INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

STANDING COMMITTEE

ON

RESEARCH AND STATISTICS

PROCEEDINGS AND SELECTED REPORTS

1961

ANNUAL MEETING

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PART I. MEETING REPORTS

1. Report of the Meeting of the Standing Committee on Research and Statistics

Chairman: Dr. Mario Ruivo; Rapporteur: Mr. H. Eckles

I. INTRODUCTION

For about ten years, ICNAF has been studying the exploited fish stocks of the Northwest Atlantic and when necessary, applying conservation measures for the protection and rational management of the fisheries to the common benefit of the nations exploiting these resources.

During this time, the tasks of the Commission have grown in complexity and urgency in the face of the development of a complex pattern of mixed fisheries, with rapidly increasing fishing effort and under an economic pattern of increasing industrialization and investment. It is against this background that the Commission's scientific work has developed.

In its early stages, observations and investigations, conducted mainly at the national level were mostly sufficient for the Commission's needs. However, due to the growth and increase in complexity of international fisheries in the area, a more comprehensive and deeper scientific approach, involving international co-operation on a more or less co-ordinated basis, became necessary. For some years, this took the form of the accumulation of data and pooling of results from the researches conducted in the member countries, and in making plans for further co-operation.

In more recent years the work has been given a new impetus due to the need for the formulation of rational and practicable systems of fishery conservation. It is in this context that we must now place the work of our Committee. An important development has been the establishment of the Working Group on Fishery Assessment, comprising an international team of fishery scientists, charged with a well-defined task within the Commission's sphere, and responsible directly to it. This Group was formed to fulfil a task of major importance to all member countries, exploiting ICNAF resources. The results produced by it offer a neutral and objective basis from which decisions concerning national and regional fishery policies can be taken, to the mutual benefit of the countries concerned.

This important piece of work could not have been undertaken in so short a period of time, without there having been in previous years a far-seeing scientific policy which provided the basic data in a comprehensive and readily accessible form. The Group's activities provided a powerful stimulus to the scientists engaged, and by their contact and personal discussions, it also proved of great educational value for scientists of member countries involved in this type of work. However, we cannot stop at this point. The complex and rapid evolution of the fisheries, and the new problems that we must face in the near future necessitate the continuation of this work. It is necessary to review and extend the programmes to fill existing gaps in our knowledge and understanding of the dynamics of the exploited stocks in the ICNAF Area, and to provide the basis for even better conservation practices. In this respect the need for economic studies is growing and must be taken into account in fishery assessment work.

In relation to assessment problems it is pertinent to refer here to the Tagging Symposium held this year by the Commission. Fish tagging is one of the most important techniques, the results of which are used in fishery assessment work. There are, however, considerable problems in designing, carrying out and interpreting such experiments, and it is, therefore, most urgent that specialists, no matter where they are working or on what species, meet to consider ways of solving these problems and to exchange experience.

While this work has provided the means for developing objective and rational long-term conservation practices for the fisheries, it is well known that major short- and longer-term changes in the productivity and fortunes of the fisheries are also generated by fluctuations and changes in the environment. At present our understanding of these phenomena is very incomplete and inadequate. An important step forward was taken in this sphere at the last meeting of the Commission with the decision to hold a symposium, dealing with an appraisal of current knowledge in this field, and with the setting up of an Environmental Working Party. Already this Group has made substantial progress in formulating the research requirements, especially in fisheries oceanography, and considering plans for co-operative, international environmental investigations in the ICNAF Area. The field of environmental studies is wide and only by careful planning and evaluation of requirements in the light of the practical fisheries situation can research be directed along the most productive lines. Special practical problems apply in each fisheries region; therefore, ICNAF, and other regional fishery commissions and agencies, are the best equipped to undertake this task in their respective areas. The work involved requires laboratory studies, combined with basic and applied work at sea. Therefore, in fulfilling these requirements, it is essential that the international organizations, responsible for the promotion of basic oceanographic research take account of the requirements for fisheries oceanography.

The responsibilities of the scientists do not end at the appraisal and proper understanding of conservation and management measures for the natural resources; they embrace also the means for improving them and increasing their productivity by human action (transplantation, selective breeding, artificial fertilization, etc.) Although these practices have not yet been applied on a large scale in the marine field, some recent developments have given encouraging results. It is important, therefore, that consideration must be given to them in our future long-term research programme.

II

In accordance with the Committee's approved programmes and recommendations, different activities have been carried out during the year by individual scientists and institutions committed to ICNAF work, and especially by the two ad hoc working groups (Assessment and Environmental), which were set up at previous meetings. The Group on Assessment met at Lowestoft during March 1961 and again at Woods Hole during this meeting. The Environmental Working Group met informally during the ICES meeting in Moscow during October 1960, and convened formally at the Marine Laboratory, Aberdeen, in March 1961 to complete, in most details, their final report. In order to consider the extensive reports and recommendations from these groups, and to undertake the further tasks assigned to the Research and Statistics Committee, the necessary ad hoc subcommittees were set up. These groups reviewed progress made, discussed specific technical problems, established new programmes and submitted recommendations for future action.

Plenary sessions of the committee were held from May 29 to June 10 (see Proceedings No.1, R.S.1-11)[1/] to co-ordinate work of the ad hoc subcommittees, and to discuss and approve their reports and recommendations.

At one session time was devoted to the discussion of the paper "Effects of Increased Trawl Cod-end Mesh Size on Georges Bank Haddock Yields," by Ralph P. Silliman and John P. Wise, which was presented to the Committee by Mr. Silliman. The Committee was pleased to receive Mr. Silliman's contribution, but noted that it is a report which is still in parts controversial.

Reports by Chairmen of Advisers to Panels were reviewed by the Committee and it was noted that scientific and technical matters of interest to the Commission had been covered. Special attention was given to matters on Assessment and Environmental Research.

The Action Committee met when necessary to assist the Chairman and to consider matters of general interest to the ICNAF scientific programmes. Recommendations concerning a number of important items were made by the Research and Statistics Committee. These are presented in section IV - General Recommendations (including Publication Policy).

This report summarizes discussions of the Committee, ad hoc subcommittees, and the various working party recommendations. The complete reports, from which guidance for future action will be taken, are attached as appendices.

The following main topics were discussed:

1/ The minutes of the separate meetings of the Committee (Proceedings No.1, R.S.1-11) are not reprinted in the Red Book.

1) Assessment evaluation	Appendix IA, IB
2) Environmental Studies	Appendix II
3) Statistics and Sampling	Appendix III
4) Gear Research and Selectivity	Appendix IV
5) Marking Symposium	Appendix VA, VB
6) Ageing Techniques	Appendix VI

III

1. Assessment evaluation (Appendix IA and IB)

(a) The Working Group on Assessment in Relation to Regulation Problems continued its work throughout the year, checking and in some cases amending their report in the light of further data which have become available since the Bergen meeting. The Group held a final meeting in Lowestoft in March 1961. The report produced was submitted for consideration during this Annual Meeting.

(b) The final position of the Research and Statistics Committee concerning the assessment of effects of mesh sizes on the major stocks of fish in the ICNAF Area, based on the original report of the Assessment Working Group and on all comments and new findings introduced during the meetings and including opinions expressed by Panel advisers is defined in the report of the Group on Assessment Evaluation (Appendix IB).

The original report is essentially a scientific document which makes no recommendations on matters of conservation policy, but endeavours to set out the scientific findings on which such policy could be based. Comments are made on conservation by mesh regulations, on assessments of mesh increase and reliability of assessments. Specification by subareas on the main species, cod, haddock, redfish and on some other species is summarized.

(c) Some further studies which are necessary are noted and a proposal is made that during 1961 and 1962 the Working Group continue in existence. To fulfil this need it is recommended that the Working Group conduct its business by correspondence during the year and convene for two or three days in advance of the 1962 meeting of the Research and Statistics Committee. Dr. Dickie was nominated Convenor (Proceedings No.1, R.S.10).

2. Environmental Studies (Appendix II)

The Environmental Working Party appointed by the Commission in 1960 met informally in Moscow, during the ICES meeting October 1960; then at the Marine Laboratory, Aberdeen, in March 1961 as planned; and finally at Woods Hole during the present meeting, to finalize its report. This report (with amendments and summaries) is available in Document No.25, 1961 Red Book p. 61 , and has been considered, amended in details and endorsed by the Environmental Subcommittee.

The following recommendations, summarized from the report, have the strong endorsement of the Research and Statistics Committee:

(a) Symposium:

That a symposium on "The Influence of the Environment on the Principal Groundfish Stocks in the North Atlantic*" be held over the six days, preceding the meeting of the Research and Statistics Committee in 1963. The detailed proposals regarding objectives and topics for contributions, and the appointment of a Chairman and Convenors are set out in Document No. 25 and Appendix II, where it is recommended that ICES should be invited to collaborate in securing contributions concerning fisheries environmental research in the northeast Atlantic. Four special "review" lectures are also to be solicited on relevant aspects of environmental research. It is further recommended that funds be made available in 1963 for (1) publication of the many contributions anticipated, which should be of great value to the ICNAF research programme, and (2) if required, for enabling special lecturers to attend. (from Proceedings No. 1, R.S. 10)

(b) Research Programme:

Most of the Working Party's task concerned the selection from the wide field open to them of a feasible programme of environment studies. The result is set out in pages 69 to 80 . After careful discussion it was endorsed by the Environmental Subcommittee in the following terms:

(1) That the research programme outlined by the Environmental Working Party be approved in principle,

(2) That, with the exception of the "egg and larvae" surveys mentioned there, the programme drafted specifically for Subareas 1 to 5 mainly concerned projects already begun or being planned and should be formally endorsed and adopted,

(3) That items 1, 5, 6, and 7 of the General Section should similarly be endorsed and adopted as reasonable and feasible in the main with present resources,

(4) That the feasibility of initiating the proposed "egg and larvae" environmental survey in Subarea 1 and adjacent waters be explored by the countries concerned with a view to its being initiated if possible in the spring of 1963.

The principal problem met by both the Working Party and the Subcommittee is the relatively scanty resources for this important aspect of ICNAF work, vital to fish stock studies. The Subcommittee therefore also recommends, and the Research and

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* i.e. excluding the Baltic, North and Irish Seas and the English Channel.

Statistics Committee endorses as most important:

(5) That the Commission urge on member governments the need to increase the resources and manpower available for fishery environmental investigations in the immediate future.

(c) Collection and Exchange of Data:

The Working Party's proposals, approved by the Subcommittee, are set out in pages 80 to 83. The chief of these is that (1) the European ICNAF countries should supply their hydrographic data for the whole North Atlantic to the ICES data centre and (2) the North American member countries should supply theirs to the U.S. National Oceanographic Data Centre. Since these two bodies have a special exchange agreement, the data may thus be conveniently retrieved by all. ICES should therefore be approached to see whether such an arrangement can be made.

3. Statistics and Sampling (Appendix III)

The series of statistics problems listed in items 7 and 8 of the Research and Statistics agenda were considered by four working groups. Their reports are given in Appendix III. 1 to 4. Their recommendations and those made by the whole committee are summarized under the headings Statistical Bulletin, Sampling Yearbook, List of Vessels, and Fishing Power (a, b, c, and d, below):

(a) Statistical Bulletin

(i) Conversion Factors. Although inconsistencies were noted in the conversion factor table in the last Statistical Bulletin (for 1958), it was agreed that responsibility for improvement and reporting of conversion factors rests with member countries. No change is proposed in the present policy of reporting conversion factors annually with statistics submissions.

(ii) Table 1. Change. It is recommended that Statistical Bulletin Table 1 be expanded to include the species American Plaice, Witch, Yellowtail, Winter Flounder, Wolffish, Pollock, Silver Hake, and White Hake. The Statistics Subcommittee considered this to be necessary because of increasing landings and scientific investigations of these species.

(iii) Statistical Divisions. After careful consideration of present knowledge of division of stocks of the major groundfish species in the Convention Area, it was concluded that ICNAF divisions are reasonably adequate. It is recommended that no changes be made in the boundaries of statistical divisions.

(iv) Vessel Tonnage Classification. It is recommended that tonnage classifica- of vessels should not be revised until related studies in ICNAF and ICES are completed.

(v) Redfish Depth Zones. Attention was given to a proposal from the Assessment Group to examine the possibility of reporting redfish statistics by depth zones. It is recommended that member countries sample their redfish statistics in an attempt to report the distribution of redfish effort in six depth zones from 51 to 350 fathoms for each gear, division and month.

(vi) Timely Reporting. Because of rapidly changing fishing operations in the ICNAF Area, it is important to have up-to-date statistics. It is recommended that timely reporting of statistics be achieved by urging all member countries to submit annual statistics reports before the May 1 deadline, and by providing the Secretariat with part-time clerical assistance.

(vii) Prescribed Statistics Forms (ESTANA). The statistics forms which are currently being tested for the Continuing Working Party of ESTANA have been found to be unsatisfactory as a means of reducing work either by member countries or at ICNAF headquarters. A series of recommendations, listed in Appendix III.1, is intended to serve as a guide for the Biologist-Statistician representing the Commission at the ESTANA Working Party meeting in Washington, D.C., beginning June 6, 1961.

(viii) Discards. In spite of the great importance of information on the quantities and sizes of groundfish discarded at sea, it has been difficult to collect useful data. Reporting of discards to ICNAF on prescribed forms has been completely inadequate. It is recommended that special reports on discards should be prepared by each country for the next Annual Meeting. Details of requirements are specified in Appendix III.4.

(b) Sampling Yearbook

Contributions of sampling data are growing each year, and each new Sampling Yearbook is increasingly useful. It was decided that sampling data would be still more useful if grouped by area, to conform with the Statistical Bulletins. The details of sampling proposals are noted in Appendix III.4.

(c) List of Vessels

It is recommended that the present prescribed forms used to solicit vessel information be used for the 1962 list. A decision concerning the amount of these data to be published in the next List of Vessels can be deferred to the next Annual Meeting.

(d) Fishing Power

One of the most important problems facing the Commission is assessment of the effects of increasing fishing effort on groundfish stocks and catches. In order to make progress with this problem we must have studies of fishing power and measurement of total fishing effort. Specific studies to be pursued within the next year are recommended in Appendix III.2.

The studies include development of indices of fishing power from propellor characteristics and operation RPM, proposed at earlier meeting. It is hoped that German scientists will be able to co-operate with Mr. Traung by testing the applicability of these indices to measures of fishing power of some of their vessels operating in the ICNAF Area.

4. Gear Research and Selectivity (Appendix IV)

The Working Group reviewed data on mesh selection, reports on mesh gauges, chafers and items on educational materials relating to mesh regulations.

(a) To assist in planning of future selectivity research and to provide valuable information for future work on assessment, all existing mesh selection data for the ICNAF Area will be summarized in tabular form and distributed by the Secretariat following the lead established by ICES.

(b) To improve future mesh assessment work it was recommended that each country prepare, for presentation at the next meeting, a report listing weights, length and girth for cod especially, but also for other species where possible.

(c) The need for continued efforts to standardize gear selectivity work in the ICNAF and ICES Areas was recognized in the consideration of a standard mesh measuring gauge for research purposes. Accordingly it was recommended that ICNAF adopt, as quickly as available, the gauge finally chosen by the ICES Comparative Fishing Committee at its next meeting. Meanwhile further researches are to be conducted on the effects of pressures between 7 and 12 pounds on measurements of size of meshes of various materials, using the 1959 Westhoff modification of the Scottish mesh gauge which has been adopted as an interim standard by ICES.

(d) The Group concerned with Gear Selectivity at the 1962 Annual Meeting is to consider the report on current use of chafing gear to determine the status of chafing gear, trends in its use and reasons for any significant changes.

(e) Recognizing opportunities for improvement in success of mesh regulations, it was recommended that appropriate educational material concerning mesh regulation, its principles, rationale and objectives be brought to the 1962 Annual Meeting. The effectiveness of posters and other methods for the education of fishermen are to be explored at the 1962 Annual Meeting.

5. Marking Symposium (Appendix VA and B)

The Marking Symposium planned at the 1960 Annual Meeting took place at Woods Hole, May 24-27, 1961. Sixty-two contributions were received, nearly all written for the Symposium, and covering many aspects of tagging methods in fishery research. The agenda included the general items under two main topics: Methods and effectiveness of marking, tagging and tag recovery; Analysis of results of marking and tagging experiments. The contributions and reviews by rapporteurs of the contributions and discussions under each agenda item will be printed.

The findings of the Working Party to consider the Symposium are contained in Appendix VB. The most relevant being:

(a) The Working Party emphasized that they had not been able to do full justice to the material of the Marking Symposium, and suggested that the Committee on Research and Statistics consider results of the Symposium at their 1962 meeting, by which time its members will have had the opportunity to study in detail the contributions and to consider more fully their relevance to the conduct of future tagging programmes in the ICNAF Area.

(b) There were, nevertheless, a number of obvious conclusions of direct importance to tagging work in the ICNAF Area, and attention is drawn to these in the Report of the Working Party. These concern types of tags and methods of tag testing; recording the condition of tagged fish at release; new techniques for improving and measuring the efficiency of tag recovery; and new methods for estimating population size and mortality rates by tagging.

(c) The Working Party also put forward several recommendations which were accepted by the Research and Statistics Committee. These include prompt circulation to member countries of details of tagging experiments conducted in the ICNAF Area; circulation of publicity posters, etc., to all relevant countries; the desirability of pooling of tagging data by countries working in a particular area and of making co-operative analysis of the results; standardization of terminology used in describing the results of tagging experiments; and the prompt publication of the proceedings of and contributions to the Tagging Symposium.

6. Ageing Techniques (Appendix VI)

(a) Further consideration was given to the programme of work for the Working Party on Ageing Techniques, set up at the 1960 Annual Meeting. A provisional agenda covering techniques, structure and development and structural variations was drawn up for its meeting. It is recommended that this meeting should take place at the Institute of Marine Research in Bergen, Norway, in autumn 1963, and that its convenor, Dr. Rollefsen, should contact institutions where age reading is undertaken, to receive the names of experts in this field, and to seek possible amendments to the provisional agenda.

(b) Attention was given to the proposed list of definitions and terms for age reading, drawn up by Mr. Jensen (U.S.A.), for consideration by the Working Party. Comments on the proposed list were drawn up.

(c) Further consideration was given to the Cod Otolith Exchange Programme, and it is recommended that the exchange should continue, with special regard to the recognition of spawning zones in populations spawning in different areas and seasons. It is also recommended that the halibut otolith exchange programme, similar to that used for cod, be continued.

(d) Attention was also drawn to the high value of tank experiments in the study of the influence of physiological and environmental factors on the growth and structure of otoliths.

IV. GENERAL RECOMMENDATIONS

1. In order to derive the maximum benefit from the Marking Symposium, it is recommended that contributions and reports of the Symposium be published as a Special Publication of ICNAF. Accordingly the Committee on Finance and Administration is requested to include funds in the 1961-62 budget to meet costs for publication of 2000 copies of the Marking Symposium contributions and proceedings (R.S.1).

2. The Report of the Working Group of Scientists on Fishery Assessment in relation to Regulation Problems is of fundamental importance to ICNAF and will be of wide interest to fishery scientists outside as well as within the Area of ICNAF. It is therefore recommended that this report be published as a Supplement to the Proceedings of the 1961 Annual Meeting. The supplement should be under separate cover from the regular Proceedings and include 2000 copies (i.e. about 600 copies more than the Proceedings itself).

3. The Report of the Environmental Working Party (Document No.25 plus appendices) is a basic document for fishery science in developing of programmes relating to oceanography and fisheries, and is also of particular importance to the research programme of the Commission. It should be published in the "Red Book" of the 1961 Annual Meeting. In addition, 200 copies should be made available as separates for general distribution as necessary.

4. Particular attention is called to the Environmental Symposium to be held in conjunction with the 1963 Annual Meeting. It is anticipated that the results will be of real practical value to ICNAF and fishery workers in general. Provisions should be made to meet expenses incurred in the publication of the papers from this symposium. Attention is drawn to the fact that in a few cases it might become necessary to pay travel costs for specialists possibly invited to contribute as special lecturers. In order to provide for full discussion in the Symposium it is

strongly recommended that member governments will ensure that scientists directly concerned with the subjects of the Symposium shall be included in their delegations for the meeting.

5. Concerning other matters of publication it is recommended that:

(a) Information for the "List of Vessels" be collected during 1962 and consideration be given to publication of the list in 1963.

(b) That the Sampling Yearbook be published according to recommendations of the Working Group on Sampling and Discards.

(c) That the Statistical Bulletin be published in the same form as in 1961 with additions to tables as enumerated in Appendix III, p.30.

(d) That the Reports of the Chairmen of Panel Advisers be a summary of research progress in the subarea concerned and that they be drawn from Research Reports and other pertinent documents submitted to the meeting from each country. The question of including as a final part of the Reports the reports of status of fisheries should be considered next year. The summaries should be arranged by subjects with reference to the serial number of documents and a final list of all documents used should should be given at the end of the reports.

(e) That the Summary Reports of the Chairmen of Panel Advisers from this year's meeting be included in the "Red Book" but that consideration be given to publishing these reports in the "Annual Proceedings" in future years.

6. Following the recommendations made at the 1960 Annual Meeting the Action Committee assumed responsibilities previously assigned the Publications Subcommittee. The Action Committee therefore recommends publication of documents from the 1961 Annual Meeting as follows:

In the Annual Proceedings: Documents Nos. 5, 6, 8, 9, 10, 15, 16, 17, 18 (combined with 15), 20, 22, 26, 27, 29, 30 and 36.

In the Red Book: Documents Nos. 3, 12, 23, 24, 25, 35 (in association with 23), 38, 40, 42, 43, 44 and 46.

7. Concerning representation at meetings of other international fishery organizations, it is recommended that formal ICNAF representation be dispensed with unless there is a special need for it. It is recognized, however, that observers at ICES annual meetings will be required, because of the many matters which are of interest to ICNAF and ICES.

8. ICNAF recognizes the importance of the ICES Herring Symposium and notes that member countries are sending herring experts to the meeting. Since the member countries probably will be represented it will not be necessary to designate an ICNAF observer.

9. It is recommended that Dr. Bertelsen be asked to represent ICNAF at the 1961 Annual Meeting of ICES. Should it be desired, Dr. Lucas is willing to present information on the Environmental Symposium to ICES in the hope that such presentation would enhance possibilities for participation by ICES members.

10. While the Committee does not recommend that ICNAF have formal representation at the FAO Research Vessel Forum, Tokyo, September 1961, this undertaking is recognized as an excellent opportunity for specialists to exchange information which will lead to improvements in design, construction, and operation of fishery-oceanographic research ships. The initiative of FAO in arranging the Forum is commended. It is recommended that the Secretariat request a set of the papers prepared for the Forum for deposit in the Commission headquarters.

11. Further attention has been given to the need for recruitment and training of scientists in the field of fishery assessment (see Chairman's Report, 1960 Annual Meeting) and recommendations on this matter are made as follows:

(a) That the Special Course in Fishery Population Dynamics, now under consideration by ICES is noted, and that the Secretariat communicate with ICES indicating that ICNAF will be interested in the course if it is to be given.

(b) That FAO is commended on its having made arrangements for revision, expansion and publication of a manual on population dynamics based on the text used in the Special Course given at Lowestoft in 1957 and is requested to make this available as soon as possible to ICNAF and other scientists concerned with fishery assessments problems.

12. In relation to Division of Stocks, it is recommended that the charts prepared by Dr. Templeman be circulated as an ICNAF document and that Dr. Templeman continue consultation on preparation of charts, with Dr. McCracken for halibut, Drs. Hansen and Meyer for Subarea 1 cod, Dr. Travin for redfish, and others as necessary to prepare charts in more final form for consideration at the 1962 Annual Meeting.

13. The Research and Statistics Committee welcomes the rapidly developing support, national and international, for the expansion of oceanography. This expansion is urgently needed and should be of the greatest benefit to fisheries research.

The need for a more thorough knowledge of marine processes in relation to fisheries has been urged at several ICNAF meetings. This year the Commission is considering the initiation of a most important programme of fisheries environmental research, and this can only be successful if the oceanic regime over a much wider area is more thoroughly understood. Such understanding can be obtained much more quickly with the assistance of the national and international oceanographic bodies. Fisheries research has its own responsibilities but would welcome the collaboration of these bodies and in return is convinced that it can further their investigations by focussing attention on vital gaps in practical knowledge. The two are complementary branches of research.

The Committee therefore recommends that the Commission urge member countries, recognizing the complementary nature of fisheries and oceanographic research, (a) to ensure that their national delegations to relevant international bodies, and in particular at the forthcoming and future meetings of Inter-governmental Oceanographic Commission under UNESCO, be fully briefed on the fisheries aspects of oceanographic research; and (b) to work for the establishment of an international committee which might be convened by FAO in consultation with national and inter-governmental bodies concerned with fisheries and fishery research, with the responsibility of providing advice to the Inter-governmental Oceanographic Commission under UNESCO on the oceanographic aspects of fisheries.

If the Commission should approve these proposals, it is suggested that their content should be conveyed not only to the member governments, but also to UNESCO and FAO and to other regional fisheries councils and commissions.

14. The Committee noted that completion of its work this year was impaired by the absence of representatives from some countries during the first week of its meetings (from Proceedings No.1, R.S.10). Attention is, therefore, called again to the recommendation of the Committee on Research and Statistics 1960 Annual Meeting (see Red Book 1960 Annual Meeting, p.14, No.5) which reads:

"Experts in many scientific disciplines are required for the planning and execution of, and appraisal of the results from, the programmes of scientific research required for fulfillment of the aims of the Commission. The Committee considers it of great importance for such experts to participate actively in its meetings.

"It therefore recommends to the Commission that member countries be urged to include in their delegations to the meetings of the Commission, as many as possible of the experts who are responsible for the various items of work."

In addition to this point the Committee emphasizes the importance of adequate representation, at all scheduled sessions of the Committee and Panel Advisers, so that reports and recommendations can be made available to the Commission early in the week of its annual deliberations.

15. Consideration was then given to Document No.45, "A Scheme of International Investigation" proposed by the USSR. The Committee observed that the plan was one which Dr. Marty mentioned at the Aberdeen meeting, as a contribution to the Environmental Working Party and expressed regrets that the communication arrived after the work of this group had finished. Adequate consideration to details of the plan could not be given at this meeting because several experts, especially the hydrographers, were no longer present. It was proposed, however, that Dr. Lucas bring together scientists from Subarea 1 to consider collaboration on the research planned for that area, that an informal meeting be arranged at the next ICES meeting for more detailed examination of the research plan and that further consideration and detailed planning be carried out at the next annual ICNAF meeting.

V. SPECIAL MEETINGS

(a) Those attending the meeting at Woods Hole were most fortunate to hear Dr. William R. Schevill present an illustrated lecture on whales and porpoises, their distribution and the noises made by them. Dr. Schevill is a Research Associate in Biology at the Woods Hole Oceanographic Institution, and an Associate Curator of Mammalogy at the Museum of Comparative Zoology, Cambridge, Massachusetts. Dr. Schevill showed his films of many species of whales and porpoises he had taken around the world. He had similarly obtained recordings, which he played, of the varied calls and noises made by these animals.

(b) During the meeting in Washington the Committee was privileged to view slides and hear a talk by Dr. Rollefsen on the aquarium and experimental research facilities of the new Institute of Marine Research in Bergen.

VI

(a) The Committee wishes to express appreciation to the staff of the Bureau of Commercial Fisheries Biological Laboratory at Woods Hole for courtesies extended during the Marking Symposium and the first week of meetings and to the Marine Biological Association and the Woods Hole Oceanographic Institution, for use of auditorium rooms and meeting facilities. The opportunity to view experimental laboratories and research installations was a satisfying and enjoyable experience for Committee members.

(b) As in previous years, it is a pleasure to recognize with full appreciation the assistance and co-operation given by the Food and Agriculture Organization of the United Nations in the technical work of the Commission. Again Mr.S.J.Holt contributed to the successful undertakings of the Working Group on Fishery Assessment during the year by attending meetings of the Working Group at Lowestoft in March, 1961, and by his participation in the Annual Meeting at Woods Hole and Washington, D.C.

(c) The Continuing Working Group on Fishery Statistics for the North Atlantic (ESTANA) met during the meeting in Washington, D.C., and provided once again a valuable opportunity for collaboration on improvements in fishery statistics.

The Committee recommended that the Secretariat write FAO expressing our appreciation for the fine co-operation being developed between FAO, ICES and ICNAF through ESTANA, suggesting consultation on scheduling of future meetings which are related to ICNAF annual meetings. Special consideration is to be given at the next Annual Meeting to items concerned with clarification of statistical requirements.

VII

(a) It is proposed that the next meeting of the Committee be held in Moscow commencing May 28, 1962.

(b) The following members are nominated to the Action Committee:

France, Italy, Portugal, Spain	Dr. J. Ancellin
Iceland, Norway, USSR	Dr. J. Jónsson
Denmark, Germany, U.K.	Dr. C. Lucas
Canada	Dr. R. Martin
U.S.A.	Dr. H. Graham

(c) Mr. R.J.H. Beverton was elected Chairman by acclamation.

(d) Adjourned at 10 a.m., June 10, 1961.

APPENDIX IA

Activities of the Assessment Working Group, 1960/61

1. The Chairman of the Working Group attended the meeting of Scientific Advisers to Panels 3, 4 and 5 in Woods Hole in December 1960. The purpose of this visit was to review progress of work arising from the Bergen meeting of the Group and to prepare for the final meeting of the group.

2. The final meeting of the Group was held in Lowestoft from March 20-30, 1961, at which the participants were:

R.J.H.Beverton (U.K.) Convenor
L.M.Dickie (Canada)
V. Hodder (Canada)
E. Cadima (Portugal)
S.J.Holt (FAO)
B.B.Parrish (U.K.)
J.A.Gulland (U.K.)
A. Hylen (Norway)
Ju.Ju. Marty (USSR)
S.S.Baranov (USSR)
R. Hennemuth (U.S.A.)

3. During the year, all the assessments had been checked and in some cases amended in the light of further data which had become available since the Bergen meeting. During the above meeting, revised versions of the subarea reports and assessments were reviewed and final texts agreed. The Group also discussed in detail the preparation of additional sections covering (a) summary of subarea assessments (b) effects of changes in fishing effort (c) other methods of regulation and (d) suggestions for future research. Final drafting of these sections was undertaken during April by Mr.J.A.Gulland and the Convenor on behalf of the Group, and then circulated for comment. The final report (apart from certain background material in tabular form in Appendices I, II, and III) was sent to the ICNAF Secretariat early in May and was distributed at the beginning of the meetings of the Committee on Research and Statistics on May 29th, as Document No.20.

4. The report was presented at two full meetings of the Committee on Research and Statistics: its findings were also discussed by Panel Advisers who were able in two instances to bring the conclusions up-to-date in the light of recent events. The suggestions in section 13 of the report concerning the requirements for future research and data were considered by the appropriate subcommittees and led to several recommendations being adopted by the Research and Statistics Committee.

5. The Report of the Assessment Working Group is essentially a scientific docu-

ment, analyzing the effects fishing had on the stocks of fish in the ICNAF Area and showing the probable effects of increase of mesh size with reference to the situation in the period 1956-58, insofar as these two questions can be answered in the present state of knowledge. The Report makes no recommendations on matters of conservation policy, but endeavours to set out the scientific findings on which such policy could be based.

6. Owing to the complexity of the stocks and fisheries in the ICNAF Area it was unavoidable that the Report is a long one, extending to 70 pages of text and 58 diagrams. To assist the Commission in evaluating its contents, a special group consisting of the members of the Assessment Group, the Chairmen of the Panel Advisers and Drs. Lucas and Martin, was convened to prepare a short outline of the main findings of the report (Appendix IB).

APPENDIX IB

Group on Evaluation of Assessment

This group was formed by the Committee on Research and Statistics at its meeting of 2 June, 1961 (see 1, R.S.3 [Revised]) to determine the position of the Committee on the findings of the Assessment Group. This *ad hoc* group, to be convened by Mr. Beverton, comprises all the members present of the Working Group on Assessment (Messrs. Hennemuth, Cadima, Hodder, and Holt), plus the Chairmen of Panel Advisers: (Drs. Hansen, Templeman, Ancellin and Graham), and Dr. Lucas, Dr. Martin and the Chairman of the Research Committee.

I

1. Purpose of Report

The Report is essentially a scientific document, analyzing the effects fishing has had on the stocks of the ICNAF Area and showing the probable effects of increase of mesh size with reference to the situation in the period 1956-58, insofar as these two questions can be answered in the present state of knowledge. The Report makes no recommendations on matters of conservation policy, but endeavours to set out the scientific findings on which such policy could be based.

2. Conservation by Mesh Regulation

The idea behind any proposals to increase the size of mesh is to allow some of the smaller fish to escape and be caught later in their life when they have grown larger (see para. 3.1, p.3). An increase of mesh size has two effects, which must be distinguished. The immediate effect is to cause some loss of catch due to the escape of the smallest fish through the bigger meshes. The immediate loss is temporary only, and begins to diminish as soon as the larger mesh is introduced. The long-term effect comes later, when the escaping fish have grown fully into the stock fished by the larger mesh.

3. General Comments on Assessments of Mesh Increase

(a) Assessments are given as the expected percentage change in weight of landings compared with what would have been obtained if the old (and smaller) mesh had continued to be used (see para. 3.3, p.3); they are not predictions of how the actual landings will change. This is because the abundance and availability of stocks of fish in the sea are subject to a number of natural influences which have nothing to do with fishing and cannot be predicted much ahead (see, in this connection, the Report of the Environmental Working Party). Nevertheless, if the long-term assessment for an increase of mesh to a larger size shows a gain, then it means that this larger mesh will enable the natural productivity of the fish stocks to be utilized that much better.

(b) Immediate loss. For several reasons, the only way immediate effects can be assessed at the present time tends to exaggerate the effective loss which would result. Para. 3.7 (p.4) of the report sets out what these reasons are. To these should be added an additional point, namely that the loss will always consist of the smaller fish in the catch, and since these usually have a lower market value (per lb.) than the rest of the catch, the immediate losses in terms of value will be lower than those given in this Report, which are in terms of weight. It should also be noted that in some fisheries market requirements lead to "discarding". In these fisheries immediate losses of landings are consequently smaller. Unfortunately, however, discarded fish of most species are dead fish; a larger mesh would have prevented their capture so that they could have grown to be caught later.

4. Reliability of Assessments

Immediate effects are easier to assess than long-term effects because they depend only on the selectivity of the gear and the present size-composition of the catches and landings. Long-term effects depend also on what proportion of the released fish will be caught again later in their life, and hence on how heavily the stock is being fished. In some stocks, particularly those in Subarea 2, it is impossible from the data presently available to establish how heavily they are being fished, and so no long-term assessments can be given (see para.3.5, p.4). In the others, it is possible to state a range of assessments within which the true effect is likely to lie, and the tables of assessments given in the report take this into account. Assessment of the effect of mesh increase cannot be expected to be exact, but in many cases it has been possible to establish with reasonable assurance that increase of mesh up to a certain size would result in a long-term gain, and to say roughly how big the gain is likely to be. After each assessment table there is a paragraph giving a brief summary of the position; for ease of reference the tables and paragraphs are listed in the summary of each subarea given later in this guide.

5. Effect of Different Gears and Size-Composition of Catches

It is an unavoidable complication that the effect of an increase of trawl mesh is not the same both to trawlers and to other gears (e.g. lines), even if they are fishing the same stock. The other (non-regulated) gears nearly always obtain a gain from any increase in trawl mesh, and certainly never suffer a loss. A distinction has also to be made between different components of the trawl fleets, if there are characteristic differences in the size composition of fish caught by them. Where relevant, separate assessments are therefore given for trawls (combined and by components) and to other gears, as well as for the total landings by all gears together.

6. Effect on Different Fish Species

It is a consequence of the characteristics of the different species that mesh changes affect their stocks and the catches from those stocks differently. Thus in general, large meshes are needed to benefit catches of flatfish (especially of halibut, see Section 9, p.46) significantly by mesh control alone. Relatively large meshes may benefit cod fishing, but usually the haddock fisheries can only benefit to a smaller size - and redfish and silver hake smaller still.

7. Effects of Changes in Fishing Effort

(a) The effect of a particular increase in mesh size depends on the amount of fishing on the stock, since this influences both the relative abundance of small fish in the catches and also what proportion of the released fish will be caught again later in life (this proportion is given the symbol E in the assessment tables; the higher the E value the bigger the long-term gain for a given mesh increase). It is therefore important to remember that the assessments of mesh increase refer for the most part to the period 1956-58, and hence to the amount of fishing exerted during that period.

(b) If the amount of fishing has increased since then, or increases in the future, the effect of this on the mesh assessments can be stated in general terms as follows:

(i) The immediate loss resulting from an increase to any particular mesh size will be greater.

(ii) The long-term gain will be greater.

(iii) The optimum mesh size, i.e. that giving the best long-term yield, will be larger.

(c) Although no comprehensive forecasts, in quantitative terms, have been offered about future trends in fishing in each of the ICNAF subareas, the indications are that it is likely to increase, at least in the trawl fisheries, rather than the reverse. To this extent the gains to trawl fisheries, relative to gains to the others, will increase as the trawl effort increases (see para.11.6, p.56). The general question therefore arises of whether it would be better to make further mesh regulations now, while the immediate loss would be less even though the long-term gain might only be small; or wait until the amount of fishing has increased, when although the long-term gains would be greater so also would be the immediate loss. Relevant here is that with increased fishing the catch per unit fishing effort would certainly be lower than it is now, so that the economy of the fleets may be less able to absorb the immediate loss. Here it must be noted that, without adequate mesh regulations, the usual effects of unrestricted fishing are among other things, towards smaller sizes of fish (para 11.10, p.58), fewer year-classes, and so greater fluctuations in annual catches.

II

8. <u>Subarea 1</u> (no mesh regulation at present)

(a) Only <u>cod</u> and <u>redfish</u> are of importance; all the redfish and about half the cod are taken by trawl (Table 4A, p.5).

(b) <u>Assessments for cod</u> (Table 4B, p.8, the right-hand column of figures being the best guide). An increase of mesh to 4 1/2" (114 mm) shows small long-term gains to all fleets. An increase of mesh to 5" (127 mm) shows small long-term gains in total landings and in landings by other gears; some trawl fleets are also likely to get small long-term gains while others might experience a very slight loss.

(c) <u>Assessments for redfish</u> (Table 4C, p.10). Only immediate losses can be given, but the average size of redfish here is large and only small immediate losses would result from increase of mesh to 4 1/2". It is reasonable to expect that some, at least, of this would be made up in the long-term.

9. <u>Subarea 2</u> (no mesh regulation at present)

(a) Only <u>cod</u> and <u>redfish</u> are important. All the redfish are taken by trawl; about 60% of cod were taken by trawl in 1956-58, but the percentage rose to 90% in 1960.

(b) No long-term assessments can yet be made either for cod or redfish. However, the immediate losses likely to result from the use of a mesh size of 4 1/2" for cod are negligible, and quite small for redfish.

(c) A mesh of 5" would result in an immediate loss of 8% of <u>cod</u>; it cannot be stated with any certainty whether this would be made up in the long-term, but the recent marked increase in trawling in the subarea makes this quite possible. A 5" mesh for redfish would result in an immediate loss of 18%, but no advice can be given at this stage about its long-term effect.

10. <u>Subarea 3</u> (4-inch mesh regulation for cod and haddock at present)

(a) Fisheries for cod, redfish, and haddock are important. All the redfish and haddock and about 45% of the cod are taken by trawl (Table 6A, p.14).

(b) Assessments for cod (Tables 6B, 6D, and 6E, pp. 18, 19, and 21). In 3KLP, where more than half of the total landings are made by gears other than [illegible], trawls, mesh increases up to 5" show no significant immediate or long-term changes in trawl or total catch. Beyond 5 inches trawls sustain losses. Mesh increases up to 6" in 3NO, where 80% of landings are made by trawls, give considerable gains to both trawl and total landings.

No long-term assessments can be made for 3M (landings from which comprise 2% of total cod from Subarea 3 - Table 6A, p.14), but immediate losses would not be large for meshes up to 5" and the fishing effort would not have to be particularly high to make up for this in the long-term.

(c) Assessments for haddock (Table 6F, p.25). Haddock have since 1957 been taken only in 3NO. Assessments depend critically on estimates of discarding, which is variable, but increases in mesh size to 4 1/2" would not give immediate losses much exceeding 10% and long-term gains would be expected - substantial ones if discarding is high. Estimates of changes with 5" mesh are variable, depending greatly on discarding estimates.

(d) Assessments for redfish (Table 6G, p.27). Long-term assessments could not be made, but small immediate losses from moving mesh size to 4 1/2" from the present 4" in 3KLM indicate that there would be negligible long-term effects. In 3NO, on the other hand, considerable immediate losses would result from an increase to 4" from the present 3".

11. Subarea 4 (4 1/2" mesh regulation for cod and haddock at present)

(a) Cod is the main species of which trawl and line fisheries take about equal quantities. Other important groundfish are haddock, redfish, and American plaice, all of which are caught mainly by trawl (see Table 7A, p.29).

(b) Assessments for cod show that increase of mesh to 5" or 5 1/2" would produce long-term gains of 3% to 4% for trawls, and rather larger gains to other gears. (Tables 7B-D, pp.35-37, and summary tables in Report of Scientific Advisers to Panel 4.).

(c) Assessments for haddock in the more important fishery of 4VW (55% of subarea total) show slight long-term gains up to a mesh size of about 5". In Division 4X (40% of subarea total) there are likely to be long-term losses with mesh sizes above 4 1/2" (Tables 7E and 7F, pp. 35-37, and summary table 2 in the Report of Scientific Advisers to Panel 4).

(d) Assessments for redfish show that increase of mesh size from 3" to 4" would result in small long-term losses in 4RST but substantial ones in 4VWX (see Table 7H, p.38; Table 8D, p.43, and table 2 of Report of Scientific Advisers to Panel 4).

(e) Assessments for American plaice. Any increase of mesh size within the range of 4" to 6" might result in long-term gains. Owing to the high discarding, the immediate losses of landings would be small.

12. Subarea 5 (4 1/2" regulation mesh for species except redfish and silver hake)

(a) Main groundfish are haddock, cod, redfish, yellowtail flounder, and silver hake, of which haddock is the most important (see Table 8A, p.39). All are caught by trawl only.

(b) At present levels of effort, increase of mesh size to 5" would produce little long-term change in the landings of cod, haddock or yellowtail; the immediate losses would be 5% (cod), 14% (haddock), and 1% (yellowtail).

(c) Further increase of mesh size to 5 1/2" or 6" may result in small long-term gains of cod and yellowtail, but for haddock the assessments become variable and some long-term loss might result (see Table 8B, p.40 for cod; Table 8C, p.41 for haddock).

(d) For redfish, increase of mesh size from the present 2-3/4" to 4" would probably result in a small long-term gain, with an immediate loss of about 24%. Further increase beyond 4" would probably result in long-term losses (Table 8D, p. 43).

(e) No long-term assessments can be made for silver hake, but increase of mesh size from the present 2 1/2" to 4" would result in an immediate loss of 40%, and fishing would have to be intense for this to be made good in the long-term. Assessments have not been made for mesh sizes between 2 1/2" and 4".

III

13. There remain uncompleted certain tasks within the original terms of reference of the Assessment Working Group, and the need for some further studies has become evident during the present meeting. It is therefore desirable that the Working Group continue in existence, and it is proposed that during 1961/62 it should conduct its business by correspondence, and should convene two or three days in advance of the 1962 meeting of the Research and Statistics Committee. The members of the Group are (1, R.S.10):

L.M.Dickie (Convenor)	R. Hennemuth
R.J.H.Beverton	B.B.Parrish
A. Hylen	Ju. Ju. Marty
V.M.Hodder	J.A.Gulland
S.J.Holt	S.A.Horsted
	E. Cadima

The Convenor should be empowered to co-opt or otherwise arrange for the assistance of other scientists for the consideration of specific questions, and observers from other countries would be welcomed. It is earnestly hoped that member governments will do everything possible to enable members of the above-mentioned group to be present.

14. The main tasks of the Working Group during the coming year would be to:

(a) Complete editing of report for publication (edited by persons originally responsible for each section, co-ordinated by Hodder);

(b) Take account of new data, and recent statistics, especially relating to discards, and changes in fishing activity generally, in improving or revising assessments (e.g. in Subarea 1 and Division 4T);

(c) Continue studies on assessing effects of changes in fishing effort;

(d) Develop methods and obtain more realistic estimates for the "immediate losses" as first year changes; study generally the transitional period after a mesh change;

(e) Study the magnitude of possible errors resulting from the effective mesh size actually in use at present, and predicted as being effective in future, being different from that which has been assumed. This study will take into account the annual returns made to the Commission by member countries on mesh size and chafing gear, etc.;

(f) Consider results of analysis of fishing power changes, and their effects on catch per unit effort trends and estimates of mortality rates;

(g) Make assessments for mesh sizes in range 3-inch to 4-inch for redfish and silver hake.

APPENDIX II

Environmental Subcommittee

The subcommittee met 30th-31st May, with the task of reporting to the Research and Statistics Committee on the Report of the Environmental Working Party. This report was approved by the subcommittee on 1st June.

Symposium

It was decided to recommend that the proposals for a Symposium on "The Influence of the Environment on the Principal Groundfish Stocks in the North Atlantic*", to be held over six days (Monday to Saturday) prior to the meeting of the ICNAF Research and Statistics Committee in 1963, be adopted, together with the detailed proposals regarding objectives and topics for sessional contributions set out in Part V of the Working Party's report. The proposals for (a) appointing a Symposium Chairman and Convenors for the eight sessions and (b) the general lines on which the Symposium should be run were also approved; within these lines it is recommended that the Symposium Chairman should have general control of the organization, with the assistance of the Convenors. It is recommended, however, that the original proposal be modified so that an invitation should be extended to ICES to collaborate with ICNAF in securing contributions from scientists experienced in studying the influence of the environment in the fisheries of the northeast Atlantic (as comprised in the footnote below). In detail, it is also proposed that "the Pacific sardine" should be substituted for "the Pacific salmon" as the title for one of the "evening" lectures, and the title of session (b) 3 should be adjusted to refer to "age and size at first maturity". A working group of four, Drs. Bertelsen, Graham (Convenor), Krefft and Templeman, was asked to make proposals, as regards suitable scientists to act as Chairman, Convenors and authors of the four "review" lectures (with alternates), to the Chairman of the Research and Statistics Committee, for final decision and announcement to the Committee. The Chairman of the Research and Statistics Committee is further requested to bear in mind the possibility of funds being required in due course for publishing the contributions to the Symposium and, dependent upon the persons selected and willing, funds also for their subsistence and travel.

Research Programme

The major part of the two meetings was spent in discussing the proposals for environmental research. Doubts were expressed as to whether, in view of present commitments, further work, however desirable, could be undertaken in the near future. In many laboratories an increase of staff and resources, particularly on the environmental sides, would be needed. It was noted, however, with the exception of the proposals for research into the effects of the environment on fish eggs and larvae,

*i.e. comprising the whole ICNAF Area and that of ICES (excluding the Baltic, North and Irish Seas and the English Channel).

that the proposals for research under the five Subarea heads almost entirely concerned research now proceeding or being planned, as also did those under items 5, 6 and 7 of the General Section. The investigations under item 1 of that section were also primarily such as could be undertaken by individual laboratories and in several instances were already in progress or being planned.

It was under items 2-4 of this section that the greatest problems in relation to existing commitments were foreseen, and perhaps particularly in relation to the proposals for fish egg, larval and plankton surveys in relation to environmental conditions. It was suggested that under item 2 (Influence of Currents) member countries should try to solicit the interest of their oceanographic laboratories in securing further information about the oceanic regime of the North Atlantic. Again, the investigation of the overall distribution of redfish in the North Atlantic in relation to temperature, water structure and meteorological conditions (item 4) could doubtless be shared by ICES.

Subsequent discussion concerned (1) the need for an agreed programme of environmental research in the ICNAF Area, within which the existing projects could be seen in perspective and which could be implemented as rapidly as resources and men became available, (2) the improbability of being able to initiate more than one "egg and larvae" environmental survey as early as the spring of 1963, (3) the need for detailed planning of objectives, techniques, etc. in all such programmes, (4) the need to interest "pure" oceanographers in fisheries objectives (and one concrete possibility of doing so), (5) the interesting manner in which the nine-ship ICES survey of the Faeroe-Iceland Ridge had been developed, and (6) the possible use of scientists with specially designed gear on commercial vessels in certain projects.

Following this discussion, the subcommittee <u>recommended</u>:

(1) That the research programme outlined by the Environmental Working Party be approved in principle,

(2) That, with the exception of the "egg and larvae" surveys mentioned there, the programme drafted specifically for Subareas 1 to 5 mainly concerned projects already begun or being planned and should be formally endorsed and adopted,

(3) That items 1, 5, 6 and 7 of the General Section should similarly be endorsed and adopted as reasonable and feasible in the main with present resources,

(4) That the feasibility of initiating the proposed "egg and larvae" environmental survey in Subarea 1 and adjacent waters be explored by the countries concerned with a view to its being initiated if possible in the spring of 1963,

(5) That the Research and Statistics Committee request the Commission to urge on member governments the need to increase, by one means or another, the

resources and manpower available for fishery environmental investigations in the immediate future.

Collection and Exchange of Data

It was noted that the Working Party had been able to finalize its recommendations on this subject in a supplementary report. The subcommittee decided to recommend these proposals to the Research and Statistics Committee.

APPENDIX III

Subcommittee on Statistics and Sampling

Chairman: W.R.Martin

The series of statistics problems listed in items 7 and 8 of the Research and Statistics agenda were considered by four working groups. Their reports are found in Appendix III, 1-4, and are summarized as follows:

A. Statistical Bulletin

1. Conversion Factors (1.III.1)

Although inconsistencies were noted in the conversion factor table in the last Statistical Bulletin (for 1958), it was agreed that responsibility for improvement and reporting of conversion factors rests with member countries. No change is proposed in the present policy of reporting conversion factors annually with statistics submissions.

2. Table 1. Change

It is recommended that Statistical Bulletin Table 1 be expanded to include the species American Plaice, Witch, Yellowtail, Winter Flounder, Wolffish, Pollock, Silver Hake, and White Hake. The Statistics Subcommittee considered this to be necessary because of increasing landings and scientific investigations of these species.

3. Statistical Divisions (1.III.3)

After careful consideration of present knowledge of division stocks of the major groundfish species in the Convention Area, it was concluded that ICNAF divisions are reasonably adequate. It is recommended that no changes be made in the boundaries of statistical divisions.

4. Vessel Tonnage Classification (1.III.2)

It is recommended that tonnage classification of vessels should not be revised until related studies in ICNAF and ICES are completed.

5. Redfish Depth Zones

Attention was given to a proposal from the Assessment Group to examine the possibility of reporting redfish statistics by depth zones. It is recommended that member countries sample their redfish statistics in an attempt to report the distribution of redfish effort in six depth zones from 51 to 350 fathoms for each gear, division and month.

6. Timely Reporting (1.III.1)

Because of rapidly changing fishing operations in the ICNAF Area, it is important to have up-to-date statistics. It is recommended that timely reporting of statistics can be achieved by urging all member countries to submit annual statistics reports before the May 1 deadline, and by providing the Biologist-Statistician with part-time clerical assistance.

7. Prescribed Statistics Forms (ESTANA) (1.III.1)

The statistics forms which are currently being tested for the Continuing Working Party of ESTANA have been found to be unsatisfactory as a means of reducing work either by member countries or at ICNAF headquarters. A series of recommendations listed in Proceedings 1.III.1 is intended to serve as a guide for the Biologist-Statistician who will represent the Commission at the ESTANA Working Party meeting in Washington, D.C., beginning June 6, 1961.

8. Discards (1.III.4)

In spite of the great importance of information on the quantities and sizes of groundfish discarded at sea, it has been difficult to collect useful data. Reporting of discards to ICNAF on prescribed forms has been completely inadequate. It is recommended that special reports on discards should be prepared by each country for the next Annual Meeting. Details of requirements are specified in Proceedings 1.III.4.

B. Sampling Yearbook (1.III.4)

Contributions of sampling data are growing each year, and each new Sampling Yearbook is increasingly useful. It was decided that sampling data would be still more useful if grouped by area, to conform with the Statistical Bulletins. The details of sampling proposals are noted in Proceedings 1.III.4.

C. List of Vessels (1.III.2)

It is recommended that the present prescribed forms used to solicit vessel information be used for the 1962 list. A decision concerning the amount of these data to be published in the next List of Vessels can be deferred to the next Annual Meeting.

D. Fishing Power (1.III.2)

One of the most important problems facing the Commission is assessment of the effects of increasing fishing effort on groundfish stocks and catches. In order to make progress with this problem we must have studies of fishing power and measurement of total fishing effort. Specific studies to be pursued within the next year are recommended in Proceedings 1.III.2.

The studies include development of indices of fishing power from propellor characteristics and operation RPM, proposed at earlier meetings. It is hoped that German scientists will be able to co-operate with Mr. Traung by testing the applicability of these indices to measures of fishing power of some of their vessels operating in the ICNAF Area.

APPENDIX III.1

Statistical Working Group

Participants: Thomas (Chairman), Almeida, Ancellin, Cannone, Hoy (Rápporteur), Krefft, LeBoeuf, Lucas, Martin, Power. Advisers: Dickie, Holt.

The subcommittee met on 29th and 30th May. Three items of the agenda 7a, d and g, were considered and the following recommendations made:

Agenda item 7d - Annual summary report

The group considered the annual summary report on groundfish landings in the ICNAF Area and recommended:

> That the Statistical Committee impress on member countries the necessity of submitting the statistical data to the Secretariat promptly by the 1st May deadline. By so doing, the Secretariat can release summary statistics by divisions at the Annual Meeting, and with additional clerical help the Secretariat believes that the distribution of the Statistical Bulletin can be advanced from 18 to 9 months after receipt of statistics.

Agenda item 7g - Review of conversion factors

The present policy on annual reporting of conversion factors, was believed to meet the requirements, and no changes were recommended.

Agenda item 7a - FAO/ICES/ICNAF combined forms

The group considered the combined forms in the light of the experience gained by two member countries who completed these schedules as a test, and from the point of view of ICNAF requirements. The group found that the schedules are unsatisfactory in their present form and that the following changes with regard to form STANA 1W should be recommended for consideration at the June 1961 meeting of the Continuing Working Party of ESTANA:

1. number of fishing units operating and trips made,

2. average gross tonnage, length in meters and horse-power,

be moved to the first section of the form entitled "Fishing Effort." The items in this section should be reversed to conform with the order of the ICNAF Statistical Bulletin.

The group also recommends:

That the requirements on effort be spelled out in the instructions for the completion of the forms, to indicate that only one of the two items in (1) above is required, while of (2) above, either the length or the tonnage be given in additiontion to horse-power.

The averages in the above items should be given by month and may be either straight averages or weighted averages, but countries should specify which has been used.

With regard to the identification of the units used in lines 1 and 2, the group recommends:

That a note stating the units used be submitted for the data as a whole, thereby making the repeated definition of units used unnecessary.

The recommendations made for the section headed "Nominal Catch" are:

1. That the following order be adopted for the items in this section:

   Cod
   Haddock
   Redfish
   Halibut
   Flounders (stratified by species in the order now given on the schedule, and subtotalled)
   Other Groundfish (detailed by species now listed on the form. A subtotal is required)
   Total Groundfish
   Other Species (these will be detailed on form STANA 2 except in those instances where the fishing effort is directed to one of these species, which will then be written in a space provided, and subtotalled)
   Grand Total (all species)

2. That blank spaces be provided for Flounders, Other Groundfish, and Other Species.

For the submissions on the schedule STANA 2 the group recommended:

That the form of Table 7 of the Statistical Bulletin be adopted, but with statistics reported by division and by month.

APPENDIX III.2

Working Group on Fishing Power

Present: Hennemuth (Chairman), Beverton, Cadima, Dickie, Hodder, Holt, Horsted, Gulland.

A. Gross tonnage classification

The group considered Document No.4, which reviewed the tonnage classification in relation to the frequency distribution of vessels fishing within the ICNAF Area. This document suggested possible revision of some tonnage classes, so that the division lines fall in the troughs of the distribution, rather than through the peaks.

It was the understanding of the group that the countries will be asked to report the actual average tonnage and horsepower of their vessels within these classes, weighted according to the time spent in the various subareas. It was concluded, therefore, that there would be little advantage in the proposed revision, and a serious disadvantage because of the backlog of data already classified by the present system. Furthermore, it was noted that ICES has asked its members to consider reporting their statistics by the present ICNAF system, and changing at this time might be deleterious to the ICES proposal.

The group noted, however, that the groups of vessels at the extremes of the 151-500 ton classification may be more closely related to the neighbouring classes, with regard to fishing power, than to each other. If further studies suggest that fishing power changes within each of the two groups are independent, measurements of the relative fishing power may be more precise by dividing the 151-500 ton class. This aspect should be considered next year in the light of results of contemplated fishing power studies. It was recommended that the tonnage classification not be revised at this time.

B. List of fishing vessels

The group considered the list of vessels over 50 gross tons fishing in the ICNAF Area, issued by the headquarters of the Commission. The information concerning the propeller characteristics of vessels was discussed. The use of this information, combined with r.p.m. data, to classify otter trawlers by factors which may be more precisely related to fishing power than tonnage, has been proposed by Dr. Traung. The value of propeller characteristics depends on the results of the study to be undertaken (see below) based on Traung's proposal. It was noted that Germany, France and Poland had submitted the data, and propeller characteristics of fleets of other countries would also be desirable. Therefore, it was recommended that the present ICNAF forms used to solicit vessel information, which have space for listing propeller characteristics, remain as they are, and that decision to publish such information be deferred to the next Annual Meeting.

C. Fishing power studies

The group discussed the need for, and the development of, indices of relative fishing power of the various fleets now fishing within the ICNAF Area. It was agreed that such indices are needed to determine more precisely the effect of the increasing effort now being applied by various countries and gears. Various possible methods of calculating a "standard" effort within and among fleets were considered. It was reported that the U.S.-Canadian data on vessels which had changed nationality, recommended for study at last year's meeting of the Committee on Research and Statistics, proved insufficient to demonstrate change in fishing power.

It was the concensus that comparisons of catch-per-unit-effort within and among fleets fishing within the same time and area strata (e.g. months and divisions) is potentially the most valuable approach to standardization of fishing power. To this end it was recommended that several specific fishing power studies should be pursued within the next year and reported at the 1962 meeting of the Statistics Subcommittee:

a. Mr. Holt should ask Dr. Traung to utilize existing data on propeller specifications to develop propulsion characteristics, which could then be related to relative fishing power of the fleets.

b. The Lowestoft Laboratory should use the statistical data published by ICNAF to calculate and compare indices of catch-per-unit-effort [illegible] and effort within and among fleets, with special reference to cod, haddock, and redfish. The consistency of these results among the various fleet units, within and between ICNAF subareas and time periods should provide a guide to the value of this approach in developing standards.

c. Mr. Hodder agreed to examine this data dealing with the relative fishing power within the Portuguese and Canadian fishing fleets fishing in Subarea 3.

d. Mr. Hennemuth agreed to assist these studies whenever possible by programming and executing such calculations on computers or by furnishing results of studies of the relative fishing power of components of the U.S. fleet. Mr. Beverton drew attention to the U.K.'s studies of the fishing power of their fleets, which may provide useful guidance to study of similar problems in the ICNAF area, and agreed to furnish records of results, where applicable.

Finally, it was agreed that the progress on these investigations should be reported at mid-year regional meetings of Commission scientists.

APPENDIX III.3

Working Group on Division of Stocks and Smallest Statistical Units

The Working Group met on May 29th and 30th, with Templeman (Convenor), and Kelly and Kohler as rapporteurs, Present: Hansen, Jensen, Kohler, Kelly, McCracken, Ruivo, Templeman, and observers.

The stock division maps requested at the 1960 Annual Meeting (1960 Red Book, Appendix IV, and Report of the Standing Committee on Research and Statistics) were presented for cod by Templeman, for haddock by Jensen, and for halibut by McCracken. Consultation was also made, for cod of Subarea 1, of Document No. 26A by Meyer (Germany), and for redfish, of Document 27B by Travin et al. (USSR). The information available on the divisions of the stocks was discussed in detail in relation to the statistical divisions.

The committee found that the ICNAF divisions agreed reasonably well with stock divisions as presently known. Some large stocks are spread over several divisions, but statistics for these divisions are valuable for research. Even in a stock which mingles widely, such as the cod of Labrador and eastern Newfoundland, there may be growth rate and other differences in different sections of the stock. In some cases, as for example the haddock of Divisions 3N and 3O, it appears to be possible to combine the area for many biological purposes, yet in one season the catch may be mainly in one division - haddock in 3N for example, mainly in summer, and in 3O in spring. Thus it is convenient to retain the divisions.

Other divisions, such as 3L for cod, contain parts of the fringes of several main stocks and contain other stocks, which intermingle considerably at various seasons of the year. It was concluded that it is often impracticable to gather statistics of separate individual stocks of such a mixing region. Biologically, however, the stocks can often be separated seasonally, and in 3L vertebral averages often help to assign the particular cod sample to its appropriate stock. In some other areas, such as 3Pn and 4Vn, a stock (in this case, cod) from a more northern division may mainly occupy the area in the winter season and be replaced in the summer time by the stock from a more southern division. Thus statistical, and other information on stocks, should be available by months.

For halibut and redfish, it would be advantageous not to have division lines running through deep channels between banks, but these deep channels usually separate cod and haddock populations relatively effectively. For redfish, the southern division between 3N and 3O is in the middle of a heavily fished stock, but this division is necessary for haddock and cod.

After discussion, species by species in relation to ICNAF divisions, it was concluded that different statistical divisions for different species are impractical and that, on present knowledge, the ICNAF statistical divisions are reasonably adequate.

The Working Group, therefore, recommends that no changes be made in the boundaries of the ICNAF divisions.

Copies of stock division maps submitted to the meeting for cod and haddock, and a distribution map for halibut, are deposited at the Secretariat. The stock division information on redfish is contained in Document No.27B.

APPENDIX III.4

Working Group on Sampling and Discards

Present: Jónsson (Chairman), Thomas, McCann, Edwards, Rodriguez, Lyles, McCracken, Gulland (Rapporteur), Horsted, Lawler.

The group met on 30th May and considered the Sampling Yearbook for 1959, and welcomed the considerable increase in data presented in this report compared with previous years. It considered that these data would be more convenient if samples from the same area taken by different countries were tabulated together, and recommended that the order of breakdown should be: species, area, gear, country, month. The group also considered that summary tables giving the total numbers of fish of each length caught by each gear in each division during the year would be helpful, and recommended that the Secretariat should consider the feasibility of producing such tables.

The group noted the gaps in sampling data found by the Assessment Group (section 13.2.1), welcomed the steps being taken to fill these gaps (Canadian halibut measurements, and observations to be made on Spanish pair-trawlers), and urged most strongly that the countries concerned should take action to fill the remaining gaps.

The group noted that a standard form for reporting discards had been used for the 1960 statistics, and that some difficulties had been experienced. In order to reduce these difficulties, the group recommended that in place of these forms each country should prepare, for the 1962 Annual Meeting, a report on the discard practice in its fisheries. This report should give an account, not only of the proportion discarded and the methods used in estimating this proportion (direct observation at sea, fishermen's log books, comparison of commercial landings and research vessel catches, etc.), but also of the relevant practical conditions. These last should include a short description of the handling of the fish on board (particularly to show whether discarded fish could survive), and the various reasons for discarding (small fish, small fish only for the earlier part of the trip, all sizes of fish still on deck when the next haul arrives, etc.). Particular attention should be given in the account of each fishery of the treatment of major ICNAF species (especially halibut) other than those species forming the main objective of the fishery.

APPENDIX IV

Working Group on Gear Research and Selectivity

The Group met on 30 and 31 May. Present were: McCracken (Chairman), Ancellin, Beverton, Cadima, Edwards (Rapporteur), Hodder, Holt, Horsted, Hoy, Jónsson, Rodr. Martin, Power, Ruivo, Skerry, Silliman and Templeman.

Review of Data on Mesh Selection

The Chairman reviewed the tabulation of selection data submitted by various countries bringing the available information on mesh experiments up to date. The group felt that the Secretariat should compile this data, perhaps following the lead of ICES, and distribute the tabulation as a document. Such a consolidation will assist in the planning of future selectivity research and provide valuable data for future work on assessment.

Document No.7 (v. Brandt) on redfish selectivity studies was reviewed and discussed. The almost linear relation between the size of haul and the selection factor was especially noted - the selection factor decreases as the catch increases.

Document No.28 (Boulanger) on cod trap selectivity studies was reviewed. The sharp selection curve was particularly noted, as well as the high selection factor of 4.3 for a 4.5" nylon mesh.

There was considerable discussion about the availability of certain cod data such as weight-length relations and girth measurements. Such data will be useful in future mesh assessment work and accordingly it is recommended that each country prepare, in document form for the next meeting, a report listing the weight/length and girth data available for cod specifically and for any other species where possible. The reports should include pertinent comment concerning the techniques employed to obtain this data - e.g. where work was done (at sea or ashore), and condition of fish (fresh, iced, round, gutted, etc.).

The lack of selection data from factory ships in particular was noted. The possibilities for obtaining such data were discussed but no immediately practical scheme could be devised. Rodriguez indicated that an effort would be made this year to obtain some information on selection by pair-trawl gear.

It was the concensus of the group that the use of multiple-layered cod-ends was decreasing rapidly due to, at least in part, the introduction of stronger synthetic materials and greater use of double twine. Beverton remarked briefly on a recent ICES paper concerning the selection properties of multiple-layered cod-ends.

Beverton reported that a draft prepared by the ICES Selectivity Working Group on synthetic twines would soon be completed. The group urged Beverton to keep the

ICNAF Secretariat informed of the progress of the draft so that it will be possible at the proper time to obtain additional copies in sufficient quantity to serve the purposes of ICNAF.

Mesh Gauges

Templeman reported on experiments carried out by his laboratory comparing the relative usefulness and precision of each of three gauges - the ICNAF, Scottish and the Westhoff 1959 Gauge (described by Bohl in Document No. 23). The data and results are presented in Document No. 35. In order of decreasing reliability and precision, the three gauges rank as follows: 1) Westhoff, 2) Scottish, and 3) ICNAF.

The group felt that Templeman's work more than justified the expeditious adoption of the Westhoff gauge as the standard tool for ICNAF's research purposes. Beverton, however, informed the group that ICES had as yet accepted the Westhoff gauge only as an interim standard. Final decision has been put off until this fall (1961) when the Comparative Fishing Committee of ICES will consider whether a modified version of the present Westhoff gauge should be adopted as a final standard. The modified gauge has been greatly simplified and, it is believed, improved in several features. The modifications include 1) simplification of the frame with scales in both inches and millimeters, 2) the pressure locking mechanism operates directly from one of the jaws, and 3) three ranges of measurement are possible, enabling easier handling of the instrument. This new gauge is presently being examined and tested by Parrish, von Brandt, and Roessingh. There is no exact information available on cost, although Beverton feels that once in production the costs will be substantially lower than the cost of the initial instrument which was about £50.

It developed that ICES has adopted a pressure of 3.5 kilo. (7.7 lbs.) as a standard. The prescribed pressure for the ICNAF gauge is 10-15 pounds (4.5 to 6.8 kilos.) The obvious desirability of having a standard pressure for both the ICES and ICNAF gauges was discussed. It was pointed out that the lower extreme of the ICNAF pressure range, i.e., 10 pounds or 4.5 kilos., was not greatly different from the ICES pressure of 3.5 kilos.

It is accordingly recommended that Templeman consider the possibility of extending his already excellent experimental studies with the Westhoff gauge (1959 model) to include an analysis of the comparative effects of pressures between 7 and 12 pounds on mesh size measurements for various materials. These data would make feasible a consideration of a possible standardization of ICNAF and ICES gauge pressures.

It is further recommended that ICNAF adopt, as quickly as available, as a research tool, whichever Westhoff gauge is finally chosen by the Comparative Fishing Committee of ICES, and that the Chairman of that Committee notify ICNAF countries through the Secretariat of ICNAF their final decision and provide information about the availability and cost of the chosen instruments.

Chafers

Beverton reviewed recent research on flap-type chafers by both the U.K. and Norway. Both experiments yielded identical and well-defined results. It appears that multiple flap chafers, if properly applied have little, if any, effect on selection regardless of the mesh size of the chafing gear. He also reported that the Permanent Commission had requested a survey of chafing gear usage by country. The Chairman noted that each year the ICNAF Commissioners received a report on the current use of chafing gear and that this material did not normally receive attention by the Research and Statistics Committee. He suggested that the group concerned with Gear Selectivity consider this document at next year's meeting to determine the present status of chafing gear, the trends in its use or non-use, and the reasons for any significant changes.

Posters and Other Educational Material

The discussion of the proposed poster illustrating the mesh regulation developed into an extended discussion of the entire problem of fisherman education. In general the group felt that much could be done along various lines and that it needed doing. Many possibilities were discussed including leaflets, films, posters and lectures. Problems associated with different national interests and attitudes were noted. It is recommended that any and all appropriate educational material concerning the mesh regulation, its principles, rationale and goals, be brought to the next Annual Meeting so that the subject of a poster or other methods may be more fully and effectively explored.

Other Items

The proposed U.S. experiments to attempt to effect species selection by taking advantage of differential behaviour were briefly described. Previous studies with UTV allow cautious optimism for the proposed attempt to allow haddock to escape while retaining silver hake. Any results obtained will be brought to the attention of the Research and Statistics Committee at the next Annual Meeting.

APPENDIX VA

North Atlantic Fish Marking Symposium

1. Preparation

The Working Group on the Marking Symposium, at the 1960 Meeting in Bergen, drew up a prospectus of the Symposium, emphasizing that the main theme would be on techniques, both practical and theoretical, and outlining a division of the subject matter under three main headings (Red Book, 1960, pp.18 and 19).

This prospectus was sent by the Secretariat to all ICNAF organizations and laboratories inviting contributions and participation. At the request of the Working Group, the Convenor also invited contributions and participation from a number of other people and organizations not normally present at ICNAF meetings. The response to this was most encouraging; a number of valuable contributions were received from these outside sources, and we were fortunate to have at the Symposium representatives from several organizations where tagging methods are used extensively in their research programmes. In all, a total of 62 contributions were received, nearly all specially written for the Symposium, and covering between them many aspects of the use of tagging methods, both practical and theoretical, in fisheries research.

2. Arrangements during the Symposium

In view of the large number of contributions, it was decided not to have papers presented formally. Instead, an agenda was drawn up and contributions, or relevant parts of contributions, were assigned to each agenda item. Thanks to the co-operation of the speakers in following out this plan, the scope of the discussion kept within the agenda item with scarcely any intervention by the Chairman.

Two rapporteurs were assigned to each of the six agenda items, as follows:

1. METHODS AND EFFECTIVENESS OF MARKING, TAGGING AND TAG RECOVERY

   1.1 Effectiveness of various types of marks, tags and attachments
   (Rapporteurs; E. Bertelsen and V.M.Hodder)

   1.2 Influence of fish condition, method of capture and handling, sea conditions etc. on return rates: tagging mortality
   (Rapporteurs: A.C. Jensen and R.L.Fritz)

   1.3 Estimating and Improving the Recovery of Recaptured Tags
   (Rapporteurs: F.D.McCracken and A.C.Kohler)

2. ANALYSIS OF RESULTS OF TAGGING EXPERIMENTS

2.1 Estimating Growth
(Rapporteurs: S.J.Holt and R.C.Hennemuth)

2.2 Estimating mixing, dispersal and migration; identifying stocks
(Rapporteurs: L.M.Dickie and W. Templeman)

2.3 Estimating population size and mortality rates
(Rapporteurs: J.A.Gulland and E.D.Le Cren)

3. Report of the Symposium

This is covered, for each agenda item, in the reviews by rapporteurs. The subject matter of particular and immediate relevance to tagging programmes in the ICNAF Area is outlined in the report of the Working Group on Tagging Programmes.

4. Concluding Remarks

Both in the preparatory stages and during the Symposium itself, I gained the impression that this Symposium, devoted essentially to techniques of tagging, was fulfilling a very definite need at the present time. The collected papers of the Symposium constitute, in my opinion, a valuable contribution to methods, ideas and experience in the field of tagging, and I sincerely hope it will be possible to implement the recommendations of the Working Group concerning their publication.

I would like to place on record my appreciation of the excellent work done by Dr. Herbert Graham and his staff both before and during the Symposium; to the ICNAF Secretariat for duplicating the papers - many of them at the last minute; and to the rapporteurs, and especially S.J.Holt, in helping to plan the agenda and record the proceedings.

R.J.H.Beverton
Chairman

APPENDIX VB

Working Party to Consider the Marking Symposium

Present: Beverton (Chairman), Hennemuth, Dickie, McCracken, Templeman, Jensen, Kasahara, Holt, Horsted, Bertelsen, Hodder, Gulland, (Rapporteur).

1. A general account of the papers presented at the Symposium, and the accompanying discussions, is given in separate reports by the rapporteurs on the six items into which the agenda was divided (Appendix VA). This report is concerned only with drawing attention to particular items on which scientists in the ICNAF Area may wish to take action. The group wishes to emphasize, however, that it has not been possible so far to do full justice to the material of the Symposium in relation to the programme of tagging in the ICNAF Area. The group therefore felt that the Committee on Research and Statistics might wish to consider further the results of the Symposium at their 1962 meeting, by which time its members will have had the opportunity to study in detail the contributions and reports and to consider more fully their relevance to future tagging programmes.

2. Type of Tags

A tag firmly attached in the dorsal position (not to the gill-cover) seems to be best for cod and similar species. It was noted that some countries will be making comparisons between the most promising tags (Petersen discs and/or spaghetti tags) with the types of tag they normally use. Stainless steel seems to be the best generally used attachment, but tantalum might be better and should be tested. Internal tags (e.g. strips or long ribbons, in fluorescent colours) would be useful, especially for small fish, and should be tested at least where the possibility of recovery is good. In making tests, the comparisons should be kept simple (e.g. not altering both type of tag and method of attachment at the same time); some comparisons (e.g. gill-cover versus dorsal attachment) can be done most easily and effectively by double tagging experiments.

3. Condition of Fish

The grading of fish at the time of tagging into best quality and less active, or slightly damaged fish, is a useful technique, giving added information to help in analysis of results. Other factors which may affect the return rate include water temperature, infestation of tagged fish by parasites, time between capture and release, and damage to swim-bladder.

4. Recovery

While it is important that the efficiency of recovery and return of tags in the ICNAF Area should be improved (particularly for those countries in which it is apparently low), it is also important that any improvement achieved (e.g. by fuller publicity, lottery, etc.) should be measured (e.g. by "seeding" the catch with a known number of tags before and after the introduction of the new publicity).

5. Mixing of Stocks

Useful techniques, other than conventional tagging, are being developed (e.g. blood-groups, etc.) which may be particularly helpful for studying the movements of small fish.

6. Mortality Estimates

Several methods were described, especially those using fishing effort data, which are directly applicable to situations in the ICNAF Area. For instance, one method is already being applied to the Georges Bank scallop tagging data to give a better estimate of fishing rate on this stock.

7. Co-operation in Tagging Studies

While the group did not wish to recommend any specific programme at this juncture, it did feel that a greater degree of co-operation in both the actual tagging and analysis is desirable.

Information on when, where and how fish are being tagged should be made available as soon as possible. It was recommended that lists giving data on all taggings should be circulated to the Secretariat and all member countries, with summaries given in the annual reports. It was felt that it would be useful to adopt a standard form giving type of tag, species, serial numbers, and time and position of tagging, for such lists. Data of releases of sea-bed drifters should be included. It was also recommended that where new types of tags are used, posters and other information should be circulated to all countries likely to recapture such fish.

When more than one country has tagged fish in an area, and especially when the numbers tagged by one country is small, it was strongly recommended that countries be encouraged to pool their data and make a co-operative analysis of their results.

8. Standardization of Terminology

It is recommended that as far as possible the following terminology should be used when describing the results of tagging experiments:

releases:	the (number of) fish tagged and released;
recaptures:	the (number of) tagged fish caught;
recoveries:	the (number of) tagged fish detected, by fishermen or in any other way;

reports: the (number of) tagged fish concerning which any information reaches the tagging organization sufficient to establish that they have been recovered;

returns: the (number of) reported tagged fish or tags which are eventually returned to the tagging organization, or the existence of which is fully authenticated.

It will be noted that the (number of) fish in each category includes those in all lower categories (e.g. all recoveries are recaptures, but not the converse).

9. Publication

The group strongly recommended the prompt publication of the papers and reports of the Symposium. A small editorial committee was proposed, which would divide the task between them: Graham (for U.S. papers), Templeman (for Canadian papers) and Beverton (assisted by Gulland) (for all other papers). It is proposed that a circular letter to all authors should be issued as soon as possible by this editorial group, in which it will be requested that authors should return papers, amended as necessary, to the appropriate editors not later than July 31st.

APPENDIX VI

Subcommittee on Ageing Techniques

A report of Subcommittee on Ageing Techniques is printed as Appendix X on page 37 in "The Red Book" for 1960. It is a brief description of what had been done up to that time. An exchange of cod otoliths had taken place and a questionnaire concerning the reading and interpretation of zones in otoliths had been circulated. The answers received had been compiled and tabulated by the Secretariat. In the opinion of the Subcommittee the results were very promising and it was therefore recommended that a Working Party should be established to guide further arrangements and studies. This Working Party was especially urged to study (1) Techniques used in age readings, (2) Interpretations of zone structures in otoliths, and (3) to decide on a uniform set of terms and symbols with definitions for the study of otoliths.

It was recommended that otolith data and studies should be continued, so far as possible by correspondence, and that a scientist should be asked to co-ordinate these activities and present to the Working Party a draft proposal on a standard set of terms, definitions and symbols generally acceptable to his colleagues in other countries, to serve as a basis for a proposal by the Working Party.

Mr.A.C.Jensen of Woods Hole kindly agreed to supervise the work and at this meeting the results are laid down in Documents No.37 and 39.

In two sittings on June 6 and 7 the Subcommittee on Ageing Techniques studied and discussed these documents entitled "Problems in developing a Standard Terminology for Ageing Techniques" and "A Standard Terminology and Notations for Otolith Age Readers."

Agenda:

1. Discussion of Documents Nos. 37 and 39.
2. Continuation of cod otolith exchange for certain areas and/or certain problems?
3. Continuation of halibut otolith exchange and start of an exchange of redfish otoliths?
4. The need for study of the influence of physiological and environmental factors on growth and structures in otoliths.
5. Preparation of an Agenda for the Working Party to be presented at the next Annual Meeting.

Item 1. Discussion of Documents Nos.37 and 39

The Subcommittee expressed its appreciation to Mr. Jensen for his selection of terms, definitions and symbols and his reasons for their choice.

The Subcommittee made the following comments on the definition of spawning zones:

For certain reasons it was suggested that the definition should read "Hyaline and opaque zones or checks formed in the otoliths from the onset of maturity."

It was, however, regarded of great value if a more detailed definition was given for the spawning zones occurring in the otoliths of the Arctic cod.

As to the type of edge growth and the recording of narrow or wide hyaline or opaque zones, it was felt that the effect of variations in growth conditions should be borne in mind.

As to the age assignation the Subcommittee is in agreement with Mr. Jensen when he underlines that this is a problem which must be solved by the biologists directly concerned.

It was observed that referring the age either to the calendar year or to the spawning time will or may have an influence upon the empirical growth curve. It was also mentioned that the opaque zones often appear earlier in the year for immature fish than for spawners. In such cases, separate age assignation tables like Table 1, page 4, in Document No. 39, should be used for immature and mature fish. In some cases (redfish) even separate tables for the two sexes might be necessary.

Item 2. Continuation of cod otolith exchange for certain areas and/or certain problems.

It is recommended that the exchange of cod otoliths should continue with special regard to the recognition of spawning zones in populations spawning in different seasons and different areas. Small (10-20) random samples accompanied by the usual data should be sent to and circulated by the Secretariat. Readers should comment upon them in turn. If possible, photographs of single otoliths would be very useful and the earmarking of otoliths regarded as A - excellent or D - poor could be of great help for readers in difficulty.

Item 3. Continuation of halibut otolith exchange and start of an exchange of redfish otoliths.

It is recommended that such exchange take place following the same system as used for cod otoliths. It was further regarded to be very valuable if the Secretariat approached the Halibut Commission and asked if this Commission was interested in an exchange programme of halibut otoliths and/or if the Commission was willing to supply ICNAF with information on otolith techniques.

Item 4. Needs for Study of the influence of physiological and environmental factors on growth and structures in otoliths.

The Subcommittee calls attention to the potentially high value of tank experiments. Two types of experiments were suggested: one attempting to clarify the formation of zone structure in otoliths from areas where age readings are difficult and another with the aim of identifying causal factors resulting in the periodic appearance of the zones in otoliths.

For some fish species it is evident that the repeated pattern in otoliths reflects the annual life cycle of the individual fish, for other species there may still exist some doubt as to the origin of the repeated pattern. Scientists within reach of accommodations and facilities enabling them to undertake tank experiments under controlled variable conditions should be asked and encouraged to plan and start experiments with suitable fish species.

Item 5. Draft Agenda for the Working Party

A. Techniques

1. Technique of reading (handling, lighting, staining, etc.)
2. Validation practice and theory.
3. Problems in establishing objective criteria for technicians engaged in routine readings (training, control, etc.).
4. Use of similar structures (e.g. spines of sharks - other bones).
5. Experimental techniques (e.g. use of lead acetate or versenate to mark structures in living fish).

B. Structure and Development

1. Otolith structure (general and special variations).
2. Physiology of otolith formation.
3. Causal factors affecting normal change in internal otolith structure (zone formation).
4. Abnormal development (other than periodic changes) as a result of tagging, disease, etc.

C. Structural Variations

1. Structural differences of different stocks, their validity etc.
2. Differences associated with long-term environmental changes.

Convenor Dr. Rollefsen (elected at the Commission's meeting in Bergen) was asked to contact institutions where age reading is undertaken to receive names of persons directly concerned, or of scientists regarded as specialists in this field. The

Convenor should ask for possible amendments of the Agenda and for contributions to the Working Party.

According to the decision of the Commission at the meeting in Bergen, and revised at this meeting, the Working Party shall meet in Bergen at the Institute of Marine Research in the autumn 1962. Date, time and necessary arrangements will be discussed at the next annual meeting. The final report should be presented at the meeting of the Commission in 1963.

2. Report of Regional Meeting of ICNAF Scientists

Woods Hole, Massachusetts, December 14-16, 1960

Dr. Graham acted as Chairman and J.L.Hart and J.B.Skerry as reporters. A list of participants is attached as Appendix I.

Sea Scallops

Merrill reported on the distribution and abundance of sea scallops in the area from Block Island to Cape Hatteras as determined by eight transects and supplementary drags made on recent surveys by the research vessel Delaware. This area, which lies south of the ICNAF Area, is a consistent producer with a 14-year average of about 3-3/4 million pounds. Scallops were found between 20-40 fathoms subject to bottom type and temperature. The positions of local concentrations is variable because of the transfer of larvae by along-shore currents in contrast to the closed circulation of Georges Bank.

Bourne reported on the Canadian scallop fishery and research. The Canadian fishery reached an all-time high in 1960, despite certain restrictions on fishing. The large landings were the consequence of a large year-class of scallops on Georges Bank and fishing practices adapted to take advantage of it. Log books have been placed on all boats with reasonable success. On trips aboard commercial vessels large numbers (up to 30%) of clappers and dying shells were noted. Clappers persist for at least 100 days. A decrease in the fishery from present levels is forecast and a falling off in catch is already observed. Two Canadian boats that were equipped to use 4-inch rings for experimental work have continued to use this gear commercially. A study of scallop larvae is being undertaken at the St. Andrews Laboratory.

Posgay reported on the status of the U.S. scallop fishery and on research conducted by U.S. biologists. U.S. landings of sea scallop meats from Georges Bank from May 1959 through September 1960 have been largely assigned to the year-class which was recruited to the fishery during 1959. This year-class made up about 90% of the catch on the most heavily exploited ground. This ground, in the vicinity of 41°00'N., 67°30'W., yielded 13.4 million pounds of meats between April 1959 and September 1960, 42% of the total U.S. landings from Georges Bank during the same period.

Quantitative research vessel samples collected at one point within this area in May 1959 and May 1960 show that total abundance was reduced 85% during the year. During the same period landings per day spent on the grounds rose from about 2,200 pounds to about 3,600 pounds. It, therefore, appears that landings per day spent on the grounds cannot be used as a reliable index of abundance. Some of the increase in yield per unit of effort was caused by changes in fishing practices and the enlargement of crews which in effect increased the number of scallops which could be shucked per day, but most of the increase was the result of growth. The average weight of meats realized from shucking 100 sea scallops rose from 3.4 pounds in July 1959 to 6.1 pounds in August 1960. This indicates the maximum potential benefit to be expected if the size at first capture were to be postponed one year. The natural mortality rate, measured by the clapper:live shell ratio was low; about 8% per year and the growth rate somewhat higher than the average for Georges Bank.

In a sedentary organism like the sea scallop, studies must be conducted in many scattered areas and over a period of time in order to obtain information pertinent to the fishing bank as a whole. Sufficient growth rate studies have now been made to provide a good average picture for the entire bank. There are no great differences on the various important fishing grounds. Mortality rates are now available for some heavily fished areas and programs under way will provide information for other areas so that an average estimate will be available for the entire bank.

Cod

Martin opened discussions of the studies of the cod fishery in Division 4T.

Characteristics of the ICNAF cod fishery are changing in response to increased fishing pressure. Landings are increasing and abundance of large fish is decreasing. A comparison with the Northeast Atlantic indicates that further increases in fishing will produce still greater landings and still lower abundance of large fish.

The cod fishery of ICNAF Division 4T is changing rapidly. Increased otter trawling by Canadian and European fleets has doubled landings to about 100 thousand metric tons per year. Catch per unit of effort by Canadian draggers has been cut in half in 10 years and sizes of cod landed have decreased significantly (less than 2% of the fish caught are now over 70 cm in length).

Jean reported on results of research vessel surveys since 1957. These show that natural factors such as recruitment, growth, and water temperature cause year-to-year variations but do not account for the downward trend in landings of cod per unit of effort in Division 4T in recent years. Smaller fish are being caught and a larger proportion of scrod are retained for landing. As a result, discards have remained at about the same level - 10 to 15% by numbers and 5 to 7% by weight - since the introduction of 4-1/2-inch mesh cod ends in 1957. No appreciable change in sizes of cod landed from Division 4T is anticipated for 1961.

Dickie reported on analysis of the Division 4T cod data for the period 1947 to 1958. Catch curves were prepared for the earlier and later parts of this study period. The data for the two different fisheries, otter trawl and hook and line, were analyzed separately. The analysis of the otter trawl data presented the classic picture of increased fishing pressure on the stocks. There has been a decrease in catch per unit of effort with an increased total catch, along with a decrease in the average size of fish landed and an apparent increase in total mortality. These data have, however, inadequately represented the total stock, particularly in the earlier years when most of the catch was made by hook and line, which gear catches larger average sizes of fish. A preliminary analysis has been made of hook and line data. These data must be taken into account to assess effectively the full influence of the fishery on this stock of cod.

May reported on the results of tagging studies on the cod population which is line-fished in winter at Isle au Morts (Division 3PN). This fishery depends on fish which immigrate to the area from the Gulf of St. Lawrence (Division 4R) in autumn and return to the Gulf in May. The small stock remaining in the area during late spring and over the summer contains many spring migrants from Burgeo Bank (Division 3PN).

Haddock

Hodder reported on the status of the haddock fishery in Subarea 3. Since 1955, when the peak landing of haddock was 104 thousand tons, the decline in annual landings has been very rapid to 35 thousand tons in 1959 with Spain and Canada together taking approximately 90% of the total. Research vessel surveys for the period 1951-1960 indicate that the haddock fishery has depended on the progression of dominant year-classes through the fishery. The very abundant 1949 year-class was largely responsible for the high level of the landings during 1955 to 1957 - 90% by number in 1955, 78% in 1956, and 52% in 1957. In 1958 the dominant year-class present in the landings was that of 1952 (47%), but the 1949 brood still contributed a very significant quantity (26% by number). By 1960, however, the landings were dominated by the 1955 year-class. In view of the scarcity of large fish of year-classes previous to 1955 and the evidence of no significant survival of year-classes since that of 1955, it would appear that at the present level of fishing the annual landings must inevitably continue to decline and remain at a very low level unless strong year-classes appear in the very near future. Discards dropped in 1958 with the use of 4-inch mesh cod ends but increased again in 1960 with the appearance in catches of the 1955 year-class.

McCracken reported research on haddock in Subarea 4. Examination of Subarea 4 haddock landings and recent haddock survey results showed relatively stable landings now taken largely by otter trawlers. Decreased size composition of landings reflected acceptance of smaller size by industry; decrease in numbers of large fish; and recruitment of relatively large year-classes. Average size at age for haddock has decreased between 1948-1959 and evidence suggests a decrease in growth rate. Research vessel haddock catches show poor recruitment of 1958 and 1959 year-classes and suggest decreased landings in the immediate future.

Dickie reported on mortality studies of Divisions 4V and 4W haddock. Data for this fishery from 1947 to 1958 show that despite the progressively slower growth rate, catch per unit effort has increased. This is associated with the acceptance of smaller haddock by the market and recruitment of the strong 1952 year-class in 1956 and 1957; effects which have led to a general increase in total landings, despite an apparent small drop in fishing effort. Mortality estimates have been compared with effort levels, and while the results suggest some effects of fishing, the correlation between them is very low. Some further studies directed at partial explanation of this variability are contemplated.

Skerry reported on young-of-the-year haddock surveys in the Gulf of Maine and Georges Bank for the years 1958, 1959 and 1960. These surveys based on 30-minute tows indicate that young haddock inhabit nearly the same areas from year to year but in varying numbers. No significant environmental changes were noted. The number of young-of-the-year taken per tow in the area were 18.8 in 1958, 16.5 in 1959, and 3.9 in 1960. It is expected that fair to good scrod catches will be landed in 1961, but the landings of scrod in 1962 will be poor.

Jensen reported on the Subarea 5 haddock fishery. Around 1950 the fishery changed from one for large haddock to scrod. The fishery reached an all-time general low in 1959. Recently, the situation has improved with increasing scrod landings as a result of the large 1958 year-class. This year-class is expected to maintain the fishery for at least another year.

Effects of Environment

Brunel reported on vertical distribution of cod in relation to food organisms. Six trawl hauls of 1-hour duration were made at the same locality, in a rather constant hydrographic and benthic environment, over a 24-hour period, twice a month from May 19 to August 29, 1960. There was no clear-cut difference between day and night in cod food, i.e. in the proportion of pelagic and benthic prey and in the frequency and abundance of these preys. But, at least twice as many codfish were caught at night as in the day on July 25 and after, and small (31-50 cm) cod were less abundant at night than medium-size (51-70 cm) cod in July, suggesting vertical migrations of the diurnal type. Correlations between cod catch and proportion of benthic prey to pelagic prey in the stomachs in June suggest another type of "feeding vertical migrations" of limited extent in depth, unrelated to day and night, when cod feed heavily on euphausiids in the absence of herring. A similar correlation on August 29 must be attributed to herring, which is also the only pelagic prey in the stomachs at other dates where correlations are only partial or absent. Herring would also attract cod to pelagic feeding, but the pattern is much less clear than for euphausiids. Small cod appear to feed more exclusively on bottom prey than medium-size cod.

Marak reported on the drift of cod eggs and larvae from the spawning area on the northern edge of Georges Bank. These studies based on surveys made in 1953, 1954 and 1956, show that spawning areas can be deduced from plankton surveys and that there is some indication of a relation between drift pattern and strength of year-class.

Jensen reviewed research results on Subarea 5 cod with emphasis on the division of the stock into four recognizable divisions.

A subcommittee to make suggestions to North American representatives at the forthcoming meeting on environmental studies submitted the report attached as Appendix II.

Yves Jean of the St. Andrews Laboratory, A. May of the St. John's Laboratory and A. Jensen of the Woods Hole Laboratory met to standardize methods of preparing charts presenting data on cod biology in their respective areas.

Co-Operative Haddock Program

Biologists of the St. Andrews Laboratory and the Woods Hole Laboratory reviewed the co-operative program for Subarea 4 haddock. It was noted that the exchange of interview data and otoliths is continuing satisfactorily and that the U.S. will presently have a report on changes in the Division 4X haddock populations resulting from the use of these data. Since the Canadian fishery in this division is changing from a line trawl fishery to an otter trawl fishery, Canada will sample the otter trawl landings as well as the line trawl landings.

Assessment Working Group

Beverton gave a report outlining the progress made during two days of special meetings preceding the general session.

For the meeting to be held in Lowestoft in March 1961, it was decided to take as first priority the preparation of a final report covering essentially the scope of the Progress Report submitted to the Bergen meeting, i.e. assessment of effort of various mesh sizes at current effort levels. Fresh data are now available for several fisheries and plans were made to use corresponding assessments to be revised in readings for consideration at the Lowestoft meeting. Arrangements were also made for the preparation of tables and data for inclusion in the final report.

Attention was given to the remaining tasks set to the Working Group, in particular, that of assessing the effect of mesh increase at fishing intensities other than those operative at the present time. A method was presented for making such assessments from length composition data which has the advantage that the assessment of mesh size can be made in the same way for any postulated level of effort. It is hoped to use an electronic computer for the rather lengthy calculations involved. If the results are available in time for the March meeting they will be incorporated in the final report; otherwise, they will be made the subject of a separate statement to the Research and Statistics Committee in June.

Evening Lecture

Dr. Paul Galtsoff gave an evening lecture on "The Concept of Prosperity in Marine Ecology," an abstract of which is attached as Appendix III.

Small Haddock Problem

Edwards reported on small haddock taken by the specialized silver hake, industrial, and animal food fisheries which have grown by more than twentyfold since 1950. The three fisheries have taken some 9 million pounds or 17 million haddock in three years. This represents a potential loss of some 34 million pounds of haddock available for food fisheries. Experimental fishing indicates that capture of part of these haddock could be avoided. The effects of possible minimum size regulation and seasonal closure of nursery grounds is being studied.

Resource Management

Brackett reported on enforcement. Exemption provisions are realistic but the special small gear vessels provide enforcement problems because, among other things, it is difficult to establish the source of fish as within the area of Federal jurisdiction. Minimum size limits at 15 inches associated with exemption provisions should be considered. This would be partly self-enforcing. Preliminary approaches to arranging complementary state regulations are promising.

McCracken aired Canadian problems in enforcement. There is no evidence from fish size of mesh regulation infractions. The application of chafing gear can impair the effects of mesh regulation and in some areas it is not properly used.

Martin pointed out that scientists should be well informed on the variability of mesh sizes and types of twine in cod ends, use of chafing gear, and discards at sea. This is essential background for mesh assessment studies. It was agreed that scientists must advise Commissioners on regulation problems, but they should not be involved in actual enforcement problems.

Beverton discussed European experience with gears down to half-inch and the various dilemmas involved. The Northeast Atlantic Fisheries Convention will go beyond mesh size and fish size to include recognizing nursery areas and other additional controls. Size limits serve two purposes: (1) as an adjunct to mesh size, and (2) to disentangle mixed fisheries. The minimum size should be set at the 50-percent point. Fisherman reaction must be considered and anticipated if possible. To meet the need we must know current catches and practices. Study must be given to how the fisherman can accommodate to conform to new regulations. Flappers as chafers do not affect selectivity. He wondered whether chafers are really necessary. There is an international enforcement officer who reviews enforcement procedures upon invitation.

List of Participants

APPENDIX I

CANADA

St. Andrews
- Dr.J.L.Hart
- Dr.W.R.Martin
- Dr.F.D.McCracken
- Dr. Neil Bourne
- Dr.L.M.Lauzier
- Dr. Yves Jean
- Dr.L.M.Dickie

St. John's
- Dr. W. Templeman
- Mr.V.M.Hodder
- Mr.A.W.May

Station de Biologie Marine, Grande-Riviere, Quebec
- Mr. P. Brunel

UNITED KINGDOM

Fisheries Laboratory, Lowestoft
- Mr.R.J.H.Beverton

UNITED STATES

USFWS, Washington, D.C.
- Mr. R. Silliman

Office of Statistical Services, Gloucester
- Mr.L.H.Couture

Resource Management
- Mr. L. Brackett

Office of Naval Research
- Mr.M.C.McLean

Woods Hole Oceanographic Institution
- Mr. D. Bumpus
- Mr. M. Howe

Woods Hole Biological Laboratory
- Dr.H.W.Graham, Chairman
- Dr.R.L.Edwards
- Dr.P.S.Galtsoff
- Dr.J.A.McCann
- Mr.J.B.Skerry
- Mr.J.A.Posgay
- Mr.A.S.Merrill
- Mr.R.C.Hennemuth
- Mr.G.F.Kelly
- Mr.A.C.Jensen
- Mr.R.R.Marak
- Mr.W.H.Callahan
- Mr.H.W.Jensen
- Mr.L.R.Porter, Jr.
- Mr.P.H.Chase, Jr.
- Mr. R. Livingstone, Jr.
- Mr.R.N.Hersey
- Mr.S.R.Nickerson
- Mr.C.L.Wheeler
- Mr.J.R.Donovan
- Mr.R.L.Fritz
- Mr.J.P.McDermott

ICNAF Secretariat

- Dr.E.M.Poulsen
- Mr. Frank Thomas

APPENDIX II

Meeting of ad hoc Committee, Environmental Studies

Attended by Lauzier (Chairman), Beverton, Brunel, Bumpus, Edwards, Graham, Hart, Martin, McLean, Poulsen and Templeman.

Lauzier, and then Graham, reviewed guidelines and directives to the Committee. The results of the Moscow meeting were reported by Lauzier.

McLean and Graham reported on the new National Oceanographic Data Center. Considerable discussion ensued about the purposes of the environmental studies committee. The consensus was that Graham and Lauzier carry two general ideas to the March meeting in Aberdeen, as follows: 1. That priority be given to the symposium, planned around a program decided on by the full committee. Careful planning of the symposium along specific lines is urged. To further the purposes of this discussion, the committee members will obtain from their respective groups a list of suggested appropriate topics on which reports may be given at the symposium. It was suggested that convenors for the symposium might well be appointed at the March meeting. It was further recommended that the committee consider inviting participants from outside the ICNAF Area should such action be considered desirable. 2. That active long-term planning of work be postponed until after the symposium.

It was also the consensus that this symposium should not be planned to take place before 1963.

The two delegates were further requested to obtain inventories of available pertinent hydrographic and biological data for the March meeting.

A considerable body of opinion was expressed about the primacy of environmental problems. There is a need for adequate, consistent long-term hydrographic information to serve two purposes: 1. As a basis for short and long-term prediction of hydrographic trends and, 2. as a basis for the evaluation of year-to-year changes in hydrographic conditions as significant causal factors in the well-being of fish populations.

APPENDIX III

The Concept of Prosperity in Marine Ecology

by Paul S. Galtsoff

ABSTRACT

The concept of prosperity, developed primarily by French marine ecologists, implies the flourishing condition and vigor of marine communities. High productivity of principal fisheries resources is found in these communities of predominantly one or few species. Prosperity means not only numerical abundance, but also great fertility, high rate of growth, low natural mortality and general healthy condition of a population. Only a few marine species form prosperous associations. The following outstanding examples may be listed: periodic blooms of diatom Aulacodiscus; Red tide caused by Gymnodinium; clam banks of the North Sea; underwater fields of eel grass, Phyllophora, Cystosira and floating kelp; scallop grounds of Georges Bank and of the western coast of Europe; oyster and pearl oyster banks; populations of limpets and other gastropods; marine birds' rookeries; and aggregations of fur seals on Pribilof and other islands of the Pacific.

Conditions determining prosperity of aquatic forms may be evaluated for those few species the physiology of which has been sufficiently studied. The evaluation is based on general principles formulated by Mitcherlich in his elaboration of the Liebig's law of the minimum.

In the majority of marine bottom communities several positive and negative factors control prosperity. The positive factors are the character of the bottom, temperature, water quality, water movements, and food. The negative factors are: sedimentation, competition, enemies, disease and parasitism, and pollution. The efficiency of each factor is evaluated from 1, for marginal condition, to 10 representing an optimum. The absence of a negative factor is given a value of 10 and its highest effect in reducing the population is designated as 1. By taking separately a sum total of + and - factors and multiplying the two sums the effect of principal ecological conditions on a population is represented as a score with the lowest value of 25 and the highest of 2500. The application of this method to oyster grounds of New England gives satisfactory results.

3. Report of the Meeting of the Environmental Working Party*

Aberdeen, 14-20 March, 1961

Contents

*As approved and amended in terms of the recommendations of the Environmental Subcommittee (p.27) and Research and Statistics Committee (p.6).

I. Introduction, List of questions, etc.

The relevant recommendations of the Commission were as follows:

(1) That a symposium on "The Influence of the Environment on the Distribution and Abundance of the Principal Groundfish in the ICNAF Area" be held in 1962 or 1963; and

(2) That a selected working party of fisheries biologists and hydrographers be requested to advise, at the expense of the Commission, on the best methods for answering the following questions:

(a) What are the effects of the environment on the survival of the eggs and larvae, and on the abundance and growth of year-classes of cod, and their effects on long-term abundance and distribution of adult cod, in the Commission's area; while the main emphasis should be on cod, it would be useful in such studies to obtain any relevant evidence on redfish and haddock.

(b) Further, how can such studies be directed so as not only to provide evidence of associations and correlations but also to lead speedily towards the prediction of such effects as long in advance as possible.

(c) Thinking in terms of the more immediate actions and reactions between the fish and factors in their environments, what fundamental studies not already proceeding should be initiated in one laboratory or another.

(d) Dependent upon the answers to (a) and (b) in particular, what standardization of methods is needed and what system of compiling, collecting, synthesizing and circulating data is needed for the Commission's purposes - with what staff, if any - bearing in mind the Commission's general principle that the bulk of its research should be done in and by the member laboratories, and the advantages to be gained by evolving methods similar to those adopted by ICES.

(e) How plans can best be laid for holding the Symposium set out in (1) above, so as to further the Commission's environmental investigations both before it and thereafter; the principal objective should be as defined but this should not preclude inviting some recognized authorities to contribute on relevant topics.

The Working Party's advice on these questions is set out below: specifically

Question (a), Section VI. pp. 69-80
(b), Section VI. Subarea 1 (pp.70-71): Introduction and paras. 1, 2 and 7; Subareas 2 and 3 (pp.71-73): Introduction and paras. 1, 2 3 and 6; Subarea 4 (pp. 73-74): Introduction and para. 1; Subarea

5 (pp.74-75): paras. 1, 2, 3 and 5; General (pp.75-80): Sections 2 and 7.

(c), Section VI. Subareas 2 and 3 (p.71): paras. 1 and 2; Subarea 4 (p.73): Introduction and para.1; General (pp.75-80): Sections 1 and 5.

(d), Section VII, pp. 80-83

(e), Section V, pp. 67-69

Attention is also drawn to the general considerations on pp.65-67.

While many of the answers are relevant to cod and also other commercial species, there are proposals specially relating to

haddock in Section VI, Subareas 2 and 3: Introduction and para.2 (p.71)
Subarea 4: para. 1; (p.73)
Subarea 5: paras. 1-3, (p.74), and to

redfish in Section VI, Subarea 1: para. 7; (p.71)
Subareas 2 and 3: para.6 (p.73)
and on pp. 75-80

A summary of the whole of the proposals is provided in Section VIII (pp.83-86).

II. Meetings, Material, etc.

Meetings

The following scientists were nominated by the Chairman of the Research and Statistics Committee to form the Working Party: Mr. F. Hermann, Dr.L.M.Lauzier, Mr.A.J.Lee, Dr.C.E.Lucas (Convener), Dr.Ju.Ju.Marty, Dr. A. Meyer and Dr. L.A.Walford.

Advantage was taken of the meeting of ICES in Moscow to arrange for those members of the Working Party who could be available to meet informally and discuss preliminary arrangements for the meeting to be held in Aberdeen. Dr. Lucas reported that it would not be possible for Dr. Walford and Dr. Meyer to serve and that Dr. Krefft would be taking the place of Dr. Meyer. Mr.J.E.King was meanwhile taking Dr. Walford's place, and it was subsequently decided that Dr. H. Graham would replace him. Those present in Moscow included: Mr. Hermann, Mr. King, Dr. Krefft, Dr. Lauzier, Mr. Lee, Dr. Lucas and Dr. Marty. A note concerning this informal meeting is attached (Appendix I).

The formal meeting was convened on March 14 at the Marine Laboratory in Aberdeen, when Dr. Graham, Mr. Hermann, Dr. Krefft, Dr. Lauzier, Mr. Lee, Dr. Lucas (Chairman) and Dr. Marty were present. In accordance with the discretion given to the Working Party, Mr. J. Corlett (Fisheries Laboratory, Lowestoft), Mr.R.S.Glover (Oceanographic Laboratory, Edinburgh), and Mr.B.B.Parrish (Marine Laboratory, Aberdeen) were co-opted for the period of the meeting. For the discussion on data centres and the indexing of hydrographic data, the Party also had the assistance of Dr.J.B.Tait (Chairman of the ICES Hydrographic Committee).

Meetings were held daily over 14th-20th March. The questions posed by the Commission were discussed in turn and the principles of the recommendations agreed in preliminary drafts. The time available, however, did not permit drafting of a full report, and it was agreed that this should be done by correspondence, subject to final approval by those who could be present at a one-day meeting to be held in Woods Hole, prior to the meeting of the Research and Statistics Committee in May. It was therefore decided (a) to circulate a draft of the report among members for comment before the end of April, and (b) to ask the Executive Secretary to request the Governments concerned to include members of the Working Party in their scientific delegations, so as to permit as many as possible to meet in Woods Hole on May 27. The following pages record the recommendations thus agreed and the considerations on which they are based.

Material provided

As a result of preliminary requests made by the Secretariat, a number of useful papers was provided for the meetings in Aberdeen (list attached as Appendix II), of which copies have been filed with the Secretariat. In particular, information about hydrographic work undertaken during recent years was provided by Canada, Denmark, Germany, Iceland, Norway, United Kingdom, United States of America, and Union of Soviet Socialist Republics. In addition, charts and notes were provided by workers from Canada, Denmark and the U.S.A. on the known facts of the biology of the cod in the Commission's Area, together with supplementary information concerning environmental work in progress, particularly on the biological side. Special papers* on results obtained since the last ICNAF meeting were provided by Mr. Hermann (Copenhagen) on cod year-class/temperature correlations and by Messrs. Henderson, Bainbridge and Robinson (Edinburgh) on material (redfish larvae and plankton) from the recent extensions of the Continuous Plankton Recorder survey. The Working Party was also assisted in its work by a paper from Mr.B.B.Parrish (Aberdeen), summarising problems met by the Assessment Working Party which involve environmental studies in their solution (Appendix III).

III. Basic principles determining discussions and recommendations

Throughout their discussions, the Working Party had particularly in mind the remit given to them by the Commission (quoted above), while taking into consideration comments made at an ad hoc meeting of ICNAF scientists, when assembled for the

*These were circulated for the 1961 Annual Meeting.

Regional meeting at Woods Hole in December 1960 (Appendix II of Document No.3 for the forthcoming General Meeting). In addition, the Working Party had in mind the questions which they considered the fishing industry would most wish to have answered, and some which the fish biologists would wish to put to the environmentalists, as well as the over-riding need for the closest collaboration between both groups of scientists if such questions are to be answered satisfactorily. Members also had in mind the available resources, the need for strengthening them in some respects, and the distinction in research between what would be desirable and what is essential. In all their considerations, as will be seen below, they were influenced by the relatively vulnerable position of the ICNAF fisheries on the edge of the Atlantic Slope, and the past history and probable future incidence of severe climatic changes in the northern subareas. In the light of these points they considered progressively what information is already available, and what projects are being investigated, subarea by subarea, so as best to decide on the requirements for a symposium and to plan for longer term research.

IV. General considerations

1. The term "environment" is used generally in the questions posed to the Working Party. It is an all-embracing term, and very properly comprises all those processes and bodies which are external to the fish: water movements; the physical and chemical properties of the waters; other organisms (prey and predator) and their secretions; fishermen; and even the sun and conceivably the pole star! We know that many of these directly affect the fish and, as our knowledge develops, we may expect to identify other environmental components of significance. Meanwhile, at any one time, we can only consider those we know or suspect and stress the significance of those which seem most influential. Among these are the temperature and salinity and chemistry of the water, other fish, the composition and abundance of phytoplankton and zooplankton, the composition and abundance of benthos and the topography of the bottom; in particular circumstances only a few of these may prove to be important.

2. The members were impressed by the wide range of conventional hydrographic data (temperature and salinity) available, particularly for some of the subareas, although they were constantly reminded that these had seldom been studied in relation to fisheries problems, and that the information was not always immediately relevant to those problems. There is moreover a general scarcity of chemical information other than salinity. In particular, they considered the series of hydrographic sections which were available in some regions, as providing information which might assist in identifying short and long term climatic trends and in the estimation of water movements. Certain limitations in their use for these purposes were recognised and a note is attached (Appendix IV) commenting specifically on these limitations. In brief, it would appear as though they can be used to provide relative indices, with certain provisos.

3. The members were also impressed with the relative paucity of environmental data on the biological side, although they were able to note very encouraging

developments in recent years. It is satisfactory that a number of these relate to more closely integrated studies than previously, and they welcomed the attention now being paid to benthic studies in relation to the fisheries.

4. It is necessary to stress that the need for precision in the identification of fish stocks, and for the fullest knowledge of fish migrations, is probably as great as it is in stock assessment studies. The stocks and their components are the essential units towards which the environmental studies should be directed, while sound knowledge of fish movements is vital in relation to observed environmental differences.

5. In general, as regards the different aspects of fishery research mentioned in 1-4, it is stressed that progress can only be irregular until the efforts directed to the different aspects of fishery research are balanced and developed through genuinely co-operative studies by the scientists concerned.

6. The Working Party noted that, while in certain directions work still needs to be initiated, in others much field work has already been done although in some analysis is only in progress or has apparently not yet been begun. It is strongly urged that wherever possible such analyses should be completed before the Symposium, so that the maximum information can then be available. It is recognised, too, that when this information is available it may lead to some modifications in the research proposals set out below, and to greater precision in their formulation. Action on the present proposals need not be held in abeyance until the symposium is completed, however, particularly on those concerning new or relatively new work.

7. It is recognised that the delay in analysing material already obtained, and in beginning projects already envisaged, is caused by staff shortages in some cases, particularly on the environmental side. In some laboratories "environmental" studies are seriously undermanned. For many of the projects suggested below, additional staff will be needed or, alternatively, a different allocation of staff, since satisfactory progress in some aspects of fisheries investigations cannot usefully be made in isolation.

8. It is strongly urged that all the responsible authorities consider carefully, and particularly in the light of the proposals set out below, how best they can strengthen the environmental sides of their fisheries research staffs, both on the hydrographic and on the biological sides.

9. It is a truism to say that the fisheries problems of the ICNAF Area cannot be considered and solved solely within the administrative boundaries of that Area, but repeatedly in its considerations the Working Party were faced with questions as to the oceanic regime in waters outside the Area and the relationship of stocks in the Area to those outside it, and indeed with problems of the migrations of some of the stocks to and from the Area. It is their view that the fisheries for which the Commission is responsible can only be understood as parts of a series of fishing banks

fringing the North Atlantic. For their understanding, it is necessary to take into account the whole oceanic regime of the North Atlantic, with particular reference to the Gulf Stream, Arctic influences and interrelationships with the deep waters offshore, as well as to the over-riding role played by meteorological events. In making these points, the Working Party noted that ICES has recently been considering rather similar "environmental" problems, and has valuable and relevant information to contribute. Not only is ICES concerned mostly with the same species of fish, but at least two of them, the cod and the redfish, extend more or less continuously from the southwest to the northeast of the North Atlantic.

10. It was in the light of the points made in 9 that the Working Party framed its proposals for answering the questions posed by the Research and Statistics Committee, and that it ventured in particular to revise the original proposals for the Symposium.

V. Proposals for an ICNAF "Environmental Symposium", 1963

Recognising

(a) the reasons set out above, which determine that ICNAF problems (environmental and otherwise) cannot be investigated solely by programmes which are restricted to its area, and

(b) the serious concern of ICES with similar "environmental" problems,

the Environmental Working Party recommend that a symposium entitled "The Influence of the Environment on the Principal Groundfish Stocks in the North Atlantic" be held over six days prior to the meeting of the ICNAF Research and Statistics Committee in 1963. Further, an invitation should be extended to ICES to collaborate with ICNAF in securing contributions from scientists experienced in studying the influence of the environment in the fisheries of the Northeast Atlantic (as comprised in the footnote below). The principal objectives should be as defined below, but this should not preclude inviting recognised authorities to contribute specified reviews on relevant topics, such as pelagic "environmental" studies, whether made in the North Atlantic or elsewhere.

A major aim of this symposium would be to bring together fish biologists and workers in relevant fields of biology and hydrography, with the object of reviewing fully the available knowledge in the field of investigation, and of demonstrating its vital place in fisheries research and in oceanographical research generally.

(a) For such a symposium, the Working Party consider that the major objectives should be to secure contributions concerning:

*i.e. comprising the whole ICNAF Area and that of ICES (excluding the Baltic, North and Irish Seas and the English Channel).

1. The factors whereby the location and availability of fish stocks are limited from time to time, on and off the fishing grounds: - e.g. by temperature and other physical factors, distribution of food organisms (plankton, nekton and benthos), parasites etc.

2. The relevant features of the physiology and behaviour of particular groundfish which are associated with these limiting factors.

3. The effects of such limiting factors on the growth, age of first maturity, and survival of particular groundfish in particular areas.

4. The longer term influence of such limiting factors, whereby fish stocks may be continuously restricted or enabled to extend their areas of distribution and availability.

5. The possibility of predicting the onset of critical phases in these factors.

6. The effects of environmental conditions on the planktonic and early demersal stages of fish, and on the plankton and benthos as the food supply of these fish.

7. How environmental factors affect the process of fishing.

(b) It is proposed, therefore, that the Symposium be subdivided into sessions, on the topics set out below, to run consecutively:-

1. Effect of physical environmental conditions on the distribution of adult fish.

2. Effect of the biological environment (including parasites) on the distribution of adult fish.

3. Effect of the environment on growth, survival, and age and size at first maturity.

4. Effect of the environment on pelagic and early demersal phases of groundfish.

5. Effect of long-term trends.

6. Physiological reactions to changes in the environment.

7. Forecasting environmental conditions.

8. Effect of the environment on the process of fishing.

(c) A Chairman should be selected for the whole Symposium and, for each of these topics, a Convener should be selected (at least eighteen months in advance, if possible) with the responsibility of securing contributions for his subject. These should be available in ample time for circulation at least two months in advance to those attending the Symposium. It is proposed that the contributions should not be read at the meetings; the object of the meetings should rather be to discuss the papers in the light of related work and the immediate research needs of the Commission. For this purpose it is important that contributors should be able to attend.

Contributions to the Symposium should be invited by the Conveners from the scientists of the ICES and ICNAF regions, but it should also be the special tasks of the Conveners to invite papers from particularly qualified scientists working in the area, to ensure that the major objectives of the various sessions are achieved.

(d) Finally, as selected relevant material, it is proposed that special "review" lecturers be invited to address the whole meeting on four topics:

(1) A review of the hydrography of the area, as an introduction to the Symposium.

(2) Reviews of the effects of the environment on (a) the Pacific sardine, (b) the herring, and (c) the tuna, as "evening" lectures.

At two informal meetings the Working Party drew up for its own guidance, and for that of the conveners, a list of possible conveners and contributors for each of the eight subjects and of possible lecturers for the reviews.

VI. Proposals for Research

These proposals are set out in relation to (1) available knowledge of 'environmental' work which has been proceeding within the Commission's area, and further work being initiated and (2) the serious gaps in local knowledge which our general understanding of oceanographic processes and fish biology reveal or imply. The object has been to endorse the value of existing or envisaged projects where they seem essential to the Commission's objectives, and to underline the urgent need for an intensification of the work in some directions and its initiation in others. A list of projects is therefore set out, subarea by subarea, together with notes on some projects of more general concern. In accordance with the Commission's remit, they should be regarded as relating particularly to the cod fisheries, unless otherwise stated, but most are in fact relevant to any of the fisheries proceeding in the Commission's Area.

If the list is a long one, this is because, despite their riches (which are by no means restricted to the fisheries) the seas are a great and relatively unexplored resource. In the Working Party's view none of the projects are merely academic exercises. All and, as our understanding grows, more are needed. Doubtless, other suggestions will emerge from the Symposium. On the other hand, our research resources are limited - and will still be so even if we increase these resources. The proposals have therefore been limited to the most important and the most likely to be productive of essential information. It is recommended that, if these proposals are accepted in principle, working parties of scientists who would be actively concerned are selected to plan the individual projects in the necessary detail. At least some of these must be, and can only be, achieved by collaboration between laboratories and research vessels. They will be the more costly, but it must be recognised that we each take our portion of the produce and should therefore do our share of the research. Those concerned will benefit in many ways from the collaboration.

Subarea 1

It is particularly in this area that most concern has been felt about the immediate and long-term effects of environmental changes on the fishable stocks. We have historical evidence of how fisheries near the limits of a stock's endurance may succeed or fail within relatively narrow environmental differences. We know how the present Greenland fisheries developed broadly in relation to relatively slight temperature increases, and we also know how even within the present history of the fisheries there have been significant temperature variations since the 'twenties when they began to develop. It is not surprising therefore that recent work has provided suggestive evidence of association between the success and failure of year-classes and relatively small temperature changes in the local waters. Such effects are as important in determining mortality rates etc. for assessment studies as they are of importance to the fishery itself. Undoubtedly one of the most important projects is to devise studies whereby the effects of environmental changes may be forecast - either immediately in terms of the success or failure of larval broods relative to the recruit classes of some years later, or alternatively through direct prediction of environmental conditions.

1. The Working Party therefore wish to stress the importance of research into the effects of the "climatic hazard" on cod year-class strengths from a long-term point of view. For this investigation a long series of environmental observations will be particularly valuable, both in terms of mean regional data, and in terms of more specific data such as can be obtained from research ships specially working in the area where the fish and their larvae are found. Though the subsurface observations hitherto obtained from the research ships are rather few, the available evidence suggests that such fluctuations are more closely correlated with year-class fluctuations than are surface observations. Regular hydrographic observations taken between April and June should greatly increase our understanding of many features in year-class fluctuations. Again, data collected from appropriate weatherships should prove useful. In order to facilitate this work, efforts should be made to devise suitable apparatus for use on research vessels, 'search' vessels and weatherships. In all such studies, it may be valuable to investigate the sequential relationships of data collected in neighbouring areas and regions.

2. In such a programme attention should undoubtedly be paid to meteorological as well as hydrographical data, particularly in so far as processed data concerning pressure differences may provide convenient summaries of environmental conditions prevailing over selected areas.

3. While the general current regime in this region is appreciated, more information is needed on the drift of eggs and fry along the coasts from east to west Greenland, and up the west coast and across the Davis Strait, in order to determine how far stocks of cod and redfish found off the coast of Labrador may be supported in part from spawnings to the east (see also p.77 below).

4. Despite the useful information already collected on spawning grounds and nurseries, evidence suggests that they are still known insufficiently, and efforts should be made to extend our knowledge of these grounds along both the east and west coasts of Greenland.

5. In relation to this question, it is particularly important to have more specific information about relevant current speeds and directions. There is some uncertainty as to the interpretation of current speeds, as deduced by hydrodynamical methods from standard sections taken at right angles to the local coasts (Appendix IV), and further investigation is needed, possibly by alternative methods.

6. Inevitably, in view of the limited research resources and the nature of the principal fisheries in the area, there is some uncertainty as to the identity of fish stocks (e.g. those off the east and west coasts of Greenland). Despite the valuable work already done, there is need for much more intensive tagging experiments devised specifically with this need in view, as also to investigate possible interrelationships between the stocks of this area and others. These should be supplemented by studies of otolith types and meristic characters, as also by blood group and blood serum investigations.

7. While there are no haddock stocks in the subarea, there are important redfish stocks, to which the same remarks apply as to the cod in (1) above. It is, however, typical of the present nature of our knowledge of the biology of the redfish that the problems met in Subarea 1 do not differ greatly from important redfish problems met elsewhere and they are most conveniently dealt with together in a special section (p. 78).

Subareas 2 and 3

In both of these subareas, as in Subarea 1, the Working Party stressed the importance of the effects of both short and long-term variations in environmental conditions. While the possible long-term consequences may not be so serious for Subarea 3 as they are for Subarea 1, they are probably quite as acute for Subarea 2 and they could be considerable for Subarea 3. The more immediate effects of environmental changes on the stocks of these areas can be acute even for cod. It may be that for

for haddock the potential effects in this region are more drastic.

1. For these reasons the Working Party emphasise the need for research into the effect of temperature on the distribution of cod (and other species of commercial value). It is important that the cod-temperature studies being maintained in these regions should be reviewed as soon as possible and the programme intensified. The results may provide vital information for our understanding of the limiting conditions for fisheries here and elsewhere.

2. Although cod is the more important, there are valuable haddock stocks in Subarea 3. These are subject to severe fluctuations, the fisheries depending sometimes for several years on the success of a particular year-class. Not only are such circumstances of key importance to the fishery, so that the ability to predict them would be invaluable, but the available data regarding such extreme fluctuations in year-class strengths might provide unusually good opportunities for investigating the environmental conditions (temperature and currents) responsible for them, in accordance with the proposals made in item 5. In association it is important to know when and where the haddock spawn each year, so that the conditions can be determined and associated with the success or failure of spawning, larval drift, etc.

3. Meanwhile, the Working Party advise that useful information might be provided by examining existing series of hydrographical data to find the magnitude of the trends and fluctuations, since this information might indicate to what extent the annual spawnings, etc., might be affected by local environmental conditions. Similar studies might also provide useful information as regards the immediate effects of the environment upon the "availability" of the existing stocks to the fisheries from year to year.

4. It is as important for environmental studies as for population studies to have the best possible information on stock identity. Information on year-classes may be helpful here and even more important is direct information concerning interrelationships between the stocks. It is therefore of the utmost importance that the valuable tagging projects in progress in this region should be reviewed just as soon as possible.

5. In relation to these and several other problems, there is urgent need for more information as regards year-class strengths in these subareas: (a) in the interpretation of stock identity (b) in relation to fluctuations in the fisheries themselves, and (c) in the more direct relation to environmental studies. Owing to the complex nature of water movements in these and adjacent subareas, and some uncertainties regarding stock identity, there is need for more up-to-date information concerning spawning, larval success and subsequent drift in relation to contemporary environmental conditions. The probable value of studying these in relation to the isolated fishery of Flemish Cap should be considered (see also p.77).

6. As in all the other subareas, there are acute redfish problems demanding investigation, although many of them are common to all (see p. 78). It is important, however, to maintain the studies already begun for the Labrador coast of the association between meteorological conditions and the availability of redfish on the coastal banks.

Subarea 4

The Working Party noted that in this subarea the fisheries are, broadly speaking, in the middle of the environmental range of the cod; for this reason the more extreme long-term effects of environmental conditions need not be expected, although there are periodic changes in the abundance of this and other species. They noted with approval, therefore, the work proceeding on long-term fluctuations in water temperatures, as bases for correlations with changes in species composition and year-class strength of the major groundfish species.

1. This is, however, a subarea in which the short-term changes of environmental conditions may be appreciable and, therefore, one very suitable for studies of these effects. The Working Party stressed the value of research into the migrations of cod in the Gulf of St. Lawrence, in relation to the hydrographic regime. They noted with approval the preliminary studies of seasonal changes in Magdalen Shallows and the proposal to continue to study there the associated seasonal changes in the distribution of fish. They also endorsed the proposal to continue the studies of the ratios of cod: haddock catches in association with environmental conditions, in order to investigate the possibilities of a long-term prediction service. In all this work, further information on the interrelationships between the different fisheries will be valuable, both within the subarea and between this and adjacent subareas.

2. As in other subareas, the necessity for more precise information on the distribution of spawning grounds and the subsequent drift of the eggs and larvae was noted, particularly in view of the fact that important spawning grounds are situated on the edge of the banks and, conceivably, are subject to environmental fluctuations which might be very significant for future success or disaster. The Working Party noted with approval the plans for reporting on preliminary studies of water transport, especially those concerning the use of bottom drifters, and hope that this work will be extended.

3. The subject of larval drift is reviewed further below (p.77), in relation to other subareas, but within this subarea, special attention was given to the possible value of an extension of the Continuous Plankton Recorder survey run from the Oceanographic Laboratory in Edinburgh. The useful information already being obtained, on records between Reykjavik and Newfoundland, pointed to the value in Subarea 4 of regular records being obtained between St. John's, Newfoundland, and Halifax, Nova Scotia, and as far south as Boston, Mass., if possible. The Working Party therefore recommend that the staffs of the St. Andrews, Woods Hole (Fish and

Wildlife) and Edinburgh Laboratories should consider as soon as possible how such an extension might be arranged. As a second priority, members preferred records taken from U.S. Weather Ships en route to Ocean Weather Station B.

4. Meanwhile the Working Party noted the work already proceeding, and that envisaged, for more detailed investigation of the feeding of groundfish species in this subarea and for related studies on the production of the bottom animals which are important elements in the food of cod and haddock. They endorse the value of these studies, and stress the importance, in this work, of associated experimental studies of the digestion rates and food requirements, for maintenance and growth, of the principal groundfish species and note with approval the work already in progress.

5. As in each of the other subareas, there are a number of redfish problems for investigation (see p.78).

Subarea 5

From the fishery point of view, this is primarily a haddock and redfish area, although cod, hake, flounder and sea-scallop support valuable fisheries. Cod in this subarea is at the southern end of its range. The Working Party noted the U.S. plan to increase their programme of environmental studies in two years time, when a new research vessel is expected to be ready for service.

1. In the view of the Working Party, the long series of age-composition data for the Georges Bank haddock stock are among the most valuable for environmental studies. Although some studies of the relation of local meteorological conditions and related water conditions to year-class strengths have been made, the U.S. should consider the feasibility of extending them. The fluctuations in the haddock year-class strength on Georges Bank represent a clear example of changes in fish abundance which are not solely related to the activities of man. They offer an opportunity to relate natural fluctuations to environmental conditions. The oceanography of the Gulf of Maine and Georges Bank (and whatever adjacent areas are required) should be examined for a period of years in an attempt to determine the conditions which result in high survival of haddock and which are conducive to failures of year-classes. An alternative and most important investigation would be the direct study of haddock egg production on the local banks, and the subsequent drift of the eggs and larvae in relation to environmental conditions, so as to know more precisely the fate of the young fish over a series of years.

2. Among several hypotheses, implying the effects of different environmental factors, one states that good survival results from a circulation pattern which permits the eggs and larvae of haddock to remain on Georges Bank or in the Gulf of Maine, whereas poor year-classes result from a movement of water off the bank to the southeast. Another theory relates high mortality of the young stages to unusual intrusions of warm slope water on the bank in the spring of the year. Among others,

there is a third hypothesis that the fate of the larvae may depend on the availability of, first, abundant phytoplankton, and then of appropriate zooplankton; the possibilities of zooplankton predation should not be forgotten. The Working Party consider that an investigation such as that outlined below (p.77) would enable such hypotheses to be tested here and elsewhere in the Commission's area.

3. The members noted the plan to make regular surveys of the distribution of groundfish, with simultaneous hydrographic observations in Subarea 5. These surveys are expected to provide valuable information on the seasonal and longer-term variations in distribution and abundance of the important species in relation to temperature, depth, and other environmental conditions, and should also provide information for relating long-term changes to changes in the occurrence of the fish.

4. It was also noted that cod data are to be analysed, with a view to obtaining age compositions of that species in Subarea 5. Similarly, it is understood that age compositions for yellowtail flounder stocks on Georges Bank will soon become available. Such analyses would be useful in providing additional biological information on annual fluctuations.

5. The members endorsed the plans for conducting benthic studies in Subarea 5, designed to describe the kind and quantity of benthic fauna throughout the subarea. These should be expanded to include further studies of the food habits of the fish species in the area and to investigate the importance of benthic fauna for the distribution and abundance of fish stocks. Such studies can be of further value, in the absence of other environmental data, in that benthic changes can indicate the effects of long-term trends and, owing to the sessile nature and relative persistence of benthic communities, can permit relatively economical types of investigation.

General Proposals

Just as one cannot usefully consider the whole ICNAF Area in isolation, one cannot consider its subareas in isolation. Some of the points mentioned above have general application and there are others which have not been mentioned. These are set out below.

While none have been stressed as more important than the others, it is worth drawing special attention to 3 and 4, concerning proposals for environmental studies in connection with the distribution of fish larvae and redfish respectively.

1. Tolerance to environmental conditions

The Working Party recognised that we are still very ignorant about the direct influence of different factors in the environment on fishes and of their reactions to them. So that wide-ranging studies of the physiology and behaviour of fishes, commercial and otherwise, will be needed before we can properly understand vital aspects of the fisheries, and these will have to be made both in the field and in the laboratory. Therefore, they commend such studies in general to all the research organizations concerned. The field is great, however, and priorities must be set.

Among the several relevant studies of the physiology and behaviour of commercial fish, the Working Party particularly wish to stress the importance of detailed studies, in the laboratory and in the field, of the tolerance of fish to environmental conditions. Both in relation to spawning and subsequent larval development, more information is required concerning the tolerance of cod and other larvae to particular conditions, while it is also necessary to investigate the tolerance of the planktonic food of the larvae. Similarly, information concerning the tolerance of recruit and adult fish to environmental conditions, as also the tolerance of their food organisms, would be invaluable, both in relation to short and long term environmental changes. Related studies should be made of the seasonal abundance of the zooplankton, comprising the bulk of the food of the fish larvae, as also of the timing of the seasonal outbursts of phytoplankton and zooplankton in relation to the time of spawning of the fish.

For this reason, the Working Party particularly wished to endorse the plans already envisaged to make regular surveys of the distribution of groundfish, with simultaneous environmental observations, and commend these plans to other workers in the area. These surveys are expected to provide valuable information on the seasonal and longer-term variations in distribution and abundance of the important species in relation to temperature, depth, and other environmental conditions, and should also provide information for relating long-term changes to changes in the abundance and distribution of the fish. Bottom temperature observations should be made with all trawl hauls.

2. Influence of currents

Particularly in relation to the distribution of fish larvae and the plankton, their tolerance and their drift with the local currents, it is most important to have more specific information in all areas about relevant current speeds and directions (but see Appendix IV).

The more localised currents envisaged here, however, are governed by variations in the flow of the major current systems of the area, which in turn are related to those being revealed by the study of the oceanography of the whole North Atlantic. Attention has already been drawn (p.66) to the significance of such studies for research in the ICNAF Area. The Working Party felt an urgent need for more information about the whole water regime of the North Atlantic, how it is maintained, what are its major variations and how they are brought about. While attacks on this broad problem are being made in some quarters, there is not yet the co-ordinated and extensive attack on this vital problem which it deserves. It is perhaps significant that we do not yet have a truly synoptic picture of the water regime of the North Atlantic.

In addition, the members wish to stress the significance of meteorological phenomena, on the large scale in supplying energy for the whole North Atlantic regime, and on the smaller scale in directly influencing local water movements by variable or persistent winds. Evidence is accruing in several quarters that in all fisheries environmental studies attention should be paid to meteorological as well as oceanographical data, particularly in so far as processed data concerning pressure differences may provide convenient summaries of environmental conditions prevailing over selected areas. In all such studies, however, the Working Party stress the importance of simultaneous study of hydrographical data, since it is ultimately essential to understand the intermediate phenomena between the meteorological and biological levels.

3. Plankton and egg and larval studies

The Working Party gave considerable thought to the problem of investigating the distribution of eggs and larvae of the principal commercial species in each subarea and of plankton studies in general. The complexity and effort required for such investigations was recognised and much thought was given to the likelihood of securing valuable results from any particular investigation. After very careful consideration the members decided to recommend that a special collaborative attack should be made on these problems in the ICNAF Area.

The Working Party recognised that, if made successfully, such studies are potentially important not only for environmental investigations but also in furthering the development of stock assessment studies, in many fisheries. They also recognised that the ICNAF Area, however, in which a series of most valuable fisheries are situated on the edge of a major continental slope, may present particularly important and valuable opportunities for a specially co-ordinated attack on the problem. Special reference has been made above to the value of egg and larval studies in Subareas 1 and 2, over the Flemish Cap and on Georges Bank. From north to south there are a series of spawning grounds which would appear to be particularly vulnerable to deviations in the normal regime of the waters flowing constantly past them and in meteorological conditions. The whole of the Nova Scotian coast is another example. In the simplest terms, persistent winds on or offshore could conceivably lead to major success or failure of one or more spawnings. The Working Party therefore strongly recommend that the Commission should plan for a co-operative plankton and hydrographic survey as soon as possible, in which research vessels from all the member countries would combine; this would comprise a study of the distribution and subsequent drift of eggs and larvae at several points along the eastern edge of the Area, over a period of three months (e.g. April, May, June). In conjunction, it would be possible, and desirable, to study the distribution of the associated plankton, as food supplies, as predators and as "indicators" of water conditions. In planning such a survey it will be essential to proceed so that the broad results can be made available to the Commission at the first possible moment, for on the success or failure of such a collaborative programme would depend important decisions as to the value of repeating it, over a term of years, either wholly or in part.

Tentatively it is suggested that this project might be planned for the spring of 1963. If this proposal is adopted, it would be essential for a planning group to be appointed this year, since the most detailed advance consideration is needed if there are to be reasonable hopes of success.

4. Redfish

In considering the ICNAF fisheries area by area, the Working Party were forced to acknowledge the serious limitations in our knowledge of the biology of the redfish and that, with odd exceptions, the problems met in one area do not differ greatly from those met elsewhere, so that they are most conveniently dealt with together.

Perhaps the most important ecological problem is that of determining the relationship between the redfish stocks found in the Commission's Area (and those on the Atlantic fishing grounds to the east) and the "pool" of oceanic redfish which, the results of larval surveys would imply, extends across a broad band of the North Atlantic Ocean. Both the Assessment Working Party and this one have had to face the curious problem of locally intense "stocks" being discovered, which on occasion have appeared to be rapidly fished out, but in the absence of the conventional signs of overfishing. In general it has not been possible to distinguish the effects of fishing upon a genuinely self-maintaining stock from those on a purely local section of a stock, nor indeed from the effects of marked environmental changes (some of which have been noted) which may have brought about significant changes in fish distribution.

Meanwhile the information obtained from the recent extension of the Plankton Recorder survey, combined with the various other data concerning the distribution of redfish larvae, has shown how, during the spring and early summer, redfish larvae are distributed in a more or less continuous broad band from the North American coast through Icelandic waters to the Norwegian and Barents Seas. Such a broad distribution is unusual for a commercial fish and it indicates that at the "spawning" season there must assemble vast numbers of females (at least), not only on the oceanic banks but right over stretches of the ocean which are normally unfished. These are the principal signs of the existence, at least seasonally, of a vast pool of redfish. Not only does the question arise as to whether fisheries for these fish might be developed by pelagic trawling or lining. The important possibility also arises that most of the presently exploited groups may simply constitute the fringes or isolated offshoots of a very large population, from which they may be replenished either continuously or periodically according to the environmental situation in the area; alternatively, they may genuinely constitute distinct unit stocks.

Unfortunately we still know next to nothing about the migrations of redfish, or about the drift of their larvae, and all too little about their environmental requirements. The Working Party recognised the value of the hypothesis set out above (and in Appendix III) and urged the importance of local tests of its significance, by the detailed study of the local abundance and distribution of redfish, in relation to fishing and environmental conditions, particularly local temperature, topography, and food distribution. But they also stress the vital importance of studying the over-all distribution of redfish in the North Atlantic in relation to temperature, water structure and meteorological conditions. Much of the necessary work, therefore, must be undertaken in the ICES as well as in the ICNAF areas.

For this purpose they advocate, in addition to studies in the conventional fisheries, the initiation and development of experiments using pelagic trawls and lines in order to study the distribution of redfish of all ages, particularly in relation to temperature and water movements. In this it would be valuable to have early information from Continuous Plankton records of the larval distribution, since this information would convey important inferences regarding the oceanic distribution of females, at least. As information develops, from CPR studies and more conventional plankton investigations, important inferences could also be drawn as to the abundance of females in oceanic waters, and for this reason it seems important to intensify studies of the fecundity of redfish.

The members were particularly impressed with the evidence over a wide area that the year 1958 was apparently most unfavourable for "spawning", and stressed the importance of seeking among hydrographic data for environmental associations. They noted that the years 1957-1959 cover the period of the IGY surveys and anticipate that unusually abundant material should be available for studying this point.

The Working Party noted, as regards the "types" of redfish, that the available evidence suggests the type marinus to be unusually abundant among the larvae collected and the type mentella among the adults. Further information is urgently needed regarding the different types of redfish and their distribution, but meanwhile the party strongly recommended special studies of the types in relation to temperature, depth and food on all research vessel cruises.

The members also noted the relative paucity of information about the 0-group and 'nursery' stages of the redfish and recommend that these and their distribution should be studied more intensively, and always in association with data concerning environmental conditions.

5. Stock identity

Inevitably, in view of the limited research resources and the nature of the principal fisheries in the area, there is some uncertainty as to the identity of fish stocks. Despite the valuable work already done, there is need for much more intensive tagging experiments devised specifically with this objective to investigate possible interrelationships between the stocks of different subareas. These should be supplemented by studies of otolith types and meristic characters, as also by blood group and blood serum investigations.

In relation to this and several other problems, there is urgent need for more information as regards year-class strengths in the Commission's area: (a) in the interpretation of stock identity, (b) in relation to fluctuations in the fisheries themselves and (c) in direct relation to environmental studies. Owing to the complex nature of water movements in the area, and some uncertainties regarding stock identity, there is also need for more up-to-date information concerning spawning, larval success and subsequent drift in relation to contemporary environmental conditions.

6. Commercial Groundfish in relation to other fish species

Since the distribution and abundance of the commercially important species may be influenced by the abundance of other species, it was noted with approval that the U.S. and Canadian surveys are recording all species present in the trawl catches. Such work could be of considerable correlative value, as well as of commercial use as the fisheries develop, and it is recommended that this step be taken by research vessels of member countries in all areas, to include also measurements of fish of the principal species.

7. Groundfish in relation to benthos

The members also noted with approval the plans already envisaged for conducting benthic studies, designed to describe the kind and quantity of benthic fauna. These should be expanded to include further studies of the food habits of the species in the area and to investigate the importance of benthic fauna for the distribution and abundance of fish stocks. Such studies can be of further value, in the absence of other environmental data, by indicating the effects of long-term trends and, owing to the sessile nature and relative persistence of benthic communities, they can permit relatively economical types of investigation.

VII. Advice on collection and exchange of data, etc.

In addition to advising on plans for a symposium and for future environmental research, the Working Party were asked...."what standardisation of methods is needed and what system of compiling, collecting, synthesising and circulating data is needed for the Commission's purposes - with what staff, if any - bearing in mind the Commission's general principle that the bulk of its research should be done in and by the member laboratories, and the advantages to be gained by evolving methods similar to those adopted by ICES." These questions were discussed at length and Dr.J.B.Tait, Chairman of the ICES Hydrographical Committee, was co-opted for the purposes of this discussion.

1. Standardisation of methods etc.

(a) This problem is common to the whole of oceanography and has recently been discussed by the UNESCO Inter-governmental Conference on Oceanography, held in Copenhagen in 1960. This body recommended that UNESCO should be responsible for the standardisation of methods in oceanography. The Group decided therefore to recommend that the Commission should take no special action at this stage, but that ICNAF requirements should in due course be considered in the light of the report UNESCO may be expected to make, in the hope that this will not be too long delayed.

(b) Members noted however that

i. there is already reasonable agreement between hydrographers on the standardisation of basic temperature, salinity and depth measurement techniques, while

ii. standardisation of phytoplankton methods was discussed at the ICES Symposium on Primary Production, held in Bergen in 1957, so that meanwhile ICNAF countries should be recommended to follow the recommendations of that Symposium.

iii. Members also noted that ICES is holding a symposium on zooplankton, or secondary production, in Copenhagen, this year, and that this will include a discussion on methods of collecting zooplankton; the party therefore considered that ICNAF should await the outcome of that discussion, and then consider adopting its recommendations pending the report from UNESCO.

Further, members noted the experience of ICES countries in standardising methods in several joint programmes, such as that of the nine-boat Faroe-Iceland Ridge survey conducted in 1960, and they agreed that it was most important, in any ICNAF collaborative programme such as that proposed elsewhere in this report (p.77) and in smaller programmes, that standardisation of methods should be agreed at the planning stage. Methods of compiling and reporting results should also be agreed when planning such surveys.

2. Compiling, Collecting, Synthesising and Circulating Data

The available information on existing and projected world data centres was discussed at some length, and is set out in Appendix V.

(a) Hydrographical Data. The Working Party consider that, in view of the existence already of at least three established modern Data Centres covering the ICNAF Area for hydrographical observations, the setting up of an additional and separate Data Centre under ICNAF is unnecessary. Providing that the following conditions are fulfilled, it is recommended that ICNAF members should submit their hydrographical data to any of the recognised Data Centres:

i. that all hydrographical information from and pertaining to the ICNAF Area will be procurable from the same Data Centre by any country or agency;

ii. that there are facilities for the interchange of these hydrographical data among the Data Centres;

iii. that the methods of recording hydrographical data at the several Data Centres are uniform.

The doubts which exist in regard to i., ii. and iii. can be discussed and as far as possible resolved at a meeting to be held in conjunction with the ICNAF Annual Meeting in Woods Hole in May 1961, members of the Working Party undertaking to arrange for the attendance at this meeting of authoritative spokesmen in respect of the existing Data Centres (see below).

(b) Biological and Hydrographical Data

The Group noted that (1) the Intergovernmental Conference on Oceanography had agreed that the World Data Centres should eventually file biological data, but that no system had been discussed; (2) the U.S. National Oceanographic Data Centre committee had considered storing biological data but had made no announcement concerning their conclusions.

The Group therefore agreed to make no recommendation at this stage, except as follows:

Meanwhile, and particularly pending international decisions on these points, the Working Party endorses for the ICNAF Area the recommendation of the Subcommittee on Environmental Research, made at the 1959 meeting, that each country should send annually lists of hydrographic stations occupied during the previous year, their dates and the kinds of information collected (Red Book for 1959, p.68). These lists should also include reports of plankton and other biological data collected and might conveniently be in the form of quarterly charts showing the stations occupied, distinguished as to objectives, etc.; they should also show to which data centres any data have already been, or will be, sent.

Members further wished to emphasise the importance of early analysis of data and the early reporting to the Commission of the results.

(c) Recommendation of Supplementary Meeting

Further discussions on this subject were held on Saturday, 27th May, and Thursday, 1st June, with Dr. Graham, Dr. Krefft, Dr. Lauzier, Mr. Lee and Dr. Lucas present. Unfortunately Dr. Marty could not be present to give further information about World Data Centre B; Mr. Dubach (U.S. N.O.D.C.) provided valuable information on the U.S. National Oceanographic Data Centre and Mr. Lee supplemented the information already available regarding the ICES centre.

The Working Group noted the exchange arrangement already made between ICES and U.S. N.O.D.C. Since many of the member countries of ICNAF already supply their hydrographic data to ICES, the Working Group suggest that the most convenient arrangement might be for all European ICNAF countries to supply their hydrographic data for the North Atlantic to ICES, and for the U.S. and Canada to send theirs to U.S. N.O.D.C. By this means, all the North Atlantic data could thus be retrieved conveniently by all. It is therefore recommended that ICNAF approach ICES to see whether such an arrangement can conveniently be reached.

Meanwhile, the Working Group wish to draw attention to the proposals made above as regards the reporting to ICNAF of both biological and hydrographical stations etc., preferably in the form of charts, as early as possible each year after they have been completed. The Secretariat should draw the attention of countries to this requirement as and when necessary.

VIII. Summary of Proposals

The Working Party repeatedly were faced with questions as to the oceanic regime in waters outside the ICNAF Area, and the relationship of fish caught in the area to those outside it. For a true understanding of these environmental problems, it is ultimately necessary to take into account the whole oceanic regime of the North Atlantic and particularly the influence of the Gulf Stream. While directing their attention particularly to the ICNAF fisheries, therefore, these considerations necessarily influenced the Party's proposals for planning both the symposium and the research programme.

Symposium

Recognising the serious concern of ICES with similar environmental problems, it is proposed that ICES should be invited to collaborate in securing contributions for a Symposium on "The Influence of the Environment on the Principal Groundfish Stocks in the North Atlantic", to be held over the six days prior to the meeting of the Research and Statistics Committee in 1963. The principal objectives, with some suggestions as to how they might be achieved, are set out on pages 67 to 69 .

Research Programme

Fisheries environmental studies have had to be neglected somewhat while essential information was being obtained about the state of the ICNAF stocks. To this extent, research progress to date has been unbalanced and a very wide field of environmental investigations is open to the Commission. A limited number of projects of the most practical importance is proposed, some new and some developments of work already begun, bearing in mind the resources available for this purpose while strongly urging that these be increased as soon as possible. Working parties should be appointed to plan these in detail.

While these proposals relate principally to the cod fisheries, they include some specific to the haddock and redfish fisheries. They are partly general, as relating to all subareas (pages 75-80), and partly relate to one or other of the subareas (pages 70-74). In brief, the proposals principally concern:

A. Regional

Subarea 1. Particularly in this subarea the long-term effects of the "climatic hazard" on cod year-class strengths are stressed. There is great need for long series of environmental data, surface and sub-surface, between April and June, both specifically from research vessels and also in terms of mean regional data such as are obtained from commercial vessels, "search" vessels and weather ships. Meteorological data should be studied in conjunction. More information is needed on spawning grounds and nurseries here and particularly on the drift of eggs and larvae round the coasts of Greenland and across the Davis Strait, in relation to local water movements (pp. 70-71).

Subareas 2 and 3. Studies of short and long-term variations will be valuable here. Although cod is the more important, the haddock stocks are subject to severe fluctuations and we need ability to predict them. Existing series of hydrographic data should therefore be examined for associations with year-class strengths, and with changes in "availability". The cod-temperature studies now being made should be reviewed and the programme intensified, as also the valuable tagging projects in progress. Spawning, larval drift and ultimate success should be studied in relation to water movements; e.g. over the isolated fishery of Flemish Cap (pp.71-73).

Subarea 4. This is in the middle of the cod range and extreme long-term effects are therefore less likely. Studies of long-term trends should, however, be maintained, and work intensified on the studies of the distribution and migrations of cod in the Gulf and over the Magdalen Shallows, in relation to the seasonal hydrographic regime. The studies of commercial cod: haddock ratios in relation to environmental changes should be continued and, again, the studies of water transport in relation to spawning and larval drift. In this respect, it would be useful if the Continuous Plankton Recorder survey could be extended, first to provide data between St. John's (Nfld.), Halifax (N.S.) and Boston (Mass.) and then along the route of U.S. weather ships to Weather Station B. The present studies of groundfish feeding habits and of the production of bottom animals were noted and the value of associated studies of digestion rates and of the requirements for the maintenance and growth of cod and haddock in this subarea is stressed (pp.73-74).

Subarea 5. This is primarily a haddock and redfish area; cod is at the southern end of its range. An invaluable series of haddock age-composition data is available and it is strongly recommended that the earlier studies of variations in year-class strength in relation to meteorological and hydrographic conditions be extended. In particular, the several hypotheses regarding the influence of local and distant oceanographic conditions on the survival of haddock eggs and larvae should be tested by investigations in the field over a term of years. The proposals for regular surveys of groundfish distribution in relation to local hydrography are endorsed, as also the proposals to analyse the age composition of cod and yellowtail flounder stocks. The plans for local bottom fauna studies should be expanded to include studies of the feeding habits and of the distribution and abundance of the local fish (pp.74-75).

B. General

1. Environmental Tolerance. Widely ranging studies of the physiology and behaviour of commercial fish are needed both in the field and in the laboratory. Stress is laid on investigating the tolerance of adult and larval fish and their food, to various environmental condition, particularly temperature (p.75).

2. Water Movements. In all this work there is need for specific information about local water movements: particularly how they are influenced by variations in the major current systems of the North Atlantic and how these in turn are brought about. Both on the local scale and over the wider field, associated studies of meteorological phenomena should be made in relation to the fisheries (pp.76 and 77).

3. Eggs and Larvae. It is characteristic that the ICNAF fisheries are mainly situated around the edge of a major continental slope, and therefore subject to variations in the water regime along that edge. This situation presents the larval fish with special hazards. A collaborative attack should therefore be planned in order to study larval survival etc. under different field conditions: for example, in Subareas 1 and 2, over the Flemish Cap, along the Nova Scotian coast and/or on Georges Bank. Such a survey should include meteorological, hydrographic and plankton studies in the appropriate areas, over periods of about three months. It could only be undertaken with the collaboration of research vessels of the member countries; it should be planned by a special group, in the first place for the spring of 1963 (p.77).

4. Redfish. There is still a great ignorance concerning the life of the redfish, although it is now a major commercial fish; information concerning its relationships with its environment is urgently needed. Larval surveys suggest that, at the least, the females extend seasonally across a broad band of the ocean, from the U.S. coast to the Barents Sea. We need to know whether the presently exploited groundfish on the shelf are offshoots of an oceanic stock or are distinct, how the adults migrate and how the larvae drift, in relation to environmental conditions, particularly temperature and water movements. For example, 1958 was unfavourable for spawning over a wide area and environmental reasons should be investigated. Environmental studies should be conducted jointly with ICES, with special reference to the intraspecific varieties of redfish (pp. 78-79).

5. Other general objectives. Environmental studies are ultimately concerned with the unit stocks of fish, and therefore remaining uncertainties regarding these need to be clarified, by tagging experiments and by studies of meristic characters, otolith

and blood types, etc. Similarly, more precise information is needed on year-class strengths, spawning places, larval success, etc. in relation to environmental conditions. Other fish species may affect the distribution and abundance of commercial species, and all countries are urged to follow the U.S. and Canadian example in recording the species found in trawl catches. Similarly, their plans for studying the benthos of the fishing grounds are commended, since fish distribution may be linked with that of their benthic food organisms; studies of the latter may also provide relatively economical assessments of important long-term environmental changes. The feeding habits of fish should be studied (p. 80).

C. Collection and Exchange of Data.

After consideration of the various problems related to the collection and exchange of data, it was suggested that all European ICNAF countries supply their hydrographic data for the North Atlantic to the ICES Data Centre and that the U.S. and Canada supply theirs to the U.S. National Oceanographic Data Centre (pages 80-82).

APPENDIX I. Informal Meeting of the Environmental Working Party in Moscow, 21 September, 1960.

The Working Party was convened informally by Dr. Lucas (Convener) in order to make plans for the full meeting of the group in Aberdeen. Present: Dr. Ju. Ju. Marty (with Dr.M.V.Fedesov and Dr.A.P.Alexseev), Dr. F. Hermann, Dr. L.M. Lauzier, Professor G. Dietrich, Dr. G. Krefft and Mr.A.J.Lee. The group was informed that it would not be possible for Dr. Walford and Dr. Meyer to serve and that Dr. Krefft was taking the place of Dr. Meyer; unfortunately, Mr.J.E.King, representing Dr. Walford, had not arrived in time for the meeting.(1)

The Convener briefly outlined the events leading to the appointment of the Working Party, referring first to the objectives set out in items (a)-(f) of the Report of the ICNAF Environmental Subcommittee (1960 Red Book, p.23-24), and then to the specific questions put to the groups - (a)-(e) on p.25-26 of that report. He emphasised the need to concentrate on definite problems if progress is to be made, as well as the need for hydrographers and biologists to work together - in committee, in the field, and in the laboratory - on these problems.

Data. In response to the Convener's request for lists of hydrographic data relevant to the ICNAF Area, Dr. Lauzier and Dr. Krefft had already been able to provide drafts of data obtained by Canada and the Federal Republic of Germany, respectively. The manner in which these had been completed was discussed, a few modifications were suggested, and it was decided that lists from all countries in similar form would be of great value. In general, they should indicate the range of data in some detail for the years 1950 onwards, with broader indications of previous data, particularly when available for key stations over long periods. Lists should include bibliographies of published data and relevant papers, as well as of laboratory reports where possible; indications of how raw data can be made available would be valuable. Dr. Marty and Dr. Hermann foresaw no difficulties in providing similar information for the USSR and Denmark within about two months, and it was understood that a list for the USA was already being prepared.(1) The Convener was asked to request similar lists from other member countries via the Secretariat (preferably 10 and at least 7 copies).

Preparatory Work. Dr. Hermann was arranging for preliminary correlations to be made of surface temperature and wind data, with those of larval abundance and year-class strength of cod in the Greenland area; he would also see whether sufficient deep temperature data were available for similar correlations and compare distributions of surface and deep data. These steps were welcomed by the group and reference was also made to the probable relevance of a paper already contributed by the Federal Republic to a WMO publication(2); it was felt that useful correlations might be obtained on the basis of air-pressure gradients between Weather Ship B and other coastal stations. Relevant data could also be obtained from publications of the U.S. Coast Guard (International Ice Observation and Ice Patrol Service in the North Atlantic

Ocean), and in due course charts would be prepared of the collaborative surveys made in spring and autumn under IGY, once funds were made available. The Convener referred to the U.S. offer to provide from their Hydrographic Office 10-day charts of surface temperature distribution and it was agreed that they would be valuable to all members and indeed to all member countries.(3)

Consideration was again given to the specific questions (a)-(e) put to the Committee, and the Convener emphasised the need for conjoint biological and hydrographical investigations directed to particular problems. The value of collaborative hydro-biological surveys under ICNAF, say once per year, was also emphasised. As to past data, the chief problem would be how to organise and integrate them economically so that all could use them to the best advantage; this might best be done by workers in each country assuming responsibility for selected problems in particular areas. Both of these questions were to be considered further in Aberdeen and recommendations made to the Commission for 1962. Members were asked to keep them under review meanwhile.

It was decided to concentrate during the Aberdeen meeting particularly on cod, whilst noting any information relevant to haddock and redfish which might emerge. Consideration was then given to the biological data available. It was decided to request as soon as possible before the end of the year

(1) summaries of information on life histories, spawning areas and seasons, larval drift, nursery grounds and fishing areas of cod (with all times and dates as far as possible), perhaps most suitably in the form of 1 or 2 charts for different areas (the names of Drs. Templeman, Yves Jean and Martin from Canada, Hansen from Denmark, and Wise(4) from USA were suggested), and

(2) relevant information being compiled by the ICNAF Working Party on Fish Stock Assessments, particularly of long-term data.

It was felt that it might also be useful if, during the Aberdeen meeting, the temporary assistance of U.K. workers concerned with such matters (such as Messrs. Beverton and Parrish) could be sought, and Dr. Lucas thought that this might be possible.

Date of Aberdeen Meeting. Since this meeting in Moscow had allowed arrangements to be agreed in advance, it was decided that the formal meeting in Aberdeen should be held in March. All those members present would be available throughout March, and it was decided for general and personal convenience that the dates of this meeting might most suitably be arranged in relation to those of the meeting of the Assessment Group in Lowestoft.(5)

In adjourning the meeting, the Convener thanked the members and other scientists who had taken part for their assistance.

(1) Mr. King subsequently arrived in Moscow, when he was given an account of the meeting and kindly took part in some useful discussions with Dr. Lauzier and the Convener. He brought with him a useful compilation of U.S. hydrographic data, for the period 1958-1960, and it is understood that this can conveniently be extended in accordance with the desires expressed by the meeting.

(2) Mr. Lee has now kindly provided a reference to this publication ('Relations between maritime meteorology and fishery biology: Relationships between meteorological factors and fish distribution', submitted by the Federal Republic of Germany, Item 22, CMM-III/Doc. 9, World Meteorological Organization: Commission for Maritime Meteorology, Third Session, Utrecht, 14.VII.1960).

(3) It is understood that the first of these charts will soon be available and copies thenceforth will be circulated to all members of the group.

(4) Mr. King's information is that Mr. Wise has now resigned from the U.S. Fish and Wildlife Service and this enquiry will therefore be directed to the U.S. Laboratory at Woods Hole.

(5) Subsequent discussions with representative members of the various North Atlantic working parties due to meet during March led to a proposal that this meeting be held in Aberdeen across the dates 14th-20th March inclusive, so as to fit most conveniently with the travelling of members who also have to attend other working parties.

APPENDIX II. List of Papers etc. Circulated to Members of the Working Party and Deposited with the Secretariat

1. Hydrographic investigations in the ICNAF Area made by Danish ships.
2. Hydrographic investigations in the ICNAF Area made by German ships.
3. Mean sea surface temperature charts (U.S.)
4. Inventory of U.S. bathythermograph data.
5. Oceanographic station data provisional chart (U.S.),
6. Representative list of U.S. cruises conducting hydrographic work in the ICNAF Area (1958).
7. Oceanographic observations made by the Fisheries Research Board of Canada in the ICNAF Area during 1950-59.
8. Table and lists of U.K. hydrographic data collected in the ICNAF Area 1950-60.
9. Chart of hydrographic observations from the ICNAF Area listed in the Lowestoft Laboratory.
10. Hydrographic investigations in the ICNAF Area made by Norwegian ships.
11. Preliminary report on oceanographic observations obtained by the USSR in the ICNAF Area.
12. Details of Icelandic cruises in the ICNAF Area, 1958-60.
13. Information concerning environmental observations obtained in the ICNAF Area by the Station de Biologie Marine, Grande Rivière.
14. "Relations between maritime meteorology and fishery biology" (Germany). (ref. in note 2 of Moscow meeting, Appendix I).
15. Mr. Hermann's paper on "Correlations between the West Greenland stock of cod and environmental factors".
16. German analysis of data on atmospheric circulation in the Northwest Atlantic Area.
17. Summary of biological information on cod in Subarea 1.
18. Summary of biological information on cod in Subareas 2 and 3.
19. Summary of biological information on cod in Subarea 4.
20. Summary of biological information on cod in Subarea 5.
21. Report on the distribution of redfish larvae obtained in the ICNAF Area with the Continuous Plankton Recorder, etc.
22. Preliminary report on plankton sampling (CPR) between Iceland and Newfoundland.
23. Notes concerning recent tagging projects and plankton work undertaken from the St.John's Station.
24. Notes concerning plankton and other work undertaken from the St.Andrews Station.
25. Charts illustrating special biological cruises made from the Woods Hole (Fish and Wildlife Service) Laboratory.
26. German observations on type composition of the redfish sampled at the Bremerhaven fish market.
27. Notes from the Lowestoft Laboratory on fishing off Labrador.
28. Charts of the distribution of *Sebastes mentella* and *marinus*, in Subareas 1, 2 and 3 (USSR).
29. Notes on relevant points for consideration arising from the Fish Assessment Studies.

APPENDIX III. Notes on Problems Encountered by Fishery Assessment Working Group

General

The main task undertaken by the Fishery Assessment Working Group has been to examine the effects of fishing on the principal stocks of cod, haddock, redfish and halibut in the ICNAF region, and where possible to estimate the immediate and long term effects on yield of changes in the codend mesh size in the trawl fisheries, and also the effects of other possible conservation measures.

While, as the Second Progress Report of the Working Group (presented to the Research and Statistics Committee at the Bergen Meeting in June 1960) shows, substantial progress was made in fulfilling this task, the Group was unable, for some fisheries to make detailed, precise assessments. This was due in some cases simply to incomplete or inadequate sampling data for estimating the parameters of the exploited stocks but in others (notably redfish and halibut) it was due to the lack of more fundamental biological information concerning, in particular, identity and delimitation of unit stocks, the seasonal movements and mixing of stock components, and the longer term fluctuations and trends in distribution, composition and abundance in each exploited area.

The provision of more precise information on these important problems must constitute the principal objectives of future biological research in the ICNAF Area, and it is in relation to some or all of them that associated environmental research is likely to be most profitable. In view of the large number of important unknowns, the vastness of the region and its environmental complexity, a most important first step is to identify and delimit the principal research requirements, and to assign priorities, in order that the limited research vessel and other resources can be deployed most efficiently and effectively in relation to them.

Priority Problems

In the following notes, an attempt is made to itemise some of the gaps in current knowledge and difficulties concerning aspects of the biology of the main ICNAF species, encountered by the Fishery Assessment Working Group, which may be of relevance to the planning of future environmental research in the area.

1. Subarea 1 Cod (West Greenland)

Current evidence indicates that the cod fished off the West Greenland coast do not form a single unit stock. Those fished inshore in the coastal fjords are distinct, and do not mix with the major offshore concentrations, fished on the banks between Cape Farewell and 71°-73°N. However, it is not clear whether the offshore cod form one stock, which mixes freely throughout its range, or whether it forms two or more stocks with little or no mixing between them. The results of tagging experiments conducted over a large number of years suggest that the latter is the case, and show at least two groups, a southern one, in Divisions 1E and F, which is closely related to the East Greenland and Icelandic stocks, and one or more northern ones in Divisions 1A, B, C and D.

At present, however, the number of offshore stocks, their boundaries and their seasonal and longer term movements are not known clearly (for its purpose, the Fishery Assessment Working Group treated the offshore cod as a single unit). Furthermore, it would seem that the biological situation in this region, which is at the extremity of the cod's range, is governed critically by climatic and environmental factors. For example, in some seasons, bottom temperatures on the offshore banks are close to, or even below, the average minimum tolerance level for cod and this probably governs the seasonal distribution, availability and pattern of movement between deep slope and shallower bank water and also the annual survival rates of the exploited concentrations. Similarly, as observed in the 1920's and 1930's, longer term trends in the climatic and environmental situation in this region would probably have important effects on the extent of the cod's distribution in this area, their annual survival, migration and growth rates and the permanence of the stock groups.

It seems clear therefore that detailed and intensive long term biological and environmental studies are required in this area, in order to elucidate further the current stock sub-divisions and their relations with the environmental complex, and perhaps more important to provide evidence of environmental trends critical to the distribution, abundance and survival of each of them.

2. Cod in Subareas 3 and 2

The cod fisheries in Subarea 3 (Newfoundland) like those in Subarea 1, are amongst the most important in the ICNAF Area. They reached almost half million tons between 1954-1957. The Subarea 2 (Labrador coast) cod fisheries are much smaller, being confined principally to inshore grounds. However, for the present purpose, it is convenient to group them with the Subarea 3 fisheries.

As a result of longer term and more intensive research, principally by Canadian (Newfoundland) workers, more is known of the biology of the cod in this region than in Subarea 1, especially with regard to stock separation and identity. Current evidence indicates the presence of the following stocks, between which there is little or no mixing:-

(a) East coast of Newfoundland (Divisions 3K and L)

This stock probably also extends into the Labrador area.

(b) Central and southern Grand Bank (Divisions 3N and O)

(c) South and west coast of Newfoundland (Division 3P)

The fish in this area mix freely with those in Division 4R and form with them a common stock. More recent analyses suggest that the cod in this area may in fact be split into more than one stock.

(d) Flemish Cap (Division 3M)

The stock in this area is a relatively small one.

Particular features of the cod fisheries based on these stocks, and their biology, of importance to the Fishery Assessment Group's analyses and of relevance to the present group, are as follows:-

(a) Many of the fisheries exhibit seasonal inshore-offshore (e.g. Division 3K and L), or deep water-shallow water movements (e.g. Division 3N and O).

(b) These movements coincide with seasonal environmental changes (e.g. temperature), by which they may be governed.

(c) Wide fluctuations in yields are experienced in the seasonal or total annual fisheries, which again seem to be related to annual environmental fluctuations.

(d) The fishery in any locality is often sharply localised, again it seems, in relation to the specific environmental complex in the region.

(e) The growth rates of the stocks differ markedly between themselves and also differ from those in Subareas 4 and 5, of which the former is more or less in the middle of the cod range and the latter at the other end.

Thus, the cod stocks in these subareas, like those in Subarea 1, encounter wide fluctuations in environmental factors, both seasonally and from year to year, which may govern critically, the short and longer term distribution, movements and survival. Further, at least in the northern part of the area, the fish are near the extremity of their biological range. Again, more detailed study of the short and longer term changes in the environmental situation is required, to determine the permanence of the current stock situation, and its influence on the distribution, abundance and survival of each stock unit.

3. Redfish: Subareas 1, 2 and 3 (eastern and northern part)

Apart from Subareas 5, 4 and the southern and western parts of Subarea 3, the redfish fisheries in the ICNAF Area are of relatively recent origin. However, in recent years, large redfish fisheries have developed on the continental slopes in Subareas 1, 2 and 3 (Divisions 3K, L and M) and are now of major importance.

Racial investigations have shown that the redfish exploited in the former area make up a different group from those exploited in the newer slope fisheries. It is possible therefore to make a first subdivision of the redfish population in the ICNAF Area into the two groups, the rosefish of the American and Canadian east coast and the redfish of the oceanic slope regions.

Relatively little is known of the general and population biology of the oceanic slope form (Sebastes marinus), on which the new fisheries and those in the north-east Atlantic (e.g. Icelandic area, Barents Sea) are based.

The fisheries for this form in the different areas are known to take place on the edge of the continental shelf, or on the slopes of oceanic banks in depths ranging up to 300-400 metres. The principal question is do these exploited groups constitute the fringes or isolated offshoots from a very large oceanic population, from which they are replenished either continuously or periodically, according to the environmental situation in the area, or do they constitute distinct unit stocks?

It is known from plankton surveys in the northern part of the eastern and central Atlantic that larval distribution is very widespread, thus pointing to a large oceanic population, but it is not known what relation this bears to the groups exploited at present.

The answer to the above question is important for the assessment of the effects of fishing on the exploited concentrations of Sebastes marinus and in gauging the importance of conservation measures. The statistics of the fisheries in some areas (including those in the north-east Atlantic) show rapid and sharp declines in catch per unit effort following the commencement of exploitation.

It is clear that a close and more extensive study is required of the distribution and abundance of the oceanic redfish population, its seasonal and annual changes, and its link with the exploited groups. Associated environmental studies are required to determine the factors determining these limits.

4. Halibut: all subareas

There are no halibut fisheries in the ICNAF Area comparable with those for cod, haddock or Sebastes, but it is, or has been fished in all subareas.

Very little information is available on halibut biology in the whole area. The results of tagging experiments suggest that there is little or no interchange between Subarea 1 and other ICNAF subareas, but information on further subdivisions of the population is incomplete. Little is known of the factors governing the distribution of halibut, its spawning localities, and their environmental features.

5. Haddock in Subarea 3

The ICNAF haddock fisheries are located in Subareas 3 (3N, O and P), 4 (4X, V and W) and 5. Separate stocks occur in each of these subareas.

A striking feature of the Subarea 3 haddock fisheries since the war has been the marked short term fluctuations in yields, due to large short-term changes in the abundance of the exploited stock. This has been shown to be due to very large fluctuations in year-class strength. Fluctuations in year-class strength are of course common to all of the haddock stocks in the ICNAF Area, but in this subarea they are of exceptionally large magnitude. The fishery is therefore often dependent for its success on one, or at the most two year-classes.

As for most other species in this and other regions, the factors governing these fluctuations are not known, but it is significant that they occur towards the extremity of the haddock's range in a region subject to a highly variable environmental complex, by which they may be critically governed.

Conclusions

These examples do not cover all the gaps in current knowledge of those aspects of general fish biology in the ICNAF Area, of major relevance to reliable fishery assessment. For example, no mention is made of the magnitudes of the apparent natural mortality rates, information on which is lacking, or is incomplete for many of the stocks. However, they may serve to illustrate some of the more important sorts of problem with respect to which environmental research might be most usefully planned. It is clear that a number of the important current fisheries in the ICNAF Area are centred on stocks of fish near the extremity of their biological range, where their distribution, abundance, growth and survival are most susceptible to short term changes and longer term trends in the environmental complex. The species and regions where this seems to be most critical are as follows:

Subarea 1	cod
Subarea 2	cod
Subarea 3	cod and haddock
Subarea 1, 2 and 3	redfish
Subarea 5	cod at the warmer end of its range

Fishery assessments, on which possible future conservation measures may be based have had to be made for these stocks on the biological situation as it is known at present. It is of great importance that a close check should be maintained on this situation in order that significant changes, particularly of a long term nature, can be detected, measured and if possible assigned to their causal agencies. It seems therefore, that attention might be focussed on detailed long term environmental studies, linked with associated biological studies, in one or more of these "critical" areas. The cod in Subareas 1, 2 or 3, or the haddock in Subarea 3 might form the starting point.

APPENDIX IV. Notes on the Value of Hydrographic Sections being made in the Area

1. Standard hydrographic sections are of value in that, if they are worked for a long period at fixed times during the year, they yield indices of certain variables such as temperature, salinity and current. These indices can be used for identifying both long and short term oceanic climatic trends in an area and for calculating correlations with year-class strengths, but it must be borne in mind that such correlations are no proof of causality.

   As it is probable that such factors as temperature and currents have greatest influence on the fish during its larval stage, it is especially important that the sections are worked at the time of the year when the fry is planktonic.

   However, before the indices can be used with any confidence, some knowledge is required of the representativeness of a particular section in a particular month. For example, are the changes in the oceanic circulation so rapid, or the internal wave effects so great, as to make a section meaningless as an index to conditions in a particular season?

2. The sections are of little use for determining actual current speeds because of the limitations of the method of dynamic computations, unless some direct current measurements are made at fixed points to which the dynamic computations can be related. The drift of icebergs in the Labrador-Newfoundland area has been used as such a check. The failure of the method to give absolute current values lessens the confidence that can be placed on the index of current referred to in para. 1, particularly in the bank and slope parts of a section. Nevertheless, although the absolute values of current may be wrong, the relative values will not be so greatly in error, so that the index can still be used with certain provisos.

APPENDIX V. Advice on Collection and Exchange of Data etc.

Note on Data Centres

The members noted that

(1) The National Oceanographic Data Centre in Washington was now operating under an inter-agency committee in premises and with facilities provided by the U.S. Hydrographic Office. It is supported entirely by U.S. funds. Data for the whole world can be obtained from it by any country upon payment of the cost of retrieving the data. It is not known how data will be obtained from other countries and non-American agencies for filing in the centre or whether data will be edited. Processing facilities will be available, however.

(2) ICES is a long-established data centre, which already collects data for the ICNAF Area and is ready to start putting data collected in the North Atlantic area since 1958 on punched cards; it is held up by lack of staff and funds. It has so far failed in an attempt to get funds from UNESCO, despite a recommendation by the International Association of Physical Oceanography in Helsinki in 1960. Its coding system for the punched cards differs from the U.S. system: the degree of difference is not known exactly but is thought to be small. The U.S. system is published and the ICES system will be published shortly. The future of the Bulletin Hydrographique has not been decided. One school of thought wishes to keep it going in its present form, the other would prefer listings of data on loose sheets to be obtained automatically from the punched cards;

(3) The World Data Centre B in Moscow is analogous to IGY World Data Centre A in Texas. Its data are stored on sheets and different organizations in the USSR put them into their own punched card systems;

(4) The Intergovernmental Conference on Oceanography in July 1960 recommended the continuation of World Data Centres A and B under the umbrella of the International Oceanographic Commission with the support of UNESCO funds. It would appear that Centre A will eventually be attached to the U.S. National Data Centre.

PART II. SUMMARIES OF RESEARCHES, 1960

1. Summary of Research Work carried out in Subarea 1 in 1960

by Paul M. Hansen

The present summary is based on the research reports from the following member countries: Denmark, France, Germany, Iceland, Italy, Norway, Portugal, Spain, USSR and United Kingdom.

1. Hydrography

Hydrographic work has been carried out by Denmark, France, Germany and Norway chiefly in April and July. Temperatures measured over the offshore banks were, on the whole, higher than in 1959. Probably the temperatures in July were the highest measured in the last ten years. In contrast to 1959, the ice conditions were favourable in the southern part of the subarea as well as off the southeast Greenland coast. High air pressure over South Greenland and low pressure over the eastern Atlantic caused strong north-easterly winds which pressed the ice towards the coast and kept the banks free of ice to the benefit of the fishing fleet. The highest temperatures in the sea (5.3°) were measured in April at depths of 250 m and deeper on the western slope of Lille Hellefiskebanke. In Godthaabsfjord the hydrographic conditions were quite different from those on the banks. On a station in the inner part of the fjord near the spawning ground for cod, temperatures below zero were measured in all water layers from the surface to the bottom (about 200 m). This phenomenon must be ascribed to the very cold winter and spring. The Greenlanders reported that dead cod were found on the spawning place in April.

2. Occurrence of cod eggs and larvae

Very few cod eggs were taken in the Godthaab Fjord and in the adjacent coastal region compared with the numbers caught in previous years.

The April 30 fishery with plankton nets on three stations from the coast near Fylla Bank gave 46, 22 and 3,457 eggs. The largest number was taken over the western slope of the bank, while the smallest was caught over the middle of the bank and the third was from a station between the coast and the bank. This big catch on the westernmost station is the largest catch of cod eggs ever taken in the Davis Strait. There is a good agreement between this large catch of eggs and the observation of the occurrence of spawning cod west of the bank, as mentioned in the German research report.

In July the number of cod larvae taken on stations in four sections over the banks were not particularly large, but still higher than in the two previous years. There is reason to consider the year-class 1960 as of medium strength.

3. Occurrence of small cod of Age-Groups I, II and III

Only nine samples of small cod were taken in order to estimate the rich and poor year-classes in the stock not fished by commercial gears. While the age groups II and III (year-classes 1958 and 1957) were strongly represented in the catches with shrimp trawl and hand seine, age group I (year-class 1959) was poorly represented. In view of the rather poor occurrence of the year-class 1958 in the catches in 1959, the strong representation of this year-class in 1960 is rather surprising. There is no doubt that the year-class 1957 must be considered the richest of the year-classes of cod, which have not yet entered the commercial fishery.

4. Commercial stock

The year-class 1953 was the predominating year-class in most of the catches taken with hand-line and trawl. In the Norwegian and German catches in April, it constituted 43% and 51% respectively. The old, rich year-class 1947, however, predominated in Danish long line catches in July. The 1950 year-class was of some importance in divisions 1C and 1F. Among the younger year-classes, 1956 seems to be important in 1D, E and F in spite of its small-sized individuals.

There is reason to believe that the catches in 1961 and 1962 will be characterized by many rather small cod, belonging to the younger year-classes 1955, 1956, and, especially, 1957. The last year-class, which seems to be especially rich, will enter the commercial catches for the first time in 1961 with a mean size of about 50 cm total length. The mean lengths of cod belonging to the year-class 1956 will be about 60 cm. The year-class 1953 will decrease in numbers, but will probably still be predominant in the long-line catches.

5. Observations on spawning cod

It seems that the spawning season was earlier than in 1959. No dense concentrations of cod were found in April over the western slopes of the banks, and none over the lower part of the banks, with the exception of Lille Hellefiske Bank. Spawners were found by the Norwegian investigations west of Fylla Bank at 150-300 m in temperatures of 2-4°, while the temperature on the spawning grounds in 1959 was 4°.

Very interesting observations on spawning cod were made in March and April 1961. German trawlers operated during these months in Divisions 1C and 1D. Concentrations of spawning cod were found by this fishery at very great depths, about 350-550 m, and there is reason to believe that spawning schools might be found even in greater depths. It is possible that cod spawns pelagically at great depths west of Fylla and Banana banks in warm Irminger water. This phenomenon explains the large numbers of cod larvae taken in plankton nets between Fylla Bank and Labrador in July during the last years.

No spawning was observed in 1960 in the southern part of the subarea between Cape Farewell and Nanortalik. It is possible, however, that concentrations of spawning cod might be found far off to the west of the fishing grounds. Further research work is needed to solve this problem.

6. Maturity studies

German investigations have shown that cod in the region of Cape Farewell and East Greenland reach maturity much later than cod from the northern part of Subarea 1. For instance, the percentages of immature cod taken, belonging to the year-classes 1953, 1952 and 1951 were 11, 12 and 18% respectively.

7. Tagging experiments

Tagging experiments with cod were carried out by Denmark, Germany and Norway. The Danish taggings included the offshore banks (2,882 cod) as well as the inshore waters (1,693 cod) of all Divisions except 1A. Germany has tagged 1,728 cod in 1F and off south-east Greenland. Recaptures of tagged cod from taggings in 1960 and previous years have shown migrations of West and East Greenland cod to Iceland. Furthermore, it has been shown that migrations between West and East Greenland take place in both directions. Two recaptures in Subarea 2 of cod tagged in Subarea 1 are of special interest, showing that a mixing between the stocks in these two subareas is possible. In previous years recaptures of cod tagged in Subarea 1 were reported from the Newfoundland area.

8. Halibut

Fishery experiments with halibut have been carried out by Norway in April, with rather poor results. It was shown that the mature halibut migrate from the colder, shallower water down to the deeper and warmer water. This verifies the observation made by Ad. S. Jensen in 1908-09. The immature halibut probably stay on the upper slopes of the banks throughout the year. Fifty-six halibut were tagged.

9. Redfish

The Danish studies of small redfish in Godthaabs Fjord were continued and tagging experiments with large redfish were carried out in the same fjord. Material for racial and age studies of redfish were collected by Germany.

Fishing experiments carried out by USSR showed a fair abundance of redfish, especially in 1C and 1D. 15 to 18 year old redfish occurred in the catches. Only immature redfish were observed. This fact, in connection with previous similar results, together with the southern distribution of redfish fry in the Davis Strait, indicates that the West Greenland redfish stock is recruited from spawning areas east of Cape Farewell.

10. Changes in the West Greenland marine fauna

Previous reports mention changes in the marine fauna in Subarea 1 in recent years. This interesting fact will only be mentioned briefly in this short survey.

Since the middle of the 'fifties, the small cod, species Gadus ogac, which is of no commercial value, has increased considerably in numbers. It was a very common fish before the change in climatic conditions during the 1920's and was a rather rare fish in the warm period. The arctic species, the Greenland halibut, (Reinhardtius hippoglossoides), has increased greatly in numbers in recent years, and is now abundant in many fjords where it was scarce before. On the traditional fishing grounds off Jakobshavn in Disko Bay the stock of Greenland halibut is increasing year by year. Some years ago the stock was very small and the fishery was very poor. Also, in the Umanak Fjord the Greenland halibut, in the last years, has become much more common than it was some few years ago. In the same period the cod has disappeared from this fjord.

11. East Greenland

German and Faeroese research work was carried out in South East Greenland from Cape Farewell to Angmagssalik and on the Anton Dohrn Bank. Spawning was observed off Cape Tordenskjold from the middle of March until early May, with a maximum in the first part of April.

The two strongest year-classes of cod in the German catches were 1953 and 1950; however, the year-class 1947 was also of importance in some of the catches, while in others it was nearly absent. The year-class 1954 was the predominating year-class in a sample off Angmagssalik in May.

In the Faeroese samples from Dohrn Bank in August, the year-classes 1947 and 1950 predominated. In samples taken off Angmagssalik and in the Angmagssalik Fjord, the year-classes older than 1950 were nearly absent. The year-classes 1954, 1955 and 1956, together with 1950, were the most important year-classes in these samples.

References:

The research reports for the year 1960 are as follows:

Denmark	- ICNAF Serial	No.	883	Norway	- ICNAF Serial	No.	860
France	- "	"	897	Portugal	- "	"	863
Germany	"	"	876	Spain	- "	"	859
Iceland	"	"	891	USSR	- "	"	877
Italy	"	"	792	UK	- "	"	807

Further:

v. Brandt: Results of a trip to Subarea 1 for the study of the selectivity of different cod-ends for redfish. ICNAF Serial No. 800.

A. Figueras: Age and growth of cod from the fisheries in the N.W. Atlantic, 1960. ICNAF Serial No. 865.

2. Summary of Research Work carried out in Subarea 2 in 1960

by Wilfred Templeman

Researches

It is gratifying to note the rapid increase in fisheries research information from Subarea 2, since until recently relatively little fisheries research was done in this subarea.

The Canadian sampling of the inshore cod catch and also of the offshore cod population was intensified and considerably more work was done on age and growth of cod (Doc. No.10, Ser. No.806). Older cod were more numerous in the 1960 samples than in those of 1959. Growth curves from the inshore cod showed the usual picture of slow growth for the area and slower growth in the north than in the south. The area of the southern two-thirds of the Labrador Shelf was surveyed for redfish and cod and interesting results were obtained on the presence and distribution of *marinus* and *mentella* forms of redfish. The usual hydrographic section off southern Labrador was taken in early August, and other hydrographic work in the area carried out in August and September. For the second time since 1950 (the other occasion was in 1957) temperatures higher than 4°C (4.1-4.4°C) were present in the offshore deep water of this section. A list of the locations and times of Canadian oceanographic observations in the subarea is given in Doc.No.21, Ser.No.869.

Spain has carried out length measurements of cod (Doc.No.15, Ser.No.859) and reported results on age and growth of cod in Doc.No.18, Ser.No.865. The usual low growth rate for this subarea was found.

A considerable amount of cod sampling and age reading was done by Portugal (Doc.No.17, Ser.No.863). The stock of this subarea continues to be characterised by relatively old cod of small size, with a low growth rate and with no great differences in year-class strength. Studies were also carried out on the stages of sexual maturity, age at first maturity, total weight, and weight of livers, gonads and other viscera of cod.

West Germany carried out racial investigations of redfish and sent a scouting trawler to the subarea in May. German trawlers found successful fishing for cod in the southern part of the area from December 1960 to February 1961 (Doc.No.26, Ser.No.876).

In the USSR investigations (Doc.No.27, Ser.No.877) one research vessel and five scouting trawlers with research scientists on board made a total of 13 cruises to different parts of the ICNAF Area. In these cruises very large numbers of cod and redfish were measured and large samples of otoliths collected for ageing. Sizes of *marinus*-type redfish measured on research and exploratory vessels were larger, and of *mentella*-type redfish smaller, and sizes of cod were smaller in Subarea 2 than in the northern part of Subarea 3. The USSR has contributed valuable information on division of stocks of mentella-type redfish and presented a hypothesis of larval drift to account for the distribution of these stocks of redfish in Subareas 2 and 3. They have noted that extrusion of redfish larvae takes place on the eastern slope of Hamilton Inlet Bank in May and at the beginning of June.

Iceland (Doc.No.30, Ser.No.891) had two research cruises in July and September by chartered trawler to the southern part of the subarea. Cod and redfish were sampled for length and age. In cod there was no exceptional predominance of individual year-classes.

Landings

The cod landings from Subarea 2 in 1960 were 188 thousand metric tons plus the Icelandic landings, more than three times as great as the 60 thousand metric tons landed in 1959. These are by far the greatest landings in the subarea for the period 1936-1960 during which the previous highest catches were 111 thousand metric tons in 1953 and 78 thousand metric tons in 1938. The increased landings were entirely due to a great increase in the trawl fishery.

For redfish the landings from Subarea 2 in 1960 were 59 thousand metric tons plus the Icelandic landings. The 1959 landings were 50 thousand metric tons, of which Iceland landed 6 thousand metric tons. The landings in 1958 were 78 thousand metric tons, of which the Icelandic landings were 33 thousand metric tons. In addition to these landings there are landings by the USSR of 35 thousand metric tons, as yet unassigned by species or subarea.

References:

Canadian Research Report, 1960	ICNAF Serial No. 806
German " " "	" " " 876
Icelandic " " "	" " " 891
Portuguese " " "	" " " 863
Spanish " " "	" " " 859
USSR " " "	" " " 877

Figueras, A.: Age and growth of cod from the fisheries in the Northwest Atlantic, 1960. ICNAF Serial No. 865.

Lauzier, L.M.: Oceanographic observations by Fisheries Research Board of Canada in the ICNAF Area during 1960. ICNAF Serial No. 869.

3. Summary of Research Work carried out in Subarea 3 in 1960

by Wilfred Templeman

Researches

The research information available for Subarea 3 is increasing rapidly as more countries enter the field and increase their research and especially as background information increases with time.

Very interesting new information on the distribution of larval redfish and on the abundance and seasonal distribution of many plankton organisms is being produced by the Continuous Plankton Recorder surveys carried out by the Scottish Oceanographic Laboratory and reported in Doc.No.6, Ser.No.798, for redfish larvae and in Doc.No.14, Ser.No.856, for plankton.

The United States redfish fishery on the Grand Bank (31 million pounds in 1960; Doc.No.8, Ser.No.801) has shown no decline in catch per ship per day since 1954 but catch per ship per day is lower than at the beginning of the fishery in 1951-53. The United States continued to sample its redfish landings from the subarea. Considerable hydrographic work in the subarea has been carried out by the International Ice Patrol.

Canada (Doc.No.10, Ser.No.806) has continued the usual life-history researches on cod, haddock, redfish and American plaice. The cod catch per unit effort in the Bonavista area (Division 3L) has continued its gradual decline and is now only about half that of 1954. This is an area where during the period after 1954 there was a great increase in the amount of European trawler and longline fishing in addition to the long established local inshore and longline fisheries. There have been interesting observations on the effects of hydrography on inshore cod catches by traps which benefit by the prolonged presence of a relatively shallow layer of slightly warmed water near shore. Danish-seine hauls for young cod of precommercial sizes have been continued on the beaches of the east coast of Newfoundland in the hope of predicting year-class size. Haddock surveys, length measurements and age readings showed that the present haddock fishery is sustained chiefly by the 1955 year-class with some additions, mainly from the smaller 1956 and the disappearing 1952 and 1953 year-classes. There have been no successful year-classes of haddock in the period 1957-60. As a result a crisis in the haddock fishery is evident with a rapidly declining population of haddock in view at least for the period 1962-64. The routine hydrographic surveys across the Labrador current were carried out in July-August. A list of the locations and times of Canadian oceanographic observations in the subarea is given in Doc.No.21, Ser.No.869.

The United Kingdom measured and sampled cod for age and growth studies during a voyage of the Fairtry I to the subarea (Doc.No.13, Ser.No.855).

Spain carried out length measurements of cod (Doc.No.15, Ser.No.859), and reported results since 1955 on age and growth of cod of the subarea in Doc.No.18, Ser.No.865. There is no evidence of great variations in year-class strength.

Portugal (Doc.No.17, Ser.No.863) collected length frequencies and otoliths of cod from her trawlers fishing in the subarea.

West Germany sent a scouting trawler to the subarea in April-May. The distribution and abundance of redfish, cod, haddock and pollock were investigated (Doc. No.26, Ser.No.876). Length and otolith sampling of cod and redfish and racial investigations on redfish were continued.

The USSR (Doc.No.27, Ser.No.877) sent one research vessel and five scouting trawlers with research scientists on board to the ICNAF Area for a total of 13 cruises. The information on the number of fish examined is not separated by subarea but 439 plankton samples were taken, 105,000 cod, 19,000 haddock and 256,000 redfish were measured and material for age determination was collected from 12,000 redfish, 8,000 cod and 1,500 haddock. The USSR has also contributed a valuable account of division of stocks of *mentella*-type redfish and a hypothesis of larval drift to account for the distribution of these stocks of redfish in Subareas 2 and 3. In 1960 the USSR diverted a large proportion of its fishing effort from redfish to haddock and cod.

France (Doc.No.33, Ser.No.894) sampled the cod caught by a French trawler in Division 3P in March and April. Lengths, stages of sexual maturity and otolith collections were obtained.

Landings

Cod landings from Subarea 3 in 1960, exclusive of the USSR and Iceland, were 407 thousand metric tons compared with 425 thousand metric tons in 1959 and 286 thousand metric tons in 1958. The highest landings in recent years were in 1954 when 475 thousand metric tons were landed.

Redfish landings from Subarea 3, exclusive of Iceland, were 98 thousand metric tons. The 1959 catch was 212 thousand metric tons and the 1959 catch exclusive of Iceland was 187 thousand metric tons. The drop of about 100 thousand metric tons was partly due to a diversion of the USSR fleet from redfish to haddock and cod, and partly to an apparent decline in the abundance of redfish.

Haddock landings, exclusive of the USSR and Iceland, were 30 thousand metric tons compared with 35 thousand metric tons in 1959 and the highest landings of 104 thousand metric tons in 1955. The USSR, however, entered the haddock fishery for the first time in 1960 and in Doc.No.27, Ser.No.877, has stated that 40% of the USSR landings of 220,000 tons in 1960, were taken in 3N. These landings from 3N probably consisted chiefly of haddock. Estimating about 70 thousand metric tons of the 79 thousand metric tons of cod and haddock caught in Subarea 3 by the USSR to be haddock, the total landings of haddock become 100 thousand metric tons. This is an increase of about 65 thousand metric tons over 1959 and approximately the same as the 1955 landings. It is hoped that these very rough estimates can be corrected at an early date when the USSR combined statistics have been separated into cod and haddock. In addition to these landings there are landings by the USSR of 35,000 metric tons, as yet unassigned by species or subarea.

References:

Canadian Research Report, 1960				ICNAF Serial No. 806			
German	"	"	"	"	"	"	876
Portuguese	"	"	"	"	"	"	863
Spanish	"	"	"	"	"	"	859
USA	"	"	"	"	"	"	801
USSR	"	"	"	"	"	"	877

Ancellin, J. : Observations on the French cod fishery: Gulf of St. Lawrence and Newfoundland banks, spring, 1961 (Preliminary Report). ICNAF Serial No. 894.

Bainbridge, V. and G.A. Robinson: Continuous plankton records: Preliminary report on sampling between Iceland and Newfoundland. ICNAF Serial No. 856.

Figueras, A.: Age and growth of cod from the fisheries in the Northwest Atlantic, 1960. ICNAF Serial No. 865.

Henderson, G.T.D.: Continuous plankton records: The distribution of young Sebastes marinus (L.). ICNAF Serial No. 798.

Lauzier, L.M. Oceanographic observations by Fisheries Research Board of Canada in the ICNAF Area during 1960. ICNAF Serial No. 869.

Sinclair, J.A. : Report of voyage of "Fairtry I" to Newfoundland banks, 30th November, 1960-11th January, 1961. ICNAF Serial No. 855.

4. Summary of Research Work carried out in Subarea 4 in 1960

by J. Ancellin

Cod

Observations reported in the Canadian Research Report for 1960 (Document No.10) show that in the western Gulf of St.Lawrence, cod appear to be a well-defined population living in the western Gulf (4T) in summer, and along the western side of the Laurentian Channel off Cape Breton Island (eastern 4T and 4V north) in winter. The observations further show that market size Gulf cod are concentrated in narrower depth and temperature ranges in winter than in late spring or early fall. There are vertical migrations of smaller cod at night, and vertical migrations of food appear to affect movement of cod off the bottom. Discards on commercial draggers appear to be 2 to 8% by weight.

The report deals with a major change in the age of landed fish which has occurred between 1949 and 1960. In the earlier years, up to 1952, the ages of the fish were well spread out between ages 3 and 14. Since 1955, there have been few individuals over 10 years of age and in 1960, there were few over 7; so the abundance of large cod is decreasing.

These changes are believed to have resulted from greatly increased fishing effort by Canadian and European fleets in this population. (Landings doubled to about 100 thousand metric tons by year, and catch by unit effort by Canadian draggers cut in half in 10 years.) These problems are also reported in Document No.3.

Mortality rate for 4T cod has been estimated. Forecasts were reported for the 1961 fishery. Document No.17 gives observations on cod in Subarea 4 (February to April) where the predominating year-classes were 53, 54 and 55 as the preceding year. The same report gives size distribution for 4Vn and 4R, and age at first maturity which was found to be between the 5th and 9th year. For most individuals maturity is reached in the 7th year, the corresponding size being 55-56 cm. in length. Document No.15 gives size of cod for 4R, 4Vn, and 4W obtained on board various trawlers in February, March and April.

Document No.18 on age and growth of cod from the fishery in the Northwest Atlantic gives age frequencies and growth rates for 4R and 4V and shows by comparison a lesser growth in this region and a more restricted range of the age frequencies than in Subarea 1.

Some other documents report various observations made on board cod fishing vessels, among those: Document No.26 and Document No.33. The latter, concerning observations on the French fishery in the Gulf of St.Lawrence made in March and April 1961 (trawler of 68 meters), indicates that the catch by haul of 2-3 hours was about 6-12 tons (round, fresh fish), and the discarded cod can be estimated to a maximum of about 5-10% in weight.

Document No.32 concerns the validation study of Subarea 4 cod otolith age determinations and concludes that good confidence may be placed in the validity of otolith ageing methods.

Haddock

Document No.10 shows that, in winter, catches of haddock were small and confined to deeper water along the Laurentian Channel and the gully between Sable Island and Banquereau. Largest catches were obtained from depths of about 45 to 70 fathoms in the vicinity of Western and Emerald Banks.

For the division 4W, mean lengths at ages have shown a marked decrease over the past 12 years. The forecasts for the following years are not very good according to the low availability of pre-recruit sizes and lack of strong year-classes.

Hydrography

Documents Nos.10 and 21 describe hydrographic observations made off Halifax, in Cabot Strait and around the Magdalen Islands.

Study of the seasonal and long-term variations of the water temperature was continued, and it is estimated that the cooling trend experienced during the last few years is continuing in most areas for the surface and bottom waters.

Document No.8 mentions the "Gulf Stream '60'" working on a network of hydrographic stations from the latitude of Bermuda to the Continental Shelf off North America, including the southern part of Subareas 3, 4 and 5.

References:

Research Reports, 1960:

Canada - 1961 Annual Meeting Document No.10	- ICNAF Serial No.806
Germany - 1961 Annual Meeting Document No.26	- " " " 876
Italy - 1961 Annual Meeting Document No.5	- " " " 792
Portugal - 1961 Annual Meeting Document No.17	- " " " 863
Spain - 1961 Annual Meeting Document No.15	- " " " 859
USA - 1961 Annual Meeting Document No.8	- " " " 801

Report of Regional Meeting of ICNAF Scientists, Woods Hole, Mass., December 14-16, 1960 - ICNAF Serial No.788

Figueras, A. Age and growth of cod from fisheries in the Northwest Atlantic, 1960. ICNAF Serial No.865.

Lauzier, L.M. Oceanographic observations by Fisheries Research Board of Canada in the ICNAF Area during 1960 - ICNAF Serial No.869

Kohler, A.C. Validation studies of Subarea 4 cod otoliths and age determinations - ICNAF Serial No.884

Ancellin, J. Observations on the French cod fishery in the Gulf of St. Lawrence, etc. - ICNAF Serial No.894.

5. Summary of Research Work carried out in Subarea 5 in 1960

Research Conducted and Status of the Fisheries in Subarea 5, 1960

by Herbert Graham

Landings from Subarea 5 in 1960

Canadian landings of groundfish for the subarea in 1960 were 2,832 metric tons, up 1,134 tons over 1959. Most of this increase (2,222 metric tons) was in the category of "other groundfish", consisting of pollock, hake, cusk, catfish, skate and scale. Canadian landings of cod were 132 tons and haddock 163 tons. Canadian landings of sea scallop meats were 3,400 tons, up markedly from the 2,000 metric tons landed in 1959.

United States landings of groundfish for the subarea in 1960 were 194,000 metric tons, as compared with 255,000 metric tons in 1959. The drop was due largely to a decrease in the activity of the industrial fishery, which took only 23,000 metric tons in 1960 as compared with 85,000 metric tons in 1959. Redfish landings dropped from 15,000 metric tons to 9,000 metric tons; haddock increased from 42,000 metric tons to 47,000 metric tons. Whiting held steady at about 48,000 metric tons; flounder increased 3,000 metric tons to 27,000 metric tons, while cod decreased 2,000 metric tons to 14,000 metric tons. Pollock held steady at 8,000 metric tons and "other fish" was up slightly to 7,000 metric tons. United States landings of sea scallops were 10,000 metric tons, surpassing the record year of 1959, when 8,500 metric tons were landed.

Research

The United States and Canada continued their sampling of the commercial catch of major species taken in Subarea 5 (Doc.Nos.8 and 10).

Abundance indices for Georges Bank haddock maintained by the United States show that the downward trend experienced in recent years reached a low in 1959. The index for 1960 was higher than for any year since 1957. The increased abundance is due to a large year-class (1958) recruited in 1960. The fishery should improve in 1961 as the fish in the 1958 year-class grow to larger size. Fall survey cruises in 1960, designed to assess the abundance of pre-recruit haddock, showed relatively low numbers of young-of-the-year. Thus, it is expected that scrod landings will drop in 1962, which may possibly have an effect on total landings, depending upon the abundance of the 1958 year-class which will then be four years old.

An analysis of tagging records showed fewer recaptures of haddock with evidence of scale loss or subcutaneous bleeding as compared with undamaged fish at time of tagging. Early returns were higher for spaghetti tags than for Petersen disc tags. Both types of tag were attached through the dorsal musculature.

Three research vessel cruises were made during the summer and fall to three areas where small haddock are taken by various small boat fisheries. Prior to 1960, when the industrial fishery was operating, samples from these areas were obtained from industrial landings. Comparison of samples from commercial landings with those from the research vessel indicates some avoidance of the small haddock by fishermen. However, analysis of the samples show that the industrial fishery (when operating), the silver hake fishery, and the animal food fishery do take sufficient quantities of small haddock to create a management problem. This analysis is presented in Doc. No.19.

United States studies of cod have continued. The initial program which comprised studies of the number of stocks, migrations, and growth rates has now been largely completed. Determination of age compositions have now been started. These data are essential to population studies of the fish in the subarea and should provide vital information on the effects of fishing.

Indices of abundance for silver hake maintained by the United States since 1956 showed some decrease in abundance on all grounds fished. The cause of this is not known.

Survey cruises were conducted to determine the winter distribution of silver hake, which in summer is fished in comparatively shoal waters. The largest number was caught in depths greater than 100 fathoms, in temperatures ranging from 44°F to 52°F. (6.7-11.1°C) in the general area between Cape Cod and Cape Hatteras.

Redfish abundance indices maintained by the United States show a stabilized condition over the last decade in the Gulf of Maine.

Studies of the Eastport stock of redfish continued. Analysis of recaptures of tagged fish has provided valuable information on growth rate, natural mortality, and estimation of population size. Reports on this work were submitted to the Marking Symposium in Woods Hole.

Yellowtail flounder landings in the United States have increased greatly during the last few years due to large year-classes spawned in 1955 and 1956. Another large year-class appeared in 1958. This entered the fishery in 1960 and should help to maintain the fishery in 1961. United States research during the past year has centered on stock identification, relative abundance, and age and growth studies. Emphasis can now be directed toward obtaining a series of age compositions for population studies.

United States benthic studies this year indicated that the pronounced differences in the haddock's diet from one locality to another on Georges Bank are due largely to differences in available food on different parts of the bank. Marked variations in species composition and quantities of benthic organisms were correlated with sediment type. Gravels and coarse sand supported greater numbers of benthic organisms than fine-grained sediments.

Canada carried out tagging studies on pollock in Passamaquoddy Bay, which lies just over the border in Subarea 4. Pollock tagged here yielded some recoveries from near Cape Cod as well as from southwestern Nova Scotia.

The United States continued its investigations of the sea scallop and the sea scallop fishery. Data on location fished and days spent on the grounds are obtained from vessel captains at the return of each trip. Weight of meats is obtained from the buyers. A monthly summary of the landings by unit areas from 5Z is sent to ICNAF headquarters and to the St. Andrews Biological Station of the Fisheries Research Board of Canada. Canadian scientists have sent similar data for their fleet to the United States.

Data on size composition of scallop landings were obtained from samples of shells brought into port by fishermen. The United States made one cruise with a research vessel using small mesh gear to collect quantitative length-frequency samples of the populations on the various fishing grounds, as well as samples for calculating growth and mortality rates.

Canadians made two trips to Georges Bank on commercial scallop draggers to observe industrial practices and on a United States research vessel to observe methods of investigation.

The growth rate of the Georges Bank sea scallop is now well established and United States research during the year has provided sufficient data on mortality rates that it is now agreed that population studies have reached the point where a statement can be made regarding the optimum age of first capture. The studies indicate that an increase in ring size of scallop dredges above that now in use would result in increased sustained yield per recruit (Doc.No.31).

Both Canada and the United States have initiated early life history studies of the sea scallop. United States studies of gametogenesis show that sexual products are rapidly regenerated during winter and spring and the animals remain fully ripe for almost six months before spawning. Evidence of mass mortalities on certain parts of the bank have been observed by both Canada and the United States.

Canadian experiments with "cluckers" (attached empty shells) show their lifetime to be greater than formerly supposed. This decreases estimates of normal natural mortality rate used in forecasts of conservation values of various fishing practices.

Hydrographic work in Subarea 5 during the year consisted of observations made through co-operating agencies and by the United States research vessel on its series of cruises in the subarea. The lightship program, consisting of daily surface temperature and salinity observations, bathythermograph recordings daily, and bottom water temperatures weekly, was continued. Drift bottles have been released from lightships and from weather ships.

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Canadian Research Report, 1960. - ICNAF Serial No. 806
U.S. Research Report, 1960 " " " 801

R.L. Edwards and J.B. Skerry: The Destruction of Pre-recruit Haddock on Inshore Nursery Grounds. ICNAF Serial No. 866

J.A. Posgay: U.S. Research on the Georges Bank Sea Scallop Fishery during 1960. ICNAF Serial No. 893.

PART III. SELECTED PAPERS

1. ICNAF Mesh Regulations, Operation of 10% Annual Exemption October 1, 1959, through September 30, 1960.

by Lawrence H. Couture 1/

The United States Bureau of Commercial Fisheries, Fish and Wildlife Service, issued 23 exemption certificates during the first year, 23 certificates during the second year, and 17 certificates during the third year to U.S. vessels. These certificates were issued by month and year as follows:

Month	Year	Certificates
October	1957	6
November	1957	3
December	1957	2
January	1958	3
February	1958	4
March	1958	2
April	1958	1
May	1958	1
August	1958	1
	Total First Year	23
October	1958	5
December	1958	1
January	1959	8
February	1959	2
April	1959	1
May	1959	2
June	1959	2
August	1959	1
September	1959	1
	Total Second Year	23
October	1959	2
February	1960	2
March	1960	2
April	1960	3
July	1960	2
September	1960	6
	Total Third Year	17

At the completion of the first year, eight (8) certificates expired and were not renewed by the vessel owners. Two (2) certificates were revoked for failure to submit required reports.

Gloucester, 28 Feb. 61

1/ FRB, Office Statistical Services, U.S. Bureau of Commercial Fisheries, Λ

During the second year, three (3) certificates expired and were not renewed by the vessel owners. One (1) certificate was cancelled when the vessel was sold. On October 1, 1959, there remained 32 certificates in effect.

During the third year, four (4) certificates expired and were not renewed by the vessel owners. Three (3) certificates were cancelled for failure to submit trip reports. Twenty-seven (27) certificates were renewed during the period. One exempted vessel was lost at sea.

At the close of the third year, September 30, 1960, there remained 43 certificates in effect.

The tonnage classes of the vessels are as follows:

			Number of vessels		
Gross tons	Class		Sept.30, 1958	Sept.30, 1959	Sept.30, 1960
0-25	OTS		1	0	0
26-50	OTS		5	9	9
51-100	OTM		7	12	21
101-150	OTM		2	4	5
151-200	OTL		7	6	7
over 200	OTL		1	1	1
		Totals	23	32	43

The landings of these vessels are presented in Table 1.

TABLE 1. Summary of the Operation of the 10% Annual Exemption

		Subarea 3					
		First Year		Second Year		Third Year	
		No.	%	No.	%	No.	%
Fishing trips		9		27		21	
All species	000 lb.	2,107	100.0	5,724	100.0	4,025	100.0
Haddock	000 lb.	0	0	28	0.5	0.2	
Cod	000 lb.	0	0	9	0.2	0.4	
Redfish	000 lb.	2,106	99.9	5,599	97.8	4,014	99.7
Other species[1]	000 lb.	1	0.1	88	2.5	11	0.3
No. of trips with haddock		0		3		1	
No. of trips with cod		0		3		2	
No. of trips with redfish		9		27		21	
Range of haddock landings per trip, lbs.		-		275-16,800		200-200	
Range of cod landings per trip, lbs.		-		90-6,900		210-230	
Excess trips[2]		0		0		0	
Pounds excess haddock[3]	000 lb.	0		0		0	
Pounds excess cod[3]	000 lb.	0		0		0	

		Subarea 4					
		First Year		Second Year		Third Year	
		No.	%	No.	%	No.	%
Fishing trips		70		102		136	
All species	000 lb.	11,840	100.0	14,864	100.0	19,821	100.0
Haddock	000 lb.	374	3.2	1,136	7.6	314	1.6
Cod	000 lb.	34	0.3	171	1.1	123	0.6
Redfish	000 lb.	11,247	95.0	12,761	85.9	18,651	94.1
Other species[1]	000 lb.	185	1.5	796	5.4	733	3.7
No. of trips with haddock		24		61		68	
No. of trips with cod		21		61		69	
No. of trips with redfish		68		89		135	
Range of haddock landings per trip, lbs.		200-89,300		200-100,200		75-51,000	
Range of cod landings per trip, lbs.		35-6,550		80-11,700		45-8,460	
Excess trips[2]		4		19		8	
Pounds excess haddock[3]	000 lb.	108		865		146	
Pounds excess cod[3]	000 lb.	0		4		2	

1) Other species include halibut, white hake, cusk, pollock, flounder, silver hake, and menhaden.

2) Trips of more than 5,000 pounds and more than 10% haddock or cod

3) Quantity of haddock or cod in excess of that covered by trip exemptions.

TABLE 1 (cont'd). Summary of the Operation of the 10% Annual Exemption.

		Subarea 5					
		First Year		Second Year		Third Year	
		No.	%	No.	%	No.	%
Fishing trips		628		1,304		1,324	
All species	000 lb.	23,178	100.0	41,206	100.0	48,152	100.0
Haddock	000 lb.	2,453	10.6	2,404	5.8	2,711	5.6
Cod	000 lb.	471	2.0	670	1.6	699	1.4
Redfish	000 lb.	7,333	31.6	12,552	30.5	14,519	30.2
Other species[1]	000 lb.	12,921	55.8	25,580	62.1	30,223	62.8
No. of trips with haddock		534		841		979	
No. of trips with cod		539		784		935	
No. of trips with redfish		265		454		610	
Range of haddock landings per trip, lbs.		15-113,000		10-63,800		10-50,500	
Range of cod landings per trip, lbs.		10-20,650		10-23,035		10-23,275	
Excess trips [2]		154		101		117	
Pounds excess haddock[3]	000 lb.	1,146		1,012		1,007	
Pounds excess cod[3]	000 lb.	68		84		80	

		All Subareas					
		First Year		Second Year		Third Year	
		No.	%	No.	%	No.	%
Exempted vessels [4]		23		32		43	
Fishing trips		707		1,433		1,481	
All species	000 lb.	37,125	100.0	61,794	100.0	71,998	100.0
Haddock	000 lb.	2,827	7.6	3,568	5.8	3,025	4.2
Cod	000 lb.	505	1.4	850	1.4	822	1.1
Redfish	000 lb.	20,686	55.7	30,912	50.0	37,184	51.6
Other species[1]	000 lb.	13,107	35.3	26,464	42.8	30,967	43.1
No. of trips with haddock		558		905		1,048	
No. of trips with cod		560		848		1,006	
No. of trips with redfish		342		570		766	
Range of haddock landings per trip, lbs.		15-113,000		10-100,200		10-51,000	
Range of cod landings per trip, lbs.		10-20,650		10-23,035		10-23,275	
Excess trips[2]		158		120		125	
Pounds excess haddock [3]	000 lb.	1,254		1,877		1,153	
Pounds excess cod[3]	000 lb.	68		88		82	

1) Other species include halibut, white hake, cusk, pollock, flounder, silver hake, and menhaden.
2) Trips of more than 5,000 pounds and more than 10% haddock or cod.
3) Quantity of haddock or cod in excess of that covered by trip exemptions.
4) Operating under 10% Annual Exemption Certificates.

2. Mesh Measurement Gauges for Cod-Ends

by H. Bohl[1/]

Among the measures taken for the protection of endangered fish stocks, the establishment of minimum mesh sizes is of particular importance. One of the tasks of fisheries science is to obtain, by selectivity experiments and thorough stock investigations, the knowledge required for a reasonable establishment of the sizes of regulation meshes.

In all selectivity experiments measuring gauges, by means of which the mesh size can be determined exactly, are indispensable. These gauges are important not only for scientific work, but also for the enforcement of the legally prescribed minimum mesh sizes in commercial fisheries.

The technique of measuring meshes has improved greatly during the last decade, leading from the yard-stick over the measuring plates - generally tapered at one side - to the modern pressure gauges. The following considerations were taken into account:

1. "The distance between the inside edges of opposite corners of a mesh when it is stretched so that its sides lie parallel to each other" (16) is, with regard to the selectivity of a net, the only really useful measure of the mesh size. Other characteristics of the mesh size - for instance, the number of knots per a length-unit or the mean length of several neighbouring legs of meshes including the knots - are unsatisfactory. Thus the yard-stick cannot be used as a measuring instrument.

2. Principally, a certain pressure is required for any mesh measurement, in order to stretch the mesh. Owing to the elasticity and distensibility of the net twines, the measuring pressure must be uniform and controllable; otherwise different measuring results are unavoidable because the gauges cannot be handled consistently. Therefore, the simple measuring plates without pressure indicators are also obsolete.

Thus circumstances required the design of a gauge which could precisely control the pressure used for the measurement. This concept was first realised in a simple way by the United States. They inserted a dynanometer spring into the handle of a measuring plate, which spring was compressed to a pressure mark during measuring.

In this form the first pressure gauge (8) was introduced into the ICNAF Area. It was proved by the British and the Dutch that substantially more consistent results could be obtained with the ICNAF gauge than with the simple measuring plates working without pressure control (2, 3, 11).

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The development of the ICNAF gauge, however, was not the final step. Other pressure gauges were designed - at first in Scotland and also in other countries - all of which differed from the ICNAF gauge. With all of these gauges, the mesh is stretched during the measurement by a force which does not, like the ICNAF gauge, exert pressure vertically towards the mesh-level, but longitudinally in the direction of the mesh-axis. In this way the direction of the pulling effort occurring in the meshes of the towed cod-end is duplicated.

It would also be useful to adapt the amount of effort to be used for the measurement to the conditions of the trawl fishery. Very little, however, is known about these conditions at present. According to German investigations (13), the stresses to which the individual legs of mesh in the anterior part of the net are exposed during towing under "normal" conditions fluctuate between 2 and rarely more than 10 kg. At the anterior edge of the lengthening piece, stresses of 3 to 5 kg have been measured. These values, which do not take into consideration high waves and heavy catches in the net, were, of course, insufficient to establish the measuring pressure. Therefore, there remained only the possibility of an arbitrary standardisation of the measuring pressure. After lengthy discussions, the Mesh Selection Working Group of ICES agreed in December 1960, that a pressure of 4 kg[1/] is most suitable for double manila, double hemp, double cotton and thick, single manila, as used in trawl cod-ends. When lighter and thinner twines are used, a lower pressure may be necessary. In any case, the pressure used for mesh measurements should be mentioned in publications (16).

It has been proved that the longitudinally-acting pressure gauges measure more uniformly and accurately than the vertically-operating ICNAF gauge. Most of these investigations, however, are limited to a comparison of measuring results from the ICNAF gauge and the Scottish gauge (7, 9, 11, 15). Intensive German investigations also consider, in addition to these two types, a number of other important pressure gauges. The purpose of these comparative investigations is to do preliminary work for the necessary standardisation of the mesh-measuring gauges.

It was possible to show that the pressure gauges now in use are not of equal value. On the basis of the consistency of the results achieved by various operators, in a series of experiments (6) the Scottish gauge (11) had greater accuracy of measurement than the Lowestoft gauge (1) and the Polish gauge (14). The ICNAF gauge had the most varying results. The results from the comparative measurements carried out with the Scottish gauge and with the ICNAF gauge are shown in the attached table. In another comparison, the prototype of a hydraulic measuring gauge developed by the United States Fish and Wildlife Service was tested (4). Although the measuring accuracy of this instrument was satisfactory, it was not found as handy as the Scottish gauge because of its inconvenient shape and complicated working method.

1/ In this connection it may be interesting to note that the rules of BISFA for textile length measurements prescribe a standard pre-tension equal to the weight of 500 m of synthetic fibres. If that rule is used for mesh measurements, substantially higher measuring pressures would result.

In 1959 C.J.W.WESTHOFF, Den Haag, chose the particularly well-designed Scottish gauge for further improvement. By installing an automatic locking device, which ensured that the desired measuring pressure could not be exceeded, a precision instrument was developed, the accuracy of which was very satisfactory. Moreover, it was a relatively handy gauge. The Comparative Fishing Committee of ICES did not hesitate in 1959 to recommend the WESTHOFF 1959 model as the standard gauge. Recent German investigations (5) proved that the WESTHOFF 1959 model meets almost all the qualifications of a standard gauge. The Mesh Selection Working Group of ICES was thus in a position to re-emphasise in 1960 the recommendation made in 1959. The WESTHOFF 1959 model is shown in Figure 1.

The choice of the standard gauge did not stop the development of other mesh-measuring gauges. In the Netherlands, for instance, a gauge is under construction which is similar to the Allen Net Rule (12), and a new gauge is also reported from Israel (10). The continued efforts to procure new high-quality instruments for mesh measurement are useful, for the standard gauge cannot be considered completely efficient in any way. Moreover, the existence of the standard gauge does not mean that in future all measurements for scientific purposes have to be carried out with the WESTHOFF 1959 model. A different gauge may well be used, but it should be calibrated against the type chosen as standard, in order to guarantee the inter-comparability of different mesh measurements.

It would perhaps be advantageous for international co-operation if ICNAF should decide to adopt the WESTHOFF 1959 model as the standard gauge.

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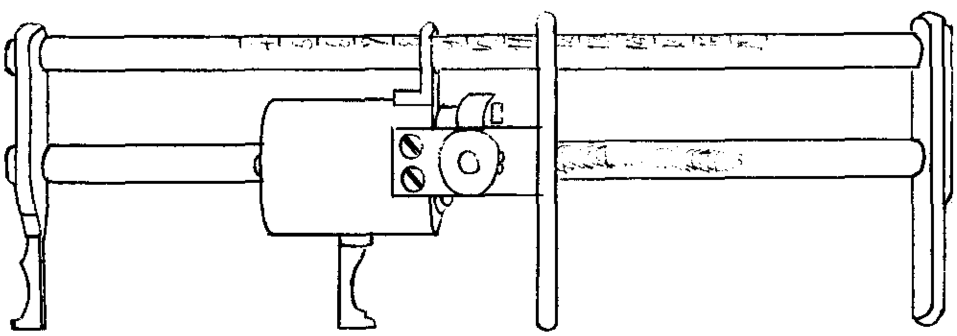

Figure 1 - WESTHOFF 1959 MODEL (Scale 1/2)

Gauge	Operator	Double Trevira (380 m/kg)			Double "Perlon" (210 m/kg)			Double Manila (163 m/kg)		
		$\bar{x} \pm m$	Combin-ation	P	$\bar{x} \pm m$	Combin-ation	P	$\bar{x} \pm m$	Combin-ation	P
ICNAF	A	100.66 ± 0.27	AB	+	98.69 ± 0.45	AB	+	131.50 ± 0.38	AB	0.05
	B	101.00 ± 0.28	AC	0.012	98.35 ± 0.42	AC	+	130.47 ± 0.36	AC	+
	C	101.64 ± 0.28	AD	<0.0002	98.83 ± 0.42	AD	0.001	132.23 ± 0.33	AD	<0.0002
	D	102.75 ± 0.29	BC	+	100.77 ± 0.44	BC	+	136.59 ± 0.31	BC	0.0003
			BD	<0.0002		BD	<0.0002		BD	<0.0002
			CD	0.006		CD	0.0015		CD	<0.0002
Scot-tish	A	101.93 ± 0.29	AB	+	99.18 ± 0.44	AB	+	129.01 ± 0.40	AB	0.045
	B	101.75 ± 0.29	AC	+	98.41 ± 0.44	AC	+	130.14 ± 0.39	AC	+
	C	101.65 ± 0.29	AD	+	98.29 ± 0.44	AD	+	129.35 ± 0.36	AD	0.03
	D	102.36 ± 0.28	BC	+	99.19 ± 0.46	BC	+	130.11 ± 0.32	BC	+
			BD	+		BD	+		BD	+
			CD	+		CD	+		CD	+

EXPLANATION OF THE TABLE:

Four operators (A–D) have carried out comparative measurements with three dry cod-ends made of various material, which had already been frequently used. Always the same rows of meshes (118 meshes) have been measured. The question, whether the individual average mesh size ($x \pm m$) differ either significantly or only incidentally, has been investigated for the six possible combinations by means of the t-method. All incidental differences (P – Probability ≥ 0.05) are marked by +. For all significant differences, however, the P-values taken from R.A.Fisher's t-table have been inserted.

3. Preliminary Results of Experiments on the Measurement of Meshes with Different Gauges and by Different Operators

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Abstract

Measurements of trawl net meshes made at sea by different operators using the ICNAF and Scottish gauges have shown differences between operators and gauges greater than any previously reported in the literature. Two experiments have been carried out in the laboratory to investigate these differences. The first was designed to examine variation between operators using the ICNAF gauge only, while the second was designed to examine operator variation and to compare the results obtained with the ICNAF, Scottish and Westhoff gauges.

Statistically significant differences between average mesh sizes were found in all but one of the comparisons between operators in the first experiment (ICNAF gauge only).

Comparisons between gauges as used by the same operator in the second experiment gave statistically significant differences in 19 of 20 comparisons involving the ICNAF gauge. Such differences were obtained in only 5 of the 10 comparisons between the Scottish and Westhoff gauges. Comparisons between operators using the same gauge resulted in great variability with the ICNAF gauge, less with the Scottish gauge and very little with the Westhoff gauge.

In both experiments the great variation between operators with the ICNAF gauge was found to be due largely to improper use of this gauge.

Introduction

Differences in the measurements of trawl net meshes by the ICNAF and Scottish gauges have been investigated by several authors, notably Parrish, Jones and Pope (1956) and von Brandt and Bohl (MS, 1959). The results of these experiments have shown that not only does the ICNAF gauge offer less precision (higher standard error) and more operator bias than the Scottish gauge, but also the measurements obtained by the former are consistently greater than those by the latter. Parrish *et al.* (1956) found that when three operators on two occasions each, measured 50 random meshes of a 70 mm mesh manila codend, the ICNAF type pressure gauge yielded results higher than the Scottish gauge by amounts ranging from 1.39 mm to 3.65 mm. The differences found between these gauges by von Brandt and Bohl (MS, 1959), when four operators measured the same set of 118 meshes in a 130 mm codend, ranged from 0.33 mm higher with the ICNAF gauge by one operator to 6.48 mm higher by another. McCracken (MS, 1957), in experiments involving the measurement of 50 random meshes of a heavy manila codend (about 4 3/4" (121 mm) mesh size) by three operators using each gauge, found the ICNAF gauge to measure higher than the Scottish by the following amounts: 0.11" (2.79 mm), 0.31" (7.87 mm) and 0.17" (4.32 mm). He did not, however, find significant differences between operators using the ICNAF gauge, as did Parrish et al. (1956). Templeman (MS, 1957) has reported a similar order of difference of 0.15" (3.81 mm) between the ICNAF and Scottish gauges from measurements on a manila codend with mesh size of about 4 3/4" (121 mm).

During recent mesh-selection experiments it has been the practice of this laboratory to measure meshes with both the ICNAF and Scottish gauges. We have been aware for some time that measurements made by the ICNAF gauge have shown considerable operator bias, and this has been aggravated by the fact that measurements in the field are made by some ten different operators. It was decided that some experiments in the laboratory would do much to clarify the situation.

Two separate experiments have been carried out. The first included the ICNAF gauge only and was designed to test differences between operators using this gauge. The second experiment was originally designed to ascertain the differences between the ICNAF and Scottish gauges as used by the same operator, and by different operators. Measurements made at sea using these two gauges gave differences considerably greater than those reported above. In a recent cruise, when the same net as used in experiment II was measured on three occasions by two different operators using both the ICNAF and Scottish gauges, the average codend mesh sizes with the ICNAF gauge were found to be 4.74", 4.53" and 4.53" compared with 4.23", 4.08" and 4.19" respectively with the Scottish gauge.

During the second experiment the modified Scottish or Westhoff type gauge (Westhoff and Parrish, MS, 1959) became available to us, and this gauge was included in the experiment.

Experiment I

This experiment was designed to examine operator variation using the ICNAF gauge in the manner in which each was accustomed.

(1) Design of the Experiment

It was decided that better comparisons would be obtained if the measurements were made over the same row of meshes. The major disadvantage of repeated measurements of the same row of meshes is that irreversible stretching or tightening of the knots might occur and invalidate the comparison. In spite of the fact that von Brandt and Bohl (MS, 1959) found very little stretching in a Perlon codend when 59 meshes were measured 12 times, it was considered best to design the experiment in such a manner that any stretching of the meshes could be compensated for.

It was decided that the form of the experiment most likely to yield useful results would be a 4 x 4 block of the form:

A	B	C	D
C	A	D	B
B	D	A	C
D	C	B	A

Thus in each "block" all four operators would measure the net four times. The arrangement of the block is such that, provided any stretch is constant for each operator, the mean values calculated for each should be comparable over the block. The above design also provides that each operator follows a different operator at each measurement.

A single longitudinal row of 50 meshes was marked off in the centre of the codend, and this row was successively measured. In an attempt to minimize bias, and reduce the possibility of remembering mesh sizes, it was decided that measurements should not start from the same mesh each time. For this reason the meshes were numbered, and the number of the mesh at which each operator started was determined from a set of random numbers.

As each operator took his turn he was instructed to make sure that the person holding the net was holding it as the measurer preferred. Apart from the fact that conditions were more comfortable than would be the case at sea (no ship movements, warm hands, a clean orderly net), every attempt was made to approach field conditions.

A single independent recorder was used throughout the experiment.

(2) The Net

The upper half of a used codend of a #41A otter trawl was used for the experiment. Specifications:- 42 x 58 meshes 5" mesh (as ordered, dry between knot centres), 50/4 manila twine, double, untreated. The codend had previously been used for 19 sets during one cruise and 4 sets during a later cruise of the research vessel A.T.Cameron. The mean measurement as measured by two technicians during the former cruise was 3.94" (100.08 mm) (based on 330 measurements with the ICNAF gauge).

(3) The Experiment

The same longitudinal row of 50 meshes was measured throughout the experiment. Before starting, the net was soaked in fresh water for a period of 18 hours. To keep the mesh consistently wet it was hosed down after each operator had made his 50 measurements.

Six of the senior technicians were available for the experiment and these technicians were tested against each other in three "blocks".

A	B	C	D	A	C	E	F	B	D	F	E
C	A	D	B	E	A	F	C	F	B	E	D
B	D	A	C	C	F	A	E	D	E	B	F
D	C	B	A	F	E	C	A	E	F	D	B
Block I				Block II				Block III			

Within each block the four operators measured the 50 meshes four times, thus the means from each operator in the block are based on 200 measurements.

Prior to the experiment the dynamometer in the gauge was checked as reading correct at the desired pressure of 12 lb (5.4 Kg).

(4) Results

At the very start, it was apparent that the experiment was going to provide little or no information on the variability between operators using the ICNAF gauge. None of the technicians used the gauge as it was designed to be used, viz. at the constant pressure of 12 lb (5.4 Kg). This constant pressure was approached by two operators, but others, and in particular operator B, used the gauge more as if it was an ordinary wedge type gauge with no constant pressure device.

The means and standard errors obtained by the different operators within each block, as well as the overall mean for each operator for each block are shown in Table 1. The differences between the operators can be seen more easily in Fig. 1 where the means obtained by each operator for each measurement of 50 meshes are plotted against time (as represented by the sequential order of measurement). It is apparent from this figure that considerable stretching of the meshes took place over the complete experiment. However, as stretching of the meshes (or tightening of the knots) was greater during the first measurements (Block I) this block has been repeated - Block IV. In Blocks II, III and IV the stretching is less and appears to have stabilized at a relatively constant rate. This trend can be seen rather clearly in the measurements of operator B.

"t" tests show that, with a few exceptions, within each block (excluding Block I) the difference between the mean mesh sizes obtained by an operator in his four measurements are not statistically significant. The exceptions occur when there are occasional extra high or low measurements and do not appear due to the gradual stretching of the mesh. This is not true of operator A, for whom there exists independent evidence that the pressure used by him increased throughout the experiment.

A comparison between operators reveals that the difference between the mean

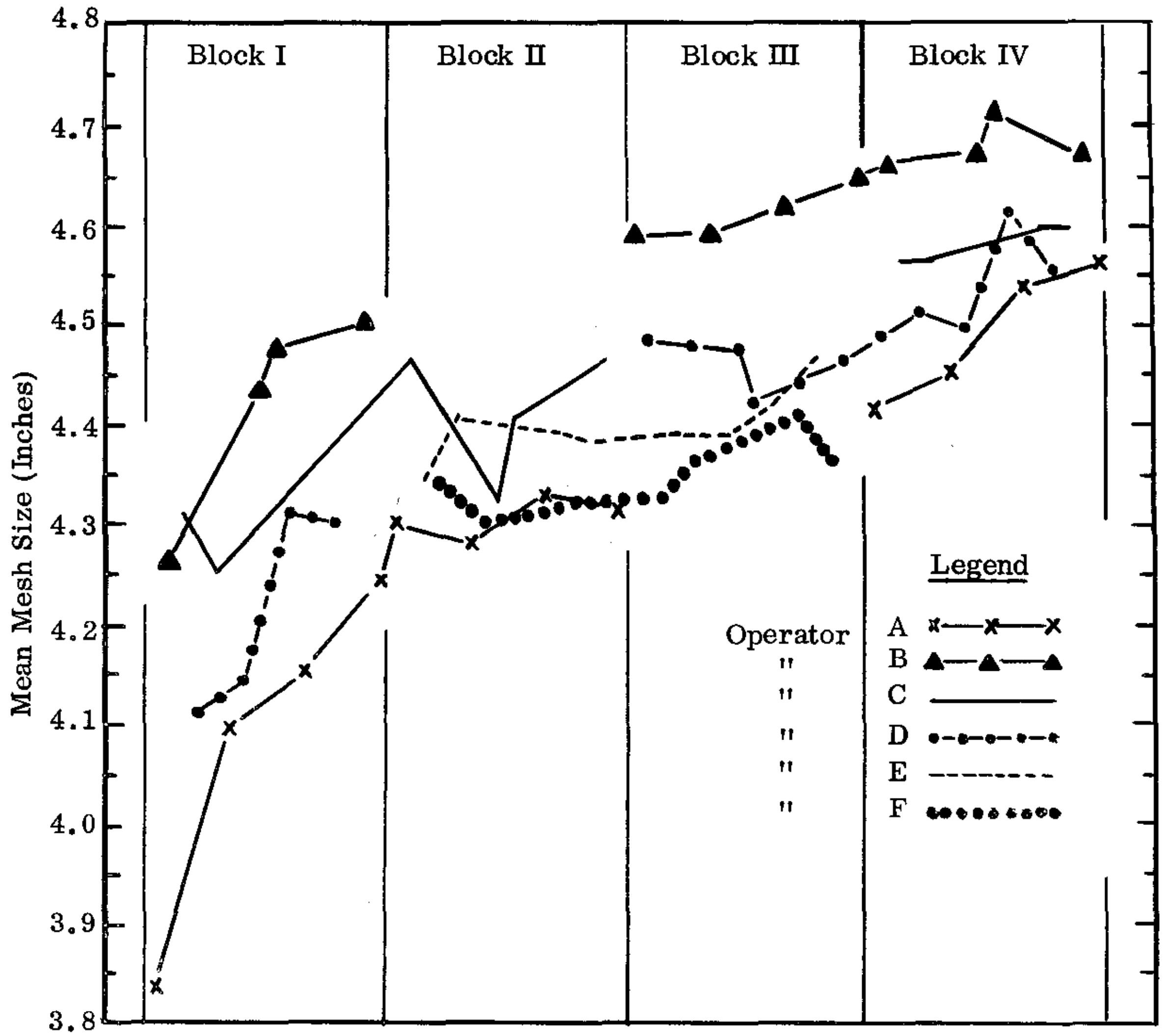

Fig. 1 - Mean mesh sizes obtained in each measurement of 50 meshes (Experiment I).

mesh sizes obtained by one operator and any other, within the same block, is highly significant (Table II). Only in one of the 18 comparisons was a significant difference not found. This involved operator A, whose lack of consistency in pressure applied makes interpretation of his results difficult.

(5) Discussion and Conclusions

The main conclusion to be drawn from this experiment is that our technicians were not using the gauge correctly. This was particularly so in the case of operator B. It is likely that the means obtained by operator F approached those which would have been obtained had the gauge been used correctly.

Of more general interest is the gradual increase in mesh size over the entire course of the experiment. This must be attributed to stretching of the mesh and tightening of the knots. The fact that the mean mesh sizes obtained by each operator within any block were not generally significantly different, is indicative that with only four measurements on any individual mesh little irreversible stretching would be expected to occur. Also, because the pressure exerted on the meshes was far greater by some operators than would be so if the gauge was used correctly, the stretch must be considered abnormal. It is interesting that in Block II, in which operator B did not participate, the stretch appeared to be less and this is reflected in the results of all the operators in the block (Fig. 1).

Because of this tendency for greater stretching to be caused by those operators who used greater pressures, it is really invalid to make comparisons between blocks or to combine data from different blocks without special precautions. In spite of this, and remembering the limitations of doing so, some clarification is obtained by fitting straight lines to the measurements of each operator over the period in which the overall stretching of the mesh appeared constant (Blocks II, III and IV). This is shown in Fig. 2, and here the overall differences between operators can be more clearly seen. Operator A has been omitted because of the documented inconsistency of the pressure he applied. Also shown is the one measurement of the 50 meshes made by the senior author, who took care in applying no more or no less pressure than 12 lb. (5.4 Kg). This measurement was made at the conclusion of the experiment and has been plotted (in the figure) at its correct position on the sequential time scale. It may be noted that this measurement coincides with the extrapolated fitted line for the measurements obtained by operator F. If operator F's measurements are regarded as approaching those that would be obtained had a true pressure of 12 lb. (5.4 Kg) been used over the experiment (excluding Block I), approximate figures for the differences between each operator and the estimate of the true ICNAF gauge value may be obtained.

Operator	B	- 0.22" to 0.28",	mean	- 0.25"
"	C	- 0.08" to 0.18",	"	- 0.13"
"	D	- 0.06" to 0.14",	"	- 0.10"
"	E	- 0.04" to 0.06",	"	- 0.05"

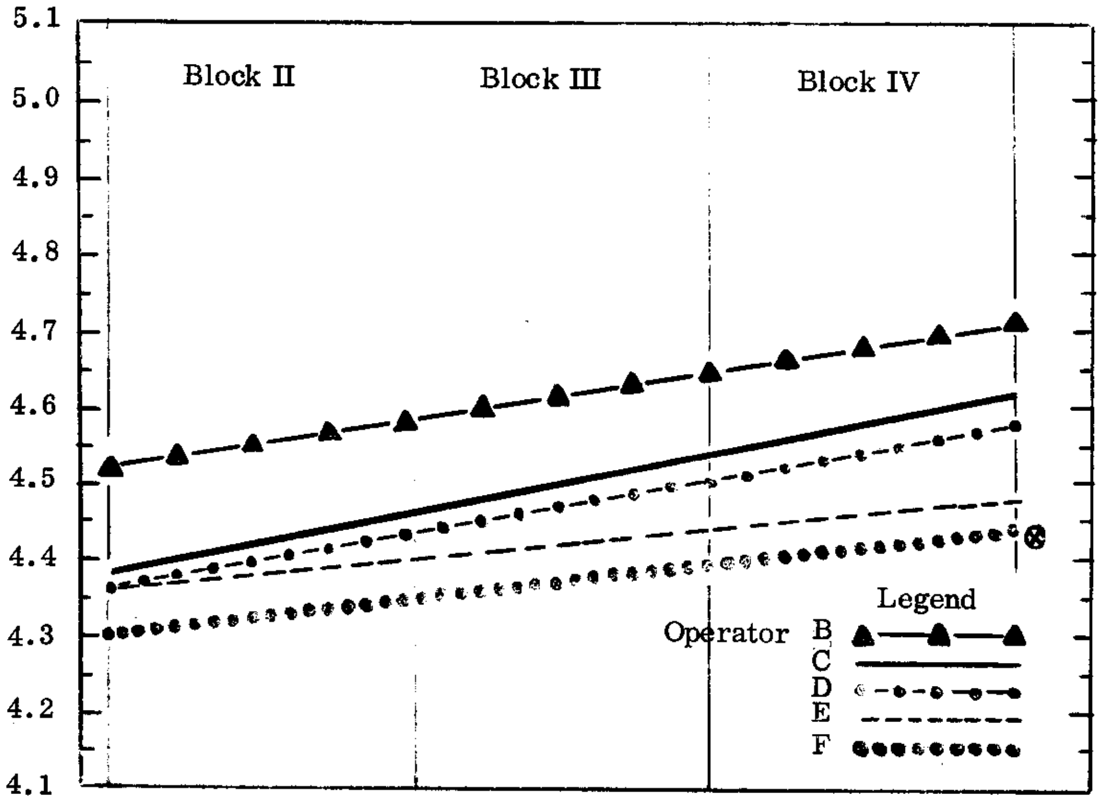

Fig. 2 - Experiment I. Straight lines fitted to measurements of each operator over Blocks II, III and IV.
⊗ shows the one measurement of 50 meshes made by the senior author

Because the differences quoted above refer only to the period when the stretch (or tightening of the knots) had stabilized at a relatively constant rate and were considerably less than those found at the very start of the experiment, they must be regarded as minimum values and greater differences would most likely be found between these operators measuring unstretched meshes.

Experiment No. II

This experiment was designed to examine variation between operators and to compare the results obtained in measuring meshes by the Scottish and the ICNAF gauges, operated in the manner in which each operator was accustomed. The experiment was extended after it had commenced to include a comparison of these gauges with the Westhoff gauge.

(1) Design of the Experiment

In view of the stretching that occurred when a long series of repeated measurements was made on the same row of meshes (Expt. I), it was considered best to limit the number of times a particular row of meshes was measured to four times. In fact, with the inclusion of the Westhoff gauge in the experiment, this was increased to six. It was necessary to test if any significant stretching had occurred, as well as whether or not there were any differences in measurements between rows which might invalidate differences attributable to gauges or operators.

With ten operators taking part in the experiment it was decided to conduct it in two series of five operators, each operator measuring two rows. Thus ten longitudinal rows of 32 meshes were chosen in the central part of the codend. Each row, which started at the 3rd mesh, was labelled with a tag. Each operator then measured a row with the Scottish gauge and the adjacent row with the ICNAF gauge. When the five operators had completed measuring their pair of rows, they started again, each using the Scottish gauge on the row previously measured by him with the ICNAF gauge, and vice versa. On completion of this second lot of measurements, each operator used the Westhoff gauge on one of his rows, and after the first round of measurements with this gauge he used it again on the other.

This whole sequence was later repeated by the second series of five operators.

(2) The Net

The upper section of a double twine manila codend of a No.41A otter trawl was used in the experiment. Specifications:- 38 x 52 meshes, 5 3/4" mesh (as ordered, dry between knot centres), 50/4 manila twine, untreated. The codend had previously been used in seven 30 minute tows on a haddock savings gear cruise of the research vessel A.T.Cameron. The total catches from these sets ranged from 0 to 8000 lb. (3.63 m tons).

(3) The Experiment

The general form of the experiment has been previously described. It is summarized here in diagrammatic form.

Series I

Rows	Operator	Gauge	Gauge	Gauge	Gauge
a	A	Scottish	ICNAF	Westhoff	
b	A	ICNAF	Scottish		Westhoff
c	B	Scottish	ICNAF	Westhoff	
d	B	ICNAF	Scottish		Westhoff
e	C	Scottish	ICNAF	Westhoff	
f	C	ICNAF	Scottish		Westhoff
g	D	Scottish	ICNAF	Westhoff	
h	D	ICNAF	Scottish		Westhoff
i	E	Scottish	ICNAF	Westhoff	
j	E	ICNAF	Scottish		Westhoff

Series II was a duplicate of the above with the other five operators making the measurements.

All measurements were made on a well wetted net. Before starting the first half of the experiment, the net was soaked in fresh water for a period of 48 hours, and before starting the second half a further period of soaking of 10 days was allowed to elapse. During each part of the experiment the net was hosed down with fresh water every 20 minutes.

Most of the operators had used the ICNAF gauge many times before, and the specific instruction was given that they should use it during the experiment in the manner in which they were accustomed. Only three of the operators had previous experience with the Scottish gauge and none had used the Westhoff gauge. In using the different gauges, each measurer had the same person holding the net for him in the manner that the measurer preferred, although different persons held the net for different operators. Operator I, however, for the Scottish and Westhoff gauges, preferred to spread the net out flat and measure without anyone holding.

Prior to the experiment the dynamometer in each gauge was checked with the following results:- ICNAF gauge, 12 lb. (5.4 Kg); Scottish gauge, 12-13 lb. (5.4 - 5.9 Kg); Westhoff gauge, 12-14 lb. (5.4-6.4 Kg).

Measurements were made in inches and tenths of inches with the ICNAF gauge and in millimeters with the Scottish and Westhoff gauges. The results obtained by these latter gauges have been converted to inches.

(4) Results

The results (means and standard errors) for each measurement of 32 meshes are shown in Table III.

To allow a straightforward comparison between the different operators and gauges, it is necessary first to establish that differential stretching of the meshes, particularly inasmuch as measurements with the ICNAF gauge are concerned, does not occur. Also, as different rows of meshes are measured by different operators, the possibility of variability between rows must be examined.

(a) Stretching of the meshes

For each operator we have measurements of one row in which the ICNAF gauge was used followed by the Scottish gauge, and of the other row which was measured in the reverse order.

For each row the difference in mean mesh size between the ICNAF and Scottish gauges and the standard error of this difference were calculated. This difference was then compared, by means of "t" tests, to the difference obtained between the gauges in the other row of each operator's pair, in which the gauges had been used in the reverse order (Table IV).

These tests showed that the differences between the ICNAF and Scottish gauges were not affected by the order in which the measurements were made, and in every case the difference between the differences was not significant at the 95% level. Furthermore the difference between the differences did not occur in the same direction all the time and for the 10 operators the insignificant stretch that might have taken place could be attributed to the Scottish gauge 5 times and to the ICNAF gauge 5 times.

On the basis of these tests it seems fair to conclude that stretching within a series was negligible. Also, with only a single measurement being made by the Westhoff gauge between the one series and the start of the next, stretching of the meshes between series or over the six measurements on each row of meshes is most unlikely.

(b) Variation between rows

We have already shown above that it does not matter whether a row is measured first with the ICNAF or Scottish gauge. Thus a comparison can be made between the mean measurement obtained by an operator using the one gauge in the one row to that obtained by him using the same gauge in his other row. If significant differences occur in the comparison this could be due either to variability within the one gauge or to variation between rows.

The results of these comparisons using "t" tests are shown in Table V. It is apparent that with both the Scottish and Westhoff gauges the differences between the two rows of each operator's pair are not significant. With the ICNAF gauge significant differences can be seen between the rows of three of the operators but not between those of the other seven. Also in connection with these significantly different measurements, it can be noted that no two occurred in the same pair of rows in the two series (i.e. no single pair of rows is responsible for these differences).

Thus with both the Scottish and Westhoff gauges, it would appear that the variation between rows is within the limits of variability of the gauge, and that in the case of the ICNAF gauge the significant differences obtained are more likely due to variability of the gauge or method of using it than to variation between the rows.

Thus we may conclude that the two rows making up each pair can be considered similar. Although, on the results of this analysis, we cannot say conclusively that there are no differences between the five pairs of rows used, it is evident that such differences are most unlikely. This is further supported by the lack of variation between operators when the results of the Westhoff gauge are examined.

The similarity of the rows in each pair allows combination of the results obtained for subsequent analyses in comparing operators and gauges.

(c) Difference between gauges for each operator

We have shown in the previous section that it is valid to combine the measurements for the two rows measured by each operator with each gauge. This has been done and the means and standard errors of the combined data are displayed in Fig.3. It is quite evident from this figure that significant differences between the gauges and between operators are of very common occurrence. This is particularly noteworthy in the case of comparisons involving the ICNAF gauge.

The means obtained by each gauge were compared by "t" tests for each operator in turn, and these results confirm what is evident in Fig.3. The results of these tests are summarized in Table VI, and it is striking that only in one of the 20 comparisons involving the ICNAF gauge was a difference obtained which could not be considered as extremely significant. The Scottish gauge could be considered as yielding similar results to the Westhoff gauge in the hands of five out of the ten operators.

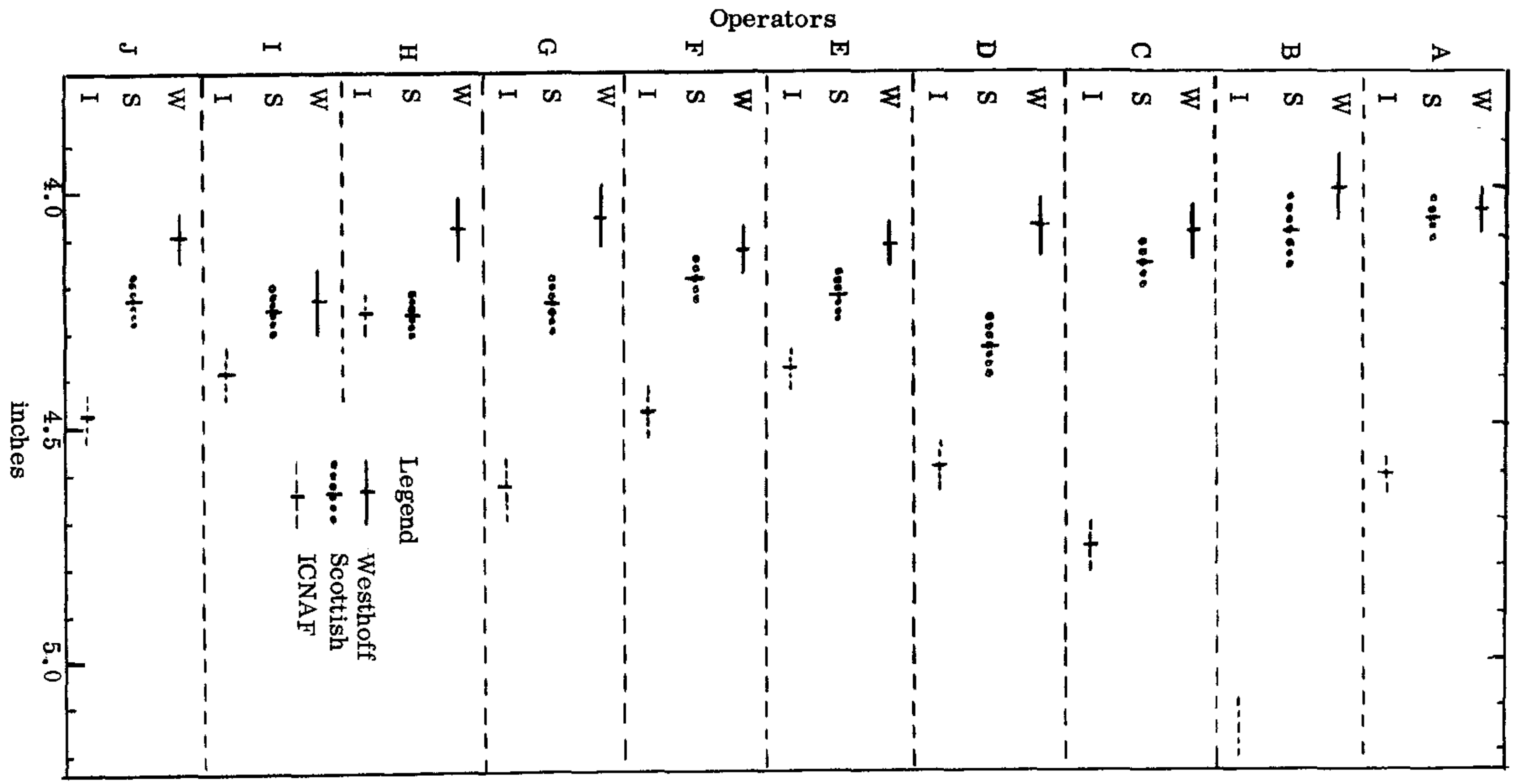

Fig.3 - Summary of the measurements obtained by each operator using each gauge. The measurements of the two rows (32 + 32 = 64 meshes) as obtained by each operator have been combined. The mean is designated by the vertical stroke and two standard errors are shown on either side.

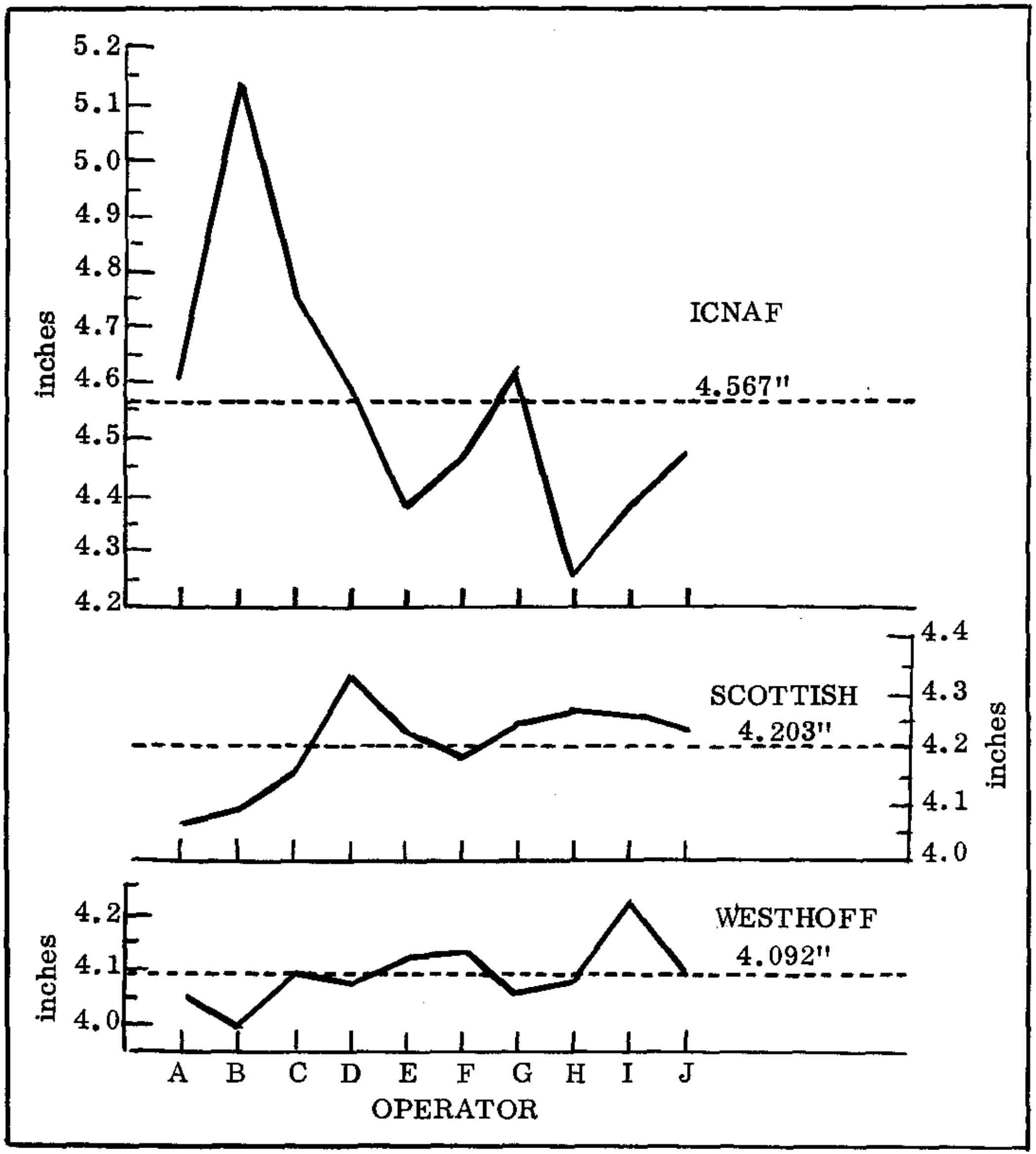

Fig.4 - Graphical summary of means obtained by each operator using each gauge. Also shown are the overall means for each gauge.

(d) Comparisons between operators using the same gauge

We have attempted to show, in a previous section, that the likelihood of variation between rows is extremely small. If this is so and the rows of meshes are normal samples of the total net section, then comparisons between operators measuring different rows are in order.

For each gauge in turn the mean measurement obtained by each operator has been compared by means of "t" tests, against that obtained by each other operator. The results of these tests are shown in Tables VII, VIII and IX for the ICNAF, Scottish and Westhoff gauges respectively. It can be seen (Table VII) that only very occasionally are comparable results obtained between different operators using the ICNAF gauge. Better results were obtained using the Scottish gauge (Table VIII), most of the significant differences being caused by particularly low means obtained by operators A and B. For the Westhoff gauge, excellent agreement between operators was obtained with the exception of operator I and to a lesser extent operator B. Operator I obtained measurements considerably higher than all other operators and he attributes this to the fact that he (the senior author) possesses rather small hands and found it difficult to maintain tension on the dynamometer while reading the scale. In this connection it should be noted that, although the Westhoff gauge locks in position when the correct tension is reached, if the tension is not maintained while the reading of mesh size is made, the jaws of the instrument may close and unlock the ratchet mechanism. If this happens, and tension is again applied to the mesh without resetting the ratchet mechanism, the locking mechanism fails to function, and pressures greater than that prescribed can be applied.

(5) Discussion and Conclusions

The graphical summary (Fig.4) of the mean mesh sizes obtained by each operator and gauge may be helpful in this section. The conclusion that the Westhoff gauge is superior to the Scottish gauge and far superior to the ICNAF gauge as handled by the present methods of the operators, is inescapable. Not only does it show less variability when used by the same operator on different rows, but in the hands of different operators it provides similar measurements. As judged from its ability to yield similar measurements between operators, results with the Scottish gauge approach those with the Westhoff gauge, but greater variability between operators may be noted.

The ICNAF gauge shows up very poorly in the comparison between operators, and not too well in the comparisons of measurements made with it by the same operator. The large differences found in the measurements from one operator to the next do not reflect the variability of the gauge but rather variation in the method of using it, as was shown in experiment I. However, the fact that this gauge is, or at least can be, abused in such a manner reflects rather poorly on the gauge itself.

Figure 4 shows the overall means for each gauge. In the case of the ICNAF gauge this mean is rather meaningless, but it does allow a comparison between the overall measurements as obtained by each gauge. It is apparent that the overall difference between the Scottish and ICNAF gauges of 0.37 inches (9.4 mm) is slightly greater than that obtained by other authors, and even the means obtained by operators I and J, who took pains to ensure that the correct pressure was applied, show differences of 0.18" (4.6 mm) and 0.27" (6.9 mm) respectively between their measurements using the ICNAF gauge and the overall Scottish gauge average. The difference of 0.11" (2.8 mm) obtained between the overall means of the Westhoff and Scottish gauges is more difficult to understand.

Better and more comparable results could probably have been obtained if attention had been paid to the point raised by Bedford and Beverton (MS, 1958), namely that of ensuring that the gauge is always inserted toward the open side of the assymetrical knot.

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Table I. --Means and standard errors of the different operators in experiment I.

Block I

1	A	3.836 ± .020	B	4.264 ± .028	C	4.310 ± .021	C	4.112 ± .019
2	C	4.252 ± .021	A	4.098 ± .019	D	4.144 ± .021	B	4.436 ± .019
3	B	4.476 ± .020	D	4.312 ± .020	A	4.154 ± .025	C	4.368 ± .016
4	D	4.304 ± .020	C	4.400 ± .021	B	4.502 ± .020	A	4.246 ± .018

Means for Block
A = 4.084 ± .015
B = 4.420 ± .013
C = 4.333 ± .011
D = 4.218 ± .012

Block II

1	A	4.302 ± .020	C	4.466 ± .021	E	4.348 ± .017	G	4.342 ± .020
2	E	4.406 ± .019	A	4.282 ± .017	G	4.304 ± .019	C	4.324 ± .018
3	C	4.408 ± .021	G	4.310 ± .017	A	4.330 ± .017	E	4.396 ± .019
4	G	4.322 ± .021	E	4.384 ± .018	C	4.464 ± .019	A	4.316 ± .017

Means for Block
A = 4.308 ± .0089
C = 4.416 ± .0106
E = 4.383 ± .0091
G = 4.320 ± .0094

Block III

1	B	4.586 ± .021	D	4.484 ± .023	G	4.328 ± .021	E	4.392 ± .020
2	G	4.366 ± .021	B	4.592 ± .017	E	4.394 ± .021	D	4.474 ± .018
3	D	4.424 ± .022	E	4.418 ± .020	B	4.618 ± .018	G	4.410 ± .021
4	E	4.460 ± .017	G	4.368 ± .019	D	4.464 ± .018	B	4.650 ± .021

Means for Block
B = 4.612 ± .0098
D = 4.462 ± .0102
G = 4.368 ± .0104
E = 4.416 ± .0099

Block IV

1	A	4.418 ± .016	B	4.662 ± .020	C	4.562 ± .027	D	4.512 ± .026
2	C	4.564 ± .022	A	4.452 ± .019	D	4.498 ± .023	B	4.672 ± .019
3	B	4.712 ± .018	D	4.614 ± .022	A	4.540 ± .017	C	4.596 ± .022
4	D	4.554 ± .021	C	4.596 ± .020	B	4.672 ± .021	A	4.562 ± .020

Means for Block
A = 4.493 ± .0099
B = 4.679 ± .0098
C = 4.579 ± .0113
D = 4.545 ± .0119

Table II. --"t" values obtained in the comparison of means between operators. Operators have been compared only within each block.

Operators	A	B	C	D	E	F
A		13.381	7.770	3.355	5.859	0.923
B			6.711	10.563	14.101	17.063
C	5.733			2.073	2.357	6.761
D		8.701			3.217	6.438
E						3.333
F					4.773	

at df = 400

P =	0.5	0.10	0.05	0.02	0.01
t =	0.675	1.65	1.97	2.34	2.59

Table III. --Experiment II - Summary of results

Operator	Row	ICNAF $\bar{x}$	ICNAF $SE_{\bar{x}}$	Scottish $\bar{x}$	Scottish $SE_{\bar{x}}$	Westhoff $\bar{x}$	Westhoff $SE_{\bar{x}}$
A	a	4.619	.026	4.093	.032	4.050	.029
	b	4.597	.026	4.034	.036	4.053	.035
	a&b	4.608	.018	4.064	.024	4.052	.023
B	c	5.166	.051	4.060	.071	3.967	.050
	d	5.128	.035	4.120	.039	4.027	.052
	c&d	5.147	.031	4.090	.040	3.997	.036
C	e	4.800	.035	4.192	.036	4.088	.043
	f	4.706	.035	4.122	.034	4.091	.035
	e&f	4.753	.025	4.157	.025	4.090	.028
D	g	4.647	.041	4.344	.041	4.094	.049
	h	4.519	.028	4.315	.053	4.058	.035
	g&h	4.583	.025	4.330	.033	4.076	.030
E	i	4.331	.025	4.213	.041	4.083	.029
	j	4.419	.025	4.237	.038	4.147	.038
	i&j	4.375	.018	4.225	.028	4.115	.024
F	a	4.441	.034	4.213	.028	4.156	.037
	b	4.494	.031	4.163	.038	4.103	.034
	a&b	4.468	.023	4.188	.024	4.130	.025
G	c	4.681	.051	4.238	.056	4.085	.055
	d	4.569	.030	4.240	.033	4.032	.040
	c&d	4.625	.030	4.239	.032	4.059	.034
H	e	4.209	.032	4.259	.033	4.075	.045
	f	4.309	.030	4.262	.037	4.085	.048
	e&f	4.259	.022	4.261	.025	4.080	.033
I	g	4.366	.042	4.249	.042	4.207	.050
	h	4.397	.032	4.254	.034	4.248	.041
	g&h	4.382	.026	4.252	.027	4.228	.032
J	i	4.500	.030	4.208	.032	4.103	.037
	j	4.444	.028	4.246	.044	4.088	.033
	i&j	4.472	.021	4.227	.027	4.096	.025
Overall average		4.567		4.203		4.092	

Table IV. --Differences and "t" values obtained in test for stretching of mesh.

Operator	Δ a	Δ b	Δa-Δb	t
A	1.106	1.008	0.098	0.965
B	0.608	0.584	0.024	0.342
C	0.526	0.563	-0.037	0.611
D	0.303	0.204	0.099	1.192
E	0.118	0.182	-0.064	0.967
F	0.228	0.331	-0.103	1.563
G	0.443	0.329	0.114	1.297
H	-0.050	0.047	-0.097	1.465
I	0.117	0.143	-0.026	0.344
J	0.292	0.198	0.094	1.379

at df = 125

P =	0.50	0.10	0.05	0.02	0.01
t =	0.676	1.66	1.98	2.36	2.62

Δ a - mean mesh size from ICNAF gauge measured first less the mean from Scottish gauge measured second, on the same row.

Δ b - mean mesh size from ICNAF gauge measured second less the mean from the Scottish gauge measured first, on the same row.

Table V. --"t" values obtained in comparing the two rows measured by the same operator using the same gauge.

Rows compared	Operator	Gauge		
		ICNAF	Scottish	Westhoff
ab	A	0.595	1.229	0.066
cd	B	0.613	0.746	0.830
ef	C	1.888	1.420	0.054
gh	D	2.575**	0.435	0.595
ij	E	2.472**	0.430	1.339
ab	F	1.142	1.053	1.064
cd	G	1.886	0.031	0.782
ef	H	2.288*	0.061	0.152
gh	I	0.587	0.092	0.632
ij	J	1.363	0.699	0.305

at df = 60

P =	0.50	0.10	0.05	0.02	0.01
t =	0.678	1.67	2.00	2.39	2.66
			*	**	***

Table VI.--"t" values obtained in comparing the three gauges as used by each operator

Operator	Gauges compared: ICNAF-Scottish	ICNAF-Westhoff	Scottish-Westhoff
A	17.95***	18.98***	0.364
B	20.81***	24.16***	1.719
C	16.98***	17.82***	1.806
D	6.10***	12.93***	5.64***
E	4.53***	8.73***	3.00***
F	8.43***	9.94***	1.686
G	8.81***	12.55***	3.85***
H	0.061	4.53***	4.39***
I	3.44***	3.68***	0.567
J	7.19***	11.71***	3.57***

at df = 125

P =	0.50	0.10	0.05	0.02	0.01
t =	0.676	1.66	1.98	2.36	2.62
			*	**	***

Table VII.--"t" values obtained in comparison of operators using the ICNAF gauge

Operators	B	C	D	E	F	G	H	I	J
A	14.931 ***	4.677 ***	0.806	9.066 ***	4.714 ***	0.486	12.203 ***	7.019 ***	4.910 ***
B		9.899 ***	14.207 ***	21.564 ***	17.545 ***	12.168 ***	23.368 ***	18.796 ***	18.145 ***
C			4.830 ***	12.353 ***	8.382 ***	3.307 ***	14.924 ***	10.220 ***	8.700 ***
D				6.797 ***	3.382 ***	1.085	9.789 ***	5.552 ***	3.437 ***
E					3.185 ***	7.225 ***	4.113 ***	0.220	3.566 ***
F						4.164 ***	6.552 ***	2.450 ***	0.129
G							9.919 ***	6.121 ***	4.238 ***
H								3.586 ***	7.100 ***
I									2.687 ***

at df = 125

P =	0.50	0.10	0.05	0.02	0.01
t =	0.676	1.66	1.98	2.36	2.62
			*	**	***

Table VIII.--"t" values obtained in comparison of operators using Scottish gauge.

				Operators					
A	B	C	D	E	F	G	H	I	J
A	0.556	2.703 ***	6.488 ***	4.375 ***	3.669 ***	4.353 ***	5.710 ***	5.193 ***	4.503 ***
	B	1.419	4.598 ***	2.761 ***	2.099 *	2.888 ***	3.623 ***	3.340 ***	2.825 ***
		C	4.179 ***	1.823	0.904	2.020 *	2.980 ***	2.596 **	1.907
			D	2.419 **	3.472 ***	1.961	1.663	1.818	2.395 **
				E	1.008	0.329	0.965	0.694	0.051
					F	1.272	2.128 *	1.778	1.080
						G	0.541	0.309	0.284
							H	0.245	0.924
								I	0.651

at df = 125

P =	0.50	0.10	0.05	0.02	0.01
t =	0.676	1.66	1.98	2.36	2.62
				*	** *** →

Table IX.--"t" values obtained in comparison of operators using Westhoff gauge.

				Operators					
A	B	C	D	E	F	G	H	I	J
A	1.288	1.061	0.635	1.915	2.315 *	0.172	0.700	4.444 ***	1.313
	B	2.044 *	1.677	2.725 ***	3.030 ***	1.250	1.697	4.753 ***	2.265
		C	0.341	0.685	1.075	0.708	0.233	3.239 ***	0.162
			D	1.013	1.378	0.374	0.089	3.423 ***	0.513
				E	0.435	1.349	0.860	2.804 ***	0.554
					F	1.686	1.211	2.396 ***	0.971
						G	0.444	3.603 ***	0.883
							H	3.203 ***	0.389
								I	3.243 ***

at df

P -	0.50	0.10	0.05	0.02	0.01
t -	0.676	1.66	1.98	2.36	2.62
			*	**	***

4. Collaboration between FAO and ICNAF 1960/61

by FAO Fisheries Division

The following notes report action taken by FAO Fisheries Division in response to recommendations in the report of the Tenth Annual Meeting of ICNAF and other aspects of the current work of the Division of interest to the Commission. The paragraph numbering follows that given in the previous Report in ICNAF Red Book 1960, p.70-74.

1. Follow-up of Joint Scientific Meeting of ICNAF/ICES/FAO, Lisbon, 1957.

1.1 Publication of Report and Contributions

The Report has been published and distributed; supplies of copies have been provided for ICNAF and ICES. The second volume will be available before the end of 1961.

1.2 Standard Notation and Terminology for Fishery Dynamics

The dictionary has now been printed and 400 copies supplied to ICNAF.

1.3 An International Journal for Fishery Dynamics

Cost estimates have been made of various ways of publication, and these discussed with a provisional editorial board.

1.4 Mathematical Tables for simplifying stock assessments

The situation has been changed by the programming of a computer at U.B.C. Vancouver, for population models. It is understood that U.B.C. will soon be publishing the required tables.

2. Methodological Manuals

Sampling Manual is expected to be completed and published this year. The Manual on field methods has been published, and a new edition dealing with both field and laboratory techniques is nearly complete. Now that the gear selectivity working group of ICES has completed its works, its convenor, Mr. Pope (Aberdeen) is preparing a manual based on the ICES report, for publication by FAO. FAO has compiled, and will publish summaries of gear selectivity data for areas other than the N. Atlantic, adopting the same tabulation format as ICES. The manual on fish tagging will be based on the ICNAF Symposium report.

3. <u>Co-ordination of fisheries statistics</u>

The first ESTANA meeting was held as planned during the 1960 ICNAF meeting in Bergen and the second ESTANA meeting was held in 1961, again in conjunction with the ICNAF meeting.

4. <u>Other Meetings</u>

4.1 The FAO meeting on the Economic Effects of Fishery Regulations takes place in Ottawa after the 1961 ICNAF meeting. Dr. L. Dickie (Canada) prepared for this a review of the biological basis of regulation.

4.2 Copies of the report and papers of the FAO World Meeting on the Biology of Sardines and Related Species will be made available to ICNAF. A similar meeting, on tunas, will be held in June-July, 1962, probably in the United States; announcement of the meeting has met enthusiastic response from tuna-fishing countries. Regional meetings on tuna biology have been held in Africa and the Mediterranean.

4.3 A sub-committee on oceanography, under ECOSOC, has been set up, at FAO suggestion, to co-ordinate the activities of the Secretariats of U.N. agencies concerned with this subject. Its first meeting was held in Rome in March 1961; participating agencies were UNESCO, FAO, WMO, IAEA and the U.N.

FAO has invited several fishing nations, which are member of FAO but not of UNESCO to participate in the first meeting of the International Oceanographic Commission (IOC) under UNESCO, to be held in Paris in September of this year. FAO has also drawn the attention of the fisheries agencies of all its member governments and of its regional fisheries councils to the importance, for fisheries research, of the forthcoming IOC meeting.

4.4 <u>An assessment of uniform mesh regulation in the North West Atlantic</u>

The Division has been very pleased to co-operate with ICNAF by the participation of one of its staff in the Working Group on Uniform Mesh Assessment.

4.5 <u>Symposium of the Indo-Pacific Fisheries Council on Fish Behaviour, Colombo, 1958</u>.

The Report and papers from this symposium have now been published, and copies made available to ICNAF Secretariat.

5. Mr. Wise's synopsis on the biology of cod has been revised on the basis of comments received from many N. Atlantic countries, and a second draft will be issued soon. Synopsis on biology of all tuna species will be prepared by consultants for the tuna meeting.

6. Current Bibliography for Aquatic Sciences and Fisheries

The Bibliography continues to be compiled with the collaboration and assistance of ICES and several national laboratories. 16 parts of the printed revision has now been published, and copies supplied to ICNAF Secretariat for use in making the ICNAF list. From 1962 it will be possible to supply ICNAF with manuscript cards so that this list will not be affected by delays in publication.

7. Intelligence Service

The World List of Periodicals for Fisheries Science is now in press. A news service on fisheries research programs and activities etc. will be published as a supplement to the "Current Bibliography" as from 1962.

8. Bio-geography of Marine Organisms and World Fisheries Atlas

FAO and ICES are now represented on the editorial board for the "Serial Atlas of the Marine Environment (N. Atlantic)" now being published by the American Geographic Society with the support of several other bodies. Any oceanographic and other synopsis of data which FAO prepares for parts of the N. Atlantic regions (including the North Sea Synopsis) will be published in the Serial Atlas. WMO has agreed to prepare the climatological and hydrological sections of these synopses.

9. Vessel Characteristics Related to Fishing Power

Now that ICNAF has tabulated propellor characteristics and other pertinent data for vessels fishing in the area, the Division will prepare suggested indexes to be correlated with relative fishing power, and will study these in collaboration with ICNAF member countries proposing to compare and analyze per unit effort data for individual vessels.

5. Annotated List of Papers on Fisheries Research in the ICNAF Area

prepared in the Secretariat

The list is mainly prepared from annotations submitted by research institutes in the member countries. The few annotations prepared in the Secretariat are marked "Secr." The FAO "Current Bibliography for Aquatic Sciences and Fisheries" was consulted.

I. HYDROGRAPHY

Boyar, H.C. and F.E.Schueler. 1960. A photoelectric current meter. U.S. Fish and Wildl. Service, Spec. Sc. Rep. -- Fisheries No.330, 6 pp.

Diagrams and description of current meter in which revolutions of a propeller are detected photoelectrically.

Bumpus, Dean F. 1960. Investigations of climate and oceanographic factors influencing the environment of fish. Woods Hole Oceanographic Inst. unpublished mss. Nos.60-1, 60-18, 60-29, and 60-41.

Hydrography of Gulf of Maine and Georges Bank.

Bumpus, Dean F. 1960. Sources of water contributed to the Bay of Fundy by surface circulation. Journ. of the Fish. Res. Board of Canada 17(2): 181-197.

Analysis of drift bottle returns.

Campbell, N.J. and L.M.Lauzier. 1960. Ice studies of the Atlantic Oceanographic Group. Fish. Res. Bd. of Canada. Ms. Rep. Ser. (Ocean. and Limn.) No.60.

(as per title)

Chevrier, J.R. and R.W.Trites. 1960. Drift Bottle Experiments in the Quoddy Region. Journ. Fish. Res. Bd. of Canada XVII, 6.

In conjunction with the research program of the International Passamaquoddy Fisheries Board, approximately 10,000 drift bottles were released in the Quoddy Region of the Bay of Fundy in 1957 and 1958. Overall return of bottles was 25%. Results have been analyzed and surface drift inferred on monthly and seasonal bases. On the average, there is a counter-clockwise circulation in Passamaquoddy Bay, an outflow on the Campobello side and an inflow along the Deer Island side of Head Harbour Passage. In the outer Quoddy

Region, there is evidence of a clockwise circulation around The Wolves, a variable flow in Grand Manan Channel, and a southerly movement off the east coast of Grand Manan Island.

Wind speed and direction, which vary seasonally, appear very effective in altering the pattern of drift.

Day, C. Godfrey. 1960. Bottom water temperature on Browns Ledge off southern Massachusetts. ICES, Journ. du Cons. 25(3): 235-239.

Continuous recorder placed on bottom in 18 m and operated for 56 days. Effect of tides and winds on water temperature is shown.

Day, C. Godfrey. 1960. Oceanographic observations, 1959, east coast of the United States. U.S. Fish and Wildl. Service, Spec. Sc. Rep. -- Fisheries No.359, 114 pp.

Daily water temperature and salinity observations from 17 locations.

Forrester, W.D. 1960. Current measurements in Passamaquoddy Bay and the Bay of Fundy, 1957 and 1958. J. Fish. Res. Bd. Canada, 17(5):727-729.

Currents were measured at sixty stations in Passamaquoddy Bay and the Bay of Fundy during the summer of 1957 and 1958. Results indicate that the tidal currents vary markedly throughout the region. Maximum recorded speeds were found in Letite Passage where mean maximum speeds reached 8 feet per second (4.8 knots). In Passamaquoddy Bay, speeds were mostly less than 1 foot per second. Near the mouth of Cobscook Bay mean maximum speeds were 5 feet per second. In the outside area, mean maximum speeds seldom exceeded 5 feet per second. Currents were usually maximum in the surface layer and decreased slowly with depth. Residual flows were mostly less than 2 miles (nautical) per day in Passamaquoddy Bay, Cobscook Bay and the approaches. In the Bay of Fundy residual flows were variable and in some areas were as much as 10 miles per day.

Joseph, Joachim 1960. Über die vertikalen Temperatur- und Trübungsregistrierungen in einer 500 m mächtigen Deckschicht des nördlichen Nordatlantischen Ozeans (On the vertical temperature- and turbidity measurements in a surface layer of 500 m in depth in the northern North Atlantic Ocean). - Ozeanographie 1959. S.49-55. Hamburg: Deutsches Hydrographisches Inst. 1960.

The researches of SRS "Gauss" carried out under the programme of the IGY at 243 stations in the northern North Atlantic comprised,

among others, continuous temperature- and turbidity measurements from the surface down to a depth of 500 m. The vertical records made at two selected stations in summer and winter are compared with each other and two sections of temperature and turbidity across the Newfoundland Bank are likewise discussed.

Lauzier, L.M. 1960. L'oceanographie est-elle vraiment utile aux pêcheries? Actualités Marines, Vol.4, No.1: 9-12.

An account of the importance of oceanography in the study of fisheries of the Gulf of St. Lawrence, with a colour plate describing seasonal variation in stratification.

Lauzier, L.M. 1960. Ocean. Obs. made by the Fish. Res. Bd. of Canada in the ICNAF Area during the Period 1950-59. Fish. Res. Bd. of Canada. Ms. Rep. Ser. (Ocean.-Limn.) No.65.

(as per title)

Whitney, G.G. Jr. 1960. Procedure for and comments on ice point tests for deep sea reversing thermometers. Limnology and Oceanography 5(2): 232-235.

Describes laboratory technique for calibrating thermometers.

II. PLANKTON

LaCroix, Guy 1960. Elements de planctonologie. Cahiers d'Information (Station de Biologie marine, Grande-Rivière), No.3, pp.1-43, pl. 1-17.

(as per title)

Legare, J.E. Henri and Delphine C. Maclellan. 1960. A qualitative and quantitative study of the plankton of the Quoddy Region in 1957 and 1958 with special reference to the food of the herring. J. Fish. Res. Bd. Canada, 17(3): 409-447.

Investigations of the composition, abundance and distribution of plankton communities within the Passamaquoddy region of New Brunswick and Maine were carried out in 1957 and 1958. Studies of the food of herring and possible relationships between zooplankton abundance, feeding activity, fat content, and catches of herring were included in the program. Similar quantities of zooplankton were found outside Passamaquoddy Bay and in Cobscook Bay. Slightly smaller volumes were taken in the passages into the Bay, but only

one-fifth as much was taken in samples inside Passamaquoddy Bay. Differences in zooplankton abundance suggest incomplete mixing of outside waters with those of Passamaquoddy Bay. The smallest volumes of zooplankton were taken in the spring and the largest in the summer months. Overall zooplankton volumes were much higher in 1958 than in 1957.

There was evidence that herring were feeding in the upper water layers. A period of low feeding activity from March to August was followed by a period of active feeding from September to November. There was a positive correlation between feeding activity and fat content of herring but no relationship between quantities of zooplankton and feeding activity could be established. Nor was it possible to demonstrate any relationship between zooplankton volumes and catches of herring over a period of 10 years.

Higher zooplankton volumes are foreseen for Passamaquoddy Bay after the dams are built. Volumes in Cobscook Bay are expected to reach values similar to those of Passamaquoddy Bay while those outside should remain unchanged.

Olsen, Steinar 1960. Observations on sound scatterers in Newfoundland waters. J. Fish. Res. Bd. Canada, 17(2): 211-219.

A sound scattering layer in the warm surface water or at the depth of the summer thermocline has frequently been observed off the southern and western coasts of Newfoundland. The scatterers have not been identified, but are most likely of biological nature.

An observation of a diurnal vertical migration of a deeper scattering layer is reported.

III. FISHES

A. Cod Group

Clark, John R. and Vadim D. Vladykov. 1960. Definition of haddock stocks of the Northwestern Atlantic. U.S. Dept. Interior, Fish and Wildl. Service, Fish. Bull. 169, vol.60, pp.283-296.

Differences in average vertebral number, related to temperature on spawning grounds, separate fish into five major stocks: Newfoundland, eastern Nova Scotia, central Nova Scotia, western Nova Scotia and New England.

Figueras, A.M. 1960. Aplicacion del estudio de los otolitos a la determinacion de la edad y crecimiento del bacalao. (Methods for the study of the otoliths and the determination of age and growth of cod). IV Meeting on Productivity and Fisheries. Inst. de Inv. Pesq. Barcelona.

The paper is concerned with the Spanish investigations of otoliths of cod from the Newfoundland and W. Greenland regions. (Secr.)

Fleming, A.M. 1960. Age, growth and sexual maturity of cod (Gadus morhua L.) in the Newfoundland area, 1947-1950. Journ. Fish. Res. Bd. Canada XVII, 6.

Samples of cod from the Newfoundland-Labrador region are considered. The growth rates from various parts of the area differ widely. Females generally grow slightly faster than males. The influence of differences in temperature and in food supply is discussed. Both the size and age at which all fish become sexually mature vary throughout the area. Labrador cod mature at a smaller size and lower age than do cod from the south west Grand Bank.

The results of the investigations indicate the existence of at least four relatively distinct divisions in the cod population of the area: Labrador, Newfoundland east coast, S. Grand Bank, and the Newfoundland west coast; St. Pierre Bank and Strait of Belle Isle are mixing areas.

Fritz, Raymond L. 1960. A review of the Atlantic coast whiting fishery. Comm. Fisheries Rev. 22(11): 1-11.

Changes in fishing methods and processing of catch during past 25 years contributed to rise in landings to over 150 million pounds annually.

Jean, Y. 1960. La Morue du golfe du St-Laurent. Actualités Marines, Vol. 4, No.1:22-25.

Effects of mesh regulation on the cod fishery of the Gulf of St. Lawrence and forecast for 1960.

Jensen, Albert C. and Raymond L. Fritz. 1960. Observations on the stomach contents of the silver hake. Trans. of the American Fisheries Soc. 89(2): 239-240.

Diet predominantly euphasiids and fishes. Some consideration given to sizes of prey ingested.

Jensen, Albert C. 1960. Haddock. U.S. Fish and Wildl. Service, Fishery Leaflet No.489, 9 pp.

Semi-popular review of life history, age and growth, and commercial utilization.

Jónsson, J. 1960. On the Spawning Stocks of Cod in east Greenlandic and Icelandic Waters in 1959. (Annales Biologiques, Vol.16).

(as per title)

Kohler, A.C. 1960. The growth, length-weight relationship, and maturity of haddock (Melanogrammus aeglefinus L.) from the region of Lockeport, N.S. J. Fish. Res. Bd. Canada, 17(1): 41-60.

Data from samples of commercial landings of inshore Lockeport haddock are used to form a curve of growth in length. Maturity and spawning data for these fish are then related to changes in their length-weight relationship. By combining length-weight and growth-in-length data, a curve of growth in weight is derived for use in yield calculations. Apparent changes in growth of inshore Lockeport haddock between 1926 and 1946-54 are discussed.

McCracken, F.D. 1960. Studies of haddock in the Passamaquoddy Bay region. J. Fish. Res. Bd. Canada, 17(2): 175-180.

From 1954 to 1957 haddock within Passamaquoddy Bay have been of intermediate sizes. Few small fish or large fish have been captured either by commercial fishermen or in small-mesh research nets. Tagged fish of the Passamaquoddy Bay region moved out of the Bay during winter and mingled mainly with haddock stocks off the New England States. In the following summer recaptures of tagged fish were again most numerous within Passamaquoddy Bay. Stocks of haddock within the Bay appear to result from annual migrations into the Bay in early summer. It is predicted that the proposed power structures would have no effect on haddock stocks outside the high and low pools but that they would probably seriously reduce the haddock population within the high pool.

Marak, Robert R. 1960. Food habits of larval cod, haddock, and coalfish in the Gulf of Maine and Georges Bank area. ICES, Journ. du Cons. XXV(2): 147-157.

Copepods and their larvae formed major portion of diet. In general, larval fish eat most abundant species of prey, but of a certain size.

Meyer, Arno 1960. Gute Kabeljauaussichten für Südgrönland? (Are there fair chances for the cod fisheries off South Greenland?). Inf. für die Fischwirtschaft. Jg. 7, Nr 5/6. 1960. S. 131-135.

Based on investigations by the "Institut für Seefischerei" - Hamburg, a forecast is given for the cod fisheries in South Greenland waters in 1960/61. Due to the very rich year-class 1953, the catches starting with autumn 1960 should be promising.

O'Brien, John J. 1960. New England haddock fishery and marketing of haddock products. U.S. Fish and Wildl. Service, Bur. of Comm. Fish., Market News Service, Spec. Rep. 35 pp. (Mimeo).

Landings and ex-vessel prices of New England fishery. Primary wholesale prices, imports, stocks, market trends, and some retail prices for haddock products.

Pavlov, M.A. 1960. Necotorie Dannie Po Biologii i Promislu Treski Proliva Devisa (Data on the biology and landings of cod, N.W. Atlantic). Ribnoie Chozyaistovo (Fishery Economy), No.8, Moscow.

The paper summarizes landings of various species of fish from different parts of the ICNAF Area in 1951-58. It further gives data on growth and age of cod for 1959. (Secr.)

Woodhead, P.M.J. and Wood, A.D. 1959. 'The effects of low temperature on the physiology and distribution of the cod, Gadus morhua L., in the Barents Sea.' Proc. Zool. Soc. Lond., 133, 181-199.

Cod in the Barents Sea appear to be limited in their distribution by low temperature; about 2°C from October to June and below 0°C in summer. During a year regular analyses were made of the blood of cod; the cytology of the gills and the activity thyroid were examined. The results support the hypothesis that low temperature acts as a physiological limit, probably acting through the breakdown of the mechanism of osmotic regulation, and that changes in the physiology are endocrinally controlled.

B. Flat Fishes

Lux, Fred E. 1960. Shrinkage of yellowtail flounder between live and landed condition. Trans. of the American Fisheries Soc. 89(4): 373-374.

Length of fish decreases by about 1.5 percent due to shrinkage while fish are iced down in the hold.

Rae, B.B. 1959. 'Halibut - Observations on its size at first maturity, sex ratio and length-weight relationship.' Mar. Res. Scot., 1959, No.4, pp.19, 1959.

This paper gives the sizes at which male and female halibut spawn for the first time in the N.E. Atlantic. In the early years of the halibut's life male and female fish occur in about equal numbers but later the females outnumber the males and all the large fish examined, over 5 feet in length, were females. Halibut of the same length vary greatly in weight, apparently for different reasons.

Ronald, Keith 1960. The metazoan parasites of the Heterosomata of the Gulf of St. Lawrence. V. Monogenea. Can. Jour. Zool., 38(2):243-247. Contr. Dept. Pêch. Quebec, No.71.

Udonella caligorum, Entobdella hippoglossi, and E. curvunca were identified in a study of 43 Atlantic halibut, Hippoglossus hippoglossus. The incidence, distribution, and host specificity of the halibut's monogenetic parasites are discussed.

Ronald, Keith 1960. The metazoan parasites of the Heterosomata of the Gulf of St. Lawrence. VI. Digenea. Can. Jour. Zool., 38(5): 923-937, fig. 1.

A number of species of Digenea were identified in a study of 560 specimens of Heterosomata from the Gulf of St. Lawrence. Host distribution is indicated, together with parasitic incidence.

C. Redfish

Einarsson, H. 1960. The fry of Sebastes in Icelandic waters and adjacent seas. Rit Fiskid. II, 7. Reykjavík.

The paper is based on material collected 1903-1952. It deals with the separation of marinus and viviparus fry and describes seasonal and areal distribution of marinus fry. Length measurements of larvae are given. Feeding habits and occurrence of food animals are discussed. (Secr.)

Kotthaus, Adolf 1960. Zum Rassenproblem beim Rotbarsch. Rotbarschformen aus dem zentralen Nordatlantik (zwischen den Faroern und Grönland-West (On the race problem in the redfish. Forms of redfish from the Central North Atlantic [between the Faroe Isl. and W. Greenland]). - Ber. der Deutschen Wiss. Komm. für Meeresf. N. F. Bd 16, H. 1, 1960. S. 18-50.

Dr. Kotthaus' final report on his race investigations on Sebastes previously submitted to the joint Symposium on Redfish of ICNAF and ICES at Copenhagen 1959.

Lambert, D.G. 1960. The food of the redfish Sebastes marinus L. in the Newfoundland area. J. Fish. Res. Bd. Canada, 17(2): 235-243.

Samples of redfish stomachs were collected from the Newfoundland area and were analysed both qualitatively and quantitatively. In the sampled area the most important items of the diet of these fish are amphipods, fish and euphausians. There is a change in the diet of the redfish related to size. The redfish feeds on pelagic organisms and not on benthic forms.

Messtorff, Joachim. 1960. Ein auffälliger Parasit des Rotbarsches (A remarkable parasite of the redfish). Inf. für die Fischwirtschaft. Jg. 7, Nr. 3. 1960. S. 78-81.

A short report on the copepod Sphyrion lumpi, its biology, distribution and abundance, mainly according to Templeman and Squires.

Rodewald, Martin. 1960. Die Extreme 1958 und 1950 des nordatlantischen Rotbarsch-Jahrgangs: atmosphärisch ausgelöst? (The extreme conditions 1958 and 1950 of the North Atlantic Redfish - year-classes: are they elicited by atmospheric conditions?) - Hansa. Jg. 97, Nr. 18. 1960. S.933-934.

The unusual scarcity of the 1958 and the strength of the 1950 year-class of redfish larvae are considered in the light of the specific prevailing weather condition. Whereas in the first three months of 1958 high pressure of 10 mb beyond the normal values in W. Greenland resulted in a strong additional wind component from ENE and therefore in an anomalous drift of water in a southwest - to west-south-westerly direction, the situation in 1950 showed quite another type of anomality. At 30°W a strong negative pressure resulted in winds from SSE carrying the warm Atlantic water into the area off SW-Iceland.

Rodewald, Martin. Bestandsschwankungen des Rotbarsches vor Südlabrador und die atmosphärische Zirkulation im Nordwest-Atlantik (Fluctuations in the redfish stock of southern Labrador and the atmospheric circulation in the N.W. Atlantic). Hansa. Jg. 97, Nr 6/7. 1960. S.365-367.

See Meyer and Rodewald: Ist die Grösse der Fischfänge vor Labrador von der atmosphärischen Zirkulation abhängig? - Hansa. Jg. 97, Nr 12/13. 1960. S.669-670.

Templeman, Wilfred and H.J.Squires. 1960. Incidence and distribution of infestation by _Sphyrion lumpi_ (Krøyer) on the redfish, _Sebastes marinus_ (L), of the western North Atlantic. J. Fish. Res. Bd. Canada, 17(1): 9-31.

Investigations of infestation of redfish by female _Sphyrion lumpi_, in the Newfoundland area, showed that in the Labrador area _Sphyrion_ were generally distributed all over the body but with the greatest infestation in the cloacal region. In the eastern Grand Bank area there was a strongly ventral distribution of the parasite on the trunk with over 40% of the parasites in the cloaca. This is contrasted with previously published data from the Gulf of Maine where most of the _Sphyrion_ were situated antero-dorsally, near the base of the spiny first dorsal fin.

The major centre of infestation, in the Newfoundland area, of redfish by _Sphyrion_ was off southern Labrador east of Hamilton Inlet Bank with as high as 8% of the redfish infested. Centres of less infestation were found on the southern part of the eastern slope of the Grand Bank and in the southeastern part of the Gulf of St. Lawrence. _Sphyrion_ were very scarce on the southwestern Grand Bank, the western part of the south coast of Newfoundland and in the northern part of the Gulf of St. Lawrence. _Sphyrion_ were not noted on redfish from the NE Grand Bank, Flemish Cap and from the Nova Scotian Shelf. A study of residual remains, in redfish fillets, of the cephalothorax from individuals of previous _Sphyrion_ generations showed the same centres of abundance but with some spreading of the previously infested fish in 2 of 3 areas in the direction of the deep-water current, thus indicating the possibility of very slow migration of some individual redfish with the current.

It is believed that almost all the redfish discussed in this paper are of the _mentella_ type.

D. Others, Various

Bergeron, Julien. 1960. Liste des Poissons marins de l'Estuaire et du Golfe Saint-Laurent. Contr. Dept. Pêcheries Quebec, no.80: 1-27.

(as per title)

Bergeron, Julien and Guy Lacroix. 1960. Le transport des poissons marins vivants dans des sacs de polyethylene. Cahiers d'Information de la Station de Biologie marine, no. 1:1-13.

(as per title)

Craig, R.E. and R. Priestly. 1960. 'Photographic studies of fish populations.' Nature, Lond., 188, 333-334, Oct. 22, 1960.

A self-contained camera, with electronic flash and operated by a time switch, was left unattended on the sea bed. An estimate of local herring population was made from the resulting photographs.

Hasler, Arthur D. 1960. Guideposts of migrating fishes. Science 132(3430): 785-792.

Describes theory of "sun-compass" navigation, principally in salmon.

Jensen, Albert C. 1960. Tracking down the spiny dog. Maine Coast Fisherman, p.16. January 1960.

Semi-popular account of tagging and migrations.

Martin, W.R. 1960. Predicted effects of proposed tidal power structures on groundfish catches in Charlotte County, N.B. J. Fish. Res. Bd. Canada, 17(2): 169-173.

It is predicted that the construction of power structures will have no measurable effect on Charlotte County groundfish landings as a whole. It is expected that the 1,700,000 lb or 12% of the Charlotte County groundfish catch, taken in 1958 inside the dam sites, will be greatly reduced. Specifically, it is forecast that the pollock line fishery in Head Harbour Passage, which yielded 1,500,000 lb in 1958, will be greatly reduced, the haddock dragger fishery will be reduced or eliminated in the high pool, and the flounder fishery in Passamaquoddy and Cobscook Bays will probably increase.

Mather, Frank and Howard A. Schuck. 1960. Growth of bluefin tuna of the western North Atlantic. U.S. Fish and Wildl. Service, Fish. Bull. 179, Vol.61, pp.39-52.

Length frequency data and annuli on scales and vertebrae analyzed. Data partially corroborated by tag returns.

Meyer, Arno and Martin Rodewald. 1960. Ist die Grösse der Fischfänge vor Labrador von der atmosphärischen Zirkulation abhängig? (Does the size of the catches off Labrador depend on the atmospheric circulation?) - Hansa. Jg 97, Nr 12/13. 1960. S. 669-670.

The fluctuations in the catches of redfish and cod off Labrador seem to be related to simultaneous changes in the atmospheric circulation. The best catches have been made with onshore winds from ENE carrying additional Atlantic water masses, whereas poor catches coincided with offshore winds from W to WNW.

IV. SHELLFISH

Bourne, N. 1960. Outlook for the Georges Bank scallop fishery. Fish. Res. Bd. Canada, Biol. Sta., St. Andrews, N.B., General Series Circular No.33, 2 pp.

(as per title)

Merrill, Arthur S. 1960. Living inclusions in the shell of the sea scallop, *Placopecten magellanicus*. Ecology 41(2): 385-386.

Three species of bivalves, and other invertebrate organisms, found in a new shell material in scallop.

Merrill, Arthur S. and John B. Burch. 1960. Hermaphroditism in the sea scallop, *Placopecten magellanicus* (Gmelin). Biol. Bull. 119(2): 197-201.

Two hermaphroditic scallops from Georges Bank were examined, macro- and microscopically. Mature ova and sperm were seen in the first specimen but the spermary of the second was spent while the ovary was large and plump.

V. OTHER MARINE ORGANISMS

Brunel, Pierre 1960. Artificial key to the Mysidacea of the Canadian Atlantic continental shelf. Can. Journ. Zool., 38(5):851-855, fig.1.

(as per title)

Brunel, Pierre 1960. De la Diatomee a la Morue. Les Invertèbres de fond. Actualités marines, 4(2):13-20, figs. 1-3. Dept. Pêch. Quebec.

(as per title)

Ronald, Keith 1960. The effects of physical stimuli on the larval stage of *Terranova decipiens* (Krabbe, 1878) (Nematoda: Anisakidae). Can. Jour. Zool. 38 (3): 623-642, figs. 1-12, tables I-V. Contr. Dept. Pêch. Quebec, No 74.

The reactions of the larval stage of the nematode *Terranova decipiens* found in the flesh of cod fish were examined under various temperature conditions. The relationship between these reactions and the survival of the nematode in the fish, as well as its future behaviour in seals, is considered.

Scott, D.M. and W.F.Black. 1960. Studies on the life-history of the ascarid *Porrocaecum decipiens* in the Bras d'Or Lakes, Nova Scotia, Canada. J. Fish. Res. Bd. Canada, 17(6): 763-774.

Larvae of the parasitic ascarid (*Porrocaecum decipiens*) occurred commonly in the musculature and viscera of Atlantic cod (*Gadus morhua*) in the Bras d'Or Lakes. They were also present in the musculature of nine other species of teleosts and probably also in the viscera of skates (*Raja* sp.) Most larvae were longer than 20 mm. None was shorter than 10 mm, a fact which suggested the existence of some earlier intermediate host, probably an invertebrate. More than 8,000 mysids, an important food of fishes when they first become infected, were examined for nematodes. Although 110 nematodes were found, only one certainly and four dubiously appeared to be *Porrocaecum*. The definitive hosts were the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*). The distribution of seals coincided with local variations in the incidence of the parasite in cod.

Wigley, Roland L. 1960. A new species of *Chridotea* (Crustacea: Isopoda) from New England waters. Biol. Bull. 119(1): 153-160.

Description and ecological notes on *C. arenicola* from Georges Bank.

Wigley, Roland L. 1960. Note on the distribution of Pandalidae (Crustacea, Decapoda) in New England waters. Ecology 41(3): 564-570.

Geographic and bathymetric distribution of four species of Pandalidae described and related to temperature and bottom sediments.

VI. FISHERIES AND FISHING INDUSTRY

Anon. 1960. Norges Fiskerier 1958 (Fishery Statistics of Norway 1958). Norges offic. Stat. XII, 17. Bergen.

The statistics include data on the Norwegian fishery in Newfoundland waters and off W. Greenland. (Secr.)

Bertelsen, E. and P.M.Hansen. 1960. Fiskeriundersøgelser 1959 (Fishery researches 1959). Copenhagen. incl:

Hansen, P.M. Undersøgelser over rødfisk in grønlandske farvande (Researches on redfish in Greenland waters).
Horsted, S.A. Undersøgelser over rejebestandene i Julianehaab distrikt (Researches on the deep-sea prawn stocks in Julianehaab district).

Edwards, Robert L. and Lewis Lawday. 1960. Species composition of industrial trawl-fish landings in New England, 1958. U.S. Fish and Wildl. Service, Spec. Sc. Rep. Fisheries No.346, 20 pp.

(as per title)

Lundbeck, Johannes. 1960. Biologisch-statisticher Bericht uber die deutsche Hochseefischerei im Jahre 1959 (Biological-statistical Report on the German Deep-Sea Fishery in 1959). - Jahresber. über die Deutsche Fischwirtschaft 1959. S.116-146. Berlin: Mann 1960.

(as per title)

Meyer, Arno 1960. Eine Winterreise nach Grönland (A winter cruise to Greenland). Allg. Fischwirtschafts-Zeitung. Jg. 12, Nr 22. 1960. S.12-14.

(See Hansa. Jg. 97, Nr 23/24. 1960. S. 1212-1215.)

Meyer, Arno 1960. Erfahrungen einer Wintersuchreise nach Grönland. (Experiences of a search trip in winter to Greenland). - Inf. für die Fischwirtschaft. Jg. 7, Nr 3. 1960. S.63-68.

See Meyer: The third search trip 1959...-Hansa. Jg. 97, Nr. 23/24. 1960. S.1212-1215.

Meyer, Arno 1960. Die zweite Suchreise 1959 nach Labrador und Neufundland (The second search trip 1959 to Labrador and Newfoundland). - - Hansa. Jg. 97, Nr 12/13. 1960. S.667-669.

A vast area off S. Greenland, North, Central and South Labrador, on the northern and eastern parts of the Grand Bank to Flemish Cap was searched from 18 Oct. - 27 Nov. Hydrographic samples as well as catch analyses have been made. Cff South Greenland cod have been tagged.

Meyer, Arno

1960. Die dritte Suchreise 1959, eine Winterreise nach Grönland. Erfahrungen und Auswirkungen. (The third search trip 1959, a winter cruise to Greenland. Experiences and results). - Hansa. Jg. 97, Nr 23/24. 1960. S. 1212-1215.

Off SE Greenland, especially on Fylkir Bank and Tordenskjold Bank, dense concentrations of large redfish (medium size 45 resp. 47 cm) were found. The catches per hour amounted to 4 t on Fylkir Bank and up to 9.5 t on Tordenskjold Bank. On Cap Bille Bank fair catches of cod (3.5 t per hour, medium size 79 cm) have been made. Based on the search trip German trawlers began fishery on these banks. Samples of cod showed the spawning area of the East Greenland cod to include the Tordenskjold Bank. Extraordinary ice conditions prevented the program for S. Greenland from being carried out. Off W. Greenland a remarkable catch to the east of Fyllas Bank consisted mainly of cod of the rich 1953 year-class, being for the first time on the spawning migration. Good catches of redfish, up to 2.5 t per hour, were made on Fyllas Bank and to the southwest of Banana Bank. Some 500 cod were tagged. The results and the positive possibilities for a winter fishery are discussed.

Meyer, Arno

1960. Die Suchreise 1960 nach Grönland (The search trip 1960 to Greenland). Hansa. Jg. 97, Nr 41/42. 1960. S.2157-2159 und - Allg. Fischwirtschaftszeitung. Jg. 12, Nr 42. 1960. S. 12-14.

Reports on a search cruise to West, South and East Greenland, that resulted in fair catches made in the area of the Lille Hellefiske Bank, Frederikshaab Bank, Nanortalik Bank, Fylkir Bank and Moesting Ground. Additional knowledge on the spawning of the cod as well as on the distribution of the younger year-classes was gained, some tagging work and hydrographic investigations were done.

Meyer, Arno

1960. Die 3. Suchreise nach Neuschottland, Neufundland und Labrador vom 12 April bis 24. Mai 1960. (The third search trip to Nova Scotia, Newfoundland and Labrador from April 12 to May 24, 1960.) - Allg. Fischwirtschaftszeitung. Jg. 12, Nr 44. 1960. S. 15-16.

In addition to the search cruises in summer and autumn 1959 the area of the southern Newfoundland Bank, the Gulf of St. Lawrence and the Nova Scotian banks were searched from 12 April to 24 May. In Divisions 4R, 4S and 4T only few cod were still found, the fishing season having ended. Off Cape Breton Island, however, catches up to 86 baskets per haul were made, but individual size was small. In Divisions 3N, 3O, 3P, 4V and 4W the trials were also mostly unsuccessful, the fish being few and too small except for American pollock. In any case, the results were rather disappointing.

Pechenik, L.N. 1960. Sir'evaya Baza Proliva Devisa (Basic information on Fishing Grounds [W. Greenland]). Ribnoie Chozyaistvo (Fishery Economy), No.6. Moscow.

The paper deals with the USSR fishery for cod and redfish in Subarea 1: Hydrographic section, fishing areas and size-distribution of samples (Secr.)

Rodewald, Martin 1960. Grosswetterlage und Fangergebnisse der deutschen Labrador-Fischerei (General weather situation and landings of the German Labrador fishery). - Der Wetterlotse. Jg. 12, Nr 158. S.73-82.

See Meyer and Rodewald: - Hansa. Jg. 97, Nr 12/13. 1960. S.669-670.

VII. GEAR

Anon. 1960. Intern. Fish. Conv. of 1946. Committee on Mesh Difficulties. Report of the Scientific Sub-Committee presented at the 7th Meeting of the Permanent Commission, Nov. 1958. ICES. Rapp. et Proc. Verb. 151. Copenhagen.

Craig, R.E. 1959. 'Some successful experiments with a pencil-beam echo-sounder.' World Fishing, 8 (12), 40-43, 1959.

Describes a sounder working at 400Kc/s with a beam width of the order of 2°. Very high definition, and separation of individual fish was possible to depths of about 40 fathoms.

Dickson, W. 1960. 'The loads imposed by trawling gear.' Traung, J.-O. ed. Fishing boats of the world 2, London, Fishing News (Books) Ltd., 388-392, 1960.

Gives measurements of trawl drag and engine power over a range of speeds for an Arctic trawler and a pocket trawler. The smaller ship towed both an otter trawl and a large lightweight herring trawl.

Dickson, W. 1960. 'The problems of headline height.' World Fishing, 9(9), 38-48, 1960.

Describes how to obtain extra headline height with notes on the advantages and penalties of doing so.

Jones, R. 1960. 'Mesh selection and apparent growth of haddock.' J. Cons. int. Explor. Mer, 25(2), 177-184, 1960.

Describes, theoretically, the effect mesh selection is likely to have on apparent growth, since, during the "mesh selection phase", fast growers become liable to exploitation, and therefore mortality, earlier than slow growers.

Nedelec, C. and L. Libert. 1960. Etude du Chalut (suite). Rev. des Trav. Rev. trim. XXIV, 4. Paris.

The paper deals with the rigging of the trawl: otter boards, methods of lashing the codend, and of hauling aboard the trawl with its catch. (Secr.)

Parrish, B.B., I.G.Baxter and M.J.D.Mowat. 1960. 'An automatic fish egg counter.' Nature, Lond., 185, 777, Mar. 12, 1960.

This paper describes an apparatus designed to determine mechanically the fecundities of fish. Eggs are made to interrupt a light beam shining on to a photomultiplier unit, linked to an electronic counter.

Suau, P.A. 1960. Sobre las pruebas de selectividad en los artes de arrastre. (Experiments as to the selectivity of trawls). IV Meeting on Productivity and Fisheries. Inst. de Inv. Pesq. Barcelona.

The paper deals with a series of experiments with trawl codends of different mesh sizes in Spanish waters, especially with the methods applied in the experiments. (Secr.)

Williams, T. 1960. '"One-man" measuring board.' F.A.O. Indo-Pacific Fish. Council. Occasional Paper 60/3.

Description of a board which can be used by one man to measure large numbers of fish under field conditions.

VIII. MISCELLANEOUS

Günter, Dietrich 1960. Zur Topographie und Morphologie des Meeresbodens im nördlichen Nordatlantischen Ozean (On the Topography and Morphology of the Sea Floor of the northern North Atlantic Ocean).