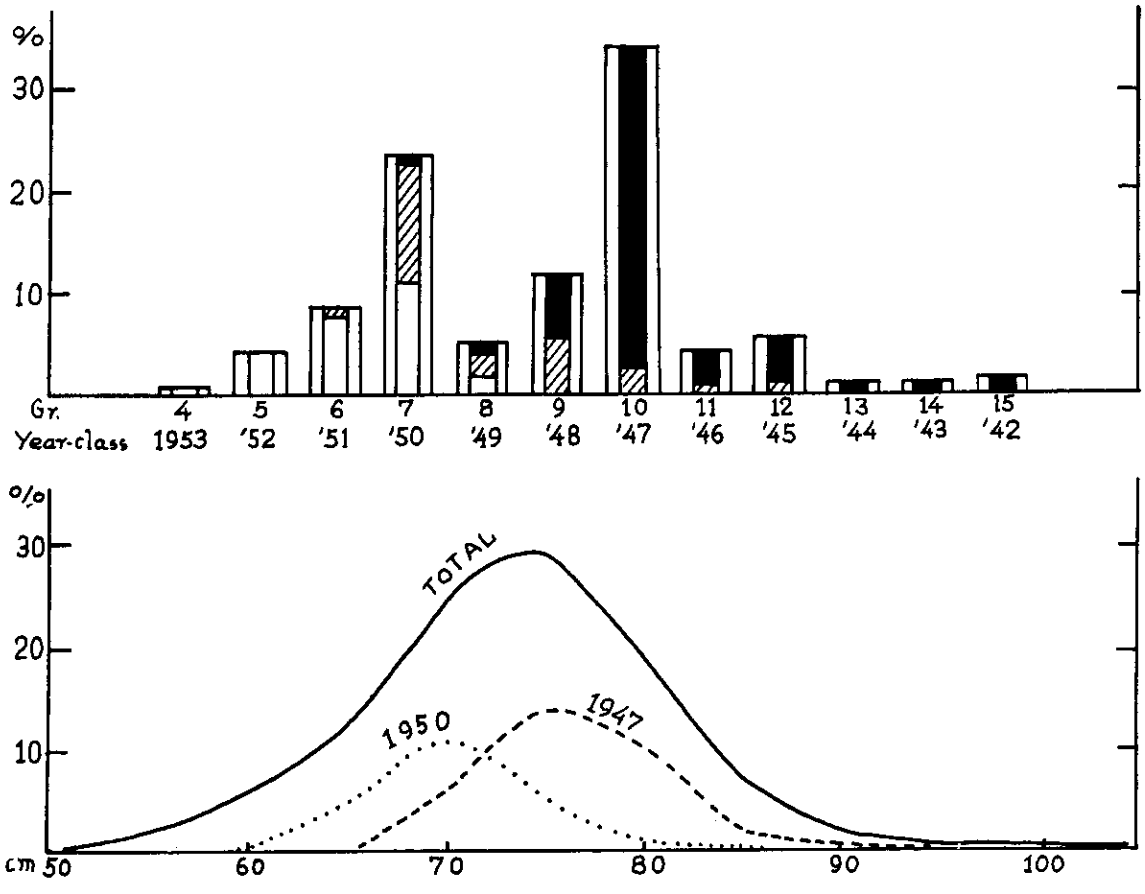

Fig. 5. Cod caught with handlines in Holsteinsborg Deep, August 1957. Above; age composition and maturity (white—immature; hatched—first time spawners; black—spawned several times.) Below: length composition, total and 1947 and 1950 year classes separately.

handlines during August. The catches varied from 3,000 to 6,000 fish per day. Altogether, four samples of cod were obtained during August 11-20 and a total of 1,091 length measurements and otoliths were collected. On August 12 the temperature in the southern part of the Deep was 6.7°C. at the surface, decreasing to 3.9°C. at the bottom (60 m). On August 22 the surface temperature in the same locality was 5.2°C. and the bottom temperature 2.8° C. A decided thermocline was present at 20 to 25 m. The echo-sounder registered shoals of cod between 25 m and the bottom. The handline fishing was excellent, with mean daily catches from the observation vessel of about 3,000 fish.

The age, together with maturity and size distribution, of the cod from the Deep is shown in Fig. 5. As indicated by the age figure, the cod in West Greenland water reach maturity at a relatively young age. In the 1957 material three individuals, or 0.3 per cent, are first-time spawners already when 6 years old. Of the 1950 year class, 7-year old fish, about 50 per cent are spawning for the first time.

In 1957 the cod were of a good commercial size for the Norwegian needs. The mean length of the fish in all samples was 73.57 cm and mean age 8.85 years. The previous year (1956) the mean size of the cod in the same locality was only 66.53 cm, mean age 7.5 years.

In 1957 the 1947 year-class (10 years old) and the 1950 year-class (7 years old) were dominating in the fishery. The 1947 year-class constituted 34 per cent of the catch as compared with 31.4 per cent the preceding year. The mean length of this year-class is 76.09 cm as compared with 72.76 cm the preceding year, when the same fish was 9 years old. This gives an increment of 3.23 cm during the last year.

In 1957 the 1950 year-class constituted 23.4 per cent of the catch, as compared with 34.3 per cent in the same locality in the preceding year. The mean length of the 1950 year-class is 70.29 cm, as compared with 61.52 cm in 1956 when the cod was 6 years old, i.e. a growth increment of 8.77 cm. Such a great growth increment between the 6th and 7th year must be characterized as rather unusual. For comparison it may be

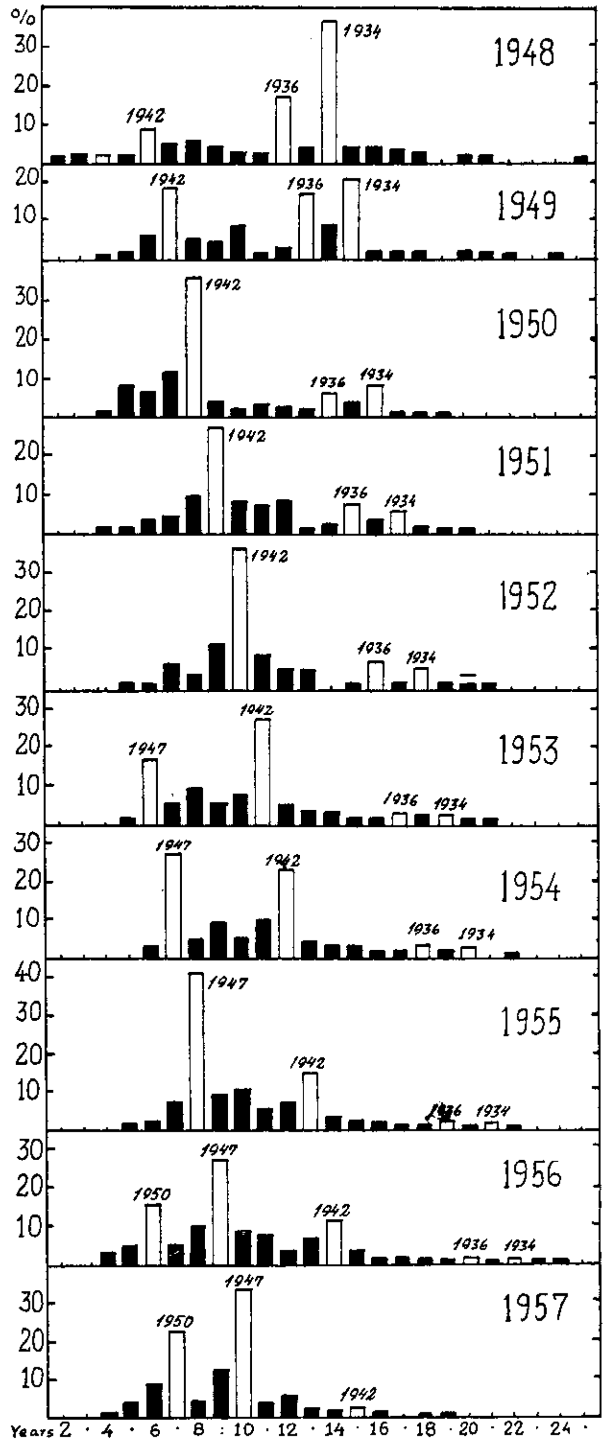

Fig. 6. Age distribution of cod in Norwegian commercial catches in the different years from 1948 to 1957.

mentioned that according to our material the 1947 year-class had a mean length of 64.2 cm when 7 years old, and the 1942 year-class measured 70 cm at the same age. It is possible that the rapid growth of the 1950 year class during the last year is a result of improved growth conditions in West Greenland waters during the winter of 1956-57.

Figure 6 shows the age composition of the 1957 samples compared with preceding years. The rich 1942 year-class, which dominated the catches for a number of years, has now practically disappeared from the catches. The 1947 year-class was still very strong, while the 1950 year-class was of increasing importance to the fishery. During the next fishing season (1958) it is expected that the 1950 year-class will reach dominance and that the 1947 class will be receding somewhat. The commercial catch will therefore be composed of relatively large fish.

Tagging of Cod.

Tagging of cod was continued in 1957. During the first half of August a total of 400 cod were tagged in the Holsteinsborg Deep where most of our tagging has been performed for a number of years. Of these 400 fish, only 5 were recaptured within the same season. All recaptures hitherto are from the tagging area.

From the 1956 marking experiments were received altogether 59 recaptures out of 491 taggings, i.e. 12%. The localities of recaptures are shown in Fig. 7. The recaptures made during the same season show a decided northward migration during late summer and autumn. In winter the cod apparently undertake a southward spawning migration to Frederikshåb, Dana, Fiskenaes and Fylla Banks. According to the fishermen the southward migration route is over the more shallow parts of the banks. On the southern banks, mentioned above, spent fish were recaptured in May and June, a few also in July. Later in the season recaptures are made further north. According to the fishermen this northward migration is along the slopes of the banks. The recaptures from the 1956 taggings confirm the picture of seasonal movement of the West Greenland cod, which was indicated by the 1953 and 1955 taggings previously reported upon, namely a southward spawning migration to about 62° N. Lat. in winter, and a northward feeding migration in summer to 68° or 70° N. Lat.

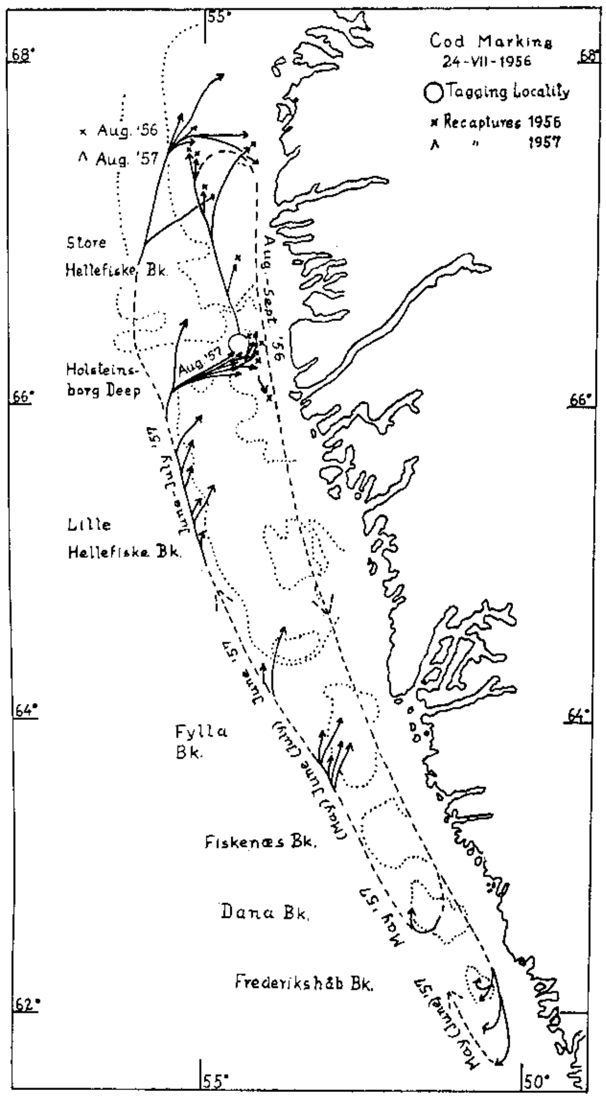

Fig. 7. **Migration pattern of the West Greenland cod as indicated by the 1956 marking experiments in Holsteinsborg Deep.**

In order to illustrate further the movement of the West Greenland cod the recaptures from the marking experiments 1953-56 are recorded as to date and latitude in Table I. From these taggings a total of 227 tags have been returned with information as to exact position and date. As indicated by the table, there obviously is a

TABLE I. Recaptures of Tagged Cod off West Greenland
Tagging Years 1953-54-55-56

	Degrees North Latitude									To Iceland	To Nfld.	Total
	61-62	62-63	63-64	64-65	65-66	66-67	67-68	68-69	69-70			
March	—	—	—	—	—	—	—	—	—	1	—	1
April	—	—	—	—	—	—	—	—	—	5	1	6
May	2	7	6	8	—	—	—	—	—	1	—	24
June	—	17	20	20	12	6	—	1	—	—	—	76
July	—	1	6	3	2	6	9	3	—	—	—	30
Aug.	—	—	1	1	1	29	24	2	2	—	—	60
Sept.	—	—	—	—	—	16	6	1	—	—	—	23
Oct.	—	1	—	1	—	2	1	2	—	—	—	7
Total	2	26	33	33	15	59	40	9	2	7	1	227

correlation between date of recapture and latitude where caught. In May and June most recaptures are registered from the southern banks, with a maximum around 63-65° N. Lat. In August-September the majority of the recaptures are made in 66-68° N. From these taggings only seven specimens had migrated to Iceland and one to Newfoundland. The material indicates that the West Greenland area north of 62° N. is dominated by an almost separate population of cod, with a more or less closed migration pattern. Only very few cod of this true West Greenland stock seem to migrate to Iceland. For the further study of this problem it would be of the greatest interest to perform large-scale taggings in the area south of 62° N., e.g. near Cape Farewell, in order to study the migration pattern of the cod population of that area.

Danish marking experiments showed a heavy migration of cod from Greenland to Iceland during the 1930's. Paul Hansen in his "Studies on the biology of the cod in Greenland Waters" (1949) mentions that the great spawning migrations of cod to Iceland take place mainly from the southern districts, Frederikshåb and Julianehåb, where over 70 per cent of the tagged cod was recaptured in Icelandic waters. In my opinion there are at least two stocks of cod in West Greenland, one with a distribution pattern as shown by our tagging results, the other and southern one belonging to the Icelandic or an East Greenland stock. Some recaptures of the true West Greenland stock are also made at present in Icelandic waters, but they are rather exceptional. During the 10 years from 1948 to 1957 the Norwegian investigations tagged a total of 3,263 cod in West Greenland waters. Of these, 431 or 13.3 per cent were recaptured. Only 27 or 0.8 per cent of the total number of cod marked have been recaptured at Iceland.

In Table II are shown the details of the annual taggings. It is particularly from the taggings in 1950 and 1952 that many recaptures have been made at Iceland. From Iceland otoliths of some of the recaptured fish were received. From the 1950 taggings, of which eight cod were taken at Iceland, we have age determinations from four fish, three belong to the 1945 year-class, one to the 1946 year-class, Of the three recaptures from the 1952 taggings taken at Iceland, two belong to the 1945 year-class and one to the 1946 year-class.

As mentioned in an earlier report, the 1945 year-class was of no importance to the Norwegian long-line fishery. This is probably a year-class not belonging to the true West Greenland stock, but only visitors on a feeding migration. This may be the reason for the heavy migration back to Iceland of this particular year-class upon reaching the age of maturity. Of the 1947 year-class, which apparently belongs to the true West Greenland stock, not a single individual has as yet been returned from Iceland. Many individuals belonging to the 1947 year-class have been tagged at the Holsteinsborg Deep. Thus in 1954 we tagged 431 fish at this locality, of which

TABLE II. Summary Table of Norwegian Taggings 1948-1957 in West Greenland Waters

Year of Tagging	No. Tagged	Total Recaptured	% Recaptured	Recaptures at Iceland No.	Recaptures at Iceland % of Recaptures
1948	387	50	12.9	3	6.0
49	143	33	23.0	4	12.1
50	300	47	15.7	8	17.0
51	200	46	23.0	3	6.5
52	124	19	15.3	3	15.7
53	512	81	15.8	4	4.9
54	431	53	12.3	1	1.9
55	275	38	13.4	1	2.6
56	491	59	12.0	0	0
57	400	5	1.2	0	0
	3,263	431	13.3	27	6.3

30.5 per cent belong to the 1947 year-class according to the sample taken simultaneously. Although we have received a recapture from Iceland from the 1954 tagging, this specimen belongs to the 1945 year-class. The tagging experiments show no indication of a large-scale emigration from Greenland of the 1947 year-class.

Tagging of Halibut.

As mentioned in earlier reports, a program of halibut tagging was instituted in the Davis Strait in 1955. This tagging program has been continued both in 1956 and 1957. During the 1957 season altogether 79 specimens were tagged over an area stretching from West Greenland to Baffin Land, Labrador and Grand Banks. Hitherto a total of 325 halibut were tagged in this area. From all taggings 15 recaptures have been reported, viz. nine from the 1955 taggings, five from the 1956 and one from the 1957 taggings. Most of the recaptures were made in the same area where the halibut had been tagged. However, as mentioned in an earlier report, the 1955 tagging showed one halibut migrating from the Labrador coast to West Greenland waters.

Cod Taggings, 1957.

Yellow plastic discs fastened in gill cover with silver wire. Serial No. 5100-5499. All tagged in the Holsteinsborg Deep, approximate position 66°23′W 54°23′N.

Halibut Taggings, 1957.

Yellow plastic discs fastened in gill cover with silver wire. Serial No. 4546-4599, and 6000-6024. (See Table III.)

TABLE III. Halibut Tagging by Norway, Subarea 1, 1957.

Tag No.	Date	No. ind.	Tagging Locality
4546-4561	28/7-31/7	16	Julianehåbs Bank
4562-4574	1/8-3/8	13	Frederikshåbs Bank
4575-4599	29/8-17/9	25	Grand Banks, Nfld.
6000-6001	26/7	2	Off Cumberland Sound (Baffin Land)
6002	1/8	1	Off Hudson Strait
6003-6007	7/8	5	Off Labrador
6008	3/9	1	Lille Hellefiske Bank
6009-6024	22/9	16	Off Cumberland Sound (Baffin Land)
	26/7-22/9	79	Subdivisions 1C, 1E, 1F, 2G, 2H, 3M

VII. Portuguese Research Report, 1957

BY MARIO RUIVO AND GLICINIA QUARTIN

A. Observations of Cod, *Gadus callarias* L., in Subarea 1 - Greenland.

1. Material and Methods.

A total of 38 samples of cod were collected, 28 from trawlers and 10 from dory vessels; they comprise in all 4,500 individuals. The samples from dory vessels (Nos. 29 - 38) include only length measurements. For 21 of the 28 trawler samples (Nos. 1 - 28) age determinations by means of otoliths were also carried out.

The average mesh size of the trawl codend used was around 117 mm. The hooks used by the dories were No. 14½.

The samples from trawls were taken just after capture, i.e. before the culling of the catch. The dory vessel samples were taken when the dories brought their catches on board the dory vessels.

Measurements, age determinations and other data from the samples will appear in tabular form in the 1957 Sampling Yearbook.

The 21 trawl samples for which age determinations were made were grouped as follows:

Sample group	Sample Nos.	Subdivision	Date
A	27	1F	24 June, 1957
B	2,3,5,11,13,14	1E	11-31 May, 1957
C	1,8,9,10,12	1D	9-26 May, 1957
D	16,17,26	1D	5-27 June, 1957
E	28	1D	11 Oct., 1957
F	15,18,20,22,24	1C	4-16 June, 1957

The map, Fig. 1, shows the positions of the samples. To the left is shown the age distribution of the six sample groups, to the right the length distributions of the sample groups and of some separate samples.

The methods for the working up of the material were the same as used in previous years (cf. Portuguese Research Report for 1956, ICNAF Ann. Proc. Vol. 7).

2. Age Composition.

(a) **Trawlers 1st campaign (May-June, Fig. 1).** The only sample from Subdivision 1F (June) shows a predominance of age group VII (34%); the IV, VI and VIII groups are represented by around 15% the V group with a little less (11%).

In 1E the age groups VII and X predominate with 37% and 21% respectively. The other age groups are lower with around 10%. The IV group (2%) and the V group (5%) are very scarce.

In 1D, age groups IV (25-27%), VII (20%) and X (18-20%) dominate. The V group is represented with 10-12%. The other age groups are around or below 5%.

In 1C, June, the IV group (33%) and the VII group (21%) are the most abundant. The V and the VI groups are around 13%, the X group only 6%.

(b) **Trawlers 2nd Campaign (Oct., Fig. 1).** One sample from 1D October shows predominance of the IV group (34%) and the V group (22%), followed by the VII group (17%) and the VI group (12%). The other age groups are lower than 5% or negligible.

Summary. In the spring of 1957 the 1950 year-class predominated in the most southern region (1F); relatively rich were the 1949, 1951 and 1953 year-classes. The 1947 year-class had nearly disappeared.

In 1E the 1950 year-class predominates, and the 1947 year-class is rather well represented. In 1D these year-classes are also well represented, but the 1953 year-class is here more abundant.

In 1C the 1953 year-class is the most abundant; it is followed by the 1950 year-class. The 1947 year-class is rather scarce.

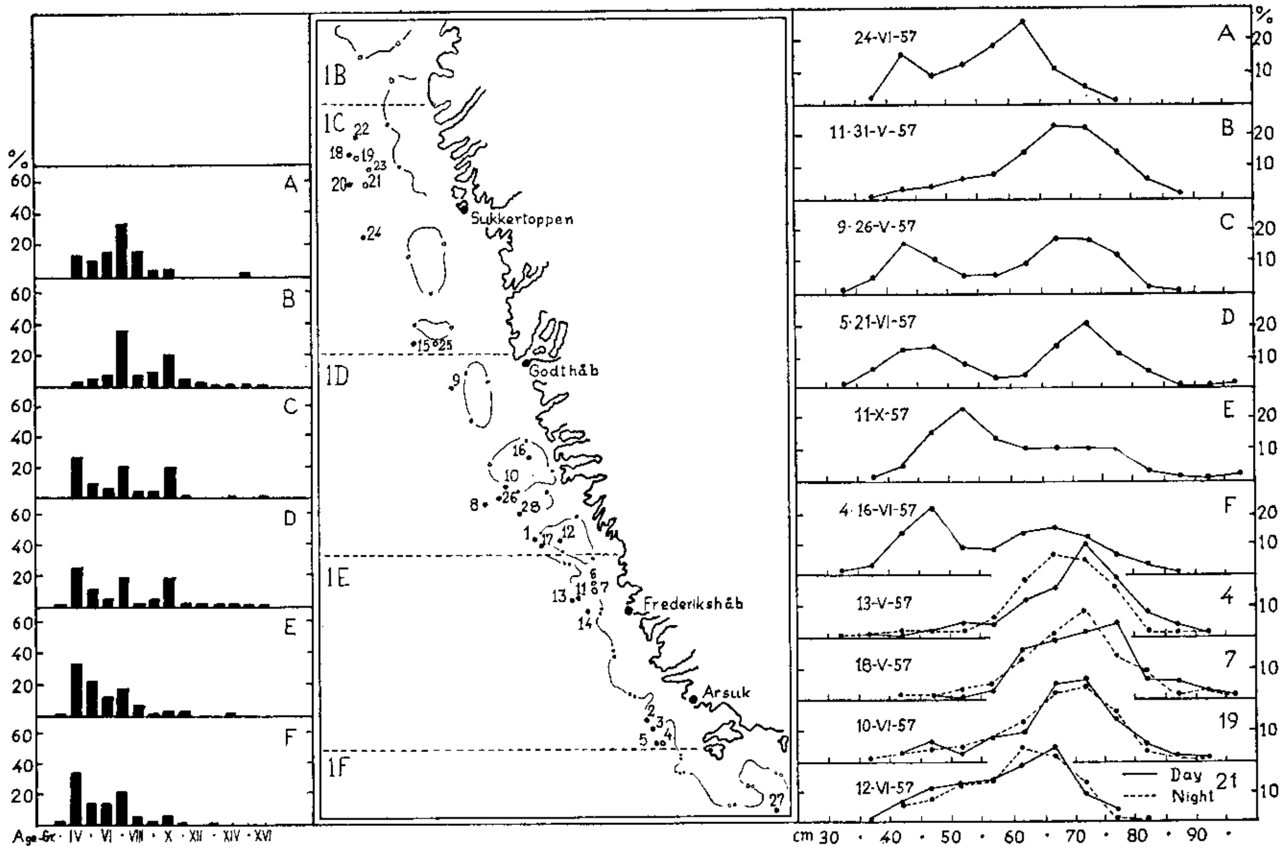

Fig. 1. **Age and length distribution of samples of cod caught by Portuguese trawlers in West Greenland waters, 1957. Left age distribution, right—length distribution. On the map are shown the positions of the samples nos. 1-28.**

In autumn a complete change in the composition of the catch appears for Subdivision 1D. The 1952 and 1942 year-classes are now about to predominate. The 1950 year-class has about the same percentage as in the spring; the 1951 year-class is a little more abundant.

3. Size Composition.

A bimodal distribution appears generally in the samples from trawlers (Fig. 1). The peaks of the curves are in the cm. groups 62-67 (less common in group 72, sample group D), and in the cm. groups 42-47. This corresponds to the predominance of the age groups VII and X and IV and V, respectively.

Fig. 1 also shows a comparison of day and night samples from trawlings carried out in the same region.

Samples 4 and 7 (1E) and 21 (1C) differ from the bimodal trend, showing only one peak. This suggests that during the night generally smaller fish are caught. Sample 19 does not show any difference in size composition between day and night catches. However, the data are not sufficient to permit valid conclusions.

The size composition of the catches from the line fishery (Fig. 2) differs considerably from that of the trawl fishery. The length curves have one, two or more peaks, in the 62 and, more commonly, in the 72, 77 and 82 cm. groups.

4. Growth.

Fig. 3 shows growth curves for males and females for the combined Subdivisions 1C, 1D, 1E, and 1F. The growth of the males is slightly inferior to that of the females for the medium and aged older fish; the crossing point of the curves is at age group VII. The figure also gives the yearly growth for the more abundant age groups (V-XI). The growth is much the same as that observed in 1956.

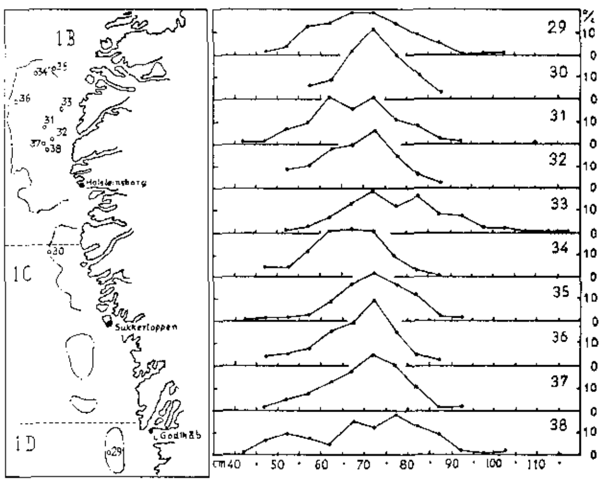

Fig. 2. **Length distribution of samples of cod caught by Portuguese dory vessels in West Greenland waters in 1957. Positions of samples, nos. 29-38, shown on map.**

5. Sex Composition.

The samples on the whole show a slight predominance of the males; only groups A and F are exceptions with 52-55% females. A comparison of day and night catches from the same place indicates a slight predominance of the males in night catches; only sample No. 19 is an exception. In the day samples the two sexes are nearly equally represented.

6. Stage of Maturity (Fig. 4).

Males. In May-June the majority are in the resting stage (48-60%) and the developing stage (25-40%). 5-8% are after spawners and 1-2% are in full spawning. In sample 27 (1F), June, only males in the resting stage (74%) or in the developing stage (26%) are observed. In October all males are either in the resting stage (59%) or in the developing stage (41%).

Females. In May practically all females re in the resting stage (45-55%) or in the after pawning stage (44-54%). Only in one sample, group (B), were a few individuals in the developing or spawning stages found (less than 1%). In June all females are either resting (54-92%) or in the after spawning stage (8-45%). In October the situation is about the same: resting —73%, after spawning—26%.

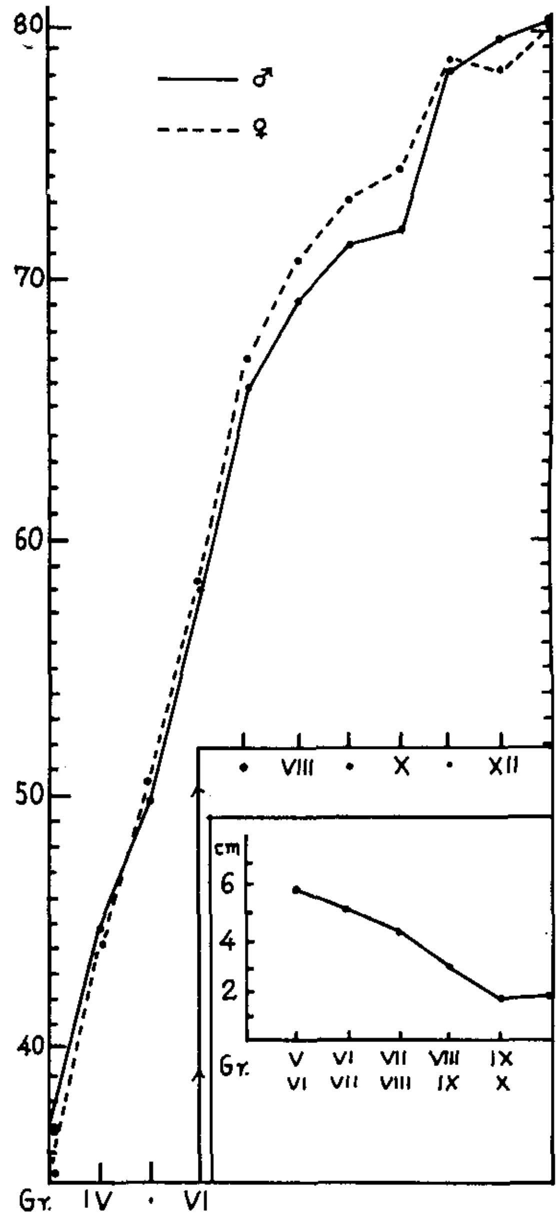

Fig. 3. **Mean lengths of males and females of cod of age-groups III-XIIII, Subdivisions 1C-1F. Inserted annual growth of age-groups V-XI.**

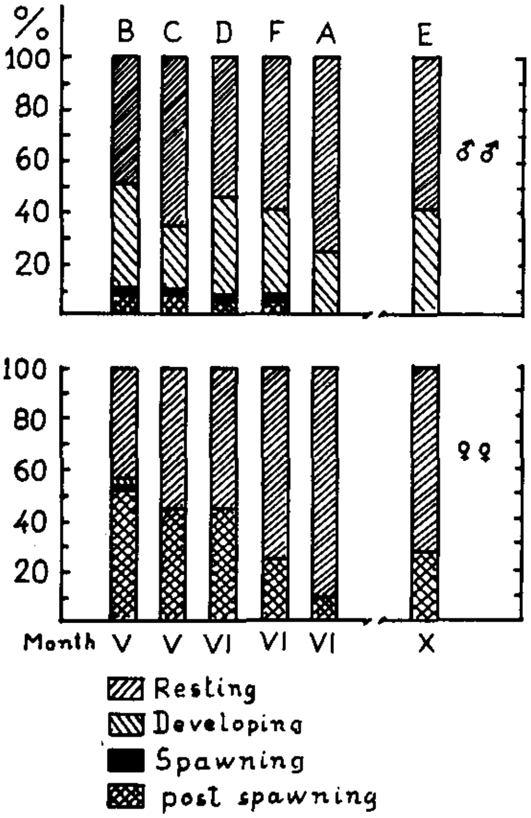

Fig. 4. Cod, West Greenland 1957. Percentage numbers of males and females of different stages of maturity in May to October (V to X). The letters A - F refer to the samples groups (see p. 52).

7. First Maturity. (Fig. 5)

Based on the observation of spawning rings, the first maturity is observed to occur between the 6th and 10th year, most commonly in the 8th year; however, quite important numbers reach first maturity in the 7th and 9th years.

The material at hand does not show any significant difference between males and females as to age at first maturity, which is contrary to what was observed in previous years (males maturing earlier than females).

8. Weight.

Data on weight (total, liver, gonads, intestines) were collected from 200 individuals; these data will be published in the 1957 Sampling Yearbook.

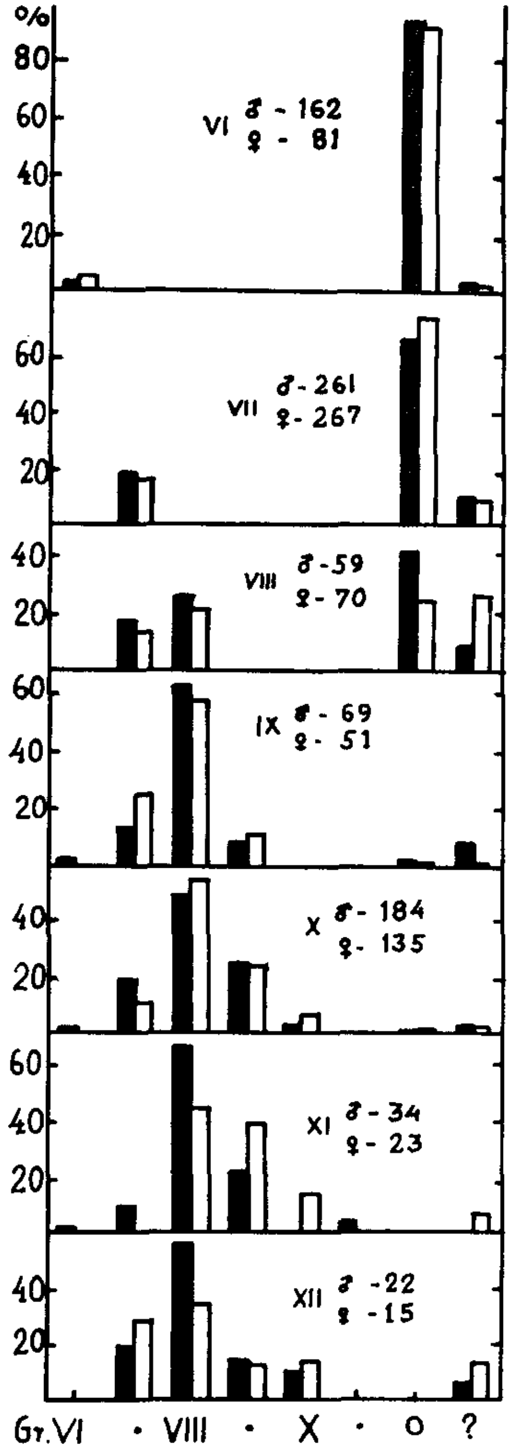

Fig. 5. Cod, West Greenland, 1957. Percentage numbers of males (black columns) and females (white columns) of the various ages VI-XI spawning for the first time; O --indicates no spawning mark.

B. Observations of Cod in Subarea 2 — Labrador

1. Material and methods

In all 25 samples from trawlers, including around 4,100 individuals, were studied. Age determinations were made for 15 of these samples (1,500 individuals). These 15 samples are grouped as follows:

Sample group	Sample Nos.	Sub-division	Dates
A	1,3,4,7,8,9	2J	5-31 Oct., 1957
B	11	2H	2 Nov., 1957
C	12,14,16,19,20	2J	6-22 Nov., 1957
D	22,23,25	2J	24-30 Nov., 1957

The mean mesh size of the codend used by the trawlers was 117 mm. The sampling included the cod as caught, i.e. before culling.

Fig. 6 shows the position of the samples, the age composition and the size distribution of sample groups or separate samples.

The methods used for the investigations are the same as those described in earlier reports (Portuguese Research Report, 1956; ICNAF Ann. Proc. Vol. 7). All data will appear in tabular form in the 1957 Sampling Yearbook.

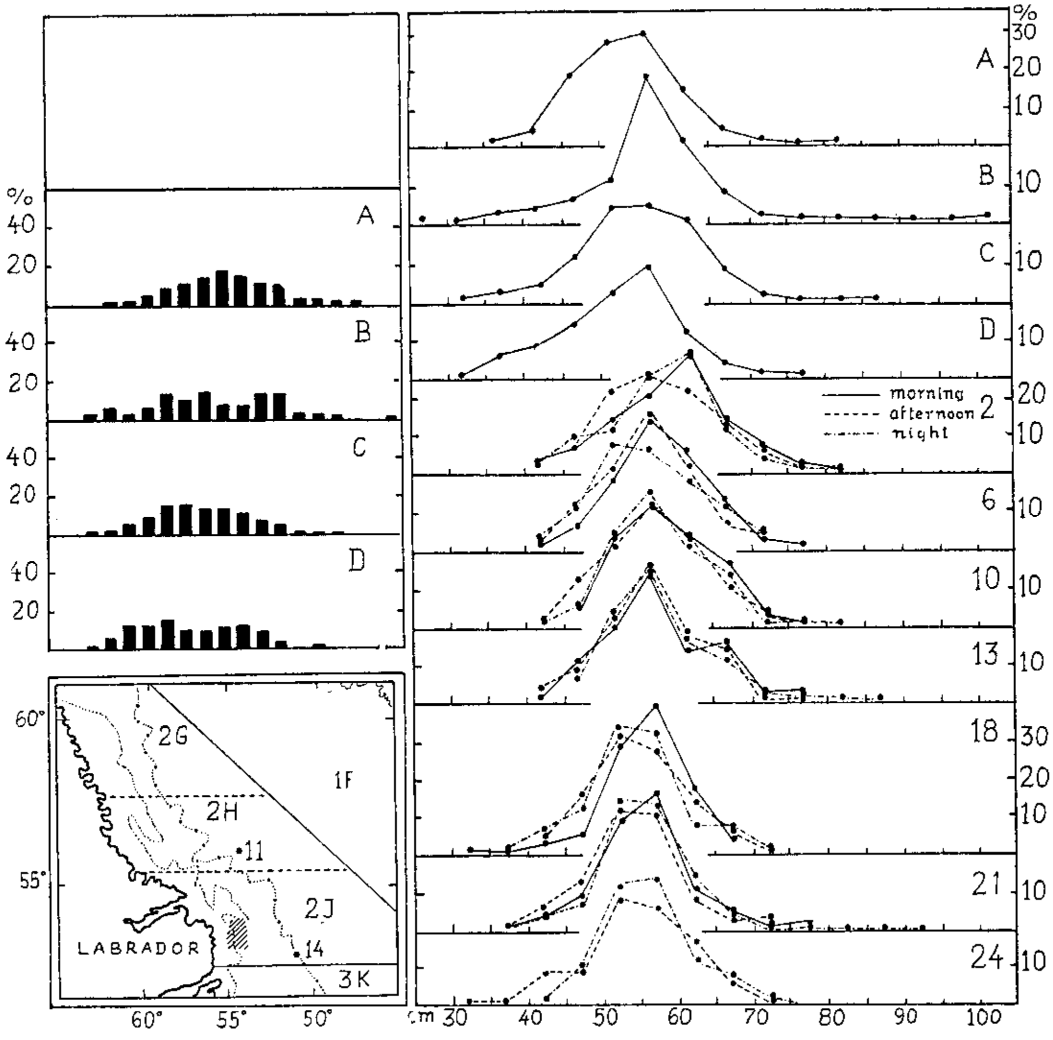

Fig. 6. Age and length distribution of groups of samples and separate samples of cod caught by Portuguese trawlers in Labrador waters in 1957; all samples except nos. 11 and 14 were taken in the hatched area.

2. Age Composition (Fig. 6)

In Subdivision 2J, October (sample group A) the X group predominates (17%); it is followed by the IX and XI groups (14%); the VIII, XII and XIII groups are represented with around 11%. The remaining age groups are poor or nearly non-existent.

In the first three weeks of November (sample group C) the VII and VIII groups predominate (15%), followed by the IX, X and XI groups (12-13%). By the end of November (sample group D) the VII group is the richest (around 16%), followed by the V, VI and IX groups (around 12%). The VIII and X groups are represented with 10%.

In the more northern Subdivision 2H, beginning of November (sample group B), the predominating age-groups are: IX-14%, VII, XII and XIII-13%. The VIII group accounts for 10%.

Summary. In the Labrador region no strongly predominating year classes appear; the 1946-1950 year-classes are those best represented.

3. Size Distribution (Fig. 6)

The sample groups A-D present a relatively uniform size distribution with a peak in the 57 cm. class. There is one exception, with the peak falling in the 62 cm. class; age group X predominates in this sample.

The figure also shows size distribution curves for samples taken by day, in the afternoon and by night. The results are too irregular to permit any conclusions as to variations in size distribution over the 24 hours.

4. Growth.

Growth curves for males and females from Subdivisions 2H and 2J are presented in Fig. 7. The growth curves are rather similar to those derived from the material collected in 1956. The growth of the males is slightly inferior to that of the females from about the eighth year.

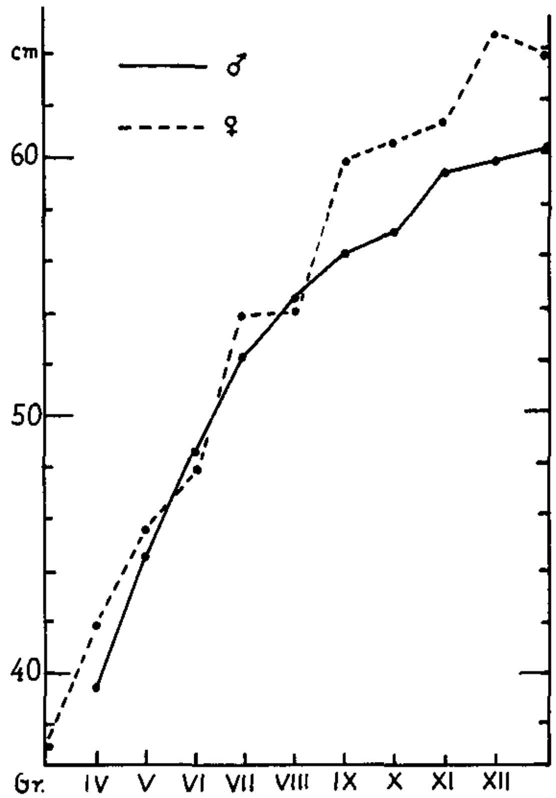

Fig. 7. Cod, Labrador, 1957. Growth curves for males and females.

5. Sex Ratio.

A considerable irregularity is found as to the sex ratio. In the sample groups C and D the percentage of males and females is nearly the same. In sample group A the females predominate with 58%, and in B the males with 56%.

Samples of cod caught at different hours of the day and night do not show any significant variation in the proportion of males and females. In their total these samples show a rather marked predominance of the females (55-65%).

6. Stage of Maturity (Fig. 8)

Males. In October-November the large majority are in the developing stage (83-89%); a small percentage (7-16%) are in the resting stage. Post-spawners are exceedingly rare (2-3%).

Females. In October the majority are in the post-spawning stage (52%), the remainder in the developing stage (25%) or in the resting stage (23%). During November the percentage of post-spawners gradually decreases. By the end of November 56% are in the developing stage (retarded stages) and 42% in the resting stage.

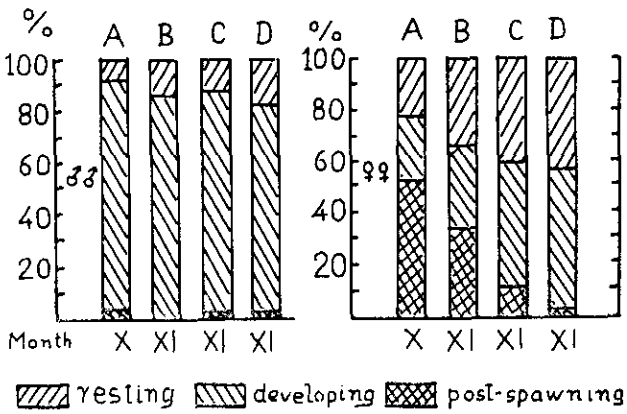

Fig. 8. Cod, Labrador, 1957. Percentage numbers of males and females of different stages of maturity in the months October (**X**) and November (**XI**). Sample groups, A - D, indicated above. (p. 56)

7. Age at First Maturity (Fig. 9)

The spawning rings in the otoliths indicate that first maturity is reached from the 6th to the 11th year, especially in the 7th and 8th years (most frequently in the 8th year). The samples did not show any difference between male and females regarding age at first maturity.

8. Weight.

Observations on total weight, weight of liver, gonads and intestines were collected from around 150 cod.

C. Observations on the Cod (*Gadus callarias* L.) in Subdivision 3K (Belle Isle)

1. Material and Methods.

Four samples including 525 specimens were taken from trawlers. Age readings by means of otoliths were carried out for three of these samples.

The mean size of the meshes in the codend used was 117 mm. The samples include the cod as caught, without culling.

The samples are as follows:

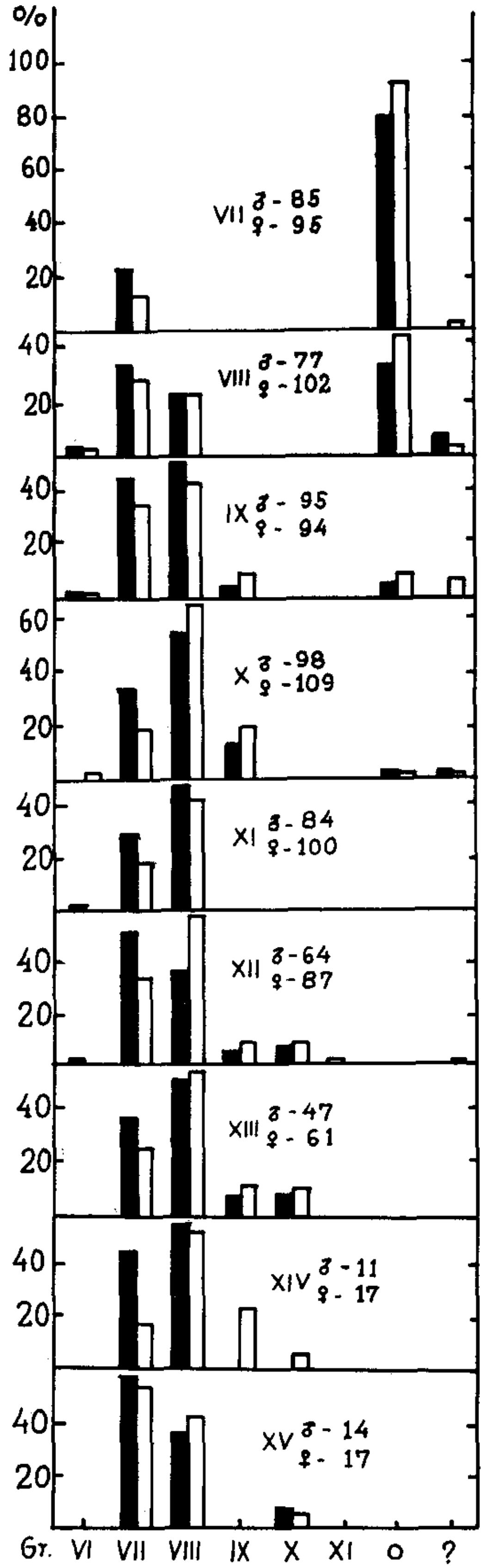

Fig. 9. Cod, Labrador, 1957. Percentage numbers of males (black) and females (white) of the various ages (VI-XI) spawning for the first time. O—indicates no spawning mark.

COD SAMPLES, 3K, OTTER TRAWL:

Serial No.	Date	No. Specimens	Ages
32	26 Oct. ,57	100	yes
33	27 Oct. ,57	100	yes
34	28 Oct. ,57	225	no
35	7 Dec. ,57	100	yes

For the study the four samples were combined in one sample group. The same methods as used earlier were applied.

2. **Age Composition** (Fig. 10)

In the samples 32, 33 and 35 (October-December) the age group X predominates with 23%, followed by XI (17%), IX and XII (around 12%). The VIII group amounts to 10%.

Thus the year-classes 1947, 1946, 1948 and 1945 are predominating; this is in agreement with the results of the 1956 researches.

3. **Size Distribution** (Fig. 10)

The size distribution is rather regular. The curves show only one peak, in the 62-67 cm. groups, which corresponds to the rich 1947 and the relatively rich 1946 and 1948 year-classes.

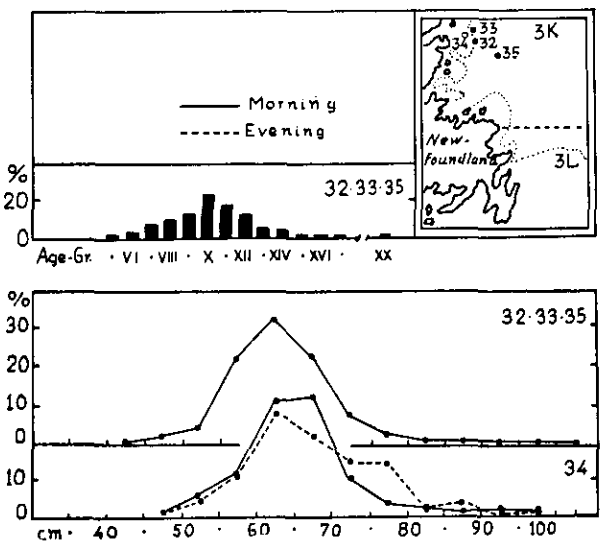

Fig. 10. **Cod, Belle Isle area (3K), 1957. Age and length distribution, positions of the four samples.**

4. Growth.

Owing to the scarce material the data for the V and VI group cannot be regarded as representative. The growth of the males is slightly smaller than the growth of the females from about the 7th year and onwards (Fig. 11). It is to be noted that within the same age groups two types of growth occur. The slow-growing (Labrador) type, and the faster growing (Grand Bank) type.

5. Sex Ratio.

A small predominance (53-57%) was observed for the females in three of the samples. In the fourth sample the two sexes were equally represented.

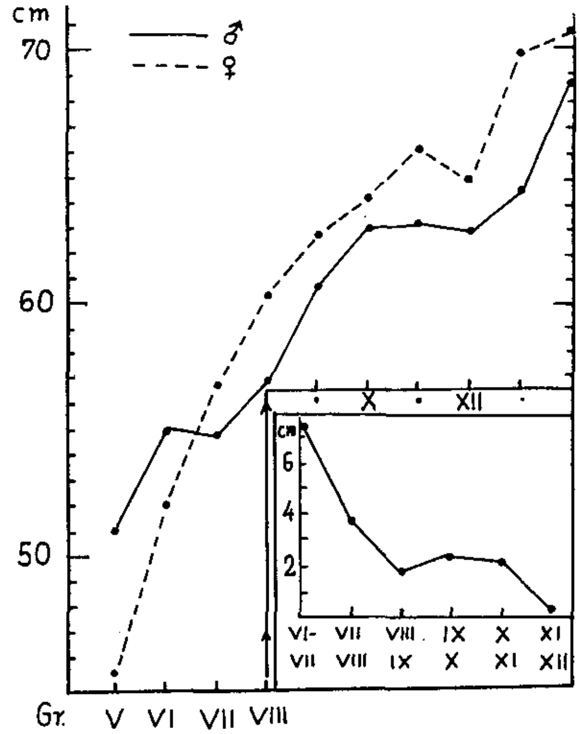

Fig. 11. **Cod, Belle Isle area (3K). Growth curves for males and females (ages V-XIV). Inserted annual growth of the age-groups VI-XII.**

6. **Stage of Maturity** (Fig. 12)

In October-December the majority of the males are in the developing stage (94%); 5.3% are in the resting stage, less than 1% are post-spawners. Of the females 45% were in the developing stage, 29% in the resting stage and 25% were post-spawners.

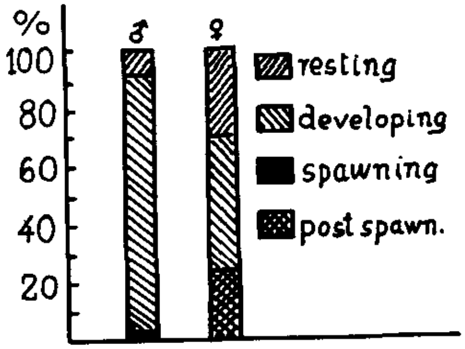

Fig. 12. Cod, Belle Isle area (3K). Percentage numbers of males and females of different stages of maturity in October-November, Sample nos. 32, 33, 35.

7. First Maturity (Fig. 13)

From the reading of the spawning zones in the otoliths it appears that the first maturity occurs between ages 6 and 10, most commonly in the 7th and 8th years.

The females mature a little later than the males, in general only in the 8th year.

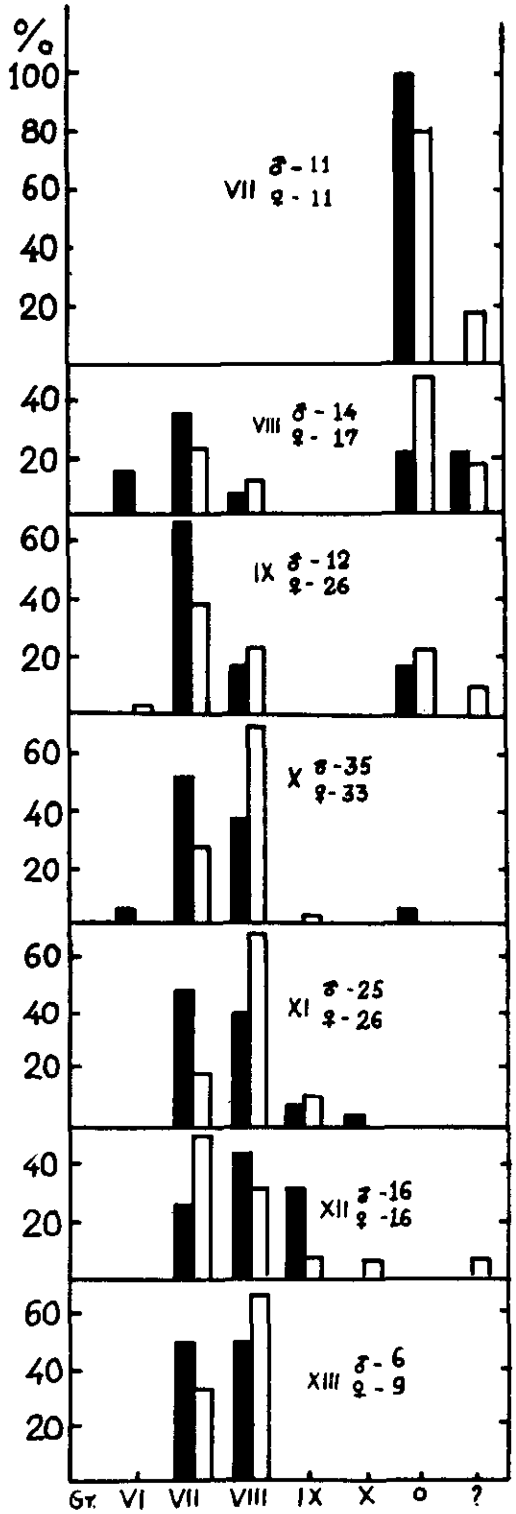

Fig. 13. Cod, Belle Isle area (3K). Percentage number of males (black) and females (white) of the various ages (VI-X) spawning for the first time. O—indicates no spawning mark.

VIII. Spanish Research Report, 1957

BY ALFONSO ROJO

A. Investigations of the Cod off W. Greenland during the year 1957.

With the present paper Spain initiates the reporting of data from studies of the cod from Greenland. The material was collected on board the trawler "ABREGO", of the PYSBE company, during September and October, 1957.

Material and Methods. All the samples have been arranged in two groups, each including samples taken at about the same time and in nearly the same area. The two groups correspond to Subdivisions 1B (Store Hellefiske Bank) and 1D (Fylla Bank). The fishery was carried out in the central part of the banks. The trawls used had a mesh size in the codend of 160 mm (6-3 /8 inches), when new and dry. To the upper side of the codend were attached one or two covers (chafing gear). Of the 16,309 specimens measured on board in 1B, 12,256 were caught with one cover and 4,053 with two covers in use

The specimens were measured on the deck before culling. The fishermen normally discard all specimens below about 40 cm in length. As the averages of the lengths were calculated on the basis of all specimens caught, the resulting lengths are lower than those found by other nations using only culled material. For the study of the length distribution 18,102 specimens were used. Of these 1,800 were used also for the study of age, sexual maturity, stomach content, etc. However, in order to allow time for the study of other samples from the ICNAF area, only 600 specimens were aged, 400 from Subdivision 1B and the rest from 1D. The weight in relation to the length was observed for 341 specimens.

Following the procedure previously used for studying the cod on the Grand Bank, the correlations between the total length and the length of the head, the pre-dorsal length and the girth were calculated using 388 specimens, as a means of studying the various races and subspecies of cod in the Northwest Atlantic.

All the data used were taken on board by two sailors selected for this work by the PYSBE company and instructed by me during a campaign on the Grand Bank in the month of August.

The data as to size and age referred to in this paper will be published in the ICNAF Sampling Yearbook, 1957.

Cod in Subdivision 1B.

Size Distribution (Fig. 1 below.). In 1B the fishery was carried out during the whole of September and October. All the samples were collected between 67°15′ and 68°18′ N and 54°20′ and 54°25′W, i.e. on the central part of Store Hellefiske Bank.

The peak of the length curve is in the 50 cm group with 27%, followed by the 45 and 55 cm groups, 17% and 16% respectively. The mean size was rather small, 54.45 cm.

Age Distribution (Fig. 1 below). The age distribution conforms completely with that of size, as we find a great predominance of four year-old cod (1953 year-class). It must be borne in mind that the samples also include specimens which would be discarded into the sea, as the measurements were made before culling.

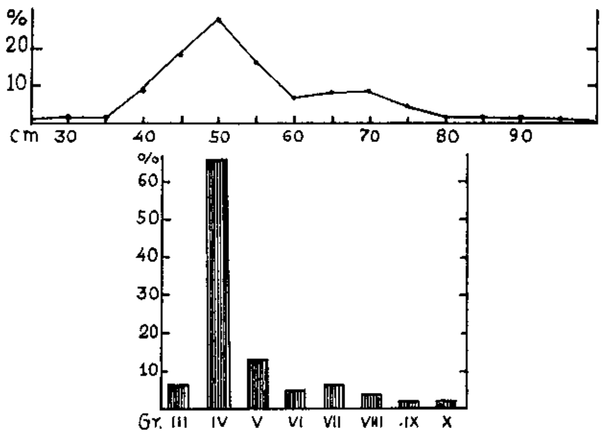

Fig. 1. **Cod, Subdivision 1B, Sept.-Oct. 1957. Above: Length frequency curve, 16,309 spec. Below: Age distribution in frequency percentages, 386 spec.**

TABLE 1. Cod, age distribution and mean length by year-classes, Subdivision 1B.

Year-class	Age	Males		Females		Total	%
		cm	(No.)	cm	(No.)	cm	
1955	2	28		...		28	...
1954	3	38.54	(11)	39.75	(12)	39.17	5.95
1953	4	48.68	(107)	48.70	(147)	48.69	65.80
1952	5	55.07	(28)	51.90	(22)	53.68	12.95
1951	6	61.42	(7)	63.09	(11)	62.44	4.66
1950	7	68.00	(10)	69.83	(12)	69.00	5.69
1949	8	68.75	(4)	72.40	(10)	71.35	3.62
1948	9	73.00	(1)	75.00	(1)	74.00	0.51
1947	10	69.00	(1)	74.00	(2)	72.33	0.77
			169		217		

386 otoliths were studied. There is an absolute predominance of the 1953 year-class with 65%, followed by the 1952 year-class with 12%. In nearly all the otoliths the growth during the summer of 1957 was shown, and it may be the case for some individuals that this marginal zone represents the fifth year. However, even in this case, the 1952 and 1953 year-classes predominate.

In Table 1 above are shown the sizes of the different age groups, separately for males and females and for both sexes together.

The strongest growth is found for the females with the exception of those of age 5 (Fig. 2).

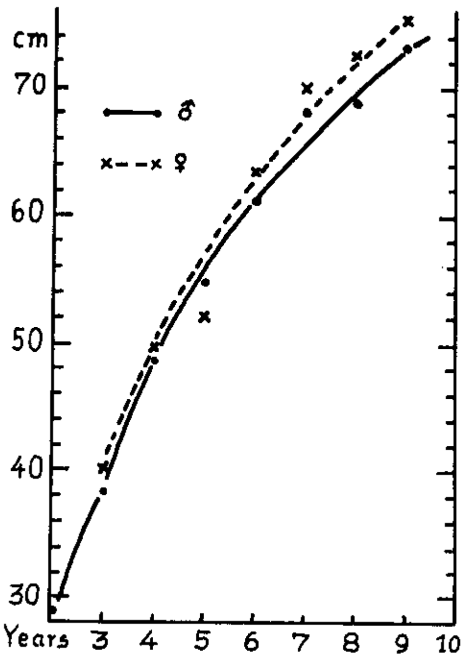

Fig. 2. Cod, Subdivision 1B, Sept.-Oct. 1957. Growth curves for males (169 spec.) and females (217 spec.).

Feeding. The principal food of the cod in this area in September and October was the capelin (*Mallotus villosus*) and the sand eel (*Ammodytes americanus*). This is a period of great voracity for the cod, and of 387 stomachs examined no less than 68% were filled with food.

Sex Ratio. The females were in the majority with 56%; this is the same percentage as that found for this area in 1956, according to the Portuguese reports.

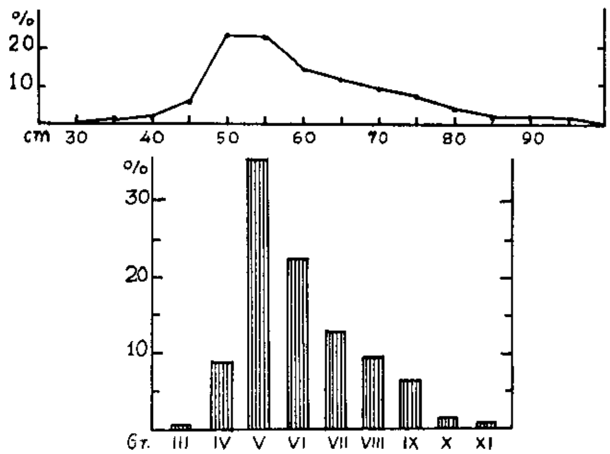

Fig. 3. Cod, Subdivision 1D, Oct. 1957. Above: Length frequency curve, 1,793 spec. Below: Age distribution in frequency percentages, 176 spec.

Cod in Subdivision 1D.

Size Distribution. In 1D the fishery was carried out during the whole of October between 63°35′ and 64°05′N and 52°50′ and 53°02′W.

Measurements of 1,793 specimens were made. The mean size was 59.65 cm, a little larger than in 1B in the same months (Fig. 3).

TABLE 2. Cod, age distribution and mean lengths by year-classes, Subdivision 1D (Fig. 4).

Year-class	Age	Males		Females		Total	%
		cm	(No.)	cm	(No.)	cm	
1954	3	41.00	(1)	...		41.00	0.56
1953	4	47.11	(9)	49.57	(7)	48.18	9.09
1952	5	52.32	(31)	53.09	(32)	52.71	35.79
1951	6	58.75	(20)	58.20	(20)	58.47	22.75
1950	7	65.81	(11)	65.83	(12)	65.82	13.06
1949	8	66.85	(7)	74.20	(17)	71.17	9.65
1948	9	71.77	(9)	63.00	(2)	70.18	6.25
1947	10	81.00	(1)	70.50	(2)	74.00	1.70
1946	11	75.00	(1)	80.00	(1)	77.50	1.13
			89		87		

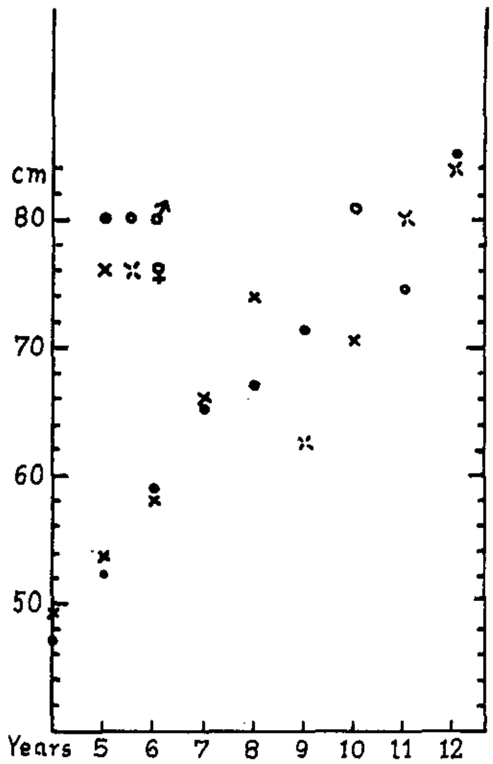

Fig. 4. Cod, Subdivision 1D, Oct. 1957. Growth for males (89 spec.) and females (87 spec.).

Age Distribution. The growth in 1D was slightly smaller than on Store Hellefiske Bank. The 1952 year-class, five years old, is the most numerous (36%). It is followed by the six and seven year-old cod with 23% and 13% respectively (Table 2 and Fig. 3).

The summer and autumn growth seemed to have stopped (October); all the specimens were resting in this period, with the majority of the otoliths showing a transparent margin. This was in agreement with the considerable number of empty stomachs (55%).

The numbers of males and females were nearly equal, 50.56% and 49.43% respectively. These figures conform well with those found in the various areas of the Grand Bank of Newfoundland.

Feeding. Capelin and sand eel were, as in 1B, the principal food.

Quantities Discarded. Owing to the use of a net with a large mesh size (6 3/8 in. or 160 mm new and dry), the quantity of cod discarded has been minimal. In 1B cod smaller than 40 cm, which is the lower limit accepted by the industry made up 5.17% by number. In 1D this quantity is much smaller, only 0.79%. When taken into account that these data are based on two months' investigations, the quantities discarded can be considered as nearly negligible.

Weight. Individual weighings were carried out for 341 cod from Greenland waters (the data will appear in the Sampling Yearbook). The weighings are, as mentioned, subject to error owing to the movements of the vessel, but when this error is eliminated and as the work was carried out on calm days, the results agree fairly well with those cited by Poulsen in Document No. 18 (ICNAF Serial No. 459) from data collected by other countries.

Biometric Proportions (Fig. 5 and 6). Using the same methods as for the cod on the Grand Bank, the correlation between the total length (L), the head length (H), and the pre-dorsal length (P), was calculated. The corresponding equations were estimated in order to compare the various stocks of cod. The equations found for the two regions are very much the same:

$$H = 0.219\ L + 0.448$$
$$P = 0.304\ L - 0.971$$

Relation of Total Length to Girth. This relation was estimated in order to compare results obtained in experimental samples with those from commercial catches, because a considerable variation of the relations occurs in both cases.

For the Greenland cod the correlation seems to be clearly lineal without any inflexion. There is, however, a considerable spread of observations for the largest individuals. The last observation (total length — 99 cm., girth — 60 cm.) is not shown in the figure.

The ratio between total length and girth is 1.919, slightly higher than for the cod of Labrador (1.90) and much lower than those found for cod in the Norwegian Arctic Sea. This shows that the Greenland cod grows more slowly in girth than that of Labrador.

Equation between total length L and girth G: $G = 0.598\ L - 4.370$

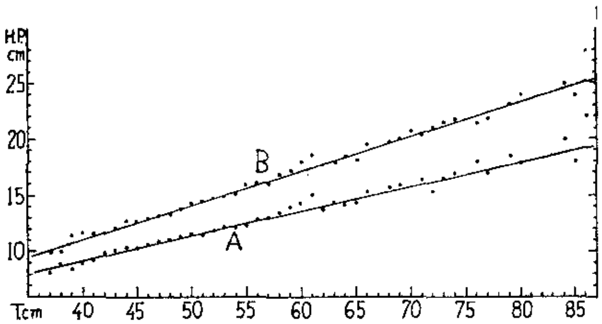

Fig. 5. Cod, Subdivision 1B, Sept. 1957 (388 spec.). Line A: Correlation between total length T and head length H. (H = 0.219T + 0.448). Line B: Correlation between total length T and predorsal length P (P = 0.304T — 0.971).

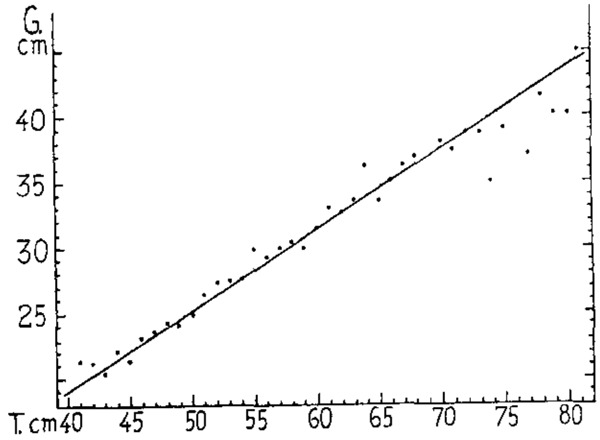

Fig. 6. Cod, West Greenland, 1957. Correlation between total length T and girth G (G = 0.598T — 4.370).

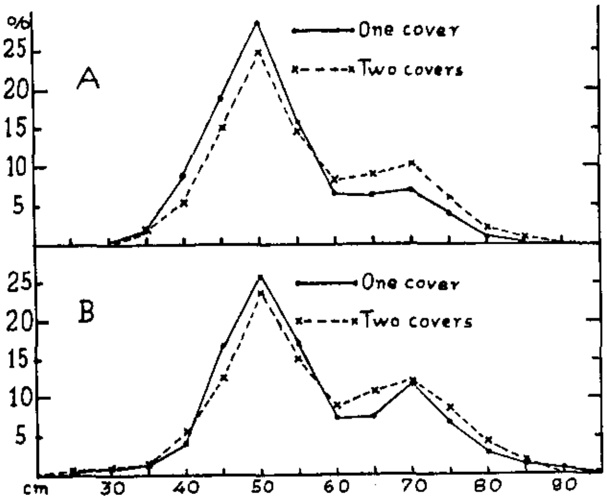

Fig. 7. Cod, West Greenland, 1957. Length distribution of catches with one and two covers. A—Sept./Oct., St. Hellefiske Bank; B—catches from four consecutive days and from the same locality.

Comparison of Catches with One and with Two Covers of Chafing Gear. During the fishery in September and October on Store Hellefiske Bank two trawls were used alternatively. One had one upper side cover, the other had two. The results (see Fig. 7) were, contrary to what one would have expected, in favour of the trawl with two covers, in so far as this gear caught the largest fish. There can be no mistake as to this observation, because it is based on a great number of hauls: one cover—55 hauls; two covers—28 hauls. The two curves showing the measurements are parallel but with a marked advantage in favour of the two covers. Also the mean size was different: 53.70 cm for the one cover trawl and 56.70 cm for the two covers trawl.

During four days it was possible to fish in the same place and under the same conditions with one cover and with two covers (see the lower set of curves).

B. The Cod in the Labrador Area.

Samples were collected on board the trawler "ABREGO" of the PYSBE company by special personnel instructed by me for this work in a campaign on the Grand Bank on board the same boat. With this work Spain initiates its study of the Labrador cod.

Material and Methods. The material collected in 11 samples on 11 days was studied as a whole, as the various positions where the hauls were made were very close to one another and as the hauls were made on successive days. The trawl used is that recently adopted by PYSBE, with a mesh size in the codend of 160 mm measured dry and before use. Measurements were carried out on 5,704 specimens and from these 10% were taken at random for the study of sexes, age, stomach contents, etc. The methods for the study are the same as in previous years. The data will appear in tabular form in the Sampling Yearbook, 1957.

Date and Place of Samples. The captures were made in Subdivision 2J between 53°25′ and 54°05′ N and 53°00′ and 54°15′W, from 28 October to 9 November.

Size Distributions. The data will appear in tabular form in the Sampling Yearbook, 1957.

Fig. 8 gives curves for the size for the various days. The size decreases during the period of fishing. The mean sizes of the first and the last days were 59.87 and 53.80 cm respectively.

A similar observation has been made for many campaigns of our fishing vessels in various areas: the size of the fish gets smaller and smaller during the fishing until a point when the fishery ceases and the vessel moves to another area.

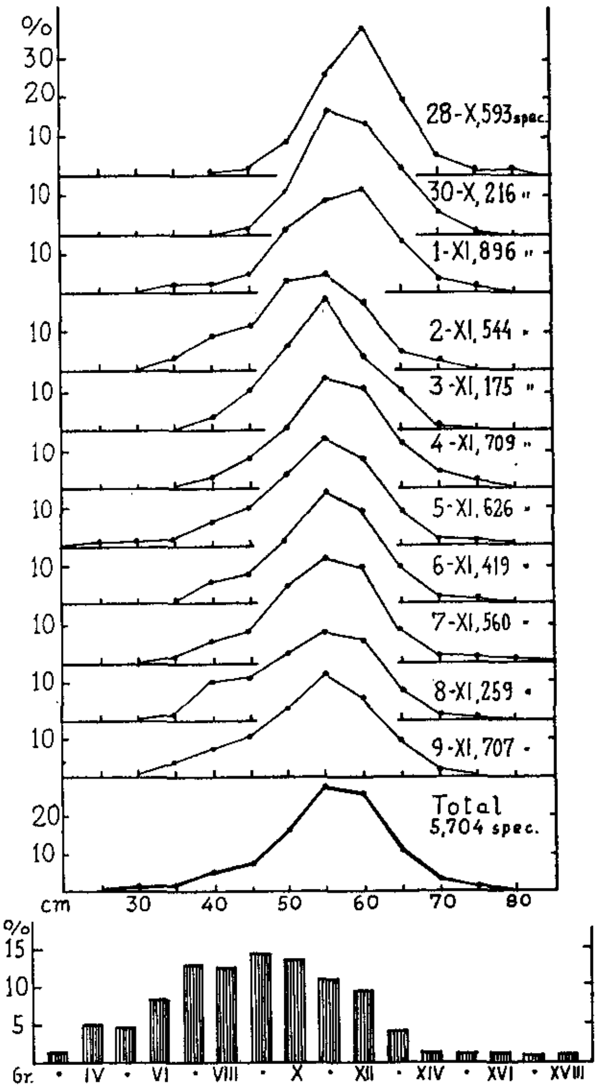

Fig. 8. **Cod, Labrador, Subdivision 2J, 1957. Above: Length frequency curves for separate days 28 Oct. to 9 Nov. and (bold curve) length frequency curve for all samples (5,704 spec.). Below: Age distribution in percentages for all specimens aged (577 spec.).**

Fig. 8 also shows a curve for all the samples. The largest frequency is found in the 55 cm group (28%), followed by the 60 cm group (26%).

Quantity Discarded. It is very difficult to estimate the quantities discarded. However, it appears that in this area, where the cod generally are not mixed with other species, the numbers of discards are very small. Taking into account that the samples were measured before

TABLE 3. Cod, age distribution and mean length of year classes, Subdivision 2J.

Year Class	Age	Males No.	Males M.L. cm	Females No.	Females M.L. cm	Total No.	Total M.L. cm	%
1954	3	6	34.33	—	—	6	34.33	1.04
1953	4	13	42.23	14	41.28	27	41.74	4.68
1952	5	14	47.14	12	46.25	26	46.73	4.51
1951	6	25	48.40	22	52.50	47	50.31	8.14
1950	7	34	52.00	41	54.87	75	53.57	13.00
1949	8	37	54.24	35	56.34	72	55.26	12.48
1948	9	34	56.44	49	57.67	83	57.16	14.38
1947	10	36	57.44	40	58.42	76	57.96	13.17
1946	11	31	58.22	33	60.60	64	59.45	11.09
1945	12	31	59.06	25	61.16	56	61.07	9.71
1944	13	13	61.23	12	63.00	25	62.08	4.33
1943	14	3	67.00	3	63.33	6	65.16	1.04
1942	15	2	65.50	4	63.25	6	64.00	1.04
1941	16	1	68.00	5	70.40	6	70.00	1.04
1940	17	1	65.00	—	—	1	65.00	0.17
1939	18	—	—	1	72.00	1	72.00	0.17
		281		296		577		99.99

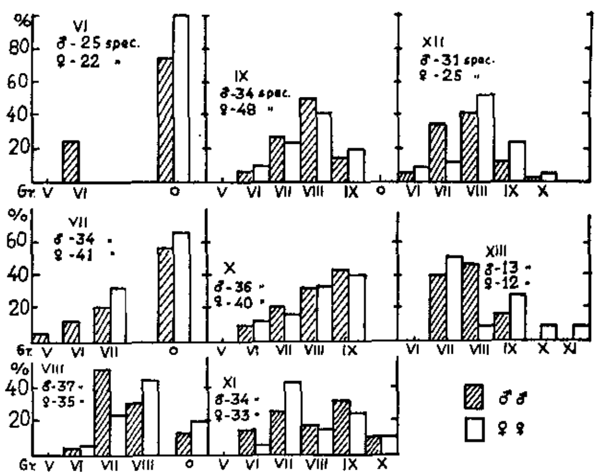

Fig. 9. Cod, Labrador, Subdivision 2J, 1957. Percentage numbers of males (hatched) and females (white) spawning for the first time at various ages (V-XI). O— indicates no spawning ring; estimated from otoliths of the age groups VI-XIII.

culling, it can be estimated that the number of cod discarded is very low. The minimal commercial size is 40 cm. In the samples from the 11 days the quantity discarded is estimated at 5.8% in number, not in weight.

Age Distribution (Fig. 8 above). For the study of age, otoliths of 577 cod were read. In general the reading of the otoliths was easy, easier than for cod from the Grand Bank and from off Bonavista.

In nearly all cases the margins of the otoliths were dark, indicating the growth of the summer and autumn of 1957.

The largest percentage is found for the nine year-old specimens (1948 year-class), namely 14.38%; it is followed by the ten and seven year-olds with 13.17% and 13.00% respectively. The smaller ones, age six years, and the larger, age 12 years or more, are found in smaller proportions than 5%. (Table 3).

In Table 4 and Fig. 9 are shown the relation and percentage of age at first spawning. It is seen that spawning begins at age six. As the fishery for cod younger than six years (3-5 years) does not amount to more than 10% in all, the majority of the small cod are saved and with this the reproduction in the region is secured.

The growth curve (Fig. 10) shows that, after the sixth year, i.e. after the first spawning, the females grow more rapidly than the males. The larger specimens of 14 years or more have lengths a little higher than those to be expected from the general trend of the curve.

Stomach Content. The contents of 577 stomachs were investigated; 85% were full and 15% were empty. Capelin (*Mallotus villosus*) was the only species observed in the stomachs. The great amounts of food and the character of the marginal zone in the otoliths indicate that

TABLE 4. Cod, Subdivision 2J, age at first maturity estimated from the rich age groups VI-XII.

Age-Group			V	VI	VII	VIII	IX	X	XI	?	im.	Total
		No.	—	6	—	—	—	—	—	—	19	25
	♂	%	—	24.0	—	—	—	—	—	—	76.0	
VI		No.	—	—	—	—	—	—	—	—	22	22
	♀	%	—	—	—	—	—	—	—	—	100.0	
		No.	1	4	7	—	—	—	—	3	19	34
	♂	%	2.9	11.8	20.6	—	—	—	—	8.8	55.9	
VII		No.	—	—	13	—	—	—	—	1	27	41
	♀	%	—	—	31.7	—	—	—	—	2.4	65.9	
		No.	—	1	18	11	—	—	—	2	5	37
	♂	%	—	2.7	48.7	29.7	—	—	—	5.4	13.5	
VIII		No.	—	1	8	16	—	—	—	4	6	35
	♀	%	—	2.9	22.9	45.7	—	—	—	11.4	17.1	
		No.	—	2	9	17	5	—	—	1	—	34
	♂	%	—	5.9	26.5	50.0	14.7	—	—	2.9	—	
IX		No.	—	4	11	21	10	—	—	1	2	49
	♀	%	—	8.3	22.9	43.8	20.8	—	—	2.1	4.1	
		No.	—	3	7	11	15	—	—	—	—	36
	♂	%	—	8.3	19.4	30.6	41.7	—	—	—	—	
X		No.	—	4	6	13	15	—	—	2	—	40
	♀	%	—	10.0	15.0	32.5	37.5	—	—	5.0	—	
		No.	—	4	8	5	10	3	—	1	—	31
	♂	%	—	12.9	25.8	16.1	32.3	9.7	—	3.2	—	
XI		No.	—	1	14	5	8	3	—	2	—	33
	♀	%	—	3.0	42.4	15.2	24.2	9.1	—	6.1	—	
		No.	—	2	11	13	4	1	—	—	—	31
	♂	%	—	6.5	35.5	41.9	12.9	3.2	—	—	—	
XII		No.	—	2	3	13	6	1	—	—	—	25
	♀	%	—	8.0	12.0	52.0	24.0	4.0	—	—	—	

?—doubtful. im.—immature

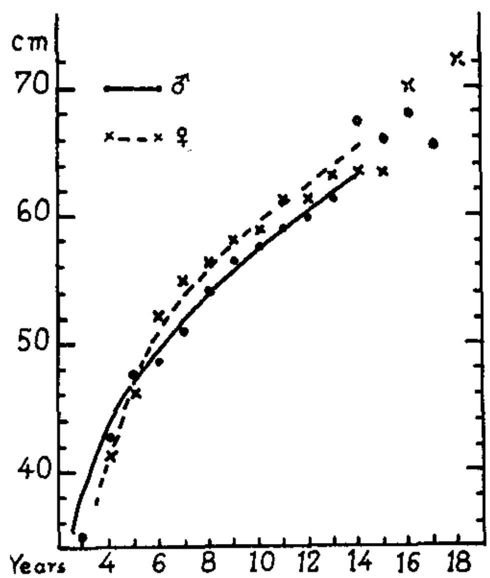

Fig. 10. Cod, Labrador, Subdivision 2J, 1957, Oct.-Nov. Growth curves for males (281 spec.) and females (296 spec.).

the cod in October-November are in a period of growth.

Correlation Between Total Length (L) **and Girth** (G). For the study of the selectivity of various mesh sizes the collection of information on the girth size of escaped and caught fish is of value. These and other similar observations have been made earlier on research vessels but not on commercial vessels, where it is difficult and uneconomic to do so when the vessel is busy fishing. Therefore, it was found advisable to compare such data which have been collected from research vessels with those from commercial trawlers. The behaviour of fish, single or in smaller or larger shoals, may no doubt differ; therefore, results from research vessels and from large trawlers may well differ considerably, due to the duration of hauls, density of stock, and the behaviour of those first caught.

The girth of the 79 cod (Fig. 11) was measured just in front of the first dorsal fin and to the half-cm, as was also the total length. The stomachs were not investigated, but of 577 other cod caught on the same day and at the same place 85% had full stomachs. However, when the girth is measured off the first dorsal fin, a full stomach will hardly influence the measurement.

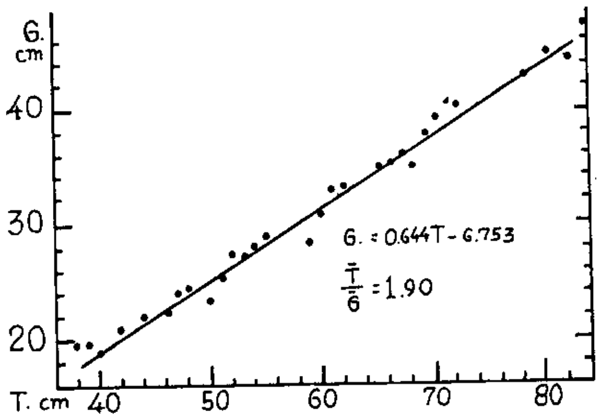

Fig. 11. Cod, Labrador, Subdivision 2J, Oct.-Nov. 1957. Correlation between total length T and girth G.

The relation between the averages of the total length and the pre-dorsal girth is 1.90, much lower than what has been found for the Arcto-Norwegian cod (G. Saetersdal: Mesh Selection Data of Arctic Cod and Haddock. 1957) for which the following values were estimated:

1st girth off posterior part of gill cover	3rd girth off middle of dorsal fin
2.41	2.17
2.51	2.23
2.36	1.97
2.44	2.43

If both stocks (Labrador and the Northeast Atlantic) showed the same ratio, the body development would have been the same. The smaller proportion found for the Labrador cod indicates that this is a stouter cod.

The relationship between total length and girth corresponds fairly well with a straight line, for which the following equation was elaborated:

$$G = 0.644\,L - 6.763$$

In this case an inflexion at 65 cm, as that found for the Grand Bank cod, was not observed. This may be due to the small number of specimens.

The ratio of total length to girth was larger than for the Grand Bank. However, the girth of the Grand Bank cod was measured near the operculum.

Observations on Spanish Trawler Catches in Subarea 3 in 1957.

Much material was collected in 1957 in the various subdivisions of Subarea 3 on board the trawlers "ABREGO" and "SANTA EUGENIA" as well as in port from various vessels; but as place and time of capture often co-incided results are comparable. Observations on the selectivity of the trawls are very difficult to make on board vessels intended for commercial fishery for economic reasons, loss of time, etc., but samples collected in that manner offer direct evidence of the variation in selectivity of trawls with meshes of different size.

The material and the results of the investigations are given separately for each of the subdivisions of Subarea 3.

The species considered are: cod, *Gadus callarias* L., haddock, *Melanogrammus aeglefinus*, (L.), and pollock, *Pollachius virens* (L.). A part of the material collected has not been worked up owing to lack of the necessary manpower and time. All samples were collected and investigated by the author.

COD

Subdivision 3K.

It was only possible to collect a small sample from the vessel "ABREGO", 50°58'N and 54°35'W, August 1957, fishing with a trawl with meshes of 160 mm (new, dry). The sample included 245 specimens. 25 were aged. The ten year-old fish, 1947 year-class, predominated. The size distribution of the sample is shown in Fig. 13, curve 1a. The mean length is 61.85 cm. (Size and age data will be presented in tabular form in the 1957 Sampling Yearbook. Owing to the scarcity of material other data are not reported.)

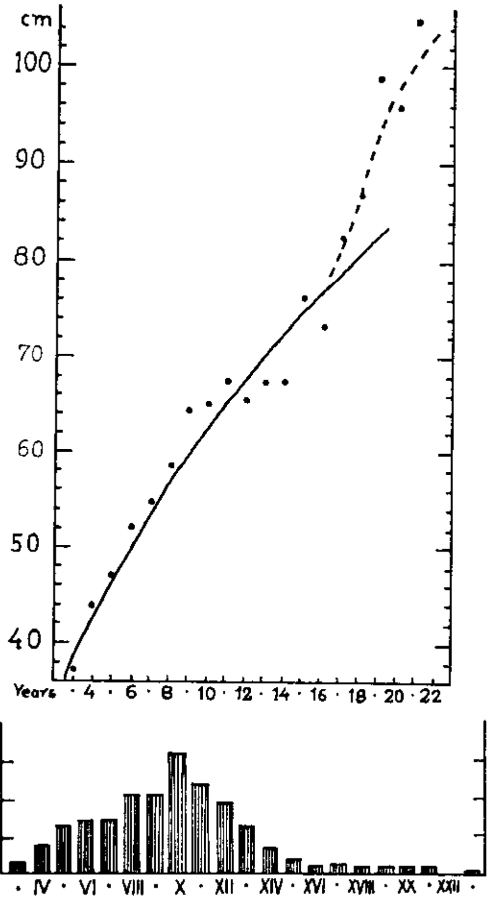

Fig. 12. Cod, Grand Bank, Subdivision 3L, Aug. 1957. Above: Growth curve (645 spec.). Below: Age distribution in frequency percentages (645 spec.).

Subdivision 3L.

Several samples were collected in August 1957. As all these samples were caught in nearly the same position, between 47°53′-48°47′N and 50°50′-52°45′W, they have here been considered only in their entirety. All samples were taken by 160 mm (6⅜ in.) meshes, new.

Size Distribution. The size distribution of 6643 cod measured on board before culling is shown in Fig. 13, curve 2a; the mean size is 61.40 cm.

Age and Growth. Otoliths of 645 specimens (10% of the sample) were studied. Until the 11th year the growth rhythm is regular, but after that age the size values lie above the curve, similar to what was found for Greenland cod the previous year (Fig. 12 above).

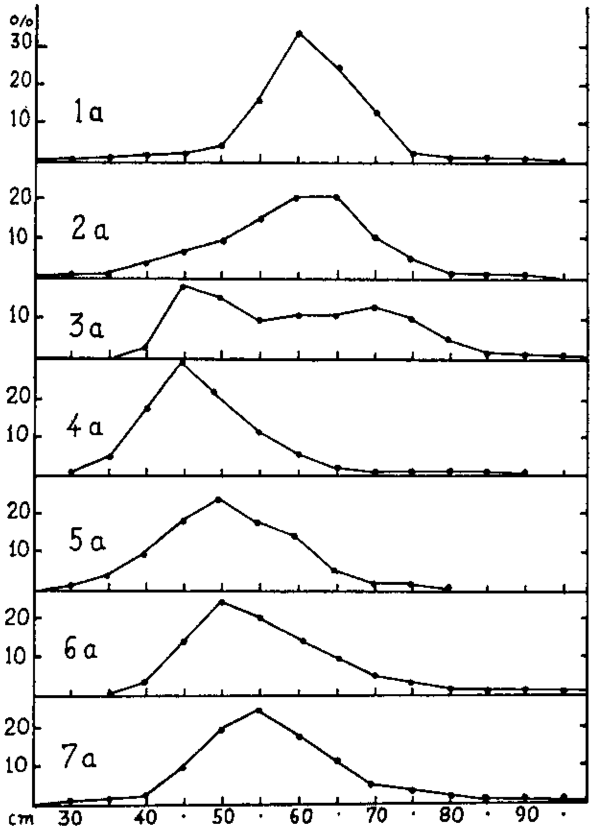

Fig. 13. Cod, Subarea 3, 1957. Length distribution curves. 1a-"Abrego" 20 Aug. 3K, 245 spec.; 2a-"Abrego" Aug. 3L, 6,643 spec.; 3a-"Abrego" 25 Aug. 3P, 436 spec.; 4a-"Abrego" 5 Aug. 3N, 416 spec.; 5a-"Santa Eugenia" Sept. 3N, 1,526 spec.; 6a-"Abrego" Nov. 3P, 2,787 spec.; 7a-"Abrego" Nov. 30, 3,531 spec.

From the sixth year (i.e. principal year of first spawning) the females grow more rapidly than the males, similar to the case with the Labrador cod.

The 1947 year-class predominated in the samples with 15.66%, followed by 1946 with 11.94%, 1948 with 10.85% and the 1949 year-class with 10.54% (Fig. 12 above).

The proportion of males and females was 49.9% and 50.1% respectively.

Stomach Contents. The stomach contents were studied on 649 specimens; 74% had full stomachs.

Weight (Fig. 14). On some of the quietest days 402 specimens were measured to the centimetre and weighed. Fig. 14 gives for each cm group the mean individual weight.

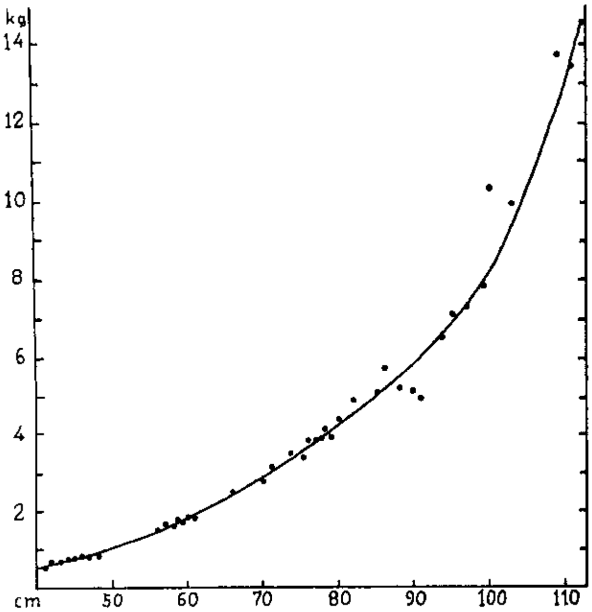

Fig. 14. Cod, Grand Bank, Subdivision 3L, Aug. 1957. Length-weight curve; mean weight (kg) for each cm-group (402 spec.).

Subdivision 3N.

The Spanish trawl fishery in 3N is carried out mainly in summer. As in previous years, a large number of samples were taken. They are here grouped in two main samples, one for August, the other for September.

The first sample-group, caught on 5th August at 44°45'N and 50°34'W, includes 416 specimens. The mesh size of the codend used was 160 mm, measured when new. The average length of the specimens is 48.35 cm.

Age determinations were carried out on 51 cod. Owing to this small number the results are not considered here.

The second sample-group is from catches made during September at 44°50'N and 50°20'W and in nearby places by the trawler "SANTA EUGENIA" using a mesh size of 130 mm (new, dry). The fishery was better in September than in August, as has been the case in the last three years. This good cod fishery lasts until the beginning of October.

Although the meshes differ considerably for these two sample-groups, the vessels, the fishing and the handling of the fish were very much the same. Further, as the region was the same and the time difference only about one month, there appears to be no very appreciable difference in the number of small fish passing through the net.

The length distribution curves, 4a and 5a, of Fig. 13 are very similar, and the quantity of discarded cod is 22.34% for the first group and 11.74% for the second. In comparison with other years it appears that no appreciable difference occurs in the improvement of the selection as far as cod is concerned. In contrast, the difference and improvement is great as regards the small haddock, the large mesh net saving more than the other.

The reason for the difference between the two species may be that the small cod do not shoal so strongly on the bank as the grown-up ones, and therefore have a better opportunity to escape the trawl. This would not be the case for the dense shoals of haddock. Also for Greenland cod large shoals, as mentioned, diminish the selectivity. From this fact it appears that the application of results of experiments on selectivity carried out by research vessels needs some revision, in so far as the selection is less pronounced for the big trawlers.

During September otoliths were collected, but time has not yet permitted a study of them.

A total of 4081 cod were measured from "SANTA EUGENIA" in September; their average size was 53.0 cm. The size distribution for 1526 of these cod is shown in Fig. 13, curve 5a.

Subdivision 3P.

From this subdivision (St. Pierre Bank) a series of samples of split cod were collected through the year in port from various trawlers fishing in the same region and at about the same period. The cod were measured on board, as split and salted, about two or three days after capture. The measurements were converted to fresh fish using the equation determined last year for cod from the Grand Bank. Thus the results of these measurements become comparable with measurements of fresh cod. For the total length the mean and the standard deviation were calculated.

At the same time and for the same vessels the codend meshes were measured. These vessels in 1957 used two upper covers for the codend, and the trawls differed somewhat for trawlers belonging to the various companies.

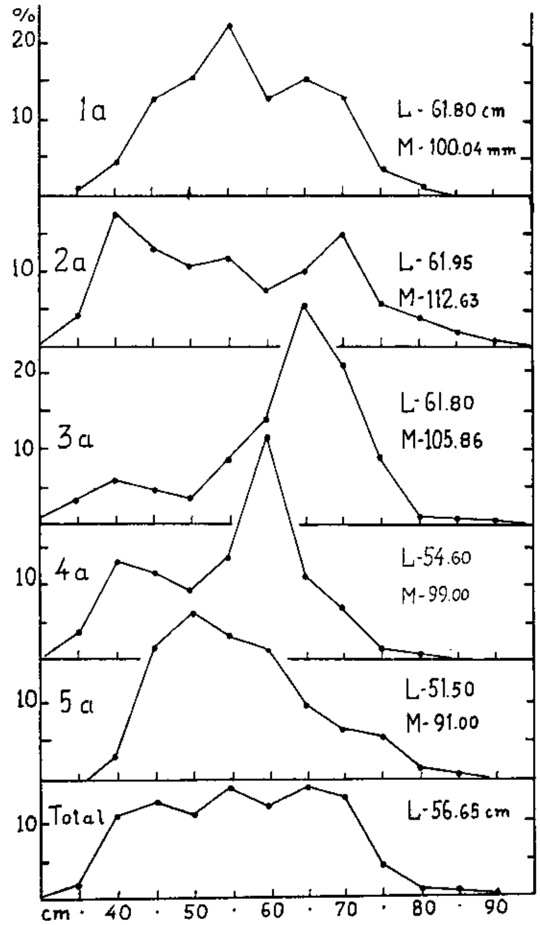

Fig. 15. Cod, Subdivision 3P, March-April, 1957. Length distribution curves: 1a—"Puerto de Navacerrada", 3 March, 403 spec.; 2a—"Puerto de Fontefria", 1 April, 488 spec.; 3a—"Santa Ines", 9 April, 406 spec.; 4a—"Santa Elvira", 9 April, 133 spec.; 5a—"Galerna", 12 April, 351 spec.; Total — all samples. L — Mean length of cod in cm, M — Codend mesh size in mm.

The **size distribution** of these samples is shown in Fig. 15. All the curves are given in the same figure in order to facilitate comparison. It is apparent that the size of the cod becomes larger with increasing size of codend meshes, owing to the different selectivity. Especially telling is the comparison between samples 3a and 4a, collected on the same day and at the same place, but from vessels using a slightly different mesh size. Two year-classes appear in the samples, and the boat using the smaller mesh caught the larger proportion of small cod. From the curves it is apparent that the mean size decreases from the beginning of March to the beginning of April. This fact has already been observed several times on the Grand Bank. Through all the samples the percentages of large cod increase with increasing mesh size, it can even be said in proportion to the mesh sizes in the five cases examined.

As the fish were split and salted, material for aging could not be collected.

In August a sample of 436 specimens was taken in Subdivision 3P from "ABREGO" (mesh size—160 mm, new, dry). The average length was 60.70 cm; the predominating size groups were 45, 50 and 70 cm. The dispersion of sizes is large, the standard deviation being ±12.85. Otoliths were collected from only 45 specimens; they have not yet been read.

Another sample of 2,706 specimens was taken at the border of Subdivision 30 in November. Its mean length was 53.90 cm, i.e. considerably below the sizes observed in August.

Subdivision 3O.

One sample was taken in November, just at the border of 3P. The trawl used had codend meshes of 160 mm (new) and one upper cover on the codend. The mean size of the 3531 specimens was 52.70 cm.

HADDOCK

During the fishing campaign of the summer of 1957 (August-September) a smaller amount of data on the haddock was collected.

Material and Methods. The samples were taken from the same vessels and with the same gears as the cod samples. The Spanish trawlers do not give special attention to fishing for haddock, which is only considered as a by-product of the cod fishery. Therefore, during some years the Spanish haddock catch has decreased considerably (the low Spanish catches of haddock in recent years are thus not due to a scarcity of this species). The Spanish captains leave areas with large concentrations of haddock, searching for cod concentrations.

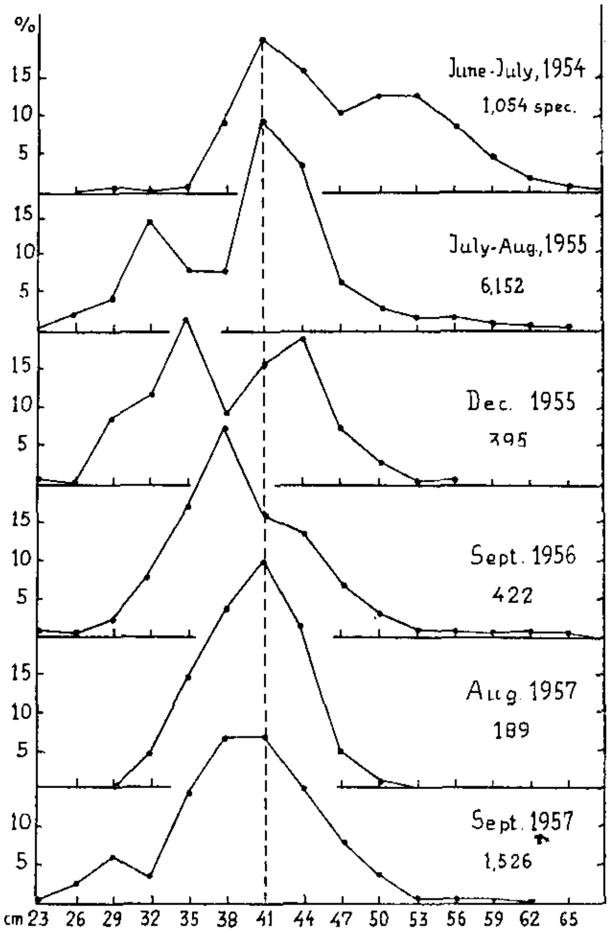

Fig. 16. **Haddock, Grand Bank, Subdivision 3N, 1954-1957. Length distribution curves.**

Size Distribution (Fig. 16). Two samples were collected in the summer of 1957 in 3N, one in August from the "ABREGO" using a mesh size of 160 mm (6 3/8 in.), new, another in September from the "SANTA EUGENIA", mesh size 130 mm (5 1/8 in.), new.

The lengths of the fish were grouped in 3 cm groups. The mean length of the "ABREGO" sample was 40.22 cm (standard deviation ± 3.90), that of the "SANTA EUGENIA" 39.59 cm (± 6.12). The size difference is negligible in spite of the considerable difference in mesh size used. However, a study of the two last curves shows that the trawl with the larger mesh size (the August sample) allowed the haddock below 30 cm to escape. These small haddock belong to the 1954 and 1955 year-classes (two and three years old).

The standard deviation is considerably smaller for the August sample than for the September sample. This is due to the fact that the former sample represents only a single day's fishing and, it might well be, just a single shoal of small haddock. The September sample, however, is from a period with rich fishery. However, the quantities discarded are in both cases very large.

The larger mesh size (160 mm) has caused some improvement in the selectivity, but not sufficient to ensure the escape of a large part of the fish not used for salting. The explanation of this is either that the two codend covers greatly diminish the escape or that the haddock concentration is so large that the large quantities in the codend hinder the escape.

Size curves for earlier years are included for comparison. In some years two peaks are observed, indicating two year-classes whose growth can be followed through the years. The year-class which predominated in 1956 continues to predominate in 1957, and in this year another appears with a modal size of around 29 cm, which, according to the growth rate for this region of the Grand Bank, is two years old (1955 year-class). These data seem to confirm the three-year cycle for haddock abundance, demonstrated earlier.

It is to be noted that the abundance of small haddock increases from year to year. The stippled line in Fig. 16 indicates the minimum size accepted by the Spanish fishing industry. The quantities to the left of this line are those discarded, increasing considerably from year to year. However, although this quantity increases, the total yearly catch does not increase, due to the fact that the Spanish trawlers, as mentioned, do not give much attention to haddock.

What is the reason for the increase in the abundance of small haddock? Firstly, it could be caused by a decrease in the size of haddock over the years. Secondly, also to a better adaptation of this species owing to improved conditions for the young, i.e. to larger year-classes. I am in favour of this second explanation because a comparison of Thompson's figures for 1939 and mine for 1954-1956 shows an increase in size for haddock of the same age. Finally, it could be noted that the mean temperature of the Grand Bank has increased during recent years which is beneficial for the haddock, which prefer warmer water than the cod.

POLLOCK

No special attention was attached to the pollock, but some material was collected on days when it appeared in abundance in the catches in Subdivision 3P (45°05′N and 55°15′W).

The measurements were made on board "ABREGO" on fish caught in a 160 mm codend (new). The length measured is, as for the cod, the fork length, to the nearest centimetre. In the last days of August 1054 pollock were measured and grouped in 5 cm groups, with multiples of 5 as the group center (as for the cod). The modal size (Fig. 17) is in the 45 cm group (fresh fish length) and the mean size is 56.55 cm. Otoliths were collected but not read.

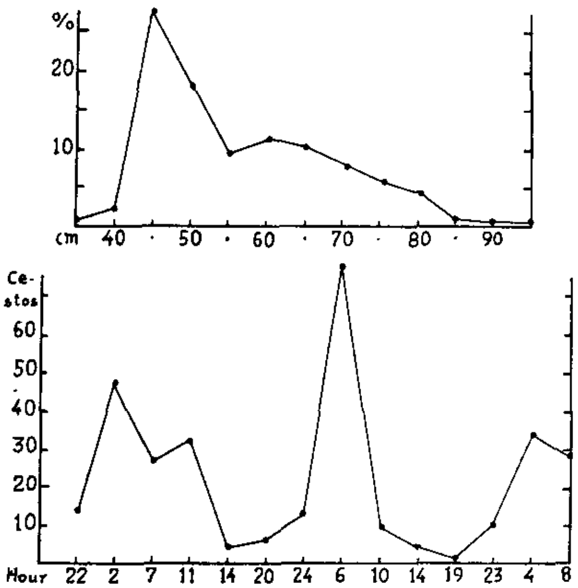

Fig. 17. **Pollock, Subdivision 3P, Aug. 1957, 1,054 spec. Above: Length distribution. Below: catch in cestos (1 cesto = 80 kg split fish) at different hours of the 24 hours.**

The yield of the fishery varies through the 24 hours, being highest early in the morning, decreasing towards noon, and being negligible in the afternoon and at night. The quantity fished (from 2½ days fishing) is expressed in "cestos" of 80 kg split fish.

The food of the pollock in this region was almost exclusively *Myctophum punctatum* Raff. and *Ceratoscopelus maderenses*, i.e. luciferous fishes.

IX. U.S.S.R. Researches In Recent Years

BY DR. MARTI

In the spring of 1954 two searching trawlers visited the waters of the Grand Bank to study conditions of catches in this area. In August 1956 the scientists of the Polar Institute found heavy concentrations of deep sea redfish *Sebastes mentella* on the southern slope of the Flemish Cap. In the course of 1957 some long-ranged trawlers continued investigating the slopes of this region.

As a result of research and scouting operations the deep sea redfish were found to keep at depths from 350 to 600 m and more and form expecially heavy concentrations in autumn and winter.

In the region of redfish concentration occur a small number of large cod (10-15% in weight). The redfish *Sebastes marinus*, halibut and catfish give a constant, but not so rich, yield. Only a few specimens of haddock, hake and cusk occur.

Up to this year the collection of biological material in the Convention Area was small. In 1956 only periodic collections of redfish samples were made. The research-scouting trawler "Odessa" with a group of research workers of the Polar Institute on board made a survey of Subareas 2 and 3 in 1957. Owing to the exertions of this vessel and the experimental-commercial trawlers as well, the fishing grounds for redfish were considerably expanded.

In October 1957 the "Odessa" found heavy concentrations of redfish *Sebastes mentella* on the northeastern slope of the Newfoundland Bank. During the period October-December a group of big refrigerating trawlers operated in this region.

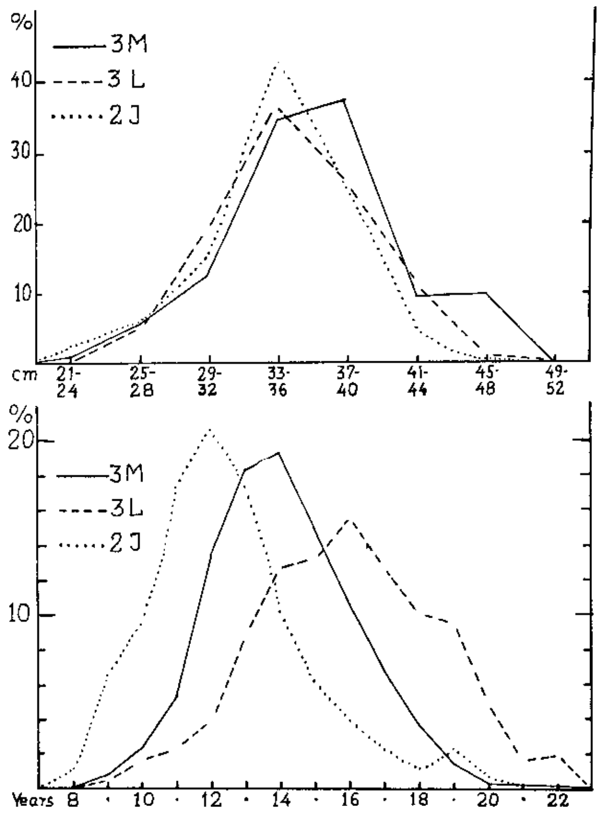

Fig. 1. **Redfish, Subdivisions 3M, 3L, and 2J, 1957. Above: Length distribution in %. Below: Age composition in %.**

The biostatistical characteristics of redfish catches in 1957 (see figure 1) will be presented in tabular form in the 1957 Sampling Yearbook. The largest specimens were observed on the southwestern slope of the Flemish Cap (3 M); the redfish from the northeastern slope of the Newfoundland Bank (3L) were very close in size to the specimens from the Flemish Cap; and the smallest fishes were taken off Labrador (2J). So far as the age composition is concerned the oldest specimens (mainly age 14-18) were obtained on the slope of the Newfoundland Bank, somewhat younger individuals (12-16 years old) in the waters of the Flemish Cap, and the youngest ones (mainly 10-14) off Labrador.

The survey along the western slope of the Flemish Cap showed that the average sizes of redfish decreased in more northern and deeper places.

In the early half of 1957 the mean size and age of redfish over the southwestern slope of the Flemish Cap were somewhat reduced as compared to 1956. The cause is likely to lie in the fact that during these years sampling was carried out in different seasons: in October 1956 and in January-June 1957.

For developing a representative picture of changes in age and size composition of the catches it is necessary to obtain data on separate little areas throughout the year.

In 1958 the extent of Soviet investigations in the Convention area is expected to increase considerably. The three searching trawlers, "Odessa", "Kreml" and "Novorossiysk", operating there will carry out the oceanographical and ichthyological research program in the regions of the Newfoundland Bank, the Flemish Cap, Labrador, and along the west coast of Greenland.

We expect that as a result of this research our future contribution to the investigations of northwestern regions of the Atlantic Ocean will increase considerably, and that more detailed information can be presented next year.

X. United Kingdom Research Report, 1957

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

Commercial Fishing.

Effort and landings in 1957 increased materially compared with 1956 figures. In all, 41 trips were made from Subarea 1 totalling 7,298 metric tons of all species (6,948 metric tons of cod).

From Subarea 3, four trips were made totalling 1,268 metric tons of all species (709 metric tons of cod).

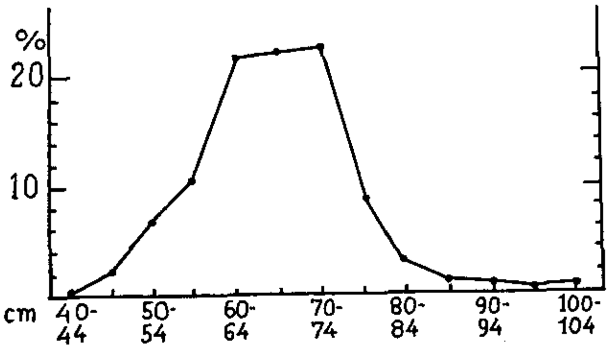

Fig. 1. Cod, Subdivision 1F, 1957. Percentage length composition by 5 cm groups of U.K. landings based on 4,830 measurements, raised to numbers landed.

Market Sampling.

Cod measured from Subarea 1 totalled 4,830 and Figure 1 gives the length distribution by 5 cm groups as percentages, of raised numbers. The data in tabular form will be given in the "1957 Sampling Yearbook."

No measurements were obtained from Subarea 3, nor were age determinations made on material from either area.

Sampling at Sea.

During October 1957 an observer on a commercial trawler studied the size range of codling and percentage of catch rejected at sea. Some 86% of those codling rejected at sea were of the 40-49 cm group, and those rejected represented 5.4% of the total catch by weight.

Comparative Fishing.

Although no comparative fishing experiments were conducted in the ICNAF area in 1957, much of the work carried out in the ICES area provided data of direct relevance to the Commission's scientific programme. Results from experiments on the selectivity of trawls and on the subject of effort measurement were presented at the joint ICNAF, ICES, FAO meeting in Lisbon in May-June 1957.

XI. United States Research, 57

BY HERBERT W. GRAHAM
CHIEF, NORTH ATLANTIC FISHERY INVESTIGATIONS

Haddock (*Melanogrammus aeglefinus* (L.))

The Fishery. U.S. haddock landings were considerably lower than in 1956. At Boston, the primary haddock port, landings were 12% below 1956 with a decline of 5% in effort. Scrod haddock were landed in slightly greater quantities than large.

Preliminary analysis of Georges Bank age composition shows the 1952 and 1954 year-classes to be dominant, the former in the western area, the latter in the eastern part. The cycle of alternation of large and small year-classes thus continues.

Tagging. A tagging program in Subdivisions 4X, 5Y and 5Z was carried out jointly by Canadian and U.S. biologists. Major taggings (500 or more fish) were conducted at eight widely separated points in spring and fall cruises. The expanded program was made possible by development of new tags. The most promising is a plastic tube ("spaghetti") type fastened dorsally. About 6,000 haddock were tagged by U.S. biologists. Returns have run as high as 6.3% at the end of the first year.

Age Determination. Special studies of otoliths and scales designed to refine the age readings are continuing. Fin rays show some promise in connection with age determination.

Effects of Mesh Regulation. Length frequency studies continue to show the selective effect of the 4½ inch regulation mesh. The average weight per fish of the 1952 year-class continues high as reported last year.

An assessment of the benefits of saving the small fish is still confined to a study of the 1952 year-class, the only large class available for this study since the regulation was brought into practice. The current year's data indicate the year-class may have been larger than originally supposed.

Canadian and U.S. biologists are making an intensive joint study of the measure of the initial strength of the 1952 year-class as compared with two large pre-regulation year-classes, 1948 and 1950.

The licensing of small mesh study boats was discontinued in June 1957. The data obtained from these vessels are being used in the above study of initial brood strengths.

Cod (*Gadus callarias* (L.))

Definition of Stocks. Over 3,000 fish have been tagged with recoveries running to over 10%. The results have not yet been completely analyzed but preliminary study indicates four main stocks in the subarea.

Effect of Large Mesh. Analyses of length frequencies show that the 4½ inch minimum mesh regulation in Subarea 5 has had no effect on landings of cod in the U.S. and that a mesh size of 5½ inches would have little or no effect. No small cod are caught by U.S. vessels.

Parasites. More than 5,000 cod were examined for the parasite *Lernaeocera*. Incidence of infection varies with locality, reaching as high as 30% in the northern part of the Gulf of Maine.

Relation to Hydrography. Correlation analysis of temperature and landings of different market categories shows some indication of a positive relationship between the recent warming trend and a decrease in abundance of large cod.

Halibut (*Hippoglossus hippoglossus* (L.))

In accordance with the recommendation of the Committee on Research and Statistics, made during the sixth annual meeting, the U.S. has been tagging halibut when possible in conjunction with tagging of other groundfish species. So far 188 fish have been tagged in Subareas 4 and 5, mostly with Petersen discs. Some returns have been received, and it is planned to analyze these and submit a complete report at a future date.

Silver Hake (*Merluccius bilinearis* (Mitchell))

The Fishery. This species continues to be an important one in the United States. Total landings for 1957 were about 25% higher than in 1956. Abundance is higher on the offshore banks than inshore. During the summer months landings by offshore medium otter trawlers exceeded 38 thousand tons as compared with 20 thousand tons in 1956.

Definition of Stocks. The hypothesis that two stocks are present in the New England area is being tested by the use of spaghetti type tags which show promise of great usefulness. One fish was recaptured 44 miles from the tagging site 6½ months after release.

Flounder.

Landings of most species of flounders were little changed over last year but yellowtail flounder (*Limanda ferruginea* (Storer)) was considerably more abundant than in the last few years due, apparently, to large year-classes in 1954 and 1955. Yellowtail effort and abundance studies are being refined.

Tagging operations are clarifying the complex movements of yellowtail populations in the area, a movement which extends for at least 200 miles.

Fish frequenting the southeast part of Georges Bank in August migrate as far south as Block Island (off Woods Hole) in the winter.

Redfish (*Sebastes marinus* (L.))

Landings of redfish for the calendar year have held fairly steady although there have been seasonal and local variations. Landings from Subarea 5 were somewhat less, due to diversion of some vessels to silver hake fishing. Abundance as shown by catch per day figures are about the same as last year.

Eastport Stock. Studies of this shallow water stock continued. During the year 5185 fish were tagged; 1388 were recaptured and released, of which three were recaptured four times. The following conclusions can be drawn from studies of this stock:

1. The fish are resistant to tagging.
2. They do not stray far from home.
3. Growth rate is slow (3.3 mm in 17 months).

Racial Studies. An extensive series of dimensions has been described for use by ICNAF biologists in preparation for the coming Redfish Symposium.

Industrial Fishery.

Landings of non-food species for meal and oil continued to expand, particularly in the Gloucester area. Species composition of the catch remained about the same, with red hake (*Urophycis chuss* (Walb.)) predominating.

Regular sampling of the catch continues. Data on lengths, numbers, pounds, and ages are collected for all principal species.

Sea Scallops (*Placopecten magellanicus* Gmelin)

Landings in 1957 increased about 20% over 1956 with abundance increasing from 1421 to 1623 pounds per day.

Current information on growth rate and mortality rates indicate desirability of advancing age of capture by increasing size of rings in dredges.

More refined measures of growth and mortality are being obtained through tagging experiments. About 6,000 sea scallops were tagged in one area. These are being recovered in large numbers by the commercial fleet.

Plankton Ecology.

The study of relations of fish eggs and larvae to environmental conditions and water drift patterns is continuing. The accumulated data for 1953, 1955, 1956 and 1957 are being summarized.

There are indications that haddock larvae remain in the upper layers longer than previously suspected.

On one cruise, in May 1956, the lethal effect of warm water on larvae of cold water species was observed. In an area where Georges Bank water had mixed with Gulf Stream water, all the larvae of a number of Georges Bank species were dead, whereas the larvae from more southern species were undamaged.

Bottom Ecology.

A better understanding of the food habits of haddock and other bottom dwelling fish is developing from recent surveys of Georges Bank. This study was broadened to include a census of bottom invertebrates and a survey of sediment types. Emerging from these is a picture of sedimentary pattern over Georges Bank with a knowledge of physical and chemical properties. The invertebrate fauna is related to this, and the demersal fish in their turn to the faunal distribution. The study is based on 540 sediment samples and 200 bottom fauna samples as well as numerous fish stomach samples in addition to those already analyzed.

OTHER SUBAREAS.

Most of the United States research was restricted to Subarea 5. The haddock tagging, however, extended into Subarea 4, and redfish abundance studies and racial studies included work on catches from Subareas 3 and 4, as in past years. All of these investigations are adequately covered in the summary of research for Subarea 5.

PART 3

B. Compilation of Research Reports by Subareas 1957.

BY ERIK M. POULSEN

Summaries of researches carried out in 1957 were reported by Canada, Denmark, France, Germany, Iceland, Norway, Portugal, Spain, U.S.S.R., United Kingdom and United States.

Some of the research reports included data in tabular form on length, age, etc. of commercially caught fish. Such tables have, as in the preceding year, been removed from the research reports and will appear in the 1957 "Sampling Yearbook," Vol. II.

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

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

An increase in the research work carried out is indicated by the extension of the Spanish investigations to cover also Subareas 1 and 2, and by the reporting on Soviet-Russian investigations in Subareas 2 and 3.

SUBAREA 1.

A. Hydrography.

Sections: Hamilton Bank Cape Farewell 26-29 July, U.S. Coast Guard.[1])
Off Cape Farewell, 8-9 Aug., Denmark.
Off Frederikshaab, 7-8 July, Denmark.
Across Fylla Bank, 15-17 July, Denmark.
Across L. Hellefiske Bank, 18-19 July, Denmark.
Across St. Hellefiske Bank, 20-21 July, Denmark.
Off Egedesminde, 21-22 July, Denmark.
Davis Strait, August, France.
Fylla Bank, August, Norway
Southern Part of L. Hellefiske Bank, August, Norway.
Northern Part of L. Hellefiske Bank, August, Norway.
Across Holsteinsborg Deep, 19 August, Norway.
Across Holsteinsborg Deep, 23 August, Norway.

According to the Danish Research report the water temperatures on and near the West Greenland Banks were a little higher than normal; the arctic component of the W. Greenland Current was weak except in the Cape Farewell Area, and the warm Atlantic component of this current was well developed, especially in the area south of Fylla Bank.

Fig. 1 shows a comparison of the upper 300 m of the Fylla Bank section in the years 1955, '56, '57. Water below 1°C was in 1955 found in a large area off the western slope of the bank, and as a tongue of the Labrador Current in the western part of the section. In 1956 water below 1° was not found in the area off the slope of the Bank, and the tongue of water below 1° reaching eastwards from the Labrador Current was smaller than in 1955. In 1957 the temperatures in the bank area were only slightly different from those in 1956, but the tongue of Labrador water of less than 1° had completely disappeared from the section.

When the temperatures in 50 m depth (Fig. 4) are compared with those in 1956 (Ann. Proc. vol. 7, p. 72) it appears that higher temperatures prevail in the bank area in 1957 than in

[1] The data from this section were distributed on 2 Dec. 1957 (ICNAF Serial No. 506).

1956, water of 3-6°C reaching farther north in 1957 than in 1956. The comparison also shows that in the central part of the bank area 62° to 65° N. Lat. warmer water of 3-4°C is found much more westwards in 1957 than in 1956. Off South Greenland 60° to 62° N. Lat. the opposite seems to be the case.

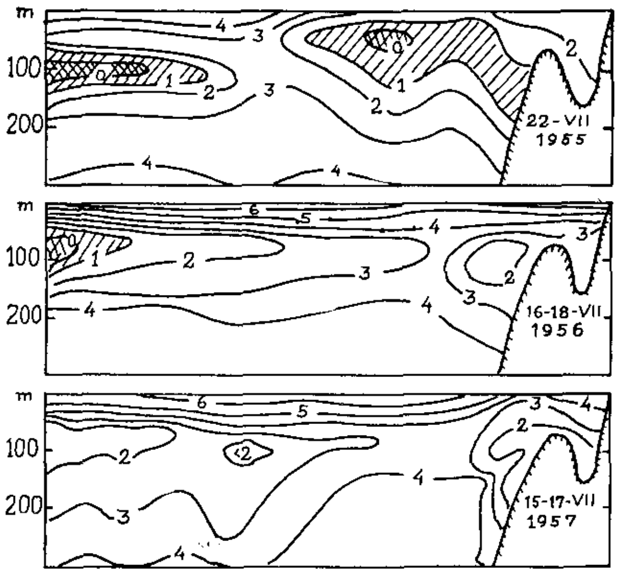

Fig. 1. Comparison of water temperatures on and off Fylla Bank in 1955, 1956 and 1957; water masses below +1°C hatched, below 0°C double hatched. (Danish sections).

B. Cod.

The Danish investigations show exceptionally large numbers of cod larvae in the central part of the Bank area, but only normal larvae catches in the southern and northern parts. In the central part large catches of larvae were made considerably farther to the west than in previous years. It can hardly be doubted that the rich occurrence of cod larvae far west in the region can be connected with the higher temperatures in this area (see above).

Age and/or length analyses of commercial sizes of cod were reported by seven of the nine countries fishing cod in Subarea 1. Of these seven countries Spain commenced its researches on cod in the subarea in this year (1957).

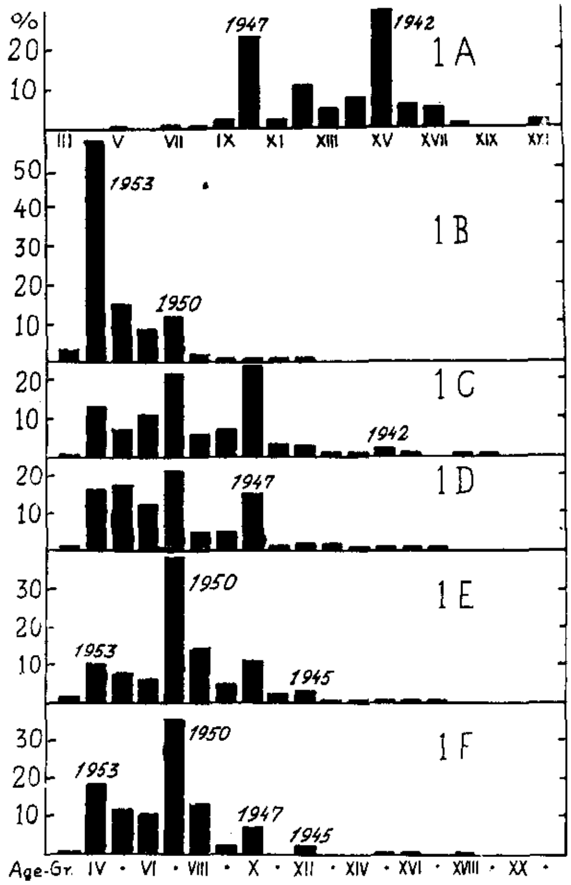

Fig. 2. Percentage age frequency of cod caught in Subdivisions 1A-F in the summer 1957. Means of Danish, German, Icelandic, Norwegian, Portuguese and Spanish data. Various gears.

In Figure 2 are shown the percentage age distributions of cod as means of the results of the Danish, German, Icelandic, Norwegian, Portuguese and Spanish researches, on the banks; for Subdivisions 1A and 1F are included Danish samples in coastal waters; both line fishing and trawling are included.

In 1A, the northernmost part, the old cod of the 1945-1947 year-classes, predominate.

In 1B, Store Hellefiske Bank, the picture is just the reverse with the 1950-1953 year-classes absolutely dominating; the 1953 year-class makes up more than half of the cod.

On the central banks (1C and 1D) the stock is composed of somewhat older cod with the 1950 and 1947 year-classes dominating followed rather closely by the 1953, '52 and '51 year-classes.

In the southern region (1E and 1F) the 1950 year-class is the richest, ca. 35-40%; next, but considerably below, come the 1950 and 1953 year-classes. The 1945 and '47 year-classes which in 1956 played a considerable role are thus strongly reduced.

SUBAREA 2.

A. Hydrography.

Sections: Off Seal Island, 6-7 August, Canada.
Hamilton Bank-Cape Farewell, 26-29 July, U. S. Coast Guard.

As in previous years a considerable mass of water below -1°C was found on the Hamilton Inlet Bank; but on the eastern slope of the Bank at 300-500 m depth the temperatures were higher than normal, 4.2° to 4.7° against 3.4° to 3.9° in 1956.

B. Redfish. Canadian researches on redfish showed the greatest abundance of redfish at 250-300 fathoms. U.S.S.R. investigations revealed that the redfish caught in 2J were smaller and younger than those caught in Subarea 3.

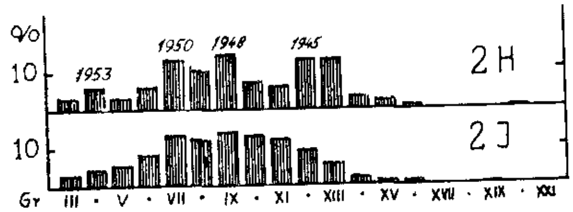

Fig. 3. **Percentage age frequency of cod caught in 1957 in Subdivision 2H (Portuguese investigations) and 2J (Portuguese and Spanish investigations). Trawl catches.**

C. Cod. Results of cod investigations were reported by Portugal and Spain based on catches by trawlers. Both countries' fishery was carried out in the southwestern part of 2J. Portugal reported a single sample from 2H. The Portuguese and Spanish researches gave exactly the same picture of the age distribution. Figure 3 gives the means for 2J (Portuguese and Spanish) and the Portuguese figures for 2H. The curve for the southern Subdivision 2J shows a rather uniform picture. Age-group IX, 1948 year-class, dominates, but is followed very closely by the 1950 and 1951 and the 1946 and 1947 year-classes.

SUBAREA 3.

A. Hydrography.

Sections: Five sections across the bank area from off Bonavista to the southern slope of the Grand Bank, July-August Canada. Data on the section St. John's Flemish Cap reported.
One section Newfoundland-Brest (France), October, France. Data not reported.

The water of the northern slope of the Grand Bank had, contrary to what is generally the case, temperatures above 4°C. Over the central and southern part of the Grand Bank temperatures were a little lower than in 1956. On the other hand in the 275 m-section paralleling the southwest slope the temperature was higher than in 1956.

B. Cod.

Researches on cod were carried out by Canada, Portugal and Spain.

The Portuguese researches were restricted to the area around Belle Isle (the northern part of 3K). The age distribution was rather uniform with the X-Group, 1947 year-class, dominating; the 1948 and 1949 as well as the 1946 and 1945 year-classes were fairly well represented. The age distribution was thus not much different from that of 2J. The size, however, was bigger, the peak being in the 62-67 cm groups, compared with 2J in the 57-62 cm groups.

Spanish research results were reported from 3K, 3L, 3N and 3P. Age determinations from 3L and 3K showed that the 1947 year-class predominated in these subdivisions. A series of measurements show considerable variations in length from subdivision to subdivision, and also within the same subdivision from month to month (see Spanish Research Report, Fig. 13). This must be borne in mind when elaborating a sampling program for this subarea.

C. Haddock.

Researches on haddock are reported by Canada and Spain.

The Canadian data from the Grand Bank show that the 1949 year-class still dominates; it is followed by the 1952 and 1953 year-classes. There was evidence of a "modestly large" 1955 year-class. The Spanish data show the same age distribution. On St. Pierre Bank only little was left of the once rich 1949 year-class, and no other year-class had entered the fishery.

D. Redfish.

Data on redfish were reported by Canada and U.S.S.R.

Canadian deep water explorations showed the greatest abundance at 200 fathoms northeast of the Grand Bank and at 170-200 fathoms south of Green Bank. U.S.S.R. found the largest concentrations on the southern slope of Flemish Cap in 350-600 m depth; especially heavy concentrations were found in autumn and winter. Heavy concentrations were also found on the northeastern slope of the Grand Bank.

SUBAREA 4.

Data on researches in this Subarea were reported only by Canada. (See p. 22).

SUBAREA 5.

Data on researches in this Subarea were reported only by U.S.A. (see p. 75).

ALL SUBAREAS.

Figure 4, based on Canadian, Danish, Norwegian, and U.S.A. hydrographic sections taken in the period 25 June to 25 August, shows the water temperature at 50 m depth through the Convention Area. It is obvious from the figure that the temperature is about the same off the central part of the Greenland west coast in 67° N. Lat. as off Newfoundland and Nova Scotia in 43° N. Lat.

A comparison with 1956 shows that warmer water, 3-6°C, penetrated farther northwards along the West Greenland coast and farther westwards in the Davis Strait in 1957 than in 1956. On the contrary in the Grand Bank area colder water (-1°C) penetrated farther eastwards in 1957 than in 1956. In Nova Scotian waters the temperatures were somewhat lower in 1957 than in 1956, but it must be borne in mind that the section was taken in the end of June in 1957, but in the end of August in 1956.

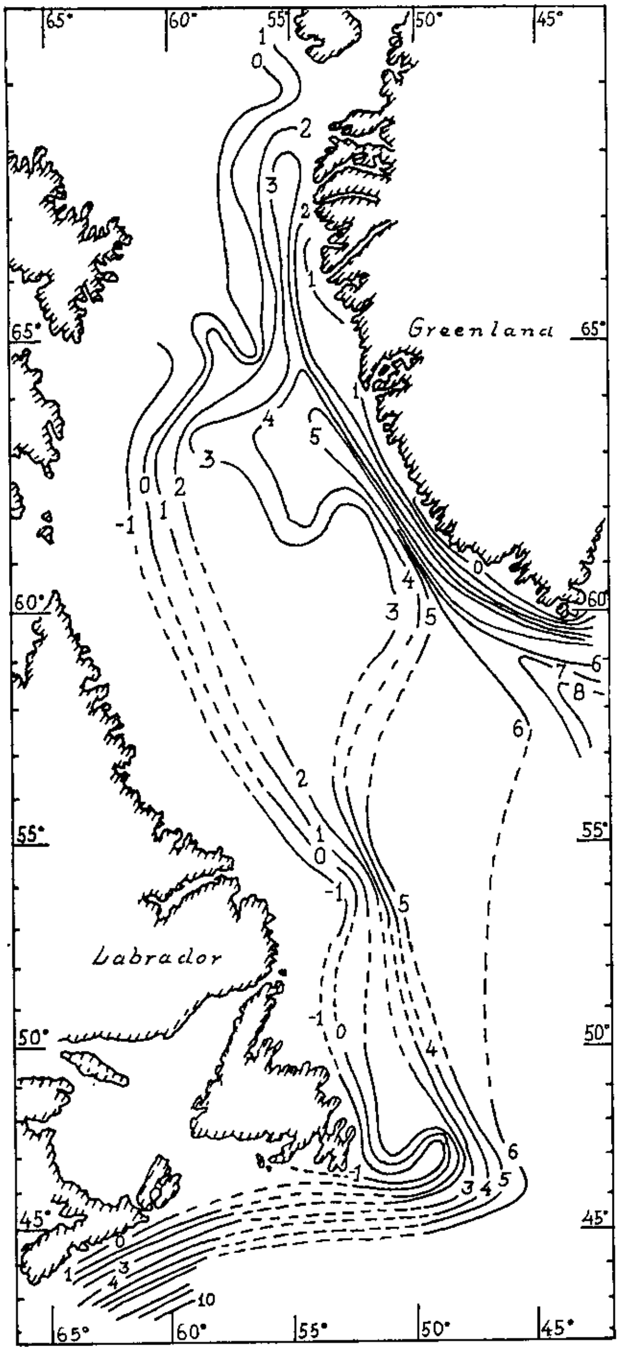

Fig. 4. Isotherms (°C) in 50 m depth in the Convention Area, end of June to end of August 1957, based on Canadian, Danish, Norwegian and United States observations.

PART 4

Selected Papers from the 1958 Annual Meeting

I. Collaboration between FAO and ICNAF, 1957-58

BY S. J. HOLT

The following notes are a summary of a report to the 1958 Annual Meeting (Doc. no. 27, Serial No. 553) on action taken by FAO Fisheries Division in response to recommendations in the report of the Seventh Annual Meeting of ICNAF and other aspects of the current work of the Division of interest to the Commission.

Two consultants had visited countries of Europe and North America and prepared a report on their survey of their fisheries statistical systems which it was proposed to present to a special meeting of experts in the autumn of 1959. Mr. J. A. Gulland's introductory paper on Sampling problems and methods in fisheries Research had now been published and a start had been made on a comprehensive manual on this subject, also one on methods in population dynamics, the draft of which will be used in the Training Center on Mackerel Research to be held in Bangkok, October-November 1958.

An account was given of the follow-up with respect to the Joint Meetings in Biarritz 1956 and Lisbon 1957, particularly concerning publication of proceedings of the latter meeting and recommendations on mathematical notation, a new International Journal of Fishery Dynamics and the use of high-speed computers.

Plans were announced for the IPFC Symposium on Fish Behaviour (Colombo, December 1958) and the world meeting on the biology of sardines (Rome, September 1959) as well as a further projected series of international meetings. The new monthly Current Bibliography for Fisheries Science was described and copies distributed. Other aspects of the FAO programme briefly reviewed were work on survey, standardization and mechanization of biological research methods, the preparation and co-ordination of synopses of knowledge of limnology and oceanography (by areas) and of fish stocks (by species subjects and areas).

II. A Note on the Simple Assessment of a Proposal for Mesh Regulation

BY S. J. HOLT

Let **R** be the number of fish recruited at age ${}_1t_c$ corresponding to the mean selection point of the existing mesh. Let **Y** be the mean annual catch in weight, and let

$$Y = {}_1Y + {}_2Y$$

where, ${}_1Y$ is the catch of fish of ages from ${}_1t_c$ to ${}_2t_c$, the latter corresponding with the selection point of the proposed larger mesh, and ${}_2Y$ is the catch of all fish above this age.

Let **E** and **I** stand for instantaneous coefficients of emigration and immigration from and to the stock respectively, and using the standard notation for other parameters, we have a general equation for the catch of fish over any age range ${}_ut$ to ${}_vt$:—

$${}_u\mathbf{Y}_v = N_u \int_{{}_ut}^{{}_vt} \left[w(t).F(t).e^{-\int(F+M+E-I)dt} \right] dt$$

$$= N_u \int_{{}_ut}^{{}_vt} [A]\, dt$$

In the situation we are considering

$${}_2Y = R e^{-\int_{{}_1t_c}^{{}_2t_c}(F+M+E-I)\,dt} \int_{{}_2t_c}^{\infty} [A]\, d\,t$$

Using primes to indicate post-regulation catches, we should have, if mesh were increased,

$${}_2Y' = R e^{-\int_{{}_1t_c}^{{}_2t_c}(M+E-I)\,dt} \int_{{}_2t_c}^{\infty} [A]\, d\,t$$

so that

$${}_2Y' = {}_2Y e^{\int_{{}_1t_c}^{{}_2t_c} F.dt}$$

The expected benefit from regulation is

$$100 \left\{ \frac{{}_2Y' - ({}_1Y + {}_2Y)}{{}_1Y + {}_2Y} \right\} = 100 \left\{ {}_2y\left[e^{\int_{{}_1t_c}^{{}_2t_c} F dt} - 1\right] - {}_1y \right\} \%$$

where ${}_1y = \frac{{}_1Y}{Y}$ and ${}_2y = \frac{{}_2Y}{Y}$

If **F** is constant from ${}_1t_c$ to ${}_2t_c$, this reduces to

$$100 \left\{ {}_2y\left[e^{F({}_2t_c - {}_1t_c)} - 1\right] - {}_1y \right\} \%$$

The meaning of this result is that: the benefit of a mesh regulation to the fishery for which it is imposed, in saving small fish for later capture, depends on the proportions of fish below and above the new selection size in the pre-regulation catches and on the original fishing mortality over the range of fish ages between the original and new selection sizes. This is true if the change in the mesh size does not result in changes in the natural mortality rates, the pattern of migration in or out of the fished area, or in the relative intensity of the fishing on smaller and larger fish above the new selection size. Its validity does not otherwise depend on constancy of mortality rates with respect to time or age of fish, or on whether fish move in or out of the area fished by the regulated fleets.

III. Summary of Gear Selection Information for the Commission Area

BY JOHN R. CLARK, FRANK D. McCRACKEN, AND WILFRED TEMPLEMAN

INTRODUCTION

At the Joint Scientific Meeting of ICNAF, ICES (International Council for the Exploration of the Sea), and FAO (Food and Agriculture Organization of the United Nations) at Lisbon in 1957 working groups considered many aspects of our knowledge of gear selection. They reviewed the current status of knowledge and suggested further important research for each of these aspects. At the final session of this Joint Meeting it was concluded that many gear selection problems should be related to specific geographical areas and recommended that the status of gear selection knowledge in the ICNAF area should be examined in order to establish priorities for necessary gear research.

Two of the authors, Clark and McCracken, were asked to carry out this review and to report their results to the Research and Statistics Committee of ICNAF at the Eighth Annual Meeting. Templeman was subsequently asked for his assistance in preparing the redfish review.

We have taken as our basic terms of reference the species caught in the ICNAF area and the gears used to catch them. A limited amount of published data is available, but our sources of information are chiefly the papers presented at the Lisbon meeting (to be published by FAO). We have used primarily the results of gear selection experiments from the ICNAF area, but Northeastern Atlantic results were included where necessary.

We have considered only "inherent" (or intrinsic) selection by gear; that is, selective properties which can be modified by changing certain properties of the gear. We have not considered non-inherent (or extrinsic) selection, which results from such factors as non-representative distribution of fishing effort over the whole range of sizes of a stock of fish.

We are indebted to our colleagues on the Research and Statistics Committee of ICNAF for their helpful comments and suggestions on preparation of the manuscript. We are particularly grateful for the thoughtful and detailed criticisms rendered by Mr. Basil B. Parrish and Dr. Erik M. Poulsen.

SUMMARY OF SELECTION KNOWLEDGE

In order to present the summary of knowledge in the most concise manner possible we have reduced the text to a minimum of essential material. General background material concerning selection processes is included in Appendix I. Detailed derivations of the selection estimates are presented in Appendices II-VI.

Otter Trawls.

An extensive series of experiments with otter trawls has been carried out in the ICNAF area. The majority of the work has been concentrated on haddock, with lesser amounts of work on cod; redfish; American plaice, *Hippoglossoides platessoides* (Fab.); witch, *Glyptocephalus cynoglossus* (L.); and silver hake *Merluccius bilinearis* (Mitch.). Most of these results and results from a considerable amount of European work are available in the Lisbon papers and in other publications.

Escapement through forward parts of the trawl.

Replicate tow experiments with haddock in Subarea 5 have indicated in general that escapement through the lower wings and belly was substantial; but that escapement through top wings, square, and upper belly was relatively unimportant. The total numbers escaping from all forward parts of a trawl are lower, however, than for a codend of the same mesh size; the estimated 50% retention point for the No. 41 trawl, of $4\frac{3}{4}$ inch mesh (internal size), excluding the codend, occurred 5 to 12 cm lower than for a codend of equivalent mesh size. In addition escapement through the forward parts of the net may be of even lower practical importance, as many of the fish which may be prevented from escaping through forward parts of the trawl will escape through the codend.

Replicate tow experiments with an 84 mm mesh trawl have shown that the forward parts are important for the escapement of silver hake (Clark, 1957c). Most of the fish of less than 16 cm. escaped; about half of the fish of 16-33 cm escaped, with little selective action shown; and most of the fish above 33 cm were retained. No definite 50% escapement length can be chosen because of the extended range over which approximately half of the fish escaped. However, it can be concluded that the forward parts permit substantial escapement of sizes of fish which would have been at least partially retained if they had entered into a codend of the same mesh size. Controlling mesh size in the forward parts of the trawl thus appears more important for silver hake than for haddock.

The data are, however, insufficient to make quantitative estimates of haddock or silver hake escapement for different trawls and mesh sizes. No data are available with which to determine the importance of escapement from the forward parts of trawls for redfish, cod or plaice in the ICNAF area.

Escapement through the codend. In a trawl of uniform mesh size most fish of sizes within the selection range of the codend will escape from the codend rather than through forward parts of the trawl. The precise area of

TABLE 1. Estimated 50% codend retention lengths for haddock taken by otter trawl. Selection span adjustment = 4 cm.

Mesh Size		50% Retention Length (cm)		
mm	in.	Double Manila Av. Selection Factor = 3.2	Single Cotton Av. Selection Factor = 3.6	Synthetics Av. Selection Factor = 3.5
102	4	32	35	35
108	4¼	34	38	37
114	4½	36	41	40
121	4¾	39	44	42
127	5	41	46	44
133	5¼	43	48	46
140	5½	46	52	48

TABLE 2. Estimated 50% codend retention lengths for redfish taken by double manila otter trawl codends. Selection span adjustment = 2 cm.

Mesh Size		50% Retention Length
mm	in.	Av. Selection Factor = 2.5
70	2¾	16
76	3	18
83	3¼	20
89	3½	22
95	3¾	23
102	4	25
108	4¼	27
114	4½	29

escapement will depend upon the amount of catch accumulating in the codend and the resulting blocking of the meshes. However, for moderate catches the greater escapement occurs in the after 6 or 8 feet. Most codend mesh sizes reported for selection experiments, however, represent averages for the whole codend, rather than the effective escape area only, and these are the figures which we have used.

The estimates of 50% retention lengths for various species in Tables 1 to 5 are based primarily upon experiments in the ICNAF area. The European data have been drawn upon where necessary, such as in the case of the variable haddock results for synthetics.

TABLE 3. Estimated 50% codend retention lengths for cod taken by otter trawl. Selection span adjustment = 5 cm.

Mesh Size		50% Retention Length (cm)		
mm	in.	Manila Av. Selection Factor = 3.5	Single Cotton Av. Selection Factor = 3.7*	Synthetics Av. Selection Factor = 3.8
102	4	36	38	39
114	4½	40	42	43
127	5	44	47	48
140	5½	49	52	53
162	6	53	—	61

*less reliable data

TABLE 4. Estimated 50% codend retention lengths for silver hake taken by otter trawl. Selection span adjustment = 4 cm.

Mesh Size		50% Retention Length (cm)		
		Manila	Cotton	Nylon
mm	in.	Single or Double	72-84th	400/3 Single
76	3	21	23	25
83	$3\frac{1}{4}$	24	26	28
89	$3\frac{1}{2}$	26	29	31
95	$3\frac{3}{4}$	29	32	34
102	4	32	35	38
108	$4\frac{1}{4}$	36	39	41
114	$4\frac{1}{2}$	39	—	—

TABLE 5. Estimated 50% codend retention lengths for American plaice and witch taken by otter trawl. Selection span adjustment = 3 cm.

Mesh Size		50% Retention Length (cm)	
mm	in.	Manila Av. Selection Factor = 2.0	Synthetics Av. Selection Factor = 2.2
102	4	20	22
114	$4\frac{1}{2}$	23	25
127	5	25	28
140	$5\frac{1}{2}$	28	31

Estimates are presented for simplicity in the form of 50% retention lengths only. The range over which the selection operates is extremely variable. The reasons for such variations are not well known at present and cannot be discussed in a work of such restricted scope. Average figures have been determined and are provided along with the estimates of 50% retention lengths as selection span adjustments, which may be added to the 50% retention length to obtain the 75% point and subtracted to obtain the 25% point. The total range of codend selection can be taken as roughly twice the 25 to 75% span.

The derivation of our estimates is detailed in the appendices, where appropriate.

The relation between mesh size and the 50% retention length is linear for all species except silver hake for each type of material. The 50% retention lengths for haddock and redfish have been read from the regression lines shown in Appendices II and III. Because the lines have appreciable intercept values, the selection factor (the ratio of fish length at 50% retention/mesh size) is not constant but varies with mesh size, but for convenience average selection factors have been estimated for the range of mesh sizes considered and are included with the tables.

Selection experiments for cod only extend over a fairly narrow range of mesh sizes, and in many cases cod have been taken as an incidental species. These data are insufficient to determine whether the selection factor is constant. The 50% retention length estimates in Table 3 are based on lines fitted to the 50% retention length and mesh size data shown in Appendix IV.

The 50% retention length/mesh size relation for silver hake is described better by a curve than a straight line (App. V). The escapement lengths have been estimated from the curve, and as average selection factors are not appropriate for this species, none have been provided.

Results for American plaice and witch suggest that selection factors for these species are similar to those for some of the flatfishes of European waters. The 50% retention lengths for these species, given in Table 5, have been determined in the same manner as for cod.

The Problem of Chafing Gear.

The codend results presented for all species are based upon single-layered codends which are uncovered on their supper surfaces. Various protective devices (chafing gear), such as secondary codends fitted over the primary codend or various covering materials, are commonly used in the ICNAF area. We have a little experimental evidence on the effect of such chafing gear on escapement. Such data as are available show that these protective devices may cause a substantial reduction in fish escapement with certain methods of application.

The considered opinion of ICNAF biologists is that a covering piece of netting should not markedly reduce escapement if affixed loosely and left open at its rearward edge. Whether this opinion is justified and whether chafing gears rigged in other ways could be used without reduction of escapement must await the results of further experiments.

Hook Selection.

Only a limited amount of information is available from which to judge the selective effect of various sizes and shapes of hooks. Little is known about the possible selective effect of various kinds and sizes of bait.

It has been established that hooks fished on longlines select sizes of fish from the stock generally in relation to the size of the hook, with large hooks catching fewer small cod than small hooks. Preliminary attempts to relate hook dimensions to sizes of cod caught appear promising, but as yet there is no well-defined relationship such as the selection factor for otter trawls. From the results available we are able to estimate selectivity values for some hooks currently in use.

Data for handlines are insufficient for reliable estimates but generally indicate that handline selective action may not be so directly related to hook size as that of longlines. The catch of the smaller sizes of cod and haddock, i.e., those within the selection range of $4\frac{1}{2}$ inch mesh codend, is low in the ICNAF area for both methods of hook fishing.

Cod. Some results for hooks fished on longlines are available for the ICNAF area (McCracken 1957a) and off Norway (Saetersdal 1957c). The estimates of selection provided by these experiments are given in Table 6.

TABLE 6. Cod selection estimates for hooks fished on longline.

Hook Type	50% Escapement Length	25-75% Selection Span
No. 17 Mustad	ca. 35-40 cm	?
No. 14 Mustad	48	12-14 cm
No. 7 (Norwegian)	55	14 cm
No. 11 Mustad	65	15-18 cm

For handlines we can only say (1) that results of Saetersdal's experiments suggest similar selectivity for handlines and longlines, and (2) that size composition of cod catches off the Newfoundland east coast suggests that large handline hooks catch the same size cod as smaller longline hooks.

Haddock. Limited results obtained by McCracken (1957a) for longlines provide the only information available for haddock. These results indicate that hooks select sizes of haddock in a manner similar to otter trawls. McCracken's data are too limited to predict a 50% retention length and indicate only that the smallest hook used by Canadian longliners (No. 17) appears to release as many haddock as a $4\frac{1}{2}$ inch mesh codend. Nothing is known about handline selection.

Pair Trawls.

There are no data on selection by pair trawls. They are so different in design and operation from otter trawls that we have not considered inference of their selection properties from those of otter trawls to be valid. Pair trawls used in the ICNAF area are made of natural fibres (manila or sisal). The twine used in these nets is usually light and flexible, the codends are unprotected on top, and their mesh size is larger than that of the otter trawls. Moreover, it is believed that pair trawls fish higher in the water than the conventional otter trawl. Comparable observations on length composition of catches by pair trawls and otter trawls are not available.

Gill Nets.

No data are available on the selection of groundfish by gill nets in the ICNAF area.

Traps.

No experimental evidence is available with which to make estimates of the selection by traps. Some general knowledge of the use of traps and their catches is presented in Table 7.

Danish Seines.

European experiments have shown that seine net escapement is usually higher than otter trawl escapement for equivalent mesh sizes. Since Danish seining is of little importance in the ICNAF area and species caught differ from those caught in European waters, no estimates have been attempted from the European information.

FURTHER RESEARCH REQUIREMENTS

Any evaluation of the adequacy of our current knowledge of gear selection must be related to the importance of species and gears. To this end we have presented in Table 8 a summary of landings from the ICNAF area for 1955. The most important species is cod; followed by haddock; redfish; and flounders, of which the American plaice is the leading species. The relative importance of species varies somewhat from subarea to subarea.

TABLE 7. Information regarding catches and selectivity of traps.

Species	Where Traps Used	Sizes Caught	Selection
Cod	Extensively for inshore fisheries of Subareas 2 and 3 and Subdivisions 4R and 4S. Also used in Subarea 1.	For example, off Nfld. east coast 1950-53, 14% by number under 45 cm; 54% by number under 55 cm.	About 15-20% by number within selection range of 4½″ mesh; more than 50% within selection range of 5½″ mesh. However, since traps take the smallest fish in the area, there is no quantitative evidence re possible escapement.
Haddock	Small catches in Subarea 4.	Vary: in 1928 less than 2% under 45 cm, 30% under 55 cm in 1955—none of scrod size (under 50 cm)	Catches mainly large haddock. General knowledge of the area suggests only large fish present; thus scarcity of small fish in the catch not a result of escapement.

TABLE 8. Statistics of landings from the ICNAF area, 1955, in thousands of metric tons.

Species	SUBAREA 1	2	3	4	5	Total
Cod	265	26	429	159	12	892
Haddock	—	—	105	43	51	198
Redfish	32	—	18	60	14	123
American Plaice	—	—	15	12	2	} 60
Witch	—	—	3	7	1	
Other Flounders	1	—	1	2	16	
Halibut	1.4	—	1	1.8	—	4
Pollock	—	—	7	19	10	36
Silver Hake	—	—	—	—	46	46
Other	4	—	2	17	107[a]	130

[a] Includes menhaden, herring, alewives, etc.

TABLE 9. Landings of major species by different gears from the ICNAF area, 1955, in thousands of metric tons.

Gear	Cod	Haddock	Redfish	Flounders
Otter trawls				
over 500 tons	345	56	32	—
151-500 tons	28	77	91[a]	56[a]
under 151 tons	30	48		
Pair Trawls	33	4	—	—
Traps	ca. 100+	Some	—	—
Hooks (Longline and Handline)	ca. 300+	ca. 12	—	0.3
Seine Nets	Negligible	Very few	Very few	1.3
Gill Nets	Negligible	Few	—	—

[a] Categories "151-500 tons" and "under 151 tons" combined.

Summaries of the catches by various gears are given in Tables 9 and 10. Otter trawls are of the greatest overall importance for cod, particularly those of trawlers over 500 tons. However, hooks and traps are also of considerable importance, especially in the inshore fishery. For the remaining species, otter trawls, primarily those of trawlers under 500 tons, are most important.

TABLE 10. Landings of minor species by different gears, from the ICNAF area 1955, in thousands of metric tons.

Gear	Halibut	Pollock	Silver Hake
Otter Trawls	0.8	Some pollock caught by most gears in Subareas 3, 4, and 5.	46
Hooks	1.7		—
Miscellaneous	1.7[a]		—

[a] Mainly hooks

We are lacking information on the catches of many important species by certain gears. The best summary of research needs in gear selection is given in the "Outline of Present Research and Long-Range Needs in the Convention Area" prepared by the Research and Statistics Committee in 1956. Although some progress towards filling the indicated gaps in our knowledge has been made since preparation of this document, it still summarizes current essential needs in gear selection research. The following excerpt contains the two sections relating directly to gear selection:

"(1) Determination of the size selectivity of different kinds and sizes of fishing gear.

Present Status: Selectivity of the catching gear is unknown for about 80% of the cod taken in the area. More adequate knowledge is available for about 75% of the present haddock catch.

a. Otter trawl selectivity—Much research has been carried out with single, large mesh codends by several countries. Selection experiments with multiple codends have not been attempted.

b. Pair trawl selectivity—Inactive.

c. Hook selectivity—Canada has compared the selectivity of various sizes of hooks. Norway has compared the sizes of fish caught by hooks with the sizes of fish caught by other gears.

d. Trap selectivity—Inactive.

Additional Resources Required:

a. Mesh experiments with traps should be carried out by countries using these gears to determine what effect mesh size has on the size of the fish caught.

b. Selective properties of otter trawls with multiple cod ends should be obtained by the countries using these gears. Covered net experiments and comparative fishing experiments are recommended.

c. Present knowledge about hook selection should be assembled and considered in relation to mesh selection. This would provide a basis for planning further hook selection experiments.

d. Length composition samples of cod and haddock taken by different gears should be compared to help assess the general problem of selectivity. For each sample a complete description of the catching gear must be included.

(2) Determine which parts of the trawl and which sections of the codend contribute most significantly to the release of fish. Determine what factors cause variation in mesh selectivity, such as effect of catch size, towing time, towing speed, differences between material, etc.

Present Status: In the ICNAF area a number of mesh selection experiments have been carried out by Canada and the U.S. Experiments are continuing on the differences in selection for different materials. Many of the experiments carried on by other countries outside the ICNAF are are applicable.

Additional Resources Required:

Most of the mesh selection experiments carried out in the ICNAF area have been only summarily analyzed. All extant mesh selection data should be analyzed with emphasis given to determining the causes for variation in selection results and amount of escapement in forward parts of the trawl. Results of the analysis should be presented as a basis for determining what further mesh selection experiments are needed. Because future planning is so dependent on the consideration of these past experiments, this should be carried out as soon as possible. Publication of the results by ICNAF should be considered."

Good progress has already been made in carrying out the goals of (2) above. This was accomplished through the workshop gathering of American and European gear selection workers at the Joint Meeting of ICNAF, ICES, and FAO in Lisbon during May and June of 1957. The collection of experimental results presented at the meeting is scheduled for publication in 1959.

APPENDIX I: GENERAL BACKGROUND MATERIAL

How Gear Selectivity is Measured.

The selectivity of gear is determined usually by either capturing the fish which have escaped the gear (covered codend experiments) and comparing their sizes with those retained by the gear, or comparing the catches of different gears fished at the same time and place. These comparisons usually reveal at first a slow increase in the retention of fish from the smallest size at which some are first retained, followed by a rapid increase in retention, and finally reaching a stage of only gradually increasing retention to the point where full retention is achieved. When such data are plotted they take the form of an extended "S-shaped" or sigmoid curve, the "selection curve" for the gear. A typical selection curve is shown in Figure 1.

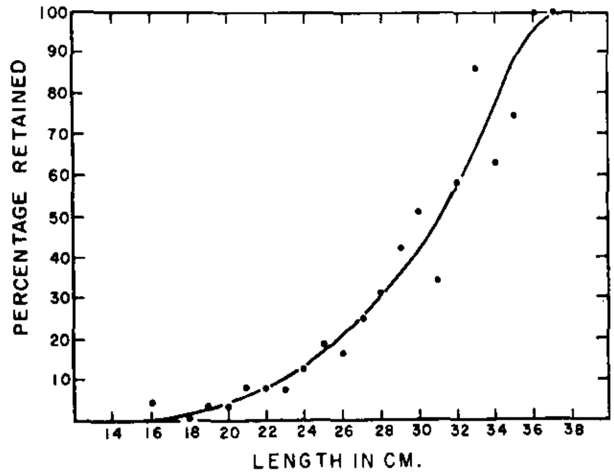

Fig. 1. **Percentage of redfish of each length retained by a manila codend of 132 mm mesh size. (From data of Clark 1957e).**

Variations from the S-shaped pattern are found for certain gears such as gill nets, in which the retention increases to its highest value at a certain fish size and then decreases again past that size, thus describing a bell-shaped or normal curve.

How the Selectivity Process is Defined.

Selection of the type that takes place in otter trawls is defined by various properties of the sigmoid selection curve. These properties are usually the lengths of fish retained at various points along the curve, such as the 25, 50, and 75% retention points. Selectivities of different gears and sizes of gears are most often described simply by giving their 50% retention lengths (the length at which 50% of the fish are retained by the gear and 50% escape). The selection span (distance between 25 and 75% retention lengths) is often included to give a measure of the steepness of the curve. The "regression coefficients" are often used to describe the relation between 50% retention length point for various gears and average internal size of mesh (see Appendix III for illustration). If the form of this relation has an intercept of 0, the "b" value of the regression formula is sufficient to define the relation. This value, termed the "selection factor," is thus the quotient of 50% retention length/mesh size, a higher factor indicating greater escapement (Permanent Commission, 1956). Selection factors for otter trawls, for example, will vary from 2.0 to 5.0, depending principally upon the species and material from which the netting is made.

The Range of Fish Sizes over which a Selection Process Extends.

The selection process is not precise, but as shown in Figure 1 operates over a more or less extended range of fish sizes. For otter trawlers it has been found experimentally that meshes over 150 mm select sizes of haddock over a range of 35 cm or more. This range, called the selection range, which extends from zero to one hundred percent retention has been related to the size of the mesh. The range is very much smaller for smaller sizes of mesh; for instance, reduced to about 8 cm for a mesh of 75 mm for haddock.

Difficulties Arising from the Extended Selection Range.

Although the gear operates selectively over a large range of sizes, the greatest selection occurs within a much narrower range of sizes. Most investigators consider the important part of the selection range as that occurring within the "selection span". The haddock selection span, for instance, may be as small as 4 cm in 75 mm meshes and as great as 14 cm in meshes of 150 mm or over. This means that to obtain substantial escapement of a certain size of fish one must accept the escapement of a substantial quantity of fish over those sizes. For example, if one is to obtain 75% encapement of 34 cm haddock from a trawl net, one must allow about 60% escapement of the fish at 36 cm, 40% at 38 cm, 25% at 41 cm, and smaller percentages of the larger sizes. This factor must be taken into consideration in recommending mesh sizes for fisheries to be sure that proper allowances are made.

Effect of Experimental Error.

The variations in gear selection results arise from experimental and from substantive causes. As an example of the kind of experimental error encountered, the use of a small mesh cover over the codend may easily result in a dampening of the escapement if the cover is not properly fitted. Results from replicate tows with large and small mesh nets tend to give higher escapement values than those from covered codends, as observed by Saetersdal (1957a) and Clark (1957g). This presumably comes about through differences in the catching rate of the two gears for different sizes of fish which are not due to the actual selectivity of the meshes. The greatest problem in comparing results of various experiments is that of isolating the causes of variation and attempting to find reasons therefore.

Selective Properties of the Trawl for Different Species.

Marked differences in escapement values have been shown for various species, although the reasons for this are not well understood. The relation between fish shape and mesh shape is undoubtedly important. Flatfish, for example, do not escape nearly so well in respect to their length as roundfish. This could be expected because they are so much broader. Redfish, which have a relatively low girth factor (length/girth ratio) compared to other roundfish are also characterized by low escapement in respect to length. Also there may be important differences among various species of the same family. Cod, for example, escape in somewhat greater numbers at any size than haddock. Silver hake which should, because of their high girth factor, escape in greater numbers than haddock, actually do not. This means that selection has to be determined separately for each species.

Escapement of Fish from Forward Parts of the Net.

It has been accepted that most of the escapement from otter trawls takes place in the codend. However, recent data indicate that although this is true in general, appreciable numbers of some species escape through the forward parts of the net. This escapement is usually restricted to smaller sizes of fish than escapement through the codend.

Data from experiments in the ICNAF area have shown, for instance, that nearly 100% of the very smallest sizes of haddock and silver hake escape through the forward parts of the net (Clark 1957c). A considerable, but gradually reducing, amount of escapement takes place toward the larger sizes in normal sigmoid fashion. In relation to the area of netting available, however, escapement through the forward parts is quite low as these parts contain 50 to 100 times as many meshes as the codend. Furthermore, for haddock the 50% point occurs at a lower fish size for the forward netting than for the codend, with the same mesh size in each.

It has been demonstrated that fish do not escape equally throughout various parts of the codend, but rather escape through the first few rows of clear meshes ahead of the accumulated catch (Beverton, 1957b; and Clark 1957b).

Differences in Escapement Associated with Differences in Net Material.

The most important substantive (non-experimental) sources of variation in selection work are those associated with the type of material of the nets. At equivalent mesh sizes, meshes of lighter, more flexible twines usually give higher escapement than those of heavier and stiffer twines. For example, the 50% retention length for haddock is about 5 cm higher for a single cotton than for a double manila codend at a mesh size of $4\frac{1}{2}$ inches (Table 3). Similarly, for silver hake it has been shown to be about 6 cm higher for light single nylon than for single manila at a mesh size of 4 inches (Table 5).

Effect Upon Escapement of the Speed with which the Net is Towed.

Little direct evidence is available on this subject because few controlled experiments on the effect of different towing speeds on escapement have been conducted in the ICNAF area. However, some of the differences in escapement between large boats and small boats (which tow more slowly) are probably due to differences in towing speed. Experimental trawling for selection purposes is usually carried out at a towing speed approximating commercial practice so that results will be directly applicable. However, "commercial practice" varies from fishery to fishery and area to area, making it difficult at times to compare and utilize the results of various experiments.

Effect Upon Escapement of the Length of Time During which the Net is Towed.

That longer tows appear to afford greater escapement has been documented for the ICNAF area in controlled haddock escapement experiments in which the 50% retention length increased by more than 5 cm in one series of tows when towing time was increased from 20 to 80 minutes (Clark 1957a).

European work has not altogether confirmed this, although there is some suggestion in Gulland's (1956) results that 3 hour tows may give higher escapement than $1\frac{1}{2}$ hour tows. No difference is apparent in the results of Parrish and Pope (1957).

Such differences as may be found will not be so large as to interfere greatly with comparison of experimental results or with their application, since tows usually approximate commercial practice, which is most often 60 to 120 minutes in the ICNAF area. The difference in 50% retention lengths between these extremes should be only a centimeter or two.

Size of Catch in Relation to Escapement from Codends.

Many investigators have shown that larger catches are generally associated with lower escapement. Work in the ICNAF area has shown that the codend 50% point for haddock, for example, may decrease 5 cm from light to heavy catches. The expected catch level in a fishery should thus be considered in planning mesh control programs.

Escapement from the Trawl Net Under Tow.

It has been amply demonstrated that meshes of the net remain open during towing and that fish escape during this time, not just while the net is being hauled. Davis (1934), for instance, demonstrated with a special choking device on the codend cover that 90% of the fish escaped while the net was under tow. Davis's findings have subsequently been confirmed by observations of SCUBA divers in shallow water and underwater television in deeper water.

Whether the fish escape undamaged or suffer injuries, perhaps, mortal, in escapement has not been adequately answered. Examination of limited results from tagging of escapees taken in codends and covers has not indicated any greater mortality for those which passed through the codend meshes into the cover. The SCUBA and underwater television observations have shown fish to swim away very vigorously, and apparently unhurt, after escaping from codends under tow. It is, of course, possible that the escape effort could result in damage having some later consequence.

Experimental Results Compared with the Results of Large Mesh in Practice.

Davis (1934) compared catches with large and small mesh on two commercial trawlers and demonstrated that selection experiments were borne out in practice. Clark's study of the regulated Georges Bank fishery has shown selectivity of the $4\frac{1}{2}$ mesh for haddock to be almost exactly that predicted by the experimental evidence.

Increased Efficiency of Large Mesh Otter Trawls.

It is a common result in comparison of catches of large and small mesh gears to find that larger meshes catch more fish of the larger sizes. This was first shown by Davis (1934) who showed that the large mesh caught 11% more fish of sizes beyond the selection range. Perhaps the best demonstration is that for the Georges Bank haddock fishery, in which the regulated ($4\frac{1}{2}$ inch mesh) trawlers caught 9% more fish of larger sizes than the small mesh ($2\frac{7}{8}$ inch) study group vessels (Clark and Nichy 1957). These increases are noticeable particularly for sizes of fish just beyond the selection range of the net.

The Value of Special Trawl Gears Devised for Improving Escapement.

Various types of special trawls or modifications of trawls have been devised with the hope of improving the precision of the selective action of the net. These trawls, incorporating rigid meshes of wire, special "escapement panels", or meshes hung in a special fashion to insure their being open, have not shown sufficient superiority over the standard type of netting to be considered for introduction into the fisheries.

APPENDIX II: HADDOCK SELECTION

So much data are available from codend selection trials with haddock that time did not permit an exhaustive analysis of the causes of variation. The lines of best fit plotted in Figures 2 to 5 were calculated by the least squares method from 50% escapement lengths for various mesh sizes. In Figure 3, the data of "early U. S. trials" were those of Herrington (1935). "Early European trials" were those reported by Bowman (1928), Davis (1934), Russell and Edser (1926), and Todd (1911). The data of Parrish are partly from the Lisbon papers (with Pope 1957) and partly from personal communication. "Other recent European trials" consist of data from the Lisbon papers of Beverton (1957a), Margetts (1957), Saetersdal (1957b), and v. Brandt (1957). The data shown in Figures 2, 4, and 5 are from the Lisbon papers of Clark (1957d), Margetts, McCracken (1957c), and Templeman (1957a). The category "European" in Figure 5 includes the data of Margetts and v. Brandt.

The line for manila (Figure 2) was fitted to the results of 30 separate trials. Only those results for 45/4 and 50/4 twine were used in the least square calculation as these are the common sizes in use in the ICNAF area. Inclusion of results for 75 and 125 yard twines would affect the line very slightly, however. The European and early U.S. experiments are included in Figure 3 for comparison. The European experiments vary considerably but in general confirm the ICNAF line. The early U.S. experiments, based on alternate tows and "trouser" codend methods, are now not considered to be applicable because of the difficulty of translating Herrington's mesh measurements into those presently used and because of the inherent bias in the experimental methods used.

The line for manila, when extrapolated, does not pass through the zero point. For this reason the selection factor is not constant, but an average factor of 3.2 is roughly applicable to the middle range of values and will suffice for most purposes. Nor does the line of best fit for single cotton (Figure 4) pass near the intercept. The one European point (not included) would have the effect of drawing the intercept somewhat nearer to zero.

The data for synthetics are much more variable (Figure 5). All the synthetics are considered together since so few data are available for the individual types. Final consideration of

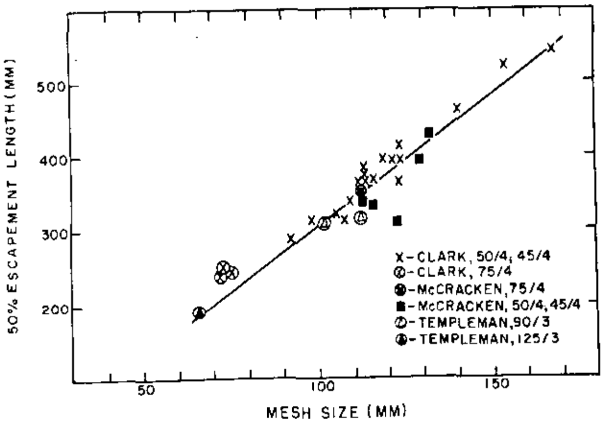

Fig. 2. Haddock 50% retention lengths for double manila for the ICNAF area. Line fitted to 45/4 and 50/4 data only.

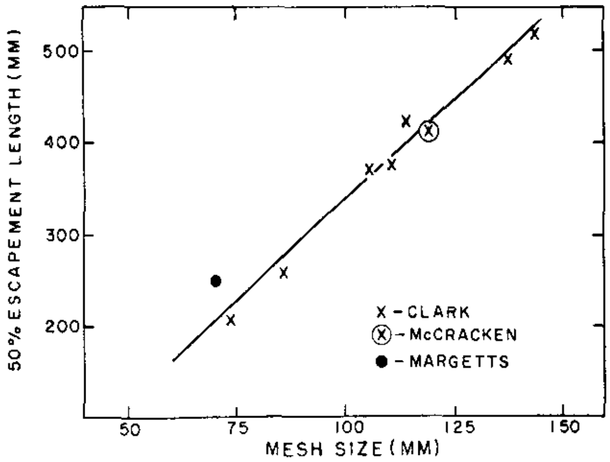

Fig. 4. Haddock 50% retention lengths for single cotton.

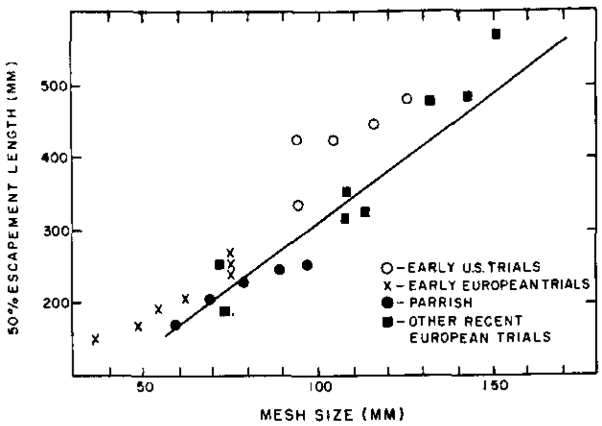

Fig. 3. Haddock 50% retention lengths for double manila for the European area, with the ICNAF line (from Fig. 4) drawn in for comparison.

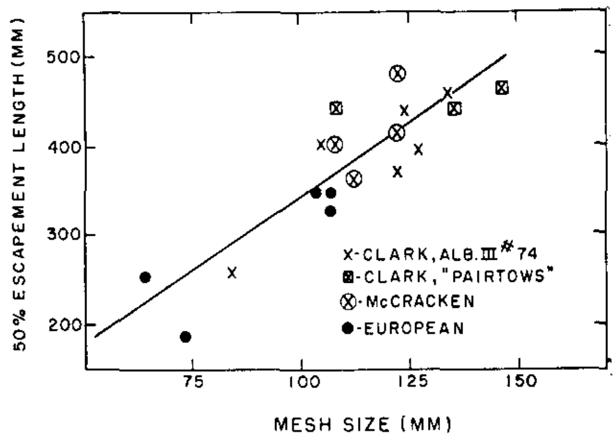

Fig. 5. Haddock 50% retention lengths for all synthetics.

differences in various kinds of twine must await more detailed analysis. One factor of considerable importance is that synthetic codends often have much larger meshes at their after ends, past the splitting strap, due to the stretching effect of the weight of fish being hauled aboard. This will produce an effect of higher 50% retention lengths for given average mesh size of the whole codend, since most fish escape from the area behind the splitting strap. If the 50% length is plotted against the mesh size in the after quarter only, for the U. S. experiments a somewhat better fit is obtained. For the purpose of making our estimates we have fitted the line in Figure 5 to all data on the basis of the average mesh size for the whole codend.

APPENDIX III: REDFISH SELECTION

The data used for the following analysis have been taken mainly from the Lisbon papers of Clark (1957e), McCracken (1957b), Saetersdal (1957b), and Templeman (1957b). All the data except those of Saetersdal are for the American form of redfish tentatively referred to as *Sebastes marinus mentella*. Saetersdal's selection data are for *Sebastes marinus marinus*. Saetersdal's mesh sizes were measured under 8 lb. pressure, while the remainder of the mesh size data are for 12 lb. pressure. In all cases the codend meshes were of double manila twine. All the redfish measurements were from the chin, with the mouth closed, to the end of the median ray of the caudal fin.

All the alternate tow data have been adjusted by assuming that large redfish, those beyond the size of 100% retention by the codend meshes, were present in good numbers in both large and small meshed nets and by adjusting the remaining part of the frequency accordingly.

In the alternate tow work the large mesh nets had codend, lengthening piece, and after belly meshes of the large mesh, while the remaining forward parts were of the same mesh size as forward parts of the small mesh nets (usually 6 inch mesh overall, apart from the usual gradation of mesh sizes from the forward belly to the size used in the after part of the belly).

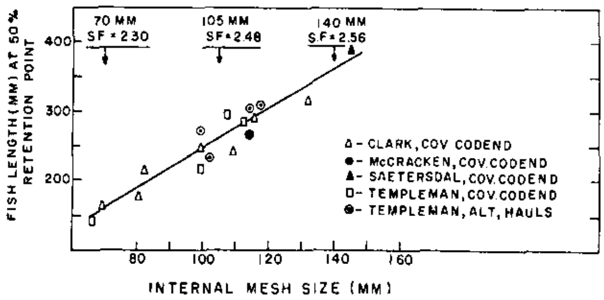

Fig. 6. **Redfish 50% retention lengths for double manila codends, 45/4 - 125/3.**

Figure 6 indicates that the selection factor for redfish increases with mesh size; e.g. from 2.30 at a mesh size of 70 mm to 2.56 at a mesh size of 140 mm. The factor for 75% retention also increases with mesh size, from 2.54 at a mesh size of 70 mm to 2.75 at a mesh size of 140 mm (Figure 7) as would be expected.

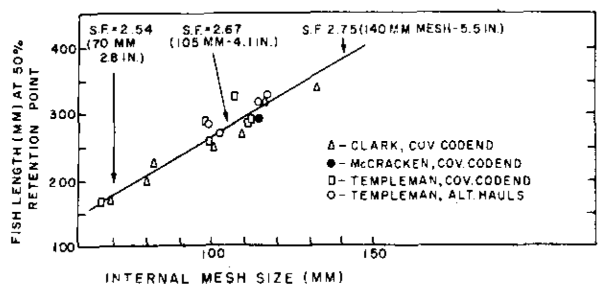

Fig. 7. **Redfish 75% retention lengths for double manila codends, 45/4 - 125/3.**

Figure 8 shows that the escapement for 45-50/4 manila, for which data are available only at the larger mesh sizes, is usually lower than that for 90-100/3 manila. It is thus possible that if heavier twine had been used at smaller mesh sizes the selection factor would have declined even more rapidly.

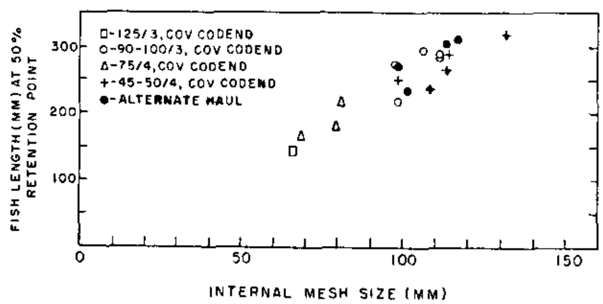

Fig. 8. **Redfish 50% retention lengths for double manila codends of different twine sizes.**

The data of Clark and Templeman have been further analyzed to show that in the covered codend experiments (Figure 6), the selection factor is lower with larger catches and higher with smaller catches.

Most of the selection points in the figures were obtained from experiments in which there were small to moderate catches. Selection factors are needed for larger hauls, preferably from the paired tow method, or if this is not possible, from alternate tows by commercial vessels with different mesh sizes operating in areas where large catches are obtained.

APPENDIX IV: COD SELECTION

Within the ICNAF area cod are caught in quantity by the greatest variety of gears, which include otter trawls, hooks, traps and pair trawls.

Results of selection experiments with hooks of different sizes have been taken from McCracken (1957a). Comparisons of sizes of cod caught by longline and otter trawl have been derived from McCracken (1957a) and Saetersdal (1957c). Comparisons of sizes of cod caught by handlines and traps have been taken from Templeman and Fleming (1956).

In many cases the otter trawl selection results for cod have been a by-product of selection experiments for haddock. Data are available only for a fairly narrow range of mesh sizes and experiments have not been carried out with small mesh codends.

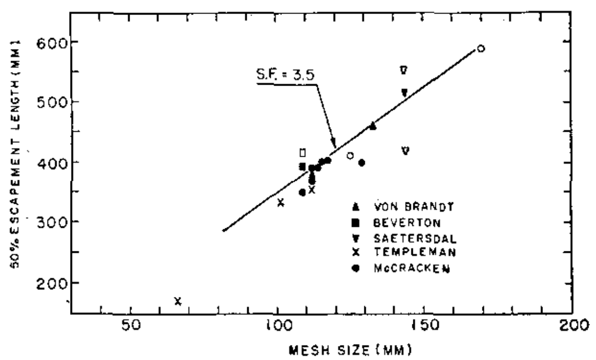

Fig. 9. Cod 50% retention lengths for manila codends of double strand construction. Open symbols represent results from experiments with less than 50 fish per tow in the selection range.

Results of covered net experiments with manila codends show a selection factor of about 3.5 for cod, Figure 9. A comparison of the length composition of cod caught by large and small mesh manila nets in the commercial fishery of Subarea 4, suggests a similar selection factor. Results of covered net experiments with nylon and perlon codends show a selection factor of about 3.8 for these materials, Figure 10. Selection experiments for cod with cotton codends have included only two mesh sizes (102 and 119 mm). These experiments suggest that cotton has a selection factor of about 3.7, intermediate to that of manila and synthetics.

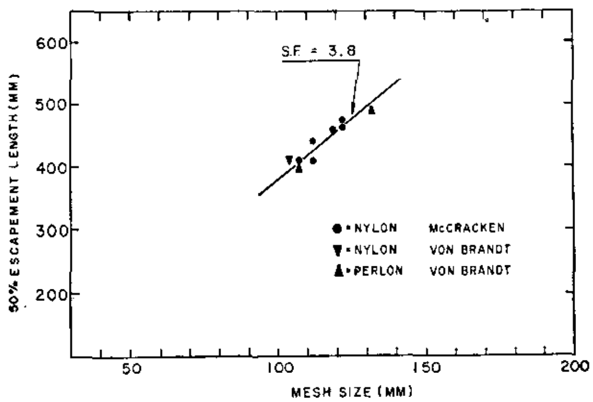

Fig. 10. Cod 50% retention lengths for nylon codends of both double and single strand construction and perlon codends of double strand construction.

The selection span, as described by the distance between 25 and 75 percent retention lengths is quite variable, Table I. Results for manila codends indicate that selection span increases with mesh size. The selection span for manila codends also appears to be greater than for nylon codends of similar mesh size. For purposes of this report a selection span of 10 cm has been chosen as most representative.

TABLE I. Selection spans for cod in covered net experiments with manila, nylon and cotton codends.

Selection Span	Codend Material and Frequency		
cm	Manila	Nylon	Cotton
6	2	3	—
7	1	1	—
8	2	1	2
9	2	—	—
10	6	—	—
11	2	—	—
12	3	—	—
TOTAL	18	5	2

APPENDIX V: SILVER HAKE SELECTION

The only extensive codend selection trials for the ICNAF area were conducted aboard a small (47 gross tons) otter trawler, *Priscilla V.*, of the type which carries out the major part of the silver hake fishery (Clark 1957f). The trawler towed a small net slowly ($2\frac{1}{2}$ knots) and results may not be directly applicable to larger trawlers. Examination of these data (Figure 11) indicated much duller and much lower escapement than would be expected from the girth of silver hake.

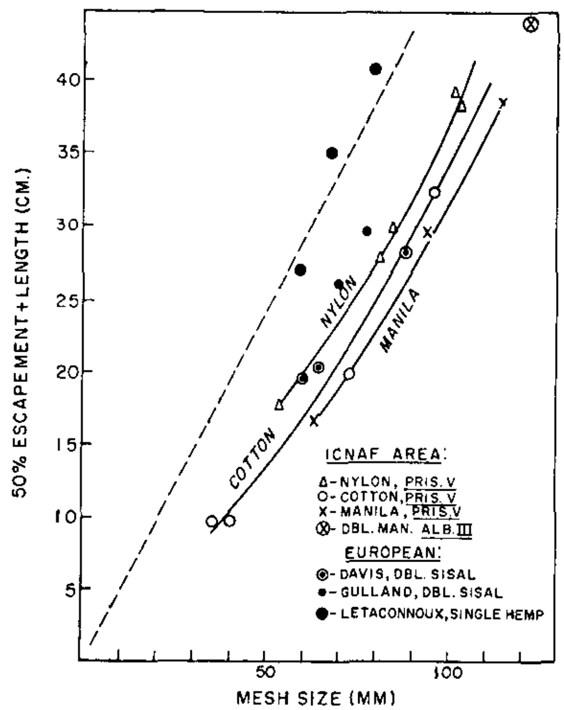

Fig. 11. **Silver hake 50% retention lengths and mesh size. The dashed line represents mesh circumference = fish girth (for** *M. bilinearis*).

Higher escapement is indicated by experiments on the related European hake. The relation between mesh size and 50% escapement length is fitted better with a curve than a straight line. The curves for the three different materials are of analogous shapes. The line for cotton may be extrapolated back to the zero point. It is perhaps reasonable to assume that the other two curves might also be fitted to conform to a zero intercept. However, consideration of the significance of intercepts is beyond the scope of this study and the estimates of 50% retention lengths have been interpolated from the curves shown which have been fitted as closely as possible to the data for each material.

The single point for double manila (*Albatross III*) was not used in drawing the line as a specific 50% point could not be estimated from the sparse data. These data do, however, indicate a 50% retention length of a minimum of 450 mm for the 123 mm mesh, which is somewhat higher than would be indicated from the *Priscilla V.* work. More selection trials must be carried out with the heavier gear and faster towing speeds of larger trawlers to ascertain whether, in fact, they would provide greater escapement.

European data, as summarized by Gulland (1956) and giving higher selection, are indicated in Figure 11. The data of Davis (1934) coincide well with the ICNAF data. Gulland's own data give higher, but not unreasonable, estimates.

The data of Letaconnoux (1955) are so much higher, notwithstanding the fact that they are for single twine of hemp, as to be considered inappropriate for our use. These data are for replicate tows which seem usually to yield higher escapement estimates than those for covered codends. The data of Letacconoux show half the hake escaping of a size which, on the basis of data for silver hake in the ICNAF area, are larger in girth than the mesh is in circumference and theoretically would be too large to pass through the meshes (see dashed line in Figure 9). Moreover, this is only the 50% length, indicating that many even larger fish are escaping. Notwithstanding the fact that the mesh size is only an average and some larger meshes are undoubtedly present, such escapement estimates remain extraordinarily high and more intensive examination of Letaconnoux's data would be required before they could be considered appropriate for our purposes. As such extensive analysis is beyond the scope of this report, the European data have not been utilized for our estimates.

APPENDIX VI: FLATFISH SELECTION

Otter trawl mesh selection results for two species of flatfish, American plaice and witch, are presented in Table 5, p. 86. These data have been obtained as by-products of selection experiments for various roundfish species. The data for American plaice are presumably better than those for witch, since they were caught in larger numbers.

These results suggest a selection factor for American plaice of about 2.0 with manila codends and 2.2 with nylon codends. It is probable that the selection factors for witch are slightly higher than for American plaice. Selection factors of the above order are similar to those found for the European plaice from extensive experiments carried out in the North Sea.

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IV. Observations on the Cod Trawl Fishery in the Gulf of St. Lawrence During the Spring of 1958.

BY

JOHN R. CLARK, U.S. FISH AND WILDLIFE SERVICE

AND

F. D. McCRACKEN, FISHERIES RESEARCH BOARD OF CANADA

At the 7th Annual Meeting of ICNAF the French delegation invited Canada and the United States to send biologists to observe fishing operations of trawlers in the 1958 spring fishing season, and to sample their catches. The appropriate arrangements were made through the Federation des Syndicats d'Armateurs à la Grande Pêche, and the trawler "Zelande" picked the two writers up at Sydney on March 15 and proceeded to Subdivision 4R where fishing commenced on March 16. McCracken transferred to the "Clairvoyant" on March 17th and remained there until March 25. Clark remained aboard the "Zelande" until March 21, went aboard the Portuguese trawler "Santo André" for five days and returned to the "Zelande" from March 26 to March 30.

Thanks are particularly due to M. Dezeustre of Pêcheries Bordeaux, Bassens, Bordeaux, and M. Girard of Les Chalutiers Malouins, Saint Malo, for their arrangements, as well as to Captain LeCoeur of "Clairvoyant", Captain Thomas of "Zelande", and Captain São Marcos of "Santo André" for their co-operation and assistance.

Areas fished.

The trawlers fished in depths of 80-300 (mostly 200) m off the west coast of Newfoundland (4R), in the central Gulf of St. Lawrence, off the northeastern part of Cape Breton Island (4T), and southeast of St. Paul Island (4V). Localities where catches were sampled are shown in Figure 1, inserted.

Fishing Gear.

The size of gear used by all three trawlers is essentially the same, with headrope about 80 feet, footrope about 110 feet, and about the same mouth opening as those used by Canadian and United States large otter trawlers. The body of the trawl was in all cases of manila. French vessels were making extensive use of nylon in the codend and lengthening piece. The nets had much longer lengthening pieces and codends than North American trawlers. Codend mesh size was 4-4½" for nylon and 5½" for manila.

Catches.

The catches of the three trawlers consisted mainly of cod. In Subdivision 4R catches were usually 70-80 thousand pounds per day, in 4T and 4V much smaller. Catch per tow (2 hours) varied between 1,000 and 70,000 pounds. Some redfish were taken in most hauls. A few catches of redfish of up to 5,000 pounds were seen, off Cape St. George, Cape Anguille and Cape Ray at depths of 80 fathoms and over. Some haddock were taken in most tows in 4R. Only occasionally were they taken in quantity, particularly off Cape Anguille and Cape Ray. Pollock were taken occasionally. Other species noted were

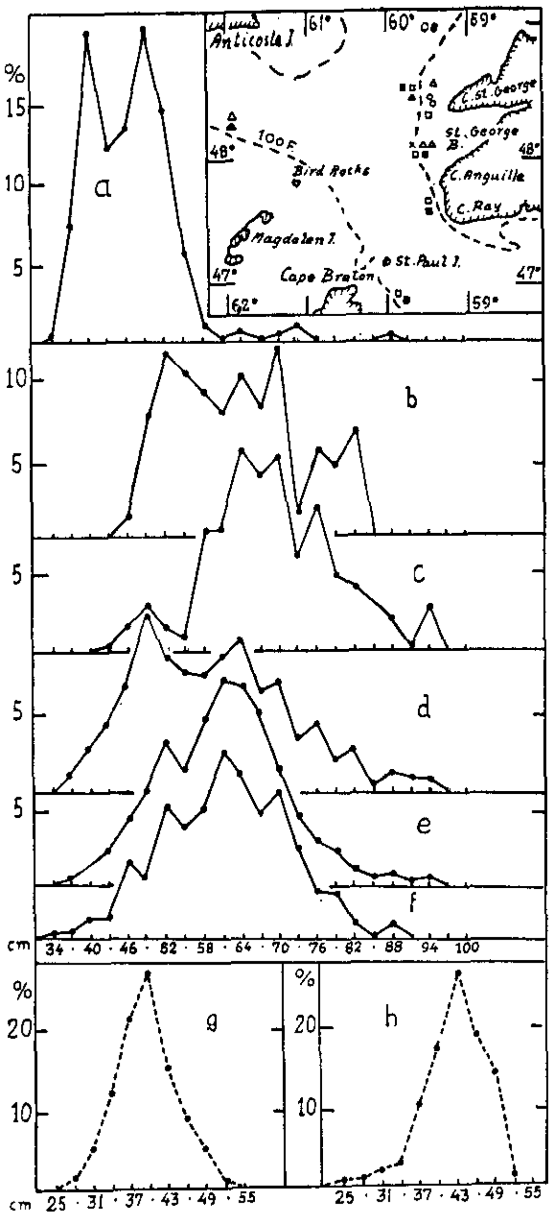

Fig. 1. a—f: Comparative length distribution (3 cm groups) of catches of cod (unsorted and retained samples). g and h: samples of discards. Map showing sampling localities inserted. a—Bird Rock 4T, b—St. Paul I. 4V, c—N. of Cape George 4R, d—W. of Cape George 4R, e—N. of Cape Anguille 4R, f—off Cape Ray 4R, g—W. of Cape George 4R, h—off Cape Ray 4R.

halibut, American plaice, wolffish, silver hake, skates, lumpfish, grenadiers and shrimps.

A series of observations on feeding and maturity of the cod were made.

Length of Cod.

Cod measurements were taken in all the major fishing areas visited (the data will be given in tabular form in the "Sampling Yearbook"). Most of the sampling was of that portion of the catch which was retained for salting. In three instances these samples were supplemented by measurements of the discarded portion of the same catch. Two samples were obtained of the unsorted catch and included some discardable sizes. The discard was so light, usually, that lengths of fish in the sorted and unsorted catches differed little.

The samples were placed into groups representing six fishing areas (Figure 1). The smallest cod were in the Bird Rock Island area (4T), 40-55 cm. In the St. Paul Island area (4V), to the south, the fish were considerably larger, 48-71 cm. In 4R the modes were between 60-65 cm and 48-53 cm. The Cape Ray and Cape Anguille fish were similar in length. Smaller fish were taken west of Cape George and larger fish north of Cape George.

Discarded Fish.

Only small amounts of cod were discarded in the areas fished, the greatest amount in any of the areas visited making up about 10 per cent of the weight of the total catch.

All redfish taken were discarded, but catches did not exceed 5,000 pounds per tow in any area. Only negligible quantities of the smaller sizes of other food fishes were discarded.

From measurements of discarded fish (bottom curves in Fig. 1) it can be concluded that cod of less than 36 cm are not usually retained.

V. Underwater Television Observations on the Effect of Chafing Gear on Escapement of Haddock

BY JOHN R. CLARK

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The use of protective coverings or "chafing gear" over the upper surface of codends is a common practice in the ICNAF area. Chafing gear may be in the form of a second codend completely encompassing the primary codend or in the form of a piece of netting attached to the upper surface only. Hides or other material may occasionally be employed for chafing gear, but usually netting in some form is used.

The usual practice of fishermen is to affix the chafing gear very tightly to the codend, allowing little or no slack. This method allows no clearance between the two layers and the codend meshes are obstructed by the meshes of the overlying netting, resulting in reduced escapement of small fish from the codend. The degree of reduction will depend upon the dimensions and arrangement of the particular chafing gear. A reduction of 11 cm in 50 percent escapement point was reported by McCracken for typical Canadian chafing gear (reported to Scientific Advisers to Panel 4, December, 1956).

The Research and Statistics Committee recognized the possible detrimental effects of chafing gear in mesh regulation programs but concluded that the necessity of protection for codends justified its use. The Committee therefore recommended certain restrictions on the use of chafing gear to prevent obstruction of the codend meshes (see Ann. Proc. vol. 7, p. 13,). The Committee also recommended that further research be conducted on the effects of chafing gear, and the U. S. Fish and Wildlife Service undertook a study of the effect of chafing gear upon escapement of haddock with underwater television equipment.

The experiment was conducted $3\frac{1}{2}$ miles west of Cape Cod on June 22, 1957, in 18 fathoms depth. A No. 41 Yankee trawl was towed at a speed of about $3\frac{1}{2}$ knots by the 180 foot research trawler, *Albatross III*. The codend used was made of 127 mm mesh (ICNAF gauge measurement) double 50/4 manila twine and was 58 meshes around. The chafing gear was designed and attached in accordance with the recommendation of the Commission and consisted of a piece of netting, identical to that of the codend, 11 meshes in length and 44 meshes in width. As its lateral edges were fixed to the laceage of the codend it covered the upper half of the circumference of the codend (29 meshes) allowing the required 50 percent slack.

The escapement of haddock was viewed from both inside and outside the codend with the television camera being supported by a four-foot diameter iron frame. The arrangement for outside viewing is shown in Figure 1.

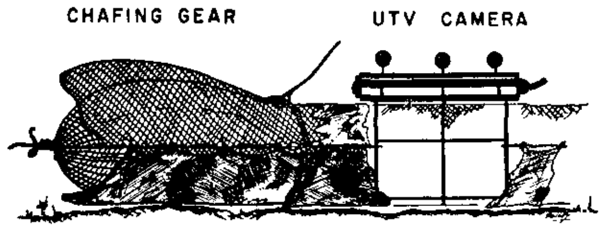

Fig. 1. Television camera rigged to study the effect of chafing gear on escapement from the codend.

Two successful tows were completed with the camera being positioned inside the codend on the first tow and outside the codend on the second. The abundance of haddock of the escape size was adequate, with about 400 fish of 30-50 cm length being taken per hour of towing. Natural illumination was adequate and no lights were used.

The codend under tow appeared to be distended with well-opened meshes. The mesh angle varied from 85° at the after end, where the codend reaches its maximum diameter, to 70° in the proximity of the camera.

The haddock which were observed inside the codend (Fig. 2) during the first tow displayed behaviour typical to those in codends without chafing gear observed under similar conditions. About 800 haddock (1,500 pounds) were taken in two hours of towing.

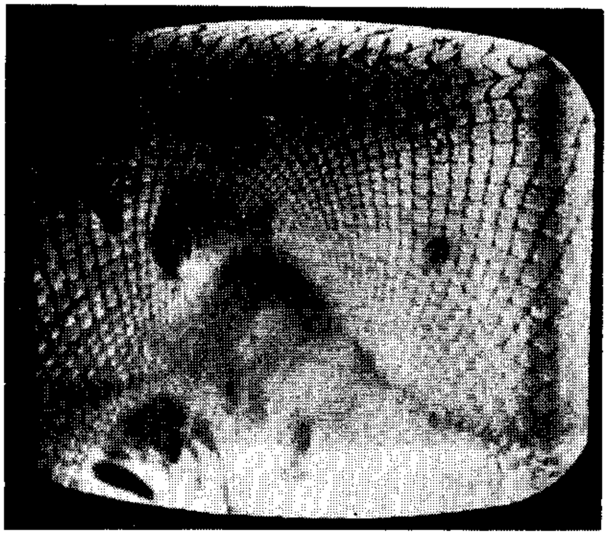

Fig. 2. Internal view of codend in action. The fish are haddock.

The camera was positioned atop the codend to permit better observation of the chafing gear and a second tow was made. The chafing gear was seen very clearly to flow up away from the codend, allowing about two feet clearance at its after end. The chafing gear meshes were not stretched so tautly nor extended so fully as those of the codend, however, and the whole piece of netting gave the appearance of being much slacker than the codend netting. Mesh angles varied from 90° at the after end to 60° at the forward end of the chafing gear.

All haddock attempting escape were successful and no fish became permanently meshed or otherwise lodged in the chafing gear. The escape patterns varied considerably.

Some fish avoided contact with the chafing gear entirely, passing down between the two layers of netting and escaping at the rear opening. Other fish swam straight upwards and escaped through the chafing gear meshes. Many fish became meshed and were able to escape only after a prolonged struggle. A few were seen to give up struggling with the mesh, back out of it, and swim out through the rear opening.

Our visual observations were supplemented by moving picture recordings of the television image. The frequency of the various chafing gear escape patterns as determined from analysis of a $3\frac{1}{2}$ minute film sequence is given below:

Total escaping	68
Number escaping through mesh:	
After considerable struggle	14
With no struggle	28
Number escaping through rear opening:	
After struggling with chafing gear mesh	4
Without contacting chafing gear	22

It may be concluded from these observations that chafing gear of the type approved by the Commission flows up clear of the codend under tow and does not obstruct the codend meshes nor interfere with the escapement of haddock through them. It may be further concluded that this type of chafing gear does not prevent haddock from completing their escape once they have emerged from the codend. Since fish escaped through the meshes as well as through the rearward opening of the chafing gear, it appears desirable to control both mesh size and degree of clearance. No conclusion can be reached from these observations as to whether sufficient clearance would be afforded by chafing gear having less than $1\frac{1}{2}$ times the number of meshes of the codend proper.

VI. ICNAF Mesh Regulation

Operation of 10% Annual Exemption

OCTOBER 1, 1957, THROUGH MARCH 31, 1958

BY LAWRENCE H. COUTURE

The United States Bureau of Commercial Fisheries, Fish and Wildlife Service, issued 24 exemption certificates to U. S. vessels during the six-month period. The certificates were issued by months as follows:

Month	Certificates
October 1957	6
November	3
December	2
January 1958	4
February	7
March	2

The tonnage classes of the vessels are as follows:

Gross Tons	Number of Vessels
0 - 25	0
26 - 50	4
51 - 100	11
101 - 150	1
151 - 200	7
Over 200	1
	24

The 24 vessels landed a total of 6,241,952[1] pounds of fish from ICNAF Subarea 5 on 272 trips.

Analysis of these landings shows 1,668,375 pounds of haddock landed on 250 trips, with a range of landings per trip from 50 to 113,000 pounds. There were 112 trips with more than 5,000 pounds and more than 10% haddock.

Cod landings were made on 243 trips to ICNAF Subarea 5, with a total catch of 235,559 pounds. The cod landings ranged from 25 to 15,100 pounds. Only five trips had more than 5,000 pounds and over 10% cod.

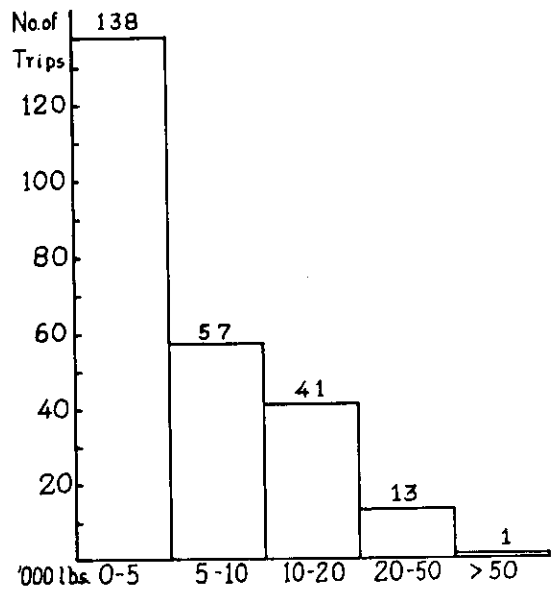

Fig. 1. Trips of exempted vessels classified by quantities of haddock landed per trip. Subarea 5.

The principal species landed by the exempted vessels during the period was redfish. A total catch of 2,820,500 pounds was landed from Subarea 5, representing the 144 trips on which this species was captured. This leaves 128 trips (total 272) on which no redfish were taken.

Other species caught by the exempted vessels included halibut, white hake, cusk, pollock, flounders, and whiting. Total catch of these species amounted to 1,517,518 pounds.

Although the exemption applies only to Subarea 5, an analysis was made of the certificated vessels' landings from Subareas 3 and 4 as well. These landings are presented in the following table.

[1] All weights of fish in this report are as landed (gutted for haddock and cod).

TABLE 1. Summary of the Operation of the 10% Annual Exemption.

Subarea		3		4		5		Total	
		No.	%	No.	%	No.	%	No.	%
Exempted vessels 1)								24	
Fishing trips		5		18		272		295	
Total all species,	000 lbs.	1,310	100.0	3,156	100.0	6,242	100.0	10,707	100.0
Haddock,	,, ,,	0		162	5.1	1,668	26.8	1,831	17.1
Cod,	,, ,,	0		16	0.5	236	3.7	252	2.3
Redfish,	,, ,,	1,309	99.9	2,891	91.7	2,821	45.2	7,020	65.6
Other Species,	,, ,,	1	0.1	87	2.7	1,518	24.3	1,605	15.0
Excess trips 2)		0		4		117		121	
Excess haddock,	000 lbs. 3)	0		108		857		964	
Excess cod,	,, ,, 3)	0		0		17		17	

(1) Operating under 10% annual exemption certificates.
(2) Trips of more than 5,000 pounds and more than 10% of haddock or cod.
(3) Quantity of haddock or cod in excess of that covered by trip exemptions.