INTERNATIONAL COMMISSION FOR  THE NORTHWEST ATLANTIC FISHERIES

REDBOOK 1968 PART I

STANDING COMMITTEE ON RESEARCH AND STATISTICS

PROCEEDINGS

FROM THE

1968

ANNUAL MEETING

Note

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

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PART I. REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS

Chairman: Sv. Aa. Horsted; Rapporteur: D. Garrod

The Standing Committee on Research and Statistics (R&S) met in London, England, from Monday, 27 May to Friday, 31 May 1968 in the week preceding the 18th Annual Meeting of the Commission. The R&S Agenda is attached as Appendix VII. The Subcommittee on Assessments and the Subcommittee on Statistics and Sampling met during the previous week from Thursday, 23 May to Saturday, 25 May. An ICNAF Working Group of Redfish Experts met in Lowestoft, England, from Monday, 20 May to Wednesday, 22 May. The major items considered at these meetings are summarized below:

1. ASSESSMENTS (APP.I)

(a) Review of Nominal Catches and Fishing Activity in the ICNAF Area

R&S compiled the latest statistics on landings in 1967 and fishing activity in 1966 (Appendix I, Tables 1-5, for Subareas 1-5 respectively). The principal changes from previous years are noted below:

Subarea 1

The total nominal catch of cod from Subarea 1 in 1967 (*ca.* 418 thousand tons) increased by about 12% compared to that in 1966 and is the second largest ever taken in the subarea (1962: 451 thousand tons). Catches of redfish continued to decrease (12 thousand tons).

There was an increase in fishing activity from 1965 to 1966 with a corresponding decrease in catch-per-unit effort. In 1967 catch-per-unit effort increased again due to the increase in mean weight of the predominating 1960 and 1961 year-classes.

Subarea 2

The nominal catches of groundfish have exceeded 300 thousand tons annually since 1965, as a result of increased otter-trawl effort. Redfish is the only other species contributing significantly to total catch, but redfish yields have been relatively low since 1961. Estimates of groundfish catch-per-unit effort show no continuing trends.

Subarea 3

Total nominal catches of fish increased from an average 676 thousand tons annually in 1962-66 to over 1 million tons in 1967. Cod catches increased almost 40% to 693 thousand tons although inshore catch continued to

decline. Catches of flounder and herring continued to increase rapidly. Redfish catches remained relatively low.

Fishing activity declined from 1959 to 1963 but has increased since then, almost entirely due to otter-trawl fishing. Catch-per-day by otter-trawlers was generally lower in 1964-66 than previously.

Subarea 4

Nominal catches of groundfish continued to decrease in 1967. With a decrease of about 100 thousand tons (*ca.* 18 percent) from the 1966 level, landings in 1967 were well below the high level of the 1963-65 period. This decline affected all the main species. Silver hake landings were the lowest since this fishery began.

There are no consistent trends in fishing activity or catch-per-unit effort in the years 1963-66.

Subarea 5

Total nominal catches of fish decreased from 887 thousand tons in 1966 to 708 thousand tons in 1967. Catches of groundfish fell from 613 thousand tons in 1966 to 391 thousand tons in 1967 owing to a sharp reduction in catches of haddock and silver hake. This was due to lower abundance as well as fishing effort being diverted to other fisheries. Herring catches increased by about 45 percent to 224 thousand tons.

General Remarks

Total nominal landings of fish in the ICNAF Area increased by about 4 percent from 1966 to 1967. There is an increase in Subareas 1-3, noticeable especially in Subarea 3, whereas there is a decrease in groundfish catches in Subareas 4-5 not compensated by an increase in herring catches. Total fishing activity in 1966 shows no clear trends compared to 1965.

(b) Assessments relating to Questions posed by the Standing Committee on Regulatory Measures

At its first meeting in January 1968, the Standing Committee on Regulatory Measures set up guidelines which should form the basis of a request for scientific information directed to R&S, and posed four questions, which it asked R&S to consider and to prepare a progress report for the 1968 Annual Meeting of the Commission. The guidelines and questions are set out in Comm.Doc. 68/6 and on pages 27 and 28 of Appendix I to the present report.

In the short time available since the first meeting of the Standing Committee on Regulatory Measures, R&S has not been able to undertake a complete study of the many scientific aspects of these questions so that

it is only possible to present a progress report for this meeting of the Commission. In particular, assessments have been made only on the basis of the constant parameter population model, and on the assumption that recruitment and stock size are independent over the range of stock sizes likely to be encountered between the unregulated and regulated states. Further, R&S has confined its attention to assessments of the effect of regulating fishing intensity (direct effort control or catch quota) on the basis of mesh size regulations remaining as at present or as proposed, and no further mesh assessments have been attempted. R&S points out, however, that previous results of mesh assessments still apply and that, in some fisheries in the ICNAF Area at the present level of fishing intensity, increases in catch-per-recruit would be expected with increases in mesh size above those currently in force or pending.

R&S considered the questions posed by the Standing Committee on Regulatory Measures on a subarea basis. Reports on the fish stocks in each subarea and their current state relative to fishing are contained in Appendix I, Annexes I-IV to the present report. A summary of the status of fish stocks in each subarea is given in Appendix I, Tables 6-9. Further explanation of these tables is given in Appendix I, page 29. On the basis of these results, the answers, so far as they can be ascertained in the time available, are as follows:

General remarks:

(i) Possibility of estimating total annual catch so as to maintain the maximum sustainable yield

For most of the ICNAF stocks, with present data, it would be extremely difficult to estimate the level of fishing mortality giving the maximum sustainable yield. It *is* possible, however, to identify several stocks for which a reduction in fishing mortality would certainly not result in any appreciable decrease in long-term yield-per-recruit and would probably increase it. For these stocks it is possible to estimate the short-term catch quota required to achieve any desired level of fishing mortality.

(ii) Research required to establish annual catch quotas

The research requirements to establish annual catch quotas are set out in detail in Appendix I of this report but the present research is sufficient to give useful results concerning the setting of catch quotas for some stocks.

(iii) Precision with which annual quotas can be set with present data. Effect of errors in annual quotas on yield

There is a wide variation in the precision of the data available for different stocks. Errors in estimating the quota will not have

a serious effect on yield provided the errors can be detected quickly and corrected by adjustments to the quotas in subsequent years. If an error made in one year is corrected in the next, the difference in yield for a long-lived species, *e.g.* cod, is negligible.

(iv) Magnitude of year-to-year adjustment in quotas

The magnitudes of the necessary year-to-year adjustments in catch quotas are of the same order as the observed past year-to-year fluctuations in catch-per-unit effort, *i.e.* from 5 to 25 percent, depending on the stock.

Answers to Specific Questions

(i) Stocks agreed to be demonstrably fully exploited or over-exploited, their sustainable yields and effect of effort regulation

The present knowledge of the state of the stocks is given in Appendix I, Tables 6-9 and Annexes I-IV. Cod in Subarea 1 and haddock in Subarea 5 are demonstrably over-exploited. The sustainable yields for these stocks are: Subarea 1 cod - 400-450 thousand tons (based on recruitment in recent years which has been high); Subarea 5 haddock - 50 thousand tons (based on long-term average recruitment). The catch quota in any year will depend on the strength of year-classes present. In the initial year of regulation the quota will be less than it would be in a steady state to an extent depending on the reduction in fishing mortality decided upon. Increase in catch-per-unit effort will result from the regulation.

(ii) Which of these stocks can be fished independently of other species?

Subarea 1 cod can be fished independently of other species. Subarea 5 haddock cannot be fished entirely independently of other species but mixture with all other stocks except cod is small. Reduction of fishing intensity aimed at management of Subarea 5 haddock will probably also benefit the cod yields.

(iii) Total yield of demersal species in each subarea. Effect on these yields by regulating fisheries mentioned in (i) above

The available data on the potential yields of demersal species in each subarea are summarized in Tables 6-9 of Appendix I. Regulation of Subarea 1 cod and Subarea 5 haddock (and cod) fisheries will not directly affect the fisheries for other important demersal fisheries in these subareas. The indirect effect of diversion of fishing effort cannot be easily estimated.

(iv) Additional information required. Preference between direct effort limitation and catch quota

The additional information required is set out in detail in Appendix I, Annex V. The direct limitation of effort requires detailed calibration of the fishing powers of all vessels of the regulated fleet fishing the stocks concerned; this appears difficult to achieve at present. Limitation of catch requires continued revision of quotas in accordance with changes in stock abundance.

As regards effectiveness, there is no preference between limitation of effort and limitation of catch since in any case the effectiveness of this limitation would be monitored in terms of catch. With regard to continued study and year-to-year adjustment, limitation of catch is preferable to limitation of effort because catch is easily determined whereas definition of effort is very difficult.

The scientific data needed to set up and operate a catch quota regulation on Subarea 1 cod and Subarea 5 haddock are currently available.

In further discussion of this question, R&S separated two requirements, (1) the initial assessment of the stock, and (2) the monitoring of the regulation.

(1) Initial assessment

This requires a knowledge of the parameters of the stock which can be obtained through routine sampling programs. Uncertainties in assessment relate to the degree of overlap between some stocks of the same species, inadequate sampling in the past, the rapidity of the expansion of fishing on some stocks and the influence of environmental changes during the period of sampling. Whilst the shortage of time at the present meeting prevented evaluation of all existing data, there would still remain important gaps. R&S therefore reaffirms the essential need, if good advice on management is desired, for full sampling coverage (length and age compositions) of all the major ICNAF fisheries.

The methods of analyzing these data are reasonably well known, but the individual peculiarities in the data from each stock mean that their application cannot be entirely a matter of routine. Thus there is rarely time during an annual Commission meeting to carry out any very detailed analysis. Equally, since it is necessary to pool the data from all countries, analysis by individual scientists in their own laboratories is not easy. Mid-term meetings of the Assessment Group as a

whole, or of those concerned with an individual stock (*e.g.* West Greenland cod), have been held very successfully in the past, and R&S strongly

recommends (1)

that continuing provision be made for mid-term meetings of the Subcommittee on Assessments or of appropriate working parties of that subcommittee, the costs of attendance of the chairman of the Subcommittee or of the working party to be borne by the Commission.

Even such meetings, however, can generally only analyze the situation in terms of the simpler population models, especially the constant parameter yield-per-recruit model. It is becoming clear that these models do not give an entirely adequate description of the situation and that if more precise assessment of the state of the stocks is required, more complex models using an increasing range of information will become necessary. It must, however, be emphasized that the use of the more realistic models will not change the general conclusions and advice of the past few years - that the fishing on several of the major ICNAF stocks has reached a level beyond which no appreciable increase in sustained yield is possible, and that future management will require some control of the total amount of fishing.

The more complex models require information from virtually any branch of marine science, and of biology generally, but certain aspects may be picked out as likely to be particularly relevant to the most urgent problems.

The major problems concern the relation between the abundance of the adult stock and the average strength of the resultant year-classes. The importance of knowing this has already been pointed out in connection with Georges Bank haddock. The solution of this problem does not seem easy and will certainly require careful observations, experiments and examination of the empirical relations between stock and recruitment for a wide range of stocks. Another important group of questions concerns the interaction between a fish stock and the population on which it feeds. This includes the case where the population of food organisms is itself the object of a commercial fishery (*e.g.* herring or capelin which are important food items for cod). In this latter case, the choice of management measures will depend, at least when both stocks are heavily exploited, on a detailed scientific knowledge of the quantitative interaction between the stocks.

In both these problems future progress seems to depend less on the direct application of existing theories to data to be collected for the various ICNAF stocks, than on a definite advance in fishery science in those fields concerned with the more realistic population results. This requires much closer collaboration than generally exists at present between stock assessment experts and other research workers. Unfortunately the pressure of routine work within R&S during the past years has left little time during Commission meetings for the necessary discussions. Improvements in the input of other branches of fishery science should result in better advice, and management measures rather closer to the optimum. While there is not the information to make a quantitative calculation of the benefits to be expected from further research in the various fields related with fisheries management, R&S believes that higher sustained catches or lower costs will far exceed the research costs involved.

(2) Monitoring the regulation

(2.1) Limitation of catch quotas

When mortality is known, quotas can be set from a knowledge of the relative abundance of year-classes already in the fishery, coupled with an estimate of recruitment expected during the year. This can be obtained from pre-recruit surveys and is currently available for several stocks. This is the most important source of variation but periodic adjustment might be necessary owing to variation in other parameters, *e.g.* growth, which would have to be kept under review.

(2.2) Direct limitation of effort

The essential points concern the difficulties of calibrating international fishing effort to standard units. This has not yet been done so the precision which could be achieved is unknown. The calibration would, however, need to be reviewed periodically to adjust for changes in efficiency.

(c) Other Items

(i) Some members of the Subcommittee on Assessments met with the Scientific Advisers to Panel A (Seals). The assessment of harp seal fisheries is reviewed in the Report of the Scientific Advisers to Panel A (1968 Meeting Proc.2, Appx.I).

(ii) R&S agreed to discuss deficiencies in the sampling data at the next Annual Meeting.

2. STATISTICS AND SAMPLING (APP.II)

(a) Sampling

(i) R&S reviewed the general scope and adequacy of sampling by member countries.

(ii) R&S requests that data for silver hake and yellowtail flounder be reported for publication in the Sampling Yearbook.

(iii) Concerning the recommendations of the Joint ICES/ICNAF Sampling Meeting, 1965, R&S reiterates the decisions of the 1967 meeting (Redbook 1967, Pt.I, p.53) and notes the general conformity of methods now in use for measuring groundfish species. R&S requests that all member countries state the length and interval of measurements used in all documents and reports.

(b) Review of ICNAF List of Vessels

R&S reviewed the replies received by the Secretariat in response to Recommendation 5 in Redbook 1967, Part I, and

recommends (2)

(i) that the Secretariat proceed with the preparation and publication of the 1968 List of Vessels in accordance with existing recommendations, and

(ii) that the CWP be requested to review ways and means of compiling and publishing statistics on the "potential" fishing fleet in the Atlantic.

(c) Statistical Reporting

Through several recommendations R&S clarified procedures to be followed when reporting and made adjustments to the list of species currently in use.

Having expressed its appreciation to the Secretariat for the prompt publication of the Statistical Bulletin and approved recent improvements in the design of the Statistical Bulletin, R&S

recommends (3)

that the Secretariat study and report its proposals to solve the difficulties of re-designing the tables in the Statistical Bulletin when it seems likely that a breakdown of the Subarea 6 catches by divisions will be obtained.

(d) Cooperation with ICES, FAO and the CWP

R&S made a number of recommendations to promote further the already high level of cooperation between the agencies concerned with North Atlantic statistics. Having regard to the wide importance of this work, R&S

recommends (4)

that ICNAF accept the proposed changes in (a) the name of the CWP from "Continuing Working Party on Fishery Statistics in the North Atlantic Area" to "Coordinating Working Party on Atlantic Fishery Statistics" and in (b) the representation on the inter-agency CWP as proposed by the Third Session of the FAO Committee on Fisheries (COFI), Rome, 24-30 April 1968, and as endorsed by the ICES Bureau at its meeting in May 1968.

Noting that the COFI proposals when properly accepted by FAO and ICNAF entitles ICNAF to appoint to the CWP, according to ICNAF's own constitutional procedures, up to four representatives, R&S

recommends (5)

(i) that the Executive Secretary and the Chairman of the Subcommittee on Statistics and Sampling participate in future meetings of the CWP dealing with the North Atlantic;

(ii) that Canada and Denmark be invited to participate in the Sixth Session of the CWP;

(iii) that Denmark and the United States be invited to participate in that session of the CWP, following the Sixth, which would deal with the North Atlantic.

3. GEAR AND SELECTIVITY (APP.III)

(a) Review of ICES Gear and Behaviour Committee Report (Res.Doc.68/30)

R&S noted that the FAO Training Manual on Acoustic Methods in Fisheries Research would be available soon, and that a Training Course in Acoustic Methods (organized by ICES, supported by FAO) will be held in the spring 1969 in the Lofoten area.

(b) Tabular Summaries of Selectivity Data

R&S considered that 5-year summaries of selectivity data are adequate. Annual summaries will therefore be discontinued. It also considered collaboration with ICES in the preparation of these summaries, and instructed the Secretariat to investigate the compatibility of the present ICNAF and ICES summary forms.

(c) Selectivity of Different Codend Materials

(i) Polypropylene fibre is manufactured as split fibre, monofilament and multifilament. It has been confirmed that this difference does not appreciably influence the selectivity of codends made of polypropylene;

(ii) USSR presented data showing that the mesh size equivalent for polyamide (Kapron) might be smaller than that approved by the Commission at present, and asked R&S to endorse a proposal to alter the equivalent to recognize this. R&S considers, however, that the whole subject of mesh size equivalents should be reviewed, and, noting that ICES is of the same opinion, R&S

recommends (6)

(i) that an ICNAF Working Group on Selectivity Analysis be formed to undertake a review of variability in selection data, including the scientific basis of mesh size differentials for different twine materials;

(ii) that the Chairman of R&S appoint a convener for this working group;

(iii) that experts be appointed to the working group by interested member countries;

(iv) that ICES be invited to participate, in order to make a joint study of these problems;

(v) that the working group meet at a mutually convenient time so that its report could be available for the next meetings of both ICNAF and NEAFC.

(d) Length, Weight and Girth Data

A bibliography of pertinent data was presented and attention was drawn to the need for further studies on species other than cod.

(e) Meshing of Redfish

R&S reaffirmed the need for information on this point, particularly in relation to the influence of catch size and selectivity.

(f) Trawl Material and Mesh Size Sampling

Both ICNAF and NEAFC have now adopted a similar form for reporting these data. Very few manila codends are now in use in the ICNAF Area.

(g) Adoption of Standard Gauge for Enforcement

R&S had no new advice on this topic, and there is no scientific basis for the preference of either of the gauges (ICNAF gauge and modified NEAFC gauge) at present under consideration by the Commission.

(h) Topside Chafing Gear

Whilst further evidence has confirmed that the 'Polish-type' chafer has no appreciable effect on selectivity, R&S recognized that some difficulties may arise in respect of its strengthening function. Experiments were reported which show that the use of larger twine size in the chafer compared to the codend may not materially reduce codend selection. R&S expressed the need for more information on this, and on the possible elimination of topside chafers by using heavier twines in the codend itself.

(i) Field Identification of Net Materials

No foolproof method of field identification is yet available and R&S asked for descriptions of procedures now in use, particularly for the main groups groups of synthetic fibres.

(j) Other Matters

(i) R&S discussed data relating to hook selection (Res.Doc.68/2 and 68/10). The evidence at hand was not conclusive.

(ii) R&S reviewed the data presented on the selectivity of trawls for yellowtail flounder (Res.Doc.68/91).

4. ENVIRONMENTAL (APP.IV)

(a) Report on NORWESTLANT Surveys (ICNAF Sp.Publ.7)

This report is in four parts. Part I, Text, and Part II, Atlas, should both be ready by the Annual Meeting, 1969. Part III, Oceanographic Data, being prepared by the Canadian Oceanographic Data Centre, will be issued in three volumes which will go to the printer in August 1968. Part IV, Biological Data, requires more time to be completed.

(b) Georges Bank-Gulf of Maine Environmental Survey

The USA drew attention to continued problems in the statistical interpretation of the biological data collected on the survey. This applied to their own data and to data collected in a joint USA-USSR survey. A further joint survey is planned for 1968 in which Canada will also participate. There is also a possibility that these three countries will conduct a joint sampling study in the spring of 1969.

(c) Environmental Aspects of the National Research Reports

On the whole, the hydrographical situation in the northern part of the ICNAF Area is characterized by colder water in the inshore areas and by warmer water in some offshore areas.

(d) Report on Activities of IOC

IOC Resolution V/13 (Comm.Doc.68/3) invites ICNAF to join ICES and IOC in establishing a joint coordinating body for the North Atlantic. R&S agreed such a body would be useful and

recommends (7)

(i) that ICNAF reaffirm the conclusions reached at the discussion in 1967 of the proposal for large-scale hydrographical surveys of the North Atlantic (Redbook Part I, 1967, pp.69-70, No.7);

(ii) that, nevertheless, the invitation to send two representatives to a coordinating group with IOC and ICES should be accepted on the understanding that the main purpose of the group will be the co-ordination of hydrographic work being undertaken under the auspices of the various international bodies and not the planning of new large-scale programs of investigation;

(iii) that ICNAF be represented at the first meeting of the group, which may be held at the forthcoming ICES meeting in October 1968, by the Executive Secretary and one other member.

(e) Consideration of Report of the ICES Hydrographic Committee

ICNAF was invited to co-sponsor with ICES, UNESCO, SCOR and IAPSO, the Symposium on Physical Variability of the North Atlantic to be held in Dublin in 1969. R&S

recommends (8)

that ICNAF accept this offer and that a member of the planning group be nominated by R&S. [Dr A. Alexeev (PINRO, USSR) was subsequently nominated by R&S.]

(f) Environmental Changes in Relation to Fisheries

(i) Recent work on the relation between the cod fishery and hydrographic conditions at Labrador was presented by USSR. This work will be continued.

(ii) R&S reaffirmed the need for periodic reviews of trends in environmental conditions. It was generally agreed that reviews such as that presented in Redbook 1967, Part IV, are extremely useful and should be produced as the need becomes apparent.

5. HERRING AND OTHER PELAGIC SPECIES (APP.V)

(a) Herring

(i) Status of fishery and research

Nominal catches show a substantial increase from 431 thousand tons in 1966 to 585 thousand tons in 1967. All countries fishing herring except USA recorded increased landings. A part of the increase is attributed to greater fishing effort by Canada, particulary in a developing purse seine fishery in Subareas 3 and 4. Increased landings were reported in Subarea 5 by the Federal Republic of Germany (a new German fishery), Poland, non-member countries and, to a lesser extent, USSR. US landings of small herring (the "sardine fishery") in the western Gulf of Maine have declined to the lowest since 1951.

Routine biological studies are being continued. The present age composition of stocks varies between areas and fisheries. In Subareas 5 and 6, the 1960 and 1961 year-classes are dominant but those of 1962, 1963 and possibly 1967 are much weaker. The age composition of young herring in the USA "sardine fishery" shows some atypical features which are being investigated.

(ii) Sampling

In reviewing the adequacy of the present sampling, R&S noted the general conformity in length measurement of herring among ICES member countries and

recommends (9)

that all herring length measurements made by ICNAF countries be total length and be reported to the half-centimeter below.

R&S further

recommends (10)

that sampling data on herring be published in the Sampling Yearbook and that the Secretariat develop a suitable format after consultation with herring workers.

(b) Other Pelagic Species

Catches and research on swordfish, tuna, porbeagle and other sharks, and mackerel were reported.

(c) Other Matters

R&S noted that the ICES Symposium on the Biology of Early Stages and Recruitment Mechanism of Herring will be held in Copenhagen, September 26-28, 1968, and a tuna stock assessment meeting will be held in Miami in August 1968 organized by FAO as part of the work of its Expert Panel for Facilitation of Tuna Research.

6. AGEING TECHNIQUES (APP.VI)

(a) Cod Otolith Photograph Exchange Program

A report (Res.Doc.68/77) of the cod otolith exchange program 1963-67 was reviewed. This program has resulted in an improvement in the consistency of readings by different countries such that at the present time (except for Subarea 4 cod) 90 percent of all readings fall within one year of the most probable age. R&S agreed that it was unlikely that further improvement would be obtained and

recommends (11)

that the cod otolith photograph exchange program be discontinued and replaced by an informal exchange of routine otolith samples between laboratories or individual consultation of otolith readers whenever required.

(b) Report of the Working Group of Redfish Experts, Lowestoft, 20-22 May 1968 (Res.Doc.68/27 and Appendix VI, Annex I)

The Working Group recorded a rather high measure of agreement in ageing between workers for redfish up to 15 years of age. In order to make further progress, R&S

recommends (12)

that an exchange of redfish otoliths and scales be started as outlined in Appendix VI, Annex I, and a report be submitted to the 1969 ICNAF Annual Meeting.

(c) Review of Information on Silver Hake Age Reading Problems

Age composition for silver hake in Subarea 5 reported by USA and USSR indicate good agreement in age determination. No further action is required at present.

(d) Age Validation of ICNAF Species

The need for the Inventory of Age Validation Studies on ICNAF species was reaffirmed and three research documents added. R&S reaffirmed the need for a "library" of otolith type photographs and

recommends (13)

that Mr Blacker of Lowestoft be requested to provide the Secretariat with a set of transparencies of type otoliths of the recent exchange program, and that these be available at the request of interested countries.

(e) Other Matters

Some difficulties were noted in age determination of red hake and R&S affirmed that an exchange of material between experts might facilitate progress.

7. REVIEW OF SECOND REPORT OF THE ICES/ICNAF JOINT WORKING PARTY ON NORTH ATLANTIC SALMON, LONDON, MAY 1968 (Res.Doc.68/106)

The second report of the ICES/ICNAF Joint Working Party on North Atlantic Salmon reviews the information received and describes the investigations made since 1966 (when the first report was prepared), and gives a record of the two subsequent meetings of the Working Party, held in Hamburg, October 1967, and in London, May 1968. R&S reviewed this document in a plenary meeting Friday, 31 May. The main items in the document are:

(a) Catch and Effort Statistics

Since 1965, catches of salmon in the inshore fishery at Greenland have stabilized at 1,200-1,300 tons, but the total catch in Greenland waters has been further increased by the development of an offshore fishery which, in 1967, landed *ca.* 300 tons. Home water catches for grilse and salmon combined for all countries have increased substantially since 1961 but those of European home rivers alone show no clear trend.

High seas salmon fisheries are also developing in the Norwegian Sea and off Faroes.

There is no reliable estimate of effort and catch-per-unit effort in the inshore Greenland fishery. Effort in the high seas fishery has increased rapidly. Although reliable estimate of fishing effort and catch-per-unit effort exist for some home river fisheries as yet it is not possible to form an overall estimate.

(b) Research

(i) Tagging and Recaptures

Large scale experiments have been carried out tagging smolts and kelts in home waters. Salmon tagged as smolts and kelts in home waters continue to be recovered at West Greenland, the major proportion being of Canadian origin, but comparison between countries

is difficult due to different kind of tags used. Canadian tags are the most efficient. It should be noted, however, that although this difference may affect the relationship between the numbers of Canadian and other tags detected on fish in Greenland, it should not affect the recaptures of Canadian tags over successive years in Greenland, since the Canadians have used the same type of tag throughout the relevant period. The number of fish caught at West Greenland tagged as smolts in Canada and the number caught per thousand fish tagged increased sharply in 1966, and the data available suggest that the return for 1967 will be similar. These results suggest that the proportion of fish of Canadian origin in the West Greenland fishery has increased during recent years.

No fish have been returned at Greenland from smolts tagged in Norway.

Of 1,326 salmon tagged at West Greenland (Div.1D, inshore) in the period 1965-67, 3 have been returned from rivers in Scotland, 1 from Ireland and 2 from Canada. 35 have been recovered in the Greenland inshore fishery, most of them close to the tagging site and within 10 days after tagging.

(ii) Blood and Other Biochemical Studies

Biological programs have been initiated to ascertain the proportion of the stock off West Greenland contributed by rivers in various countries. Results to date are promising but further studies are necessary and are currently undertaken.

(iii) Work on Parasites

Good progress is reported in these studies but so far it has not been possible to use this method to distinguish between stocks.

(iv) Sampling

Research vessel cruises to collect material have been continued in Greenland waters and in the Davis Strait. Routine programs have been continued in the inshore fishery at Greenland and in home rivers.

(c) Assessments

The results of assessments of the effect of fishing on the salmon stocks in Greenland waters and in home rivers are necessarily qualified by the uncertainties still surrounding the proportion of the various home river stocks exploited in the West Greenland fishery, and in the rate of natural mortality during migration to and from Greenland. Nevertheless the Working Party was able to reach some conclusions:

(i) It has been confirmed that the number of pre-grilse in catches at West Greenland is negligible, and the few which are caught are likely to be of local origin.

(ii) The examination of scale samples from fish caught in the research fishery as well as from commercial catches in West Greenland indicate that virtually all the salmon in this fishery have already spent at least one winter in the sea and that nearly all were entering upon their second winter in the sea. If they return to home waters, they will be salmon which have spent at least two winters in the sea. Therefore, the West Greenland fishery can have no direct adverse effect on the number of grilse (1 sea-winter fish) returning to home waters, and hence on the fishery for grilse. Therefore, any assessment of the effects of the West Greenland fishery on the total catches in home waters must take into account the relative proportions of grilse and salmon in the exploited stocks in home waters.

(iii) Data obtained from small numbers of fish tagged at West Greenland and recaptured in home waters confirm the earlier suggestion that the major part of the stock exploited at West Greenland is composed of fish which, if returning to home waters, would belong to the 2 sea-winters component there. This component makes up the greater part of the exploited stock of salmon in most countries, except in Ireland and Sweden (west coast) where grilse make up over three-quarters of the catch by weight. In Canada, very few grilse are taken in Nova Scotia and New Brunswick but form a significant part of Newfoundland catches. (Details of the grilse/salmon relation are found in Table 1B of the Working Party's report).

(iv) The proportion of the exploited stock at West Greenland,originating from Canadian river systems, is likely to be higher than from any other country and seems to have increased in most recent years (differences between tags used in various countries may have caused some bias in the estimates).

Very few, if any, of the salmon exploited at West Greenland originate from those Norwegian rivers in which smolts have been tagged.

(v) Previous estimates of growth between Greenland and home waters indicated that 70 percent (in terms of numbers) or more of the fish exploited at Greenland would have to be caught in home waters (in the absence of the Greenland fishery) if the Greenland fishery were to have an adverse effect on the total catch of 2 sea-winter or older salmon. This break-even value may still hold for salmon of Canadian origin but for salmon from European home rivers growth between Greenland and home rivers seems to have been over-estimated in previous assessments. A break-even value of 80 percent may be more appropriate for salmon originating from these rivers.

The available information on exploitation rates in those European countries from which salmon are known to occur at Greenland points to a rate of exploitation for even the fish entering the river system lower than the 70-80 percent break-even values, so it seems clear that it will be much lower than this for fish having been in Greenland waters bearing in mind that the natural losses between West Greenland and home waters have to be taken into account.

The evidence therefore suggests that at the present rate of exploitation in the European fisheries, the West Greenland fishery has resulted in an increase in the total catch (West Greenland plus home waters) by weight of those salmon from European rivers which visit West Greenland.

The situation regarding total catch of salmon of Canadian origin visiting West Greenland is less clear. In one of the major Canadian salmon rivers (Miramichi), the exploitation rate of fish entering the river was estimated to be 90 percent or more in 1964 and 1965. Thus it is possible that if the natural losses between West Greenland waters and this river are small, the break-even value of the exploitation rate of fish returning from West Greenland might have been exceeded. Unfortunately the magnitude of the natural losses is not known. Further, there are no reliable estimates of the exploitation rates in other Canadian river systems, although they are thought to be lower than that given above for Miramichi.

(vi) Tagging experiments in Greenland waters have shown that at least some of the salmon present at West Greenland subsequently return to home waters in North America and Europe. The fishery at West Greenland will, therefore, tend to reduce the numbers of salmon (2 sea-winters or more) available to the fisheries in home waters. The best available estimate is a reduction in catch of not more than 100 tons in each European country concerned (for some countries much less) but probably greater in North America.

(vii) It was noted that while the inshore Greenland fishery has been stabilized in most recent years the offshore fishery is still expanding. The offshore fishery close to West Greenland is supposed to take fish of the same age and origin as the inshore West Greenland fishery (no direct effect on grilse). It is possible that further extension of this offshore fishery to waters farther from Greenland might include the exploitation of pre-grilse. The fishery which has developed recently in the Norwegian Sea is reported to exploit a wide range of sizes and ages, including pre-grilse.

(d) Future Research

Intensive research work will be continued in home waters and in Greenland inshore waters. The work in Greenland waters is a close cooperation

between scientists from Denmark, UK and Canada (with other countries willing to assist if required). The developing high sea fishery should be investigated as soon as possible.

(e) Future Meetings of the Working Party

It was agreed that those representatives to the Working Party who will attend the ICES meeting, Copenhagen, October 1968, should meet during the course of that meeting and that the next full meeting of the Working Party should be held in Copenhagen or London immediately before the ICNAF Annual Meeting, 1969.

(f) Recommendations

The following recommendations were made by the Working Party:

(i) That efforts should be made to provide separate records of grilse and salmon catches in home waters. Where possible more detailed records of home water catches (covering net catches and catches made by rod and line) should be provided, including information on the length and weight of the fish caught, sex ratio and age composition of the catch.

(ii) That, where possible, more detailed information should be provided on catch-per-unit effort for home water catches.

(iii) That efforts should be made to standardize the type of tag used for smolts in those countries which contribute fish to the West Greenland fishery.

(iv) That the Working Party should next meet shortly before the next meeting of the Research and Statistics Committee of the International Commission for the Northwest Atlantic Fisheries and that arrangements should be made for those members of the Working Party attending the next meeting of the International Council for the Exploration of the Sea to meet during the course of that meeting.

R&S approved the report by the Working Party including the recommendations, but in approving the report also noticed that no new data concerning possible influence of the West Greenland fishery and high seas fishery on the spawning stock and subsequent recruitment (smolt production) are mentioned in the Working Party's report. R&S, therefore, reiterates the statement made in the first report of the Working Party that

> "there is no direct evidence on the probable effect of increased exploitation on subsequent natural production of smolts. The West Greenland fishery may reduce spawning stocks but if this reduction is small, the effect on smolt production will be negligible."

Bearing in mind the recent increase of salmon fishing in the open sea, R&S is of the opinion that the whole question of size of spawning stock and subsequent recruitment should be carefully watched by the Working Party. Having approved the report, R&S

recommends (14)

that the second report of the Joint ICES/ICNAF Working Party when properly approved by ICES be published in the ICES Cooperative Research Report Series A as was the first report of the Working Party.

8. PUBLICATIONS AND REPORTS

R&S

recommends

(15) *that research work in statistical Subarea 6 be reported only on species which are of importance to the Commission and which are also exploited in Subarea 5;*

(16) *that any meeting papers on seal research be made available during the R&S meetings each year and be treated in the same manner as other research documents;*

(17) *that 50 free reprints of papers in Redbook Part III be given to each author;*

(18) *that the Executive Secretary continue to explore possible schemes for indexing ICNAF publications and meeting documents.*

9. REVIEWS DURING R&S PLENARY SESSION

Mr R. Hennemuth reviewed two papers (Res.Doc.68/86 and 68/87) dealing with the results of the interesting and important USA/USSR comparative groundfish survey studies in Subarea 5.

10. ORGANIZATION OF R&S

(a) Composition of Steering and Publications Subcommittee

R&S

recommends (19)

that the Steering and Publications Subcommittee be composed of a representative from each of the following groups of ICNAF member countries:

Germany, Denmark, UK
USSR, Romania, Poland
France, Portugal, Spain
Iceland, Norway, Italy
Canada
USA

(b) Status of R&S Subcommittees

R&S

recommends (20)

(i) that only the following subcommittees continue to function:

Steering and Publications
Assessments
Environmental
Statistics and Sampling

(ii) that other matters formerly dealt with by the other subcommittees be referred to the subcommittees named in (i), or be given to working parties, and then dealt with in R&S, or dealt with directly in R&S plenary session.

(c) Officers for 1968/69

(i) Subcommittee chairmen

The following were elected to serve for the coming year and at the 1969 Annual Meeting:

Assessments:	Mr B.B.Parrish (UK)
Environmental:	Dr H.W.Graham (USA)
Statistics and Sampling:	Dr A.W.May (Canada)

(ii) Representatives on the Steering and Publications Subcommittee

The following were named members of the subcommittee for 1968/69:

USSR, Romania, Poland	Mr C. Nicolau (Romania)
France, Portugal, Spain	Dr R. Monteiro (Portugal)
Iceland, Norway, Italy	Dr J. Jonsson (Iceland)
Germany (Fed.Rep.), Denmark, UK	Dr H.A.Cole (UK)
Canada	Dr W. Templeman
USA	Dr H.W.Graham

(iii) Chairman of R&S

Mr Sv. Aa. Horsted (Denmark) was unanimously reelected Chairman of R&S

(iv) Arrangements for 1969 Meetings

In view of the fact that the assessment work requested by the Standing Committee on Regulatory Measures was only dealt with by a progress report and that additional assessment work was requested by Panels 3, 5 and A (Seals), R&S

recommends (21)

that there be a mid-year meeting of an Assessments group and that, if the Standing Committee on Regulatory Measures has a mid-year session, the best time for the Assessment group to meet would be immediately afterwards and at the same place.

11. COORDINATION AND COOPERATION WITH OTHER ORGANIZATIONS

Dr H.A.Cole (UK) kindly agreed to be the ICNAF observer to ICES and Mr A.J.Lee (UK) the ICNAF observer to IOC and SCOR.

12. OTHER MATTERS

The Chairman of R&S (Mr Horsted) thanked his Rapporteurs the subcommittee chairmen and rapporteurs as well as the Secretariat for their great assistance. He also expressed his thanks for the excellent meeting facilities provided by the United Kingdom. Dr Cole expressed the appreciation of R&S to Mr Horsted for the able manner in which he led the committee at the meeting.

APPENDIX I - REPORT OF THE SUBCOMMITTEE ON ASSESSMENTS

Chairman: B.B.Parrish

The Subcommittee met on 23 and 24 May 1968 and at intervals during the week of the Research and Statistics Committee.

1. Review of Latest Statistics of Landings (Nominal Catches) and Fishing Activity in the ICNAF Area

The series of data on landings (nominal catches), landings-per-unit fishing effort and total "fishing activity" summarized in recent years was extended to include the provisional landings data for 1967 and the landings-per-unit effort and estimated total fishing activity for 1966. These are presented in Tables 1-5. It should be noted that the estimates of fishing activity for past years in Subareas 2 and 3 differ slightly from those presented in previous years (Redbook 1967, Part I, Tables 2 and 3), due to a revision of the method of estimation as described in Res.Doc.68/93. As pointed out in the 1967 report, the fishing activity estimates provide only a general index of the amount of fishing in the Convention Area, as a guide to the direction in which it is changing; they do not necessarily represent the best indices of effective fishing effort, for use in detailed assessment work. This was confirmed by data presented for Subarea 4 in Res.Doc.68/84, which showed that different methods of estimating fishing activity, whilst revealing the same major trends, may give different indices of the magnitude of the changes from year to year.

Subarea 1

The nominal catches for 1967 shown in Table 1 do not include the data for non-member countries. The total nominal catch of cod from Subarea 1 in 1967 increased by about 12 percent compared to that in 1966 and is the second largest ever taken (highest in 1962). Catches of redfish continued to decrease.

There was an increase in fishing effort from 1965 to 1966 but a decrease in catch-per-unit effort. In 1967 catch-per-unit effort may have increased again due to the increase in mean weight of the predominating 1960 and 1961 cod year-classes.

Subarea 2

In Subarea 2, the nominal catches of groundfish have exceeded 300 thousand tons annually since 1965, as a result of increased otter trawl effort for cod. Redfish is the only other species contributing significantly to the total catch, but redfish yields have been relatively low since 1961. Estimates of groundfish catch-per-day show no continuing trends. The offshore cod fishery appears to be still in the developmental stage, and in

recent years there has been a tendency to concentrate fishing on the spring spawning concentrations and to extend fishing to previously lightly fished areas within Div.2G and 2H.

Subarea 3

Total fish nominal catches in Subarea 3 increased from an average 676 thousand tons annually in 1962-66 to over 1 million tons in 1967. Cod catches increased almost 40 percent to 693 thousand tons, although the inshore catch continued to decline. Yields of flounders and herring continued to increase at a rapid rate, while redfish yields remained relatively low in comparison with past years. The catch-per-day by otter trawlers was generally lower in 1964-66 than previously.

Fishing activity in Subarea 3 declined from 1959 to 1963, but has increased since then. Again, this increased activity was almost entirely in otter trawl fishing rather than other gears.

Subarea 4

The landings (nominal catches) of groundfish in Subarea 4 in 1967 continued to decrease. With a decline of about 100 thousand tons (around 18 percent) from the 1966 level, landings in 1967 were only about 20 percent higher than the base year 1957. They were well below the high level of the 1963-65 period. In 1966 fishing activity remained at the same high level as in 1965 and was well above the long-term average. Provisional information indicates that fishing activity was considerably reduced in 1967.

Cod landings declined by about 4 percent. Haddock catches declined again and are now near the long-term average. Increased landings of haddock from Div.4X counterbalanced a marked reduction in landings from Div.4V, W. Redfish catches declined about 18 percent from those of 1966, but continued to be about 50 percent higher than the general level of catches between 1957-1965. Catches were mainly from Div.4R, S and T. Flounder catches declined by about 15 thousand tons to 41 thousand tons. Most of this decline was in catches of unspecified flounders by the USSR. Silver hake catches were the poorest since the fishery began, just over 2 thousand tons. The continued decline has been related to poor recruitment, a resulting decrease in abundance of the stock and a decline in effort (Res.Doc.68/15). Herring catches increased 10 percent to an all-time high at 261 thousand tons. The increase reflects greater effort by a developing purse seine fleet.

Subarea 5

Preliminary statistics indicate nominal catches of 710 thousand tons in 1967, compared to 887 thousand tons in 1966. For groundfish, fishing activity and landings decreased considerably in 1967. Herring, however,

was landed in the largest quantities - 246 thousand tons. Haddock landings were 57 thousand tons compared to 127 thousand in 1966. This was due to a lower abundance which has caused fishing effort to be diverted to other fisheries. Silver hake landings decreased from 162 thousand tons in 1966 to 101 thousand tons in 1967, primarily because of a drop in fishing effort. Red hake landings decreased by half to 45 thousand tons in 1967.

2. Assessments relating to Questions posed by Standing Committee on Regulatory Measures

At its mid-term meeting in January 1968, the Standing Committee on Regulatory Measures proposed a series of guidelines which should form the basis of requests for scientific information directed to R&S, and posed four questions, which it asked R&S to consider and prepare a progress report for the 1968 meeting of the Commission. The guidelines and questions are set out below.

Guidelines

(1) To elucidate the possibility of estimating the total annual catch so as to maintain the maximum sustainable yield, as a basis for regulating the total catch;

(2) Research required to establish annual catch quotas;

(3) Precision that can be achieved with available data, and effects of the errors in annual quotas on yield;

(4) What are the magnitudes of the year-to-year adjustments in quotas necessary to take into account for each stock, year-class fluctuations, recovery of the stock due to conservation measures, errors in setting previous quotas, etc.

(5) Timetable.

Questions

(1) Which stocks are agreed to be demonstrably fully exploited or overexploited (identified by species and ICNAF subareas or, where appropriate, divisions)? What sustainable yields (catch quotas) could these stocks support, and what would be the effect of effort restrictions in obtaining those yields?

(2) Which of these stocks can be fished independently of other species?

(3) What are the total yields of demersal species which could be supported by the stocks in each subarea? In which way would these total yields be affected by regulating the fisheries identified in (1)?

(4) What additional information is required for the regulation of fishing intensity a) through limitations of effort, and b) through limitation of catch and what time is required to get it? What continuing study and year-to-year adjustment would be required for a) and for b)? Which method, a) or b), is preferable as regards effectiveness and work needed for continued study and year-to-year adjustment?

In the short time available since the meeting of the Standing Committee it has not been possible to undertake a complete study of all the many scientific aspects of these questions so that it is only possible to present a progress report at this meeting. In particular, the assessments of the state of the stocks and the effects of regulations limiting fishing intensity have been made only on the basis of the constant parameter population model and on the assumption that recruitment and stock size are independent over the range of stock sizes likely to be encountered between the unregulated and regulated states. Further, the Subcommittee has confined its attention to assessments of the effects of regulating fishing intensity on the basis of mesh size regulations remaining as at present (or pending) and no further mesh assessments have been attempted. The Subcommittee wishes to point out, however, that the results of mesh assessments, presented to the Commission at previous meetings, still apply and that in some fisheries in the ICNAF Area at the present level of fishing intensity, increases in catch-per-recruit would be expected with substantial increases in mesh size above those currently in force or pending. This applies especially to the cod fisheries in Subarea 1 and Div.3N and O.

The Subcommittee considered Questions 1-3, posed by the Standing Committee on Regulatory Measures, on a subarea basis. Reports on the fish stocks (excluding shellfish) in each subarea and present knowledge of their current state, relative to the amount of fishing, are contained in Annexes I-IV.

Question 4 was considered in general terms for the ICNAF fisheries as a whole, but with special reference to those fisheries and stocks which are demonstrably fully exploited or over-exploited. The report on this question is set out in Annex V. Consideration was also given to the limitations of our present knowledge of the biological processes governing the types of scientific data needed to allow improvements to be made in assessments. In addition, consideration was given to the questions of the precision with which catch quotas can be estimated with available data and the time needed to provide the necessary scientific information, as specified in the guidelines.

Results of assessments

The results of the considerations of the state of the stocks in each subarea relevant to Questions 1-3 posed by the Standing Committee on Regulatory Measures which are set out in detail in Annexes I-IV are given in tabular

form in Tables 6-9. Within the table for each subarea, the principal species are divided by stocks and the main divisions in which they are located (column 2). Column 3 gives the average yield for the five years, 1962-66, together with the provisional landings for 1967, where these are very different from this average. Column 4 gives estimates of the potential yields for the different stocks in each subarea. For those stocks which have been shown to be demonstrably over-exploited, the estimates of potential yield refer to the maximum sustainable yield, on the assumption that recruitment remains close to the average level of recent years. For those which are lightly fished or unexploited, an indication is given of the order of magnitude of the potential yield (see footnotes to tables). Column 5 indicates the quality of the scientific data available for assessment purposes for each stock; for some stocks there are few data, while for others data may be available which have not yet been analyzed to the level of permitting their use in estimating maximum sustainable yield. Column 6 indicates the state of the exploitation of the stocks so far as this can be determined from existing data, and column 7 gives information on the species which may regularly occur in catches of the stock tabulation.

On the basis of these results, the answer to the general remarks (A) and specific questions (B) posed by the Standing Committee on Regulatory Measures, so far as they can be ascertained in the time available, are as follows:

A.1 For most ICNAF stocks, with present data, it would be extremely difficult to estimate with any accuracy the fishing mortality which will give the maximum sustainable yield. However, it is possible to identify several stocks where a reduction of fishing mortality (*e.g.* through regulation) would certainly not result in any appreciable reduction of average long-term yield and would probably (though not certainly) result in an increase in yield. It is possible to estimate the short-term catch quota required to achieve any desired level of fishing intensity (mortality).

A.2 The research requirements to establish annual catch quotas are set out in detail in the following section and Annex V of this report but the present research is sufficient to give useful results concerning the setting of catch quotas for some stocks.

A.3 There is a wide variation in the precision of the data available for different stocks. Errors in estimating the quota will not have a serious effect on yield provided the errors can be detected quickly and corrected by adjustments to the quotas in subsequent years. If an error made in one year is corrected in the next, the difference in yield for a long-lived species, *e.g.* cod, is negligible.

A.4 The magnitudes of the necessary year-to-year adjustments in catch quotas are of the same order as the observed past year-to-year fluctuations in catch per unit effort, *i.e.* from 5 to 25 percent, depending on the stock.

B.1 The present knowledge of the state of the stocks is given in Annexes I-IV and Tables 6-9. Cod in Subarea 1 and haddock in Subarea 5 are demonstrably over-exploited. The sustainable yields under average recruitment for these stocks are: Subarea 1 cod - 400-450 thousand tons (based on recruitment in recent years which has been high); Subarea 5 haddock - 50 thousand tons (based on long-term average recruitment). The catch quota in any year will depend on the strength of year-classes present. In the initial year of regulation the quota will be less than it would be in a steady state to an extent depending on the reduction in fishing mortality decided upon. Increase in catch-per-unit effort will result from the regulation.

B.2 Subarea 1 cod can be fished independently of other species. Subarea 5 haddock cannot be fished entirely independently of other species but mixture with all other stocks except cod is small. Reduction of fishing intensity aimed at management of haddock will probably also benefit the cod yields.

B.3 The available data on the potential yields of demersal species in each subarea are summarized in Tables 6-9. Regulation of Subarea 1 cod and Subarea 5 haddock (and cod) fisheries will not directly affect the fisheries for other important demersal fisheries in these subareas. The indirect effect of diversion of fishing effort cannot be easily estimated.

B.4 The additional information required for the regulation of fishing intensity is set out in detail in Annex V. The direct limitation of effort requires detailed calibration of the fishing powers of all vessels of the regulated fleet fishing the stocks concerned; this appears difficult to achieve at present. Limitation of catch requires continued revision of quotas in accordance with changes in stock abundance; the necessary scientific data needed to set up and operate a catch quota regulation on Subarea 1 cod and Subarea 5 haddock are currently available.

As regards effectiveness, there is no preference between limitation of effort and limitation of catch since in any case, the effectiveness of this limitation would be monitored in terms of catch. With regard to continued study and year-to-year adjustment, limitation of catch is preferable to limitation of effort because catch is easily determined whereas definition of effort is very difficult.

Consideration of future work

The Subcommittee emphasizes that the conclusions presented here and in previous reports to the Commission are the best that could be reached with the time and information available to it.

The requirements for improving the estimates may be considered in three groups:

(a) provision of basic data
(b) estimation of the vital statistics of the fish populations
(c) further research into the population dynamics in the widest sense of exploited stocks, in general, and for the individual ICNAF stocks in particular.

The routine data required include catches (by species, and small area and time breakdown), fishing effort (preferably for the entire fishery, but complete coverage is only essential if control of fishing mortality is by direct regulation of effort), and size and age composition of the catches, as well as certain auxiliary information on gear selectivity etc. ICNAF has had good data on catches and fishing effort for many years. Data on size and age composition has been much less complete, but has been improving; the present coverage is shown in Res.Doc. 68/52, which indicates that there are still important elements in the ICNAF fisheries which are not adequately sampled. Reasonable assumptions can be made to fill some of these gaps, *e.g.* the use of sampling data from one country to estimate the composition of the catches by another country fishing with similar gear in the same area. The Subcommittee reaffirms the essential need, if good advice on management is desired, for full sampling coverage (length and age composition) of all the major ICNAF fisheries.

The methods of analyzing these data are reasonably well known, but the individual peculiarities in the data from each stock mean that stock assessment cannot be treated as entirely a matter of routine. Thus there is rarely time during an annual Commission meeting to carry out any very detailed analysis. Equally, since it is necessary to pool the data from all countries, analysis by individual scientists in their own laboratories is not easy. Mid-term meetings of the Assessment Group as a whole, or of those concerned with an individual stock (*e.g.* West Greenland cod) have been held very successfully in the past, and the Committee strongly

recommends (1)

that continuing provision be made for mid-term meetings of the Subcommittee on Assessments or of appropriate working parties of that subcommittee, the costs of attendance of the chairman of the subcommittee or of the working party to be borne by the Commission.

Even such meetings, however, can generally only analyze the situation in terms of the more simple models of the population, especially the constant parameter yield-per-recruit model. It is becoming clear that these models do not give an entirely adequate description of the situation and that if more and more precise assessments of the state of the stocks is required, more and more complex models using an increasing range of information will become necessary. It must, however, be emphasized that the use of the more

realistic models will not change the general conclusions and advice of the past few years - that the fishing on several of the major ICNAF stocks has reached a level beyond which no appreciable increase in sustained yield is possible, and that future management will require some control of the total amount of fishing.

The more complex models may require information from virtually any branch of marine science, and of biology generally, but certain aspects may be picked out as likely to be particularly relevant to the most urgent problems. The major problems concern the relation between the abundance of the adult stock and the strength of the resultant year-classes. The importance of knowing this has already been pointed out in connection with Georges Bank haddock. Its solution does not seem easy, but seems certain to involve an examination of the empirical relations between stock and recruitment for a wide range of stocks; field observations of the growth and mortality of eggs and very young fish (which is likely to require extensive research vessel time), laboratory experiments on the factors (especially food) controlling growth and possibly mortality (though since in nature the major proximate cause of mortality is likely to be predators, such experiments may be difficult), and studies on the population dynamics of the species on which the young fish feed, and of their predators.

Another important group of questions concerns the interaction between a fish stock and the population on which it feeds. This includes the case where the population of food organisms is itself the object of a commercial fishery (*e.g.* herring or capelin which are important food items for cod). In this latter case the choice of management measures will depend, at least when both stocks are heavily exploited, on a detailed scientific knowledge of the quantitative interaction between the stocks. The scientific requirements include a good knowledge of the population dynamics of the stocks concerned and of the influence of food supply and consumption on growth, including the quantitative relation between food consumed and the resulting growth increment.

In both these problems future progress seems to depend less on the direct application of existing theories to data to be collected for the various ICNAF stocks, than on a definite advance in fishery science in those fields concerned with the more realistic population results. This requires closer collaboration than generally exists at present between stock assessment experts and other research workers, and a closer awareness of how research, say in the consumption of food by larval haddock, can be related to stock assessment problems, and hence to the practical problems of management faced by the Commission. Unfortunately the pressure of routine work within R&S during the past years have left little time during Commission meetings for the necessary discussions. Improvements in the input of other branches of fishery science should result in better advice for management purposes. While there is not the information to make a quantitative calculation of the benefits to be expected from further research in the various fields

related (in the broadest sense) with fisheries regulation and management, the Subcommittee believes that higher sustained catches or lower costs will exceed by several fold the research costs involved.

3. Assessment of harp seal fisheries

Arrangements were made for members of the Subcommittee to attend the meeting of the Scientific Advisers to Panel A to consider assessment problems relating to the assessment of the state of the exploited seal stocks in the Gulf and Front areas. The results of their considerations are dealt with in the Report of the Scientific Advisers to the Panel (1968 Meeting Proc.2, App.I).

4. Deficiencies in sampling data

The Subcommittee noted the summary of sampling data published in the Sampling Yearbook in Res.Doc.68/22. It was agreed that members of the Subcommittee would examine the present sampling coverage of the Convention fisheries, with special reference to identifying its principal gaps and deficiencies for assessment work, for further consideration at the next Annual Meeting.

Table 1. Subarea 1. Landings (=Nominal catches), landings per unit effort and fishing activity, 1957-1967.

			1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Landings (000's tons)	All Gears	Cod	269	320	234	243	345	451	406	350	360	366	419
		Redfish	28	18	33	44	54	60	47	30	19	17	12
		Total (all species) a)	304	345	273	295	414	526	475	409	399	404	447
	Otter Trawl	Cod	140	173	110	101	171	247	244	250	209	190	
		Total (all species) a)	169	192	143	147	236	318	306	290	238	207	
Landings (tons) of Otter Trawlers (all size groups) per day on ground (all groundfish species)			19.6	19.6	16.1	17.7	18.7	22.4	19.7	-	-	-	
Landings (tons) of Otter Trawlers per day fished (all groundfish species)			-	-	-	-	-	29.1	25.1	20.3	21.1	17.3	
Estimated total fishing activity for all groundfish species	Otter Trawl	Days on ground	7,614	9,781	8,864	8,286	12,618	14,165	15,519	-	-	-	
		Days fished						10,928	12,185	14,282	11,281	12,000	
	All Gears	Days on ground	15,500	17,600	18,200	16,200	22,100	23,400	24,100	-	-	-	
		Days fished						18,100	18,900	20,050	19,481	25,000	

a) excluding herring, other pelagic species and shellfish

Table 2. Subarea 2. Landings (=Nominal catches), landings per day and fishing activity, 1959-67.
+ indicates amounts <500 tons or <50 days fished.

			1959	1960	1961	1962	1963	1964	1965	1966	1967
Landings (000's tons)	Cod	Otter T.	41	171	246	230	191	197	307	313	268
		Inshore	19	17	19	25	25	16	26	24	27
		Other				+		+		1	
		Total	60	188	265	255	216	213	333	338	297[a]
	Haddock		+		+	+	+	+	+	+	+
	Redfish		53	83	26	8	6	27	23	14	44[a]
	Halibut		+	+	+	+	+	+	1	1	3
	Flounders		+	2	1	+	+	3	7	3	8
	Other Groundfish		1	6	4	2	1	2	12	9	+
	Total Groundfish		114	279	296	265	223	245	376	365	351[a]
	Other Fish		+	1	1	1	+	6	1	1	25
	Total Fish		114	280	297	266	223	251	377	366	377[a]
Days fished (000's)	OT	<50 GRT									
	"	51-150 "									
	"	151-500 "	+	5.1	3.9	1.4	+	+	0.2		
	"	501-900 "	0.9	1.2	0.4	+	+	3.4	4.4	3.9	
	"	901-1800 "	1.0	4.8	6.0	5.6	5.8	5.6	7.3	6.0	
	"	>1800 "	0.2	1.5	3.0	2.1	0.6	1.9	2.2	3.1	
	All OT >500 GRT		2.1	7.6	9.4	7.8	6.4	10.9	13.9	13.0	
Tons/day fished	OT	<50 GRT									
	"	51-150 "									
	"	151-500 "	3	6	6	12	1	2	9		
	"	501-900 "	42	36	29	46	20	13	21	24	
	"	901-1800 "	12	25	22	30	29	24	25	23	
	"	>1800 "	20	31	36	26	44	31	34	34	
	All OT >500 GRT		26	28	27	29	31	21	25	26	
Fishing activity for groundfish in 000's equivalent days by trawlers >500 GRT[b]			4.5	9.9	10.9	9.3	7.3	11.7	15.1	14.1	

a) Catches by non-member countries in Subareas 2 and 3 are combined and are shown in Subarea 2 only
b) For revised method of estimation used here see ICNAF Res.Doc.68/93

Table 3. Subarea 3. Landings (=Nominal catches), landings per day and fishing activity, 1959-67.
+ indicates amounts <500 tons or <50 days fished.

			1959	1960	1961	1962	1963	1964	1965	1966	1967
Landings (000's tons)	Cod	Otter T.	160	186	235	175	223	307	261	283	
		Inshore	180	184	136	150	155	144	114	112	102
		Other	85	101	90	64	88	130	121	104	
		Total	425	471	461	389	466	581	496	499	708[a]
	Haddock		35	67	80	35	15	12	9	10	12
	Redfish		246	99	90	61	69	95	112	79	61[a]
	Halibut		3	3	2	2	1	2	1	1	6
	Flounders		25	35	30	27	34	54	81	111	150
	Other Groundfish		19	17	11	8	7	7	17	11	22
	Total Groundfish		753	692	674	522	592	751	716	711	959[a]
	Herring		5	5	4	5	6	3	8	23	78
	Other Pelagic		+	+	1	1	1	2	1	1	2
	Total Pelagic		5	5	5	6	7	5	9	24	80
	Other Fish		6	7	5	5	6	14	6	7	11
	Total Fish		764	704	684	533	605	770	731	742	1,059[a]
Days fished (000's)	OT	<50 GRT		0.1	+	0.1	0.2	0.1	0.2	0.4	
	"	51-150 "	0.5	0.6	0.5	0.5	0.3	0.5	0.6	0.7	
	"	151-500 "	8.2	11.6	16.4	11.8	13.9	18.3	26.5	12.1	
	"	501-900 "	0.5	0.7	0.3	0.1	0.2	4.6	7.6	3.3	
	"	901-1800 "	7.4	5.9	7.7	5.6	5.9	8.4	7.9	8.7	
	"	>1800 "	6.0	5.2	3.6	2.0	2.3	5.5	3.0	4.6	
	All OT >500 GRT		13.9	11.8	11.6	7.6	8.5	18.5	18.5	16.6	
Tons/day fished	OT	<50 GRT		3	3	3	3	2	2	3	
	"	51-150 "	7	7	7	4	3	3	4	3	
	"	151-500 "	12	10	9	11	9	8	6	10	
	"	501-900 "	26	18	17	13	28	11	14	16	
	"	901-1800 "	14	17	22	22	24	23	17	19	
	"	>1800 "	25	29	28	22	27	19	21	27	
	All OT >500 GRT		19	22	24	22	25	19	16	21	
Fishing activity for groundfish in 000's equivalent days by trawlers >500 GRT[b]			39.4	30.7	28.3	23.9	23.5	39.7	44.8	34.5	

a) Catches by non-member countries in Subareas 2 and 3 are combined and are shown in Subarea 2 only
b) For revised method of estimation used here see ICNAF Res.Doc.68/93

Table 4. Subarea 4. Landings (=Nominal catches), landings per unit effort and fishing activity, 1957-67.

		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Landings	Cod	188	213	214	218	212	219	218	229	225	215	204
(000's tons)	Haddock	48	49	53	46	47	44	51	60	85	66	49
	Redfish	55	55	42	50	42	43	59	53	68	106	87
	Halibut	3	3	2	3	2	2	2	2	2	2	2
	Flounder	16	17	20	26	27	25	30	34	48	55	41
	Silver hake	-	-	-	-	-	9	123	81	50	10	2
	TOTAL (Demersal)	369	403	395	406	387	412	586	548	565	541	419
	Herring	91	92	102	105	81	116	111	140	180	236	261
Landings (tons) per day fished (all groundfish species)		14	15	14	13	13	12	13	14	13	13	
Estimated fishing activity for all groundfish in days fished		26,400	27,100	27,900	31,000	28,800	35,200	45,000	39,100	43,500	42,600	
Alternative estimate*		33,500	33,600	32,900	40,600	38,700	45,800	73,250	68,500	70,600	60,100	
Landings (tons)	Over 1800	none	none	none	?	22	35	35	35	41	33	
per day fished	501-1800	33	25	22	28	31	31	25	36	25	27	
(all groundfish	51-500	11	12	12	10	10	9	8	8	8	9	
species) by	Pair trawlers											
gross tonnage	(all tonn.)	12	11	11	12	13	13	15	17	19	17	
Estimated fishing	Over 1800	none	none	none	90	28	600	4,006	3,418	3,038	3,077	
activity for	501-1800	1,295	2,853	2,747	2,645	2,062	1,274	1,290	1,424	1,539	1,176	
all groundfish	51-500	10,027	10,316	9,949	13,029	12,327	14,124	21,769	20,520	25,737	23,915	
in days fished	Pair trawlers											
by gross tonnage	(all tonn.)	650	986	1,305	2,747	3,164	3,859	3,580	2,856	2,382	3,039	

*Based on landings per day fished, 51-500 gross ton otter trawlers only.

Table 5. Subarea 5. Landings (=Nominal catches), landings per unit effort and fishing activity, 1957-67.

		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Landings (000's tons)	Cod	13	16	16	14	18	26	30	28	42	57	42
	Haddock	55	45	41	46	52	59	60	70	155	127	57
	Redfish	18	16	16	11	14	14	10	8	8	9	11
	Flounders	23	26	25	27	29	38	48	58	57	54	49
	Silver hake	57	48	50	47	42	86	147	220	323	162	101
	Total a)	310	262	276	221	228	300	391	475	728	613	391
	Herring: inshore	23	81	48	69	27	71	70	28	34	29	31
	offshore	-	-	-	-	68	151	97	131	40	137	213
Landings (tons) of groundfish per day fished[b]		-	7.3	7.0	6.5	7.3	8.2	7.9	7.0	6.0	6.0	5.8
Catch (tons) of herring per hour fished (offshore)[c]		-	-	-	-	-	1.2	0.8	1.9	?		
Estimated fishing activity for groundfish in days fished[b]			36,000	39,000	34,000	31,000	36,000	50,000	68,000	120,000	101,000	61,000
Estimated fishing activity for herring (offshore) in hours fished[c]							130,000	123,000	67,000	?	?	?

a) includes all species except shellfish and herring; b) estimates based on US trawlers of 50-150 GRT; c) estimates based on USSR middle-sized trawlers. This class of vessel did not operate on herring in 1965 or 1966.

Table 6. Summary of state of fish stock in Subarea 1.

Species	Div.	Present Yield 1962-66 (000's tons)	Potential Yield (000's tons)	Data Available	State of Stock	Overlap
Cod	A-D	226				
	E-F	53				
	Total	380[a)]	400-450	VG	OE	None
Redfish	B-F	26	25	MI	OE	None
Sand eel	All	+	3+	P	UE	None
Capelin	All	+	3+	P	UE	
Salmon	All	1.5	NK	MI		None
Greenland halibut	All	+	2+	P	UE	?
Grenadiers	?	+	NK	P	UE	?
Am. plaice	All	+	2+	P	UE	?
Skates	All	+	NK	P	NK	?
Wolffish	All	+	2+3	P	NK	?
All species		429				

a) including unallocated catches

Potential Yield
Where figures are quoted they represent estimates of maximum sustainable yield
1+ = up to 10,000 tons
2+ = between 10 and 100,000 tons
3+ = over 100,000 tons

Data Available
VG - Very Good
MI - Moderate - improving
P - Poor

Overlap
None - stock can be fished independently
Otherwise significant overlap with species stated

State of Stock
OE - Overexploited
Max - at or near maximum
UE - Underexploited
NK - Not known

Table 7. Summary of state of fish stock in Subareas 2 and 3. (For explanation of abbreviations see Table 6)

Species	Div.	Present Yield 1962-66 (1967) (000's tons)	Potential Yield (000's tons)	Data Available	State of Stock	Overlap
Cod	2G,H,J					
	3K	557 (655)	600	VG	Max	
	3L					
	3M	34 (36)	2+	MI	NK	Redfish
	3N&O	73 (220)[a]	75	VG	Max	(10%)
	3Ps	52 (62)	120	VG	Max	
	3Pn-4R	66 (71)				
Total Cod		782				
Haddock	3N,O	13	2+	VG	Nil	Redfish, Cod, Flounders
	3Ps	2				
Redfish	2G to 3K	33	3+	P	NK	G.halibut
	3M	13				
	3N,O	23				
	3P	16				
Flounders (Plaice, Witch, Yellowtail)	2G,J	3 (4)	3+	Plaice only	NK	Cod, Haddock
	3K,L	28 (62)				
	3N,O	27 (76)				
Greenland halibut	All		2+	P	NK	Redfish
Herring	3P	80	3+	P	UE	None
Capelin	All	+	3+	P	UE	Haddock, Flounder, Cod
Sand eel	All	+	3+	P	UE	?
Grenadier	All	+	3+	P	UE	Redfish
Wolffish	All	+	2+	P	UE	?
Skate	All	+	2+	P	NK	?
Pollock	3N,O	+	1+	P	NK	?
White hake	3N,O	+	1+	P	NK	?
Dogfish	3P	+	2+	P	UE	None
Argentines	30	+	1+	P	NK	?

a) This increased landing is partially attributed to recruitment of the strong 1964 year-class and increased fishing effort

Table 8. Summary of state of fish stock in Subarea 4. (For explanation of abbreviations see Table 6)

Species	Div.	Present Yield 1962-66 (1967) (000's tons)	Potential Yield (000's tons)	Data Avail-able	State of Stock	Overlap
Cod	R+S	58	(	MI	NK	Flatfish
	T+Vn	73 (49)	(	VG	Max	Am. plaice
	Vs+W	67 (50)	(3+	P	Max	Haddock, Flounder
	X	23 (32)	(	MI	NK	Haddock
Total		221				
Haddock	V+W	30 (11)	(2+	MI	NK	Cod
	X	30	(	VG	NK	Cod
Redfish	R+S+T	34 (71)	(2+	VG	NK	Hakes
	V+W+X	32 (16)	(	P	NK	Argentines
Silver hake	W+X	55 (2)	2+	P	NK	Haddock
American plaice	T+Vn	8	2+	VG	NK	Cod
Pollock	W	11 (4)	(2+	P	NK	(Cod
	X	17 (7)	(	P	NK	(
White hake	T	6	(2+	P	NK	(Cod
	W+X	5	(			(
Herring	T	39 (63)	(3+	MI	NK	? groundfish depending on gear
		107 (190)	(			
Halibut, Mackerel, Witch, Yellowtail, Winter Flounder, Wolffish, Cusk		+	(At least) 2+	P	NK	
Angler		+	?	P	UE	?
Skate		+	?	P	UE	?
Sand eel		-	3+	P	UE	?
Argentines		-	2+?	P	UE	?
Sculpins		-	?	P	UE	?

Table 9. Summary of state of fish stocks in Subarea 5. (For explanation of abbreviations see Table 6)

Species	Present Yield 1962-66 (1967) (000's of tons)	Potential Yield (000's of tons)	Data Avail-able	State of Stock	Overlap
Cod	34	2+	MI	OE?	Haddock
Haddock	95	50	VG	OE	Cod
Silver hake	163 (323)	3+	MI	Max	Mod (Haddock & Red hake)
Red hake	39 (89)	2+	MI	Max	Mod (Silver hake)
Yellowtail flounder	33	50	VG	Max	Mod (Flounders)
White hake	+	2+	P	UE	Wide
Pollock	+	2+	P	UE	NK
Redfish	11	2+	MI	UE	None
Butterfish	+	2+	P	UE	?
Mackerel	+	2+	P	UE	None
Argentine	+	1+	P	UE	Redfish
Dogfish	+	2+	MI	UE	Wide
Skate	+	3+	P	UE	Wide
Flounders	+	2+	P	UE	Wide
Eel pout	+	2+	P	UE	Wide
Herring	146 (244)	3+	MI	NK	None

Subarea 1

1. Description of stocks

The present fishery in Subarea 1 is based almost exclusively on cod, this species accounting for about 90 percent of the total nominal catch. In terms of weight the only other important species is redfish which in the years 1962-63 formed *ca.* 10 percent of total catch but in most recent years only about 3-5 percent of total catch. The present situation in the fishery for redfish is characterized by a very low proportion of the total catch of redfish in landings from Div. 1A-1D, redfish only being taken as by-catches in the fishery for cod. In Div. 1E-1F the proportion of redfish in the landings is somewhat higher (9 percent) as a result of the activity of a small specialized, West German fishery operating on the rough grounds in these divisions. This fishery is independent of those for other species, there being no significant by-catches.

The present Subarea 1 fishery may therefore be described as an almost pure cod fishery.

The cod in Subarea 1 is composed of two stocks: a northern one mainly occurring in Div. 1A-1D and a southern stock in Div. 1E and 1F. This latter stock extends to Southeast Greenland and at the age of maturity part of the stock emigrates to Icelandic and East Greenland waters. The mixing between cod in Subarea 1 and other ICNAF subareas is negligible. The northern and southern stocks of cod in Subarea 1 are, however, not quite clearly separated and they are here regarded as a single unit.

The nominal catch for cod, redfish and all species for the period 1963-67 is given in Annex I Table 1 and shows a fairly stable catch in these years, but the cod stock is influenced by large fluctuations in year-class strength which might be expected to lead to a wider variation in catch than that observed in the period 1963-67. It should also be noted that the fishery in this period has been favoured by the occurrence of the very good 1956, 1957, 1960 and 1961 year-classes.

Important stocks of sand eel (offshore) and capelin (inshore) exist but these are currently only exploited by Greenlanders and the potential yield is difficult to assess. The FAO study on marine resources (Res.Doc.68/75) provides an estimate of the potential yields of sand eels and capelin to be of the order of a hundred thousand tons. A small-scale trawl fishery for sand eel started in the offshore areas in Div.1D in 1967 but although this fishing took place with very small-meshed trawls on Fyllas Bank, virtually no species other than sand eel were caught. Sand eel and capelin may therefore be exploited independently of any other species even although necessarily fished with small-meshed gears.

Salmon is also fished independently of other species. Present annual catch is about 1,500 tons.

Annex I Table 1. Subarea 1. Nominal catch (000's tons). 1967 figures are preliminary.

Year	Div.1A-1D			Div.1E-1F			Div.1NK	Total Subarea 1		
	Cod	Red-fish	All Species	Cod	Red-fish	All Species	All Species	Cod	Red-fish	All Species
1963	231	24	274	75	23	104	100	466	47	478
64	196	16	234	54	11	71	108	350	30	413
65	223	8	266	38	10	51	87	360	19	404
66	228	7	252	45	9	59	93	366	16	404
67	254	6	276	54	5	61	112	418	15	449
Mean	226	12	260	53	12	69	100	380	26	429
% of all species	87	5	100	77	17	100	100	89	6	100

Stocks of Greenland halibut exist and may be fished independently of other species, except probably grenadiers (*Macrurus* spp.), *Lycodes* sp. and some skates, the potential yields of which are not very well known. The grenadiers generally occur in deeper water than redfish and especially cod.

American plaice occur throughout the area and are taken as by-catch in the cod fishery but it should be noted that the quality of American plaice in Greenland waters is so poor that a direct fishery for this species is unlikely to develop in Subarea 1. The concentration of American plaice is probably too low to allow a fishery for fish meal production.

Wolffish (*Anarhichas* spp.) also occur and are frequently taken as by-catch in the fishery for cod but not in large quantities.

2. Assessment of state of intensively fished stocks

(a) Cod

The method used in this assessment of the present state of the cod fishery is the constant parameter population model developed by Beverton and Holt (1957) using the FAO yield function tables. This method does not take possible density dependent fluctuations in parameters into account. The parameters used for this assessment are given in Annex I Table 2, the symbols being the same as those used in the FAO tables.

Annex I Table 2. Subarea 1 cod. Values of parameters used in assessment.

K	0.20	Z	0.80
L_∞	95 cm	M	0.20, 0.30
l_c	35, 45 cm	F	0.60, 0.50
		$E = \frac{F}{lz}$	= 0.75, 0.625
		M/K	1.00 - 1.50
		$c = \frac{lc}{L_\infty}$	= 0.36, 0.48

The values of the growth parameters (K and $L\infty$) are well known and although they are subject to short-term variations due to changes in environmental factors these fluctuations will not have any significant effects in the general results of the assessments made here.

The Subcommittee considers that the actual value of total mortality rate (Z) is close to that used in the assessment, but the values of its two components fishing mortality rate (F) and natural mortality rate (M) is less well known. However, it is again considered that the actual value of M lies within the range used in the assessments.

Wherever a range of values of parameters has had to be used in the assessments due to uncertainty about the true values, this range is chosen so as to ensure that the present position on the yield per recruit - fishing mortality curves is in no case more to the left hand side on the curves (or more "optimistic" as regard present state).

The mean size at first capture (lc) cannot be given by a single estimate in the present fishery. In those situations where trawlers are known to catch rather small cod lc is about 35 cm. The catch by this fishery is roughly one-fourth of the total Subarea 1 cod catch (in terms of weight). The line fishery does not take small cod in significant quantities. This fishery takes roughly about one-third of total cod catch in Subarea 1 and lc for this fishery is close to 45 cm. For the remainder of the fishery lc is between 35 and 45 cm. If an effective mesh size of 130 mm as agreed upon is introduced in Subarea 1, then the lc value of 45 cm will apply to the whole cod fishery.

The assessments show that at one extreme (lc = 35 cm, M = 0.2) a 60 percent reduction of present F could give a 16 percent increase in yield per recruit. At the other extreme (lc = 45 cm, M = 0.7) the present fishing mortality rate is close to that giving the maximum sustainable yield. In no case is the stock of cod underexploited and by the most probable combination of parameters the present yield could be obtained with a reduction of the order of 25 percent in present F. It is noted, however, that owing to the specialization of some fleets on fisheries characterized by particular age-groups, it is not immediately clear how F should be related to its actual fishing activity.

(b) Redfish

No special assessments have been made for the redfish in Subarea 1. Parameters necessary for assessments of redfish are difficult to obtain especially as regards to parameters of growth and natural mortality rate. Redfish is known, however, to have a very slow growth

rate which in itself makes the species rather vulnerable to fishing.

A drift of larvae from areas off Southeast Greenland to West Greenland waters occurs but overall knowledge of recruitment of redfish in Subarea 1 is rather poor.

The history of the redfish fishery shows that in all stocks of redfish, after a short period of increasing catches by a high rate of exploitation, catch and catch-per-unit effort decline continuously to a very low level. The redfish stock in Subarea 1 now seems to be at this last stage as shown in Annex I Table 3.

Annex I Table 3. Subarea 1 redfish.

Year	Total catch (000's tons)	Tons/day German trawlers
1962	60	8.8
63	47	6.2
64	30	4.1
65	19	3.1
66	16	3.2
67	15	2.2

Although we do not know much about parameters and fluctuations in recruitment and migration, this development in the fishery, together with the very low growth rate of redfish, clearly seems to indicate an overexploitation of Subarea 1 redfish.

3. Sustainable yield of cod and redfish

(a) Cod

The maximum sustainable yield of cod will vary with fluctuations in year-class strength. Assuming these fluctuations remain at the level of year-classes entering the exploited stock in recent years and that a 130 mm effective mesh size is introduced, one would expect the mean maximum sustainable yield to be of the order of 400,000-450,000 tons.

(b) Redfish

From the history of the fishery this species may not be able to give a higher annual yield than about 25,000 tons.

Subareas 2 and 3

1. Description of stocks

(a) Cod

A number of more or less well-defined cod stocks are present in the subareas. Some of these are very small and are of importance mainly in the Newfoundland inshore fisheries. At least five major groups are present during part or all of the year in areas fished by trawlers (Templeman, Redbook 1962, Part III, pp.79-123). These are the Labrador-Newfoundland stock, occupying Div.2G to the northern part of Div.3L; the Flemish Cap stock, occupying Div.3M; the southern Grand Bank stock, present in Div.3N and 3O and possibly for part of the year in Div.3L; the St. Pierre Bank stocks, occupying Div.3Ps; and the West Newfoundland stock present in winter and spring in Div.3Pn and in summer-autumn in Div.4R. Recent yields from each of these groups are summarized in Annex II Table 1.

(b) Haddock

There are no resident stocks in Subarea 2 or the northern divisions of Subarea 3. Separate stocks are present on the Grand Bank (3NO) and St. Pierre Bank (3Ps). Success of the fishery depends on successful survival of year-classes, and survival has been extremely poor for about the last 10 years. As a result, the fishery has declined to a very low level for both stocks.

(c) Flounders

Four species contribute to the catches. Of these, the most important is undoubtedly the American plaice but exact figures cannot be given since large amounts of unspecified flounders are landed each year. Plaice are distributed throughout Subareas 2 and 3, though important fisheries for this species alone exist only on the Grand Bank (Div. 3N, 3L and 3O). Separate stocks probably exist in Div.3N and 3L.

Witch flounder and Greenland halibut are also distributed throughout Subareas 2 and 3, but a significant fishery exists only for the Greenland halibut, for which a Newfoundland coastal fishery in some deep bays has developed in recent years. It is possible that greater quantities of Greenland halibut may be present in water deeper than that presently fished for other species.

Yellowtail flounder are taken as by-catch in Div.3N and 3O, but the stocks are probably not very large.

(d) Redfish

Redfish are present and fished throughout Subareas 2 and 3, though the level of the fishery as a whole is below that of about 10 years ago. Identification of stocks is not always certain, but at least four major groups are present, divided among the various ICNAF divisions as follows: 2G to 3K, 3M, 3N and 3O, and 3P (north and south). Div.3L is probably an area of overlapping.

(e) Other Species

Herring catches from a fishery, mainly with purse seines, on the southwest coast of Newfoundland, have increased rapidly in recent years to a level of about 80 thousand tons in 1967. Potential yield could be much larger.

Capelin and sand eels appear to be present over most of the area, though not usually on bottom. Both species might well support large fisheries if they could be caught.

Macruridae (grenadiers) are sometimes taken in large quantities, usually in depths greater than 600 m. Two species are involved: *Macrurus berglax* and *Macrurus (Coryphaenoides) rupestris*. Potential catches,particularly of the latter, could be great, and although some information is available on these species in depths down to about 800 m, their distribution and abundance in deeper waters is not known.

Wolffishes (3 species) occur throughout the area as a by-catch in fisheries for cod, redfish and flounders. The most abundant species by weight, *Anarhichas denticulatus*, is not presently a desirable market species. There is little possibility of large-scale fisheries for any of the wolffishes, since they tend not to be concentrated in restricted areas.

Skates, mainly the thorny skate *(Raja radiata)* are present as a by-catch in most fisheries. Amounts caught are probably fairly large and could be increased, but there is little possibility of a fishery only for these.

Species which might support moderate fisheries in the southern divisions of Subarea 3 are pollock and white hake in Div.3O and 3P, and dogfish in Div.3P.

2. Assessment of state of intensively fished stocks

(a) Cod

Assessments for cod in Div.2G to 3L are particularly difficult because of variations in growth within this large area, and also because of the unstable nature of the fairly recent cod fishery in Labrador.

Large increases in fishing and changes in distribution of fishing, both in area and season, have occurred in recent years. Catch-per-unit effort data do not necessarily give reliable indices of stock abundance because of variations in fish distribution and in distribution of fishing effort due to environmental factors (*e.g.* ice conditions). Different approaches to the problem of assessing the state of the stock relative to the yield - fishing mortality rate function have produced somewhat different conclusions. It is clear, however, that fishing is now at a level producing at least 80 percent of, and may even be beyond, the possible maximum sustained yield.

For the remainder of Subarea 3, individual assessments have been made previously for the separate cod stock in Div.3N and 30 and Div.3P (Beverton, 1965, ICNAF Res.Bull. 2, pp.59-72) and for the stocks of Subarea 3 as a whole. The individual assessments for Div.3NO and 3P indicate that in the former area the level of fishing mortality rate in the late 1950's had exceeded that giving the maximum sustained yield, while in Div.3P it was approaching and may even have reached this level. Since that time the fishing effort on these stocks and in the subarea as a whole has not decreased significantly; indeed it has increased since 1963. This suggests that fishing mortality rate has remained at least at the earlier level, and this is confirmed by a recent assessment for the cod fisheries indicating that the fishing effort in Subarea 3 as a whole has produced cod yields at about the maximum sustainable level.

Recruitment variations in cod within the southern part of Subarea 3 tend to be greater than in Subarea 2 and the northern part of Subarea 3. Thus in 1967 cod catches increased greatly in Div.3L and tripled in Div.3N and 30, largely because of the strong 1964 year-class. At the same time it is evident from large increases in flounder landings in this subarea that effort in 1967 probably increased appreciably.

(b) Haddock

Assessments for haddock are complicated by the very large fluctuations in recruitment in Div.3N, 30 and 3P, and by differences in growth rate of the various year-classes. In the past the fishery has been based on only one or two year-classes in any given year. Yields will clearly depend almost entirely on the relative success of survival of these year-classes, and no significant survival has occurred since 1955-56. Yields are now at a very low level, with no prospects for significant increases in the immediate future.

(c) Redfish

No catch/effort assessments have been made for redfish because of the lack of essential biological data for the various stocks, particularly the lack of mortality data. It appears fairly certain, however, that

the stocks in Subareas 2 and 3 can sustain yields greater than those presently being taken. Wide recruitment variations appear to be common in this species, and yields will probably fluctuate widely in response to these variations.

3. Distribution and overlap of fishing

The only significant fisheries in Subarea 2 are those for cod and redfish. These are largely independent of each other because of differences in depth distribution of the species, except in winter-spring when redfish are caught in fisheries for cod in amounts of about 10 percent of the total catch. This statement would also be true for winter-spring cod fisheries in Div.3K. Small amounts of flounder (except yellowtail flounder) and wolffishes also occur as by-catches in these cod fisheries. By-catches of cod are insignificant in fisheries for redfish, but significant quantities of Greenland halibut might be taken in deep fishing for redfish.

Fisheries which might develop for macrurids in Subarea 2 and Div.3K would probably be independent of fisheries for other species and could be carried out with present mesh sizes. Catches of 50 tons/day of *Macrurus (Coryphaenoides) rupestris* have occasionally been reported by USSR trawlers.

Cod, haddock and flounder fisheries in the southern divisions of Subarea 3 are generally not independent of each other except that haddock are present in Div.3L and 3N only in summer and only in the shallower parts of these divisions. Thus, in 1967 (Table 1) catches of cod and flounders in Div.3L, 3N and 30 have increased together. Redfish, pollock and white hake also occur as by-catches in fisheries for cod or flounders in Div.3N and 30, and argentines in Div.30.

Thus any development of fisheries for the minor species would result in larger effort on the species already fished as well, though mesh sizes need not be any smaller than those presently in use.

Development of fisheries for capelin and sand eels in Subarea 3 would require small-meshed gears, but fishing would be mainly pelagic and by-catches of other species would likely be small. This would not be true it fishing developed in known shallow-water spawning areas of capelin, when substantial catches of cod, haddock and flounders might also be taken.

Annex II Table 1. Recent yields of cod, haddock, flounders and redfish in Subareas 2 and 3

Species	Area	Yields (000's tons)			
		1962-66			1967
		Minimum	Maximum	Average	
Cod	2G-3K	338.5	427.7	375.9	400.0
	3L	156.4	215.1	180.6	255.4
	3M	15.9	53.9	34.2	36.3
	3NO	34.4	106.0	73.1	220.2
	3Ps	46.7	64.0	52.1	61.7
	3Pn-4R	57.8	76.9	66.4	71.0
Haddock	3NO	5.3	32.8	12.6	8.0
	3Ps	1.5	2.5	2.0	2.4
Flounders	2G-J	0.4	6.8	2.7	4.4
	3K	0.3	8.7	4.4	7.9
	3L	13.7	31.6	23.5	54.2
	3M	0.2	5.3	2.4	0.1
	3N	4.0	45.7	20.6	36.0
	3O	3.3	15.4	6.3	39.9
	3Ps	1.7	5.4	2.9	8.2
	3Pn	0.1	0.3	0.2	3.8
Redfish	2G-3K	19.7	50.2	33.3	15.0
	3L	3.4	9.5	6.4	2.5
	3M	7.0	26.2	12.9	0.7
	3NO	20.3	25.4	23.4	35.0
	3P	13.4	20.9	16.1	16.6

Subarea 4

1. Description of stocks

The division of various stocks in Subarea 4 are described in detail in Res.Doc.68/61. There are four major cod stocks, two haddock stocks, at least two redfish stocks and one silver hake stock which are intensively fished. In addition two major herring stocks (with probable partial divisions within them) are now being fished. These stocks are shown by ICNAF division in Annex III Table 1, which also gives average landings from these stocks in the years 1962-1966 and for 1967.

In addition there are stocks of four flatfish species fished throughout the area, of which American plaice is the most important. Landings of this species are given for Div.4T and Vn. Details on distribution of and landings for witch, yellowtail and winter flounder are presented in Res. Doc.68/61. In addition there are primary and incidental fisheries for pollock and white hake (landings given in Annex III Table 1), cusk, mackerel, wolffish and argentines.

Among species lightly exploited or unexploited are sand eels, skates, anglers and sculpins. Of these sand eels are believed to have a potential for a large fishery.

2. Assessment of state of intensively fished stocks

(a) Cod

All cod stocks of Subarea 4 are believed to be intensively exploited. The most studied stock, Div.4TV, has been recently reassessed. This assessment has indicated major changes in stock parameters which could be density dependent. The conclusions reached were that the static yield per recruit model will not provide estimates of the maximum sustained yield for this stock.

Earlier assessments for other cod stocks in Subarea 4 gave very wide limits for the relationship between stocks and their yields. Most were considered to be near their maximum yield, however, because of the wide range of parameters used, various interpretations were possible.

While recent detailed assessments have not been made it is believed that the basic data are available for yield per recruit models for all cod stocks, except that of 4VsW, where recent fishing by Spanish pair trawlers has not been adequately sampled.

(b) Haddock

Div.4VW. Average landings from 1962-66 are slightly higher than those of the previous assessment period, when effort was calculated to be below that giving maximum yields per recruit. However, landings in 1967 at about 11,000 tons are much below the previous levels. Recent developments in the fishery of this area present a complicated picture. In general, Canadian effort on this stock has decreased and sampling of Canadian landings shows no major change in sizes and ages caught. The increase in average landings has resulted from so-called "pulse" fishing by the Soviet fleet in 1965 on one or two good year-classes. In 1966 and 1967, this effort ceased as subsequent year-classes were poor. Age-size data are not available for the Soviet fishery in 1965. Since the fishery by the USSR was probably concentrated on fish younger than those taken in the Canadian fishery, assessment of fishing intensity will be very difficult. Recent year-classes are poor. Data on sizes and ages in the Canadian landings are available since 1948 and in Soviet catches from 1966 on. Catch/effort figures are very much affected by recruitment and shifts in operations of the fleet to other divisions.

Div.4X. Landings in 1957-58, at about 19,000 tons, increased to about 30,000 tons in 1962-66 and 37,000 tons in 1967. No estimate of equilibrium yield was made in 1962 but a 1965 assessment estimated effort as being near that giving maximum yield. Data on the recent fishery are available and their analysis should provide reliable estimates of mortality and yield per recruit.

The Canadian and US fleets which exploit haddock in Div.4VWX and 5Z appear to direct their effort according to the relative availability of haddock on these grounds.

(c) Redfish

4RST. Previous estimates suggested that fishing effort might have been near maximum sustainable yield. The recruitment of good year-classes (after poor recruitment for about 5 years) has resulted in much larger redfish landings. Landings increased from a low in 1962 to quantities in 1965, 1966 and 1967 which exceeded the previous high of 1956 (which was exploiting an accumulated stock of old fish). Both effort and catch/effort has increased during this recent period largely due to the recruitment of new year-classes. Current data are available to provide estimates for the state of exploitation.

4VWX. These stocks have not been assessed but sufficient data from the US are probably available for yield-per-recruit estimates.

(d) Silver hake

4WX. This fishery began in 1962 with landings of 8,000 tons, went to 123,000 in 1963, and has declined sharply since to 2,500 tons in 1967. Gulland (Res.Doc.68/75) in reviewing the available data concluded that this stock would probably not provide a high sustained catch. Various

other evidence (Res.Doc.68/15) from USSR catches suggest major changes in abundance probably caused by poor recruitment.

Although data are available on age composition and fishing effort, they do not provide a basis for a reliable yield calculation. Some work done at the St. Andrews Biological Station indicates that "gill disease" could be a factor causing increased mortality and poor recruitment.

Annex III Table 1. Resumé of Subarea 4 stock divisions for exploited stocks with average landings, 1962-66 and 1967.

Species stocks	1962-66 Avg catch (000's tons)	1967 catch (000's tons)
Cod		
R+S	57.7	58.9
T+Vn	73.0	48.9
Vs+W	67.0	50.1
X	23.4	32.4
Haddock		
V+W	30.5	10.7
X	29.9	37.3
Redfish		
R+S+T	34.0	71.0
V+W+X	32.0	16.0
Silver hake		
W+X	54.6	2.5
American plaice		
T+Vn	8.5	8.8
Pollock		
W	11.5	4.3
X	17.1	7.5
White hake		
T	6.3	6.5
W+X	4.6	1.1
Herring		
T	39.0	62.6
X	107.2	190.0

(e) American plaice

4T, 4Vn. Landings of plaice from this region have been relatively stable and are mainly taken along with cod catches. An assessment of this stock is being prepared and will be available soon.

(f) Pollock

4WX. Although these stocks are probably separate, landings from both areas were steady at about 29,000 tons (1962-66) but have dropped sharply to 12,000 tons in 1967. No data are available for assessing these stocks.

(g) White hake

4T. Landings have been steady around 6,000 tons since 1962. There are no data, at present, for assessing the state of the stocks.

4WX. Widely fluctuating landings range from 1,000 to 9,000 tons. No data are available for assessment.

(h) Herring

4T. Landings from 1962-66 were steady at about 39,000 tons but increased to over 60,000 tons in 1967 with development of a Canadian purse seine fishery. Some estimates of fishing effort and mortalities may be possible but the potential yield is not well known. It is believed that the stock is not heavily exploited.

4X. Landings, which in 1962-3 were about 65,000 tons, increased to about 189,000 tons in 1966 and 1967. Earlier fisheries were based mainly on young fish taken by inshore stationary gears. The recent increase has been the result of the development of purse seining on both large and small fish. The estimation of various stock parameters is difficult because of the problem in collecting representative samples of different sections of the population and because the expansion in the fishery has been so recent.

(i) Other Exploited Species

There are primary and incidental fisheries for halibut, mackerel, witch, yellowtail, winter flounder, wolffish and cusk. Landing statistics are given in Res.Doc.68/61, but no assessment data are available for detailed assessments on these species.

Landings of argentines from Subarea 4 have ranged between 4,000 and 15,000 tons between 1963 and 1967. As stated by Gulland (Res.Doc. 68/75), catches probably could be increased by increasing effort. No reliable estimate of yield is feasible.

(j) Species exploited lightly or not at all

There are stocks of sand eels, skates, anglers, and sculpins, but comprehensive distribution charts and parameters for stock assessment are not available. Sand eels are believed to have a large potential yield.

3. Distribution and overlap of fishing

Details of the various overlapping stocks and fisheries are given in Res. Doc.68/61. In brief, in Div.4V, W and X, cod and haddock cannot be fished separately; throughout Div.4T American plaice are caught incidentally to cod; redfish stocks are essentially separate from those of cod and haddock in Subarea 4. Various flatfish species are taken incidentally while fishing for cod and haddock, although in some areas (particularly Div.4Vn and inshore) flatfish may be a primary objective of the fishery. Pollock usually appear to be taken separately but in the same area as cod and haddock.

For silver hake a small mesh trawl is necessary. The silver hake fishery takes some haddock and probably also cod, and in an intensive silver hake fishery these amounts could be significant in relation to total haddock and cod catches.

Stocks such as argentines and sand eels would also have to be fished with small mesh nets. Redfish and silver hake would likely be found with argentines. It is not known how much overlap there might be with other species if trawl fisheries for sand eels developed.

To date the fleet fishing for herring have used purse seines. These have usually taken only herring, but it is expected that pelagic trawl fisheries will develop for herring and it is likely that these will take various groundfish species.

Subarea 5

1. Description of stocks

This subarea is characterized by having many species of fish. Most of the species are fished to some degree; however, only a few are currently of major importance, and not very many more are known to be of sufficient magnitude to support a major fishery. Landings of the major species are given in Annex IV Table 1. Rather sharp increases in landings are to be noted for most of the species in the last four or five years.

(a) Cod and haddock

Nearly all landings are taken by trawl fisheries. Cod and haddock are distributed in commercial abundance on Georges Bank (5Ze). Both species form an integral fishery, and studies have shown them to be single stocks of fish.

Haddock have been under study for many years, and its population dynamics is as well known as any in the Convention Area. Estimates of mortality, effects of fishing, and yield curves have been estimated by several authors in recent years. The recent increase in landings was the result of a rather strong year-class (1963) being recruited to the fishery in 1965 which attracted additional fishing effort.

This increased effort also caused cod landings to increase, after a gradual decline for many years. Definitive studies of the population dynamics of this stock have not been done.

(b) Silver hake

A recent assessment has indicated the stock abundance in 1966 may be about half of that in 1960, at which time intensive exploitation began. Good estimates of mortality and yield curves are not yet available, although some good data is now being collected on abundance and age composition. There may be separate stocks within the area, but these are not yet defined.

(c) Red hake

Very little information is available on growth, mortality or yields. However, the abundance in 1966-67 is apparently much lower than that before the recent heavy exploitation which began in 1965. An intense fishery had previously developed in the late 1950's, reaching a level of about 75,000 tons annually for about two years. This was accompanied also by a significant drop in abundance. This stock is densely concentrated at certain seasons and highly vulnerable to trawls.

(d) Redfish

This species was heavily exploited in the 1950's. Abundance has rebounded after several years of light fishing.

(e) Yellowtail flounder

Studies on yields, abundance, growth and mortality have recently been completed. Wide variations in abundance have occurred in the past which seem to be caused by factors other than fishing. A fishing rate of at least 80% has been applied in recent years when recruitment has been good.

(f) Herring

There are essentially two herring stocks or stock complexes in Subarea 5: the inshore Gulf of Maine stock complex in Div.5Y exploited by the USA and Canadian fisheries, and the Georges Bank stock which is found in Div.5Z during summer and fall but which apparently migrates in winter to Div.6A and 6B.

The offshore stocks of herring have been intensively exploited in Subarea 5 and 6 since 1961. This recent fishery was started by substantial fleets from USSR, Federal Republic of Germany, Poland and non-member countries fishing on Georges Bank (Div.5Ze).

The Gulf of Maine stock is apparently smaller than the Georges Bank stock and some elements of it have apparently declined in abundance or changed their distribution in recent years.

There is no conclusive evidence concerning the maximum sustainable yield that either of these stocks can support decline in catch per unit effort by the USSR fleet in 1967 for the Georges Bank stocks would indicate that the catch level obtained in 1967 could not be maintained without the recruitment of substantially more abundant year-classes.

Each of the herring stocks in Subarea 5 can be exploited without substantial incidental catches of other fishes.

Annex IV Table 1. Subarea 5 landings (000's tons)

	Year						
Species	1961	1962	1963	1964	1965	1966	1967
Cod	18	26	30	29	42	57	42
Haddock	46	54	55	64	149	91	57
Silver hake	43	86	147	221	323	162	101
Red hake	3	2	6	29	72	89	45
Yellowtail	16	25	35	36	37	31	26
Redfish		13	9	8	7	7	11
Herring	94	223	167	159	74	166	246

2. Assessment of the state of stocks

The estimated sustainable yields and exploitation rates of major stocks in Subarea 5 are given in Annex IV Table 2. Only for haddock are we very certain of the effects of fishing.

(a) Haddock

Recent studies have shown the 1965-66 fishery level to exceed greatly the maximum sustainable yield. The stocks of haddock are now at a relatively low level because of the heavy removals of the past three years, and the recruitment of poor year-classes since 1963. The index of abundance, based on landings-per-standard days fishing of US trawlers stands at 3.7 for the year 1967. At the maximum equilibrium yield level with average year-classes, the index is estimated to be 6.4. The earliest possibility for good recruitment to begin increasing stock size is in 1971, when the 1968 year-class would be three years old. Thus, for the next three years at least, stock density will probably continue to decrease.

The immediate course of action with regard to regulation depends on assumptions about stock recruitment relations. If recruitment is independent of stock density, restricting the catch would not be necessary to assure good recruitment in future years. If, on the other hand, good recruitment is dependent on maintenance of moderate stock size, removals should be severely restricted immediately to foster rebuilding of the stock density.

In either case, when the stock has been rebuilt, then the future catches must be controlled to provide a rational basis for this fishery. The requisite information is complete enough to formulate such regulations at the present time. The necessary monitoring of stock densities, and yields in the commercial fishery, and the strength of year-classes about two years before they enter the fishery is quite feasible.

(b) Cod

This species could not be regulated separately because of its co-existence with haddock. In any case, it is probably now over exploited and inclusion with the haddock in any quota regulation should be done to restrict its catch, thereby obtaining some benefits. This means that fishing cod would be permitted only as a by-catch of haddock.

(c) Silver hake, red hake and herring

These three species are similar in that there has been a very rapid buildup of fishing intensity in the last few years, but lack of knowledge of the dynamics of the stocks does not permit a firm evaluation

of the effects of fishing and sustainable yields. Some data does exist for each of these species which might, when analyzed, provide some of the required information, and certainly the importance of the fisheries will lead to the gathering of additional data in the next few years. However, the recent development has been too rapid to allow the time necessary for scientific studies, and the magnitude of year-to-year effort changes in itself complicates the problem of assessing the effects of fishing. The existence of large, highly mobile fleets of fishing vessels, and the continuing demand for fishery products means that this type of "pulse" fishing will continue to occur.

It is difficult under these conditions to foster and promote regulatory measures which will allow "rational" fishing, *i.e.* the achievement of maximum sustainable yields in terms of protein or dollars. In the case of hake, coastal states operate non-mobile fleets which are maintained on the basis of stabilized abundance, and which are severely affected when the stock is harvested by a cycle of rapid depletion, followed by a period of recovery and then rapid depletion again.

Perhaps, in this situation, some interim or initial regulations which limit the rate of increase of catch or effort rather than the absolute magnitudes should be considered. This may achieve the necessary stabilization to allow assessment of effects of fishing without causing undue loss of yield.

In the case of silver hake, for example, the intensity, up to 1962, was presumably rather light and, in a period of 4 years, jumped by a factor of 8 to a level which may well have been near or beyond the maximum sustainable level. A higher demand may well have pushed the effort to further levels, and the fishery could have been severely over-exploited before any studies were completed or action taken. The point is we do not yet know for certain if the level achieved was too high, and could not have found out in the period available.

(d) Yellowtail flounder

It is quite possible that environmental factors have caused long-term (10-15 years) changes in production for this stock. Fishery intensity, over the levels experienced to date, do not appear to have any effect on long-term abundance. In fact, because of the nature of the fishing fleet, intensity of fishing is positively correlated with abundance. However, the high rate of fishing is most likely obtaining the maximum average catch under present environmental conditions.

Annex IV Table 2. Sustainable yields (000's tons) and exploitation rates of stocks in Subarea 5.

Species	Avg Landings 1961-66	Maximum Landings (year)	Landings 1967	Estimated Sustainable Yields A	B	C	Exploitation Level
Cod	34	57 (66)	42	25	20-30	---	**
Haddock	95	149 (65)	57	50	50-70	---	**
Silver hake	163	323 (65)	101	200	300-400	---	*
Red hake	39	89 (66)	44	100	70-100	---	*
Ocean perch	11	-	11	15-20	15-30	---	-
Yellowtail	33	37 (65)	26	25	50	---	*
Sea herring	146	244 (67)	244	120-200	150-300	---	No opinion
Pollock	-	-	10	---	20-30	100	-
Dogfish	+	+	+	---	---	100	-
Skates	+	+	+	---	---	300	-
Butterfish	---	---	2	---	50	42	-
Mackerel	---	---	15	---	50	---	-
Argentine	---	---	2	---	10	32	-
Flounders	---	---	22	---	---	72	-
Eel pout	---	---	7	---	---	32	-
White hake	---	---	1	---	25-30	---	-

A. Graham, H.W., 1967 (Based on catch/effort data)
B. Gulland, J.A., 1968 (Based on catch/effort and biomass data)
C. Edwards, R.L., 1968 (Based on biomass data, half of standing crop)
** >maximum sustainable yield; * =maximum sustainable yield; - <maximum sustainable yield

3. Distributional and fishing overlap on stocks

The many species in Subarea 5 overlap considerably in geographical distributions, which are well known through the many groundfish surveys conducted by the USA. On a purely geographical basis, there would be little separation of species which would promote ease of management.

It is the species composition in trawl catches that is of prime interest, however, since depth, temperature and other factors lead to some separation of species which is not apparent on geographical plots alone.

One approach to this problem is to plot the percentage of a given species per unit catch against the cumulative total catch of that species. Thus, if most of the catches of the species occur in units which have a high percentage of the given species some basis for species separation does exist.

Annex IV Table 3 lists the average percentage of total landings (for US commercial fishery data) or of total catch (for US research vessel surveys) for which the percentage of a given species per unit catch was *at least* 70. For commercial records, the unit catch is a trip - from two days to two weeks duration. For research surveys, the unit is a single trawl haul of 1/2-hour duration; in this set of data, the percentages are calculated as of all species and as of the six commercial species alone.

Annex IV Table 3. Average percent of total US commercial landings and research vessel catches of important commercial species taken in individual catches which are composed of at least 70 percent of the given species in Subarea 5.

Commercial Species	Commercial (US Fleet)		Groundfish Survey Cruises *(Albatross IV)*[4]					
			All species[5]			Commercial Species[6]		
	Food[1]	Industrial[2]	Summer	Fall	Winter	Summer	Fall	Winter
Cod	-		0	0	0	0	0	45
Haddock	70		60	27	61	85	74	80
Redfish	95		34	0	77	57	44	86
Red hake	-	[30[3]	14	0	0	50	22	54
Silver hake	98	13]	23	1	14	54	45	45
Yellow-tail	70		40	12	0	58	32	56

[1]Sampling for the various species were: Haddock, port of Boston 1960-61, OTL and OTM's, one month in each quarter (February, May, August, November). Redfish, ports of Gloucester and Portland, 1960-61, all other trawlers, one month in each quarter (same as haddock). Silver hake, ports of Gloucester and Portland 1960-61, all other trawlers for the 3rd quarter (July, August, September). Yellowtail, port of New Bedford 1960-61, all other trawlers, one month in each quarter (same as haddock).

[2]Sampling of industrial landings comprised data collected by R.L.Edwards at port of Pt. Judith 1957-58 with 329 trips sampled.

[3]Indications are that red and silver hake comprised approximately 65 percent of the NE industrial landings for these two years which amounted to 199 million pounds.

[4]One survey cruise for each of three seasons was used to obtain these data: Summer, ALB IV 65-510, 7 July-10 August 1965; fall ALB IV 65-514, 6 October-9 November; winter, ALB IV 66-601, 18 January-23 February 1966

[5]Percent catch using total weight of all species

[6]Percent catch using total weight of the six commercial species only.

Except perhaps for red hake and cod, the US commercial catches of the major species are relatively pure. The survey catches, which represent *random* sampling of the area, show considerably more mixture except for haddock, which averages about 70 percent for all series of data.

The difference between the two sets of data may be attributed to the ability of fishermen to ferret out the specific locations where a given species exists in higher and purer concentrations. The US commercial fishery data are subject to some bias because of discarding, but this would be primarily of species such as dogfish and skates which are not of commercial value to US markets.

The observations of USSR scientists indicate that relatively pure (70-80 percent) trawl catches of haddock, red hake and silver hake are obtained in their commercial operations.

The US catches of haddock are mixed mostly with cod, which amounts to 20 percent on the average. The Canadian catches contain somewhat higher percentages of cod with haddock, roughly 60 percent haddock, 40 percent cod. This apparently reflects the greater desire by Canadian fisheries for cod than is the case in the US fishery.

Thus, with the exception of herring, none of the main fisheries, nor any future developing fisheries, can be prosecuted on the basis of pure catches of the species. However, in application, the efforts of fishermen seeking a particular species can be directed so that the by-catches are minimized - generally under 30 percent.

An important point to note, however, is the rather large differences in the fishing effort which might be applied to the different stocks to obtain the maximum sustainable yield level. Thus, if a given species which requires only a low level of effort to obtain the maximum sustainable yield is mixed only at, say, 10 percent with a second species for which the required effort is high; the former species could well be overfished as a by-catch.

Consideration of Question 4

The kinds of scientific information required for the efficient application of regulatory measures controlling fishing mortality rate, whether by limitation of catch or of fishing effort can be considered in relation to (1) the initial assessment of the "state" of the fish stocks, which will form the scientific basis for estimating the immediate and long-term effects of regulation, and (2) the efficient application of the regulation, to ensure the maintenance of the fishing mortality rate at the desired level and for monitoring its effects.

With regard to (1), on the basis of the constant parameter population model used here, the essential requirements for (1) are average estimates of the population parameters - recruitment size and age, growth, natural mortality rate and fishing mortality rate, during the pre-regulation period, which form the basic information needed for determining the "state" of the fishery relative to the theoretical equilibrium curve relating catch per recruit and fishing mortality rate. Clearly, therefore, the precision with which this "state" can be defined will be largely determined by the accuracy of the estimates of these parameters during the pre-regulation stage.

It is evident from the preceding sections of this report that the precision with which the present "state" can be defined varies widely for the major fisheries in the ICNAF Area. The fisheries and stocks for which it can be specified with greatest confidence - *i.e.* the Subarea 1 cod and the Subarea 5 haddock - are ones for which intensive long-term scientific investigations, aimed at the measurement of the main population parameters have been conducted. For those for which it cannot be defined with confidence - *e.g.* some of the cod and haddock stocks in Subareas 3 and 4 and the redfish stocks, the greatest uncertainty concerns the magnitudes of these parameters especially the rates of fishing and natural mortality, operating over their total exploited life spans. This is due to one or a combination of a number of factors in the different fisheries of which the following are important:-

a) Uncertainty regarding the division between and unity of individual fish stocks and especially the relationship between fish concentrations exploited seasonally in different localities by fleets of different countries. This uncertainty applies particularly to some of the cod stocks in Subareas 2, 3 and 4.

b) The lack of adequate biological sampling data for all components of the fisheries during periods of low and high fishing intensity.

c) The relatively short period of time, in some fisheries, during which the intensity of fishing has grown and hence the absence of relative stability in the fishery at a high level of fishing intensity.

d) The influence of environmental factors on short-term fluctuations in distribution and availability, affecting estimates of stock abundance and mortality rate obtained from commercial catch sampling.

e) Uncertainty concerning the extent to which the constant parameter yield-per-recruit model fits the true situation for each stock.

It is evident, therefore, that the current uncertainty regarding the "state" of the fisheries on these stocks can only be remedied by further intensive scientific research, including comprehensive sampling of the commercial catches of all of the main components of the fisheries. The speed with which definite answers regarding the "state" of these stocks can be given will therefore depend to a large extent on the amount of research effort which can be devoted to investigations of their population dynamics, important aspects of which are outlined in more detail in the next section. The Subcommittee wishes to point out that the research effort available for the study of many of these exploited resources is small in relation to their size and complexity and that therefore rapid progress toward a definition of their "state" is unlikely without a substantial increase in the research effort which can be applied to studying them.

With regard to (2), the principal kinds of scientific information required to permit a regulation controlling fishing mortality rate to be applied efficiently once its "state" has been determined depend on whether the regulation is (a) by limitation of catch or (b) by limitation of fishing effort. They are therefore dealt with separately below.

Regulations limiting catch (Catch Quotas)

While the "state" of an exploited stock and the expected long-term benefits in catch and catch-per-unit effort to be gained from a reduction in fishing mortality rate can be gauged on a "per-recruit" basis, using average values of natural mortality rate and growth, and the known fishing mortality rate prior to regulation, the actual catch which can be taken from a fish stock in any year at a given fishing mortality rate will change as a result of annual variations in the natural parameters. Adjustments to the total quota may therefore have to be made from year to year to take account of these variations.

If the catch quota is not adjusted to take into account changes in abundance, then when the stock is low, the catch and the mortality coefficient will be too high and conversely if the stock is high.

Reliable forecasts of stock abundance are therefore required for as far ahead as it is desired to set quotas, either provisionally or definitely. Such forecasts will probably be expressed as changes from the stock in previous years and be based on changes in the stock due to changes in fishing, including the effects of regulation and any deviations above or below the

desired quota in previous seasons, any revisions to the estimate of stock abundance or of the desired fishing mortality, but particularly on changes in year-class strength. Changes in year-class strength is the major natural factor in the changes in abundance of stocks (particularly of haddock) in the ICNAF Area. Most year-classes present in the fishery in one year would also have been present in the previous year, so that, to a greater (for long-lived fish) or less (for short-lived fish) extent, the influence of year-class strength can be predicted from the catches of the fishery itself. The youngest fish, entering the fishery for the first time, cannot be predicted in this way, and so some estimate of year-class abundance before recruitment is desirable. Studies of the cod stock in Subarea 1 and the haddock stocks in Subareas 3, 4 and 5, have shown that reasonable estimates of year-class strength can be obtained during the pre-recruit stage.

These pre-recruit estimates require adequate facilities for carrying out the necessary sampling surveys. Less detailed studies have been made of the changes in the pre-recruit abundance of year-classes for most of the cod stocks in Subareas 2, 3, 4 and 5, but the data which are available suggest that, again given the necessary sampling facilities, adequate estimates could be obtained for operating a catch quota system on them. The prediction of stock abundance from estimates of year-class strength, whether from pre-recruit surveys, or from the fishery itself, requires good knowledge of the age composition of the catches. If this differs between sections of the fishery, *e.g.* fisheries on immature and spawning fish, as in the cod in the northeast Atlantic, then the abundance in these sections will not change in proportion, and this may have to be taken into account in setting catch quotas (*e.g.* by setting and adjusting quotas separately for each section).

In addition to the variations in recruitment considered above, variations in the other natural parameters, growth and natural mortaltiy rate may also take place and so affect the catch which can be taken for a given value of fishing mortality rate. Such variations may be brought about as a result of changes in environmental factors - *e.g.* temperature, food supply, etc. - or they may be related to the changes in the stock abundance resulting directly from the reduction in fishing mortality rate. Such density-dependent changes, resulting in a decrease in growth rate or increase in natural mortality rate, with increase in stock abundance are of particular importance in that, unless allowed for in the initial assessment, they would tend to lead to over-estimation of the total quota for the fish stock in question.

Changes in growth rate have been observed in a number of the fish stocks exploited in the ICNAF Area, especially of cod, and these have been of sufficient magnitude to significantly affect the total stock abundance (in weight) and hence the catch which would be taken at a given value of fishing mortality rate. It is evident, therefore, that the routine collection of data on the mean weight-at-age of the year-classes within the exploited

stock would be required following the introduction of a catch quota regulation, together with detailed studies of the pattern of growth of each year-class, to provide a basis for predicting the weight-at-age of the post-recruit age-groups from the pre-recruits.

No reliable data are available on short-term variations in natural mortality rate of the principal exploited stocks in the ICNAF Area, but there is no evidence of large, short-term variations taking place.

Regulations limiting fishing effort

The essential information required for a regulation based on direct control of fishing effort is a measure of the total amount of effective fishing effort for the fishery as a whole and the respective contributions to it of the different main components of the fishery.

The following major problems arise in obtaining these estimates:

(a) in standardizing and combining the effort data for the fisheries of different countries and methods of fishing;

(b) in making allowance for changes in the efficiency of a unit of fishing effort for each group of vessels both within a year, due to seasonal changes in the availability of fish and other factors, and from year to year through changes in fishing power due, for example, to changes in technological developments.

At present a complete study of these problems cannot be made for most of the major fisheries in the ICNAF Area because of the absence of information on fishing effort for some of the important components of the total fisheries. This applies especially to the non-trawl fisheries. For such a study the following items of information are required for each component (defined in terms of country, method of fishing, size of vessels and, where necessary, season) of the total fishery:

(a) measures of fishing effort in suitable units, for small areas (*e.g.* fishing grounds or statistical squares) and time intervals (*e.g.* weeks or months);

(b) corresponding data on the catches associated with the fishing effort for each component in each area and period of time;

(c) data on the size and age composition of the catches.

It is also essential to specify the degree of refinement of the measures of fishing effort subject to regulation, necessary to ensure that the fishing mortality rate in the exploited stock is maintained at the desired level. For the present purpose, fishing effort can be defined as the product of

the fishing powers of the individual fishing vessels and the time they spend fishing, and it is necessary to determine the appropriate measures of fishing power and time which are required to effectively control the fishing mortality rate. Analyses of the problem for trawl fisheries have shown that fishing power is associated with a number of factors relating to the fishing vessel, of which its size (tonnage) and engine power are important, and that for trawlers a reasonably efficient index of fishing power within a national fishery is the gross tonnage of the vessels operating. However, no information on fishing power factors is available for the other methods of fishing employed in the fisheries under consideration (*e.g.* longline, gill net and trap). Similarly, whereas for the trawl fisheries the most efficient measure of time is the number of hours spent fishing, in the case of some of the non-trawl fisheries there is uncertainty regarding the proportion of the total time spent on the fishing grounds which should be included as "fishing time".

It is evident, therefore, that at present it is not possible to gauge the degree of accuracy with which a total fishing effort quota could be determined for each of the major ICNAF fisheries which, if properly enforced, would maintain the fishing mortality rate at the desired level. The best prospects of this being possible would seem to apply to the fisheries prosecuted only by trawl - *e.g.* the haddock and cod fisheries in Subarea 5 and the redfish and flatfish (excluding halibut) fisheries throughout the Convention Area. However, even for these, detailed studies of the relative fishing powers of the fisheries of different countries and the difference in fishing power for each unit of effort between different seasons and parts of the total fishing area are required before the feasibility of establishing an efficient total fishing effort quota in multi-national, multi-gear fisheries such as exist over most of the ICNAF Area can be determined. It should also be noted that should this prove feasible any fishing effort regulation arrived at in this way would require, after its introduction, periodic reassessment of the relative efficiencies of the fishing effort units both within and between fishing fleets to allow account to be taken of the effects of technological developments affecting the efficiency of the fishing operations, and hence the magnitude of the total effort quota, required to maintain the fishing mortality rate at the desired level.

A further factor affecting the accuracy with which regulations limiting fishing effort can be achieved is the variation from year to year in the "catchability" of the exploited stock, resulting in variations in the fishing mortality rate generated by unit fishing effort. Such variations arise from natural factors affecting the distribution of the fish concentrations (*e.g.* their degree of aggregation) and their vulnerability to capture.

Such variations are not predictable in advance and they may, therefore, result in the effort quota generating a higher or lower mortality rate than the desired one. This factor also affects the efficiency with which a catch quota system can be operated in that, in years of low "catchability", the total annual quota for the fishery in question might not be achieved by the size of fishing fleet operating in the fishery, resulting in the fishing mortality rate falling below the control value, and in years of high "catchability" it might be achieved more quickly than expected during the year.

APPENDIX II - REPORT OF STATISTICS AND SAMPLING SUBCOMMITTEE

Chairman: F.D.McCracken; Rapporteur: L.P.D.Gertenbach

The Subcommittee met on 25 May 1968 - morning and afternoon.

1. Sampling Yearbook, Vol.11 for 1966

The Subcommittee expressed appreciation for the early issue of this volume and in its review noted the need for countries to provide more data in response to the ICNAF Secretariat's request for material.

The Subcommittee reiterated that length and age data for all species should be submitted and especially requested that any data for silver hake and yellowtail flounder be reported.

The Subcommittee decided that the instructions in the report of the ICES Statistical Newsletters Working Group for collecting sampling data should be made available for comparisons during the 1969 meeting.

A provisional statement about the findings of the Working Group of Redfish Experts was received and it was decided to postpone further consideration of publishing age/length keys for redfish until analyses of material for ageing from all subareas are complete.

The Subcommittee referred to the Herring Subcommittee questions about the nature and specifications of the herring sampling data to be included in the Yearbook.

2. Analyses: age/length key data

The Subcommittee noted that analytical work on the 1961-63 data proposed in preceding years should be completed during 1968 by Canadian scientists.

3. Sampling (length/age) catches, 1964-66

The Subcommittee reviewed Res.Doc.68/22 which compares sampling in relation to catches and

recommends (22)

(i) that the Assessments Subcommittee indicate any stocks for which length and age sampling are inadequate and that data on these be included separately by ICNAF divisions if necessary in this annual sampling review;

(ii) that any sampling data not reported by countries on ICNAF sampling forms be listed by each country and submitted to the Secretariat, by species, gear, division, month and numbers of ages and/or lengths;

(iii) that the 1966 and 1967 summary review of sampling activities together with the relevant catches (using provisional data when final statistics are not available) be published in Volume 12 of the Sampling Yearbook.

4. Implementation of decisions on length measuring

After reviewing previous ICNAF decisions on length measuring, no changes were suggested. The Secretariat again requested that countries state the length and interval of measurement used in all documents and reports. The Subcommittee

recommends (23)

(i) that the decisions on length measuring as recorded on page 53 of Redbook 1967, Part I, again be brought to the attention of all concerned;

(ii) that measuring problems concerning herring be referred to the Herring Subcommittee which should also note ICES action.

The Subcommittee noted that Res.Doc.68/96 shows very good agreement in results between different measuring methods in certain instances for cod, redfish and American plaice.

5. Review of the ICNAF List of Vessels

The Subcommittee, having reviewed replies received by the ICNAF Secretariat in response to Recommendation 5 (1967), and statements on the ICES and OECD activities in related fields,

recommends (24)

(i) that the Secretariat proceed with the preparation and publication of the 1968 List of Vessels in accordance with existing recommendations;

(ii) that the details with regard to propellors and electronic equipment be deleted, except for (a) echosounder-vertical and (b) echosounder-ranging or horizontal;

(iii) that the Secretariat explore the feasibility of obtaining call signals for each vessel;

(iv) that the CWP be requested to review ways and means of compiling and publishing statistics on the "potential" fishing fleet in the Northwest Atlantic (bearing in mind the world-wide implication).

6. Review of supplementary data on fishing effort

The Subcommittee examined Res.Doc.68/20 which presented, for certain countries, supplementary effort data by subarea, vessel category etc. on ICNAF Statistical Form 3. Since the deadline for reporting data for the preceding calendar year is 15 July, it is impossible to provide data for all countries at the May/June Annual Meeting of ICNAF.

The Subcommittee

recommends (25)

(i) that a summary of fishing effort, similar to Res.Doc.68/20, be prepared and presented to the 1969 Annual Meeting, the document to include complete data for 1966 and 1967, and such 1968 data as may be available;

(ii) that complete fishing effort data for 1966, 1967 and 1968 be presented in the "List of Vessels for 1968".

7. Fishing effort concepts: standardization and clarification

The Subcommittee, on reviewing current practices and problems of national reporting offices,

recommends (26)

(i) that the ICNAF Secretariat ask countries to report the criteria they use when completing the box "main species sought" on the STANA 1W form;

(ii) that the CWP consider improving the definition of the effort measure "days on ground".

8. Data on discards and industrial fish

The Subcommittee, on reviewing Res.Doc.68/21, welcomed this publication for which data have been obtained through the ICNAF Statistical (Revised) Form 4.

The Subcommittee

recommends (27)

(i) that the document arising from ICNAF Statistical Form 4 submissions, insofar as it covers discards, should be published in Part III of the ICNAF Redbook;

(ii) that descriptions in the stubs and column headings be expanded where necessary to make it clear that nominal catches include industrial fish even where separate statistics for the latter might be available;

(iii) that it should be emphasized that industrial fish refers to those parts of the nominal catch processed (reduction) as whole fish to meal and oil at sea;

(iv) that the discard and industrial fish summary should be prepared annually;

(v) that the tabulation should include the total nominal catch for each subarea.

9. Design and layout of the Statistical Bulletin

The Subcommittee expressed appreciation to the Secretariat for the prompt publication of ICNAF Statistical Bulletin (Volume 16 for 1966), and for preliminary data on 1967 nominal catches in Res.Doc.68/18. It appears unlikely that it will be possible to further expedite the release date and that maintenance of the present date depends on continued close cooperation of all the national reporting offices. It was also noted that several of the recommendations passed in preceding years, *e.g.* reporting for side and stern trawlers separately, for Div. 5Ze and 5Zw, etc. require several years before they can be implemented by national offices and for data to become available for reporting to ICNAF.

The Subcommittee considered also Res.Doc.68/19 listing the implementation of the various changes introduced in the Statistical Bulletin in accordance with recommendations and suggestions approved in preceding years. In expressing its approval of the changes so far incorporated in it, the Subcommittee

recommends (3)

that the Secretariat study and report its proposals to solve the difficulties of re-designing the tables in the Statistical Bulletin when it seems likely that a breakdown of the Statistical Subarea 6 catches by divisions will be obtained.

10. List of common and scientific names of species and their tabular arrangement

The Subcommittee considered the revised and rearranged list of species presented in Vol.16 of the Statistical Bulletin and Res.Doc.68/26. It noted the work in progress at FAO on the codification and classification of species on a world-wide basis for eventual computerization of fishery statistical publications.

The Subcommittee

recommends (28)

(i) *that any further consideration of revisions in the tabular arrangement, classification and groupings of species in ICNAF publications be postponed until completion of the FAO studies;*

(ii) *that the revised ICNAF species list in the Statistical Bulletin (Vol.16) include an item covering "Roundnose grenadier = Macrurus (Coryphaenoides) rupestris" unless the common name is not one of those used by American Fisheries Society;*

(iii) *that for Cynoscion regalis the common name be either "Squeteague" or "Grey weakfish" depending on the American Fisheries Society usage;*

(iv) *that the ICNAF species list on page 62 of Part I of the Redbook 1967 be corrected by (i) changing "Other Groundfish" and substituting "Other Fish" after "Sea bass, black" and (ii) deleting the line referring to Cynoscion regalis;*

(v) *that the Secretary of the CWP investigate through correspondence with national reporting offices the possibility of clarifying the North Atlantic catches reported as halibut. This action should establish clearly the extent to which the figures for the varicus fishing areas refer to either Hippoglossus hippoglossus or Reinhardtius hippoglossoides;*

(vi) *that the ICNAF Secretariat investigate the questions relating to the reporting of blueback herring and other species reported in the national submissions but not included in the list of species in Vol. 16 of the Statistical Bulletin and make proposals to the 1969 meeting for their inclusion in the ICNAF species list.*

11. Standardization of tabular symbols and abbreviations

In the light of Res.Doc.68/28 and a report by the Secretary of the CWP, the Subcommittee

recommends (29)

that the Secretariat continue to use the present symbols and abbreviations in Statistical Bulletin Vol.17 and in other statistical presentations, until a standard list has been proposed by the CWP for all agencies.

12. Maps of the North Atlantic

The Subcommittee noted the revisions made in the North Atlantic map (equal area projection) published in the Statistical Bulletin (Vol.16) for 1966 in order to accommodate the southward extension to cover Statistical Subarea 6. Similar revisions have been made in the recently published revised version of the coloured ICNAF map now being distributed by the Secretariat.

13. Cooperation with ICES, FAO and the CWP

The Subcommittee reviewed reports submitted by the ICNAF Secretariat and by ICES, FAO and the CWP Secretary. It expressed its great satisfaction with the continued cooperation between all the agencies concerned with North Atlantic statistics.

The Subcommittee noted that, in the field of fishery statistics, it is becoming obvious that an Atlantic-wide, if not a world-wide, approach is becoming necessary; the work of the national offices and reporting to the different fishery bodies can only be kept to a minimum if all these agencies coordinate and standardize their regular requests to national offices.

The Subcommittee

recommends (30)

(i) that ICNAF continue to provide copies of the report of this Subcommittee for distribution to ICES;

(ii) that this Subcommittee continue to receive the reports, complete or abbreviated, of the ICES Statistics Committee;

(iii) that the ICNAF Secretariat continue the existing close collaboration with the CWP Secretariat;

(iv) that the Assistant Executive Secretary of ICNAF and the Secretary of the CWP revise, where necessary, the Notes for the Completion of the STANA 1W and 2 Forms before these are distributed in January 1969;

(v) that ICNAF accept the proposed changes in (a) the name of the CWP from "Continuing Working Party on Fishery Statistics in the North Atlantic Area" to "Coordinating Working Party on Atlantic Fishery Statistics" and in (b) the representation on the inter-agency CWP as proposed by the 3rd Session of the FAO Committee on Fisheries (COFI), Rome, 24-30 April 1968, and as endorsed by the ICES Bureau at its meeting in May 1968;

(vi) that ICNAF continue to participate in all future sessions of the CWP whenever such sessions deal with matters of direct and significant concern to the North Atlantic.

The Subcommittee, noting that acceptance by ICNAF of the COFI proposals (which depends as far as FAO's participation is concerned, on approval by the October 1968 session of the FAO Council), entitles ICNAF to appoint according to ICNAF's own constitutional procedures to the CWP up to four representatives,

recommends (31)

(i) that the Executive Secretary and the Chairman of the Statistics Sub-committee participate in future meetings of the CWP dealing with the North Atlantic;

(ii) that Canada and Denmark be invited to participate in the 6th Session of the CWP;

(iii) that Denmark and the United States be invited to participate in that Session of the CWP, following the 6th Session which would deal with the North Atlantic.

APPENDIX III - REPORT OF SUBCOMMITTEE ON GEAR AND SELECTIVITY

Chairman: A.W.May; Rapporteur: H. Bohl

The Subcommittee met on Tuesday, 28 May 1968.

1. Review of ICES Gear and Behaviour Committee Report

This report was summarized in Res.Doc.68/30 and was presented by Dr Bohl. It was reported that the FAO Training Manual in Acoustic Methods in Fisheries Research should be available soon. The FAO/ICES Training Course in Acoustic Methods has been postponed, but will be held in the spring of 1969 in the Lofoten area.

2. Tabular Summaries of Selectivity Data

The summary of data presented in meeting documents from 1962 to 1967 has been published in Redbook, Part III, 1967. It was felt that in view of the program of preparing 5-year summaries of selectivity data, it would not be necessary to summarize these data annually. It was noted that data should be presented in the form recommended in Redbook 1965, Part I, pp.64-65, as this would simplify preparation of summaries.

The Subcommittee discussed a request from ICES to consider preparation of joint summaries of selectivity data and agreed that this was worthwhile. It was decided that the ICNAF Secretariat should contact ICES to determine whether the present form of ICNAF summaries was suitable, and to ask for any suggestions concerning modification.

3. Selectivity of Different Codend Materials

Reports of selectivity experiments in the ICES area (Comm.Doc.68/14) with polypropylene split fibre, confirmed previous evidence that the kind of polypropylene fibre used (split fibre, monofilament or multifilament) does not appreciably influence polypropylene selectivity.

USSR presented a summary (Res.Doc.68/58) of selectivity data - comparing selection properties of manila with those of polyamide (Kapron). This study indicated that mesh size differentials for polyamide might be greater than those presently approved by the Commission. USSR therefore wished the Subcommittee to endorse an alteration of the present polyamide equivalent to that calculated in Res.Doc.68/58. The Subcommittee, however, while recognizing the practical difficulties of USSR, felt that the whole subject of differences in selection properties of various materials deserved further careful study, especially in view of the ICES Liaison Committee's suggestion (Comm.Doc.68/14) that ICES undertake a study of variability in selectivity data. It was agreed that ICNAF scientists should immediately undertake a similar review, and in view of the fact that data from the northeast Atlantic would be required for a complete analysis, the Subcommittee

recommends (6)

(i) that an ICNAF Working Group on Selectivity Analysis be formed to undertake a review of variability in selectivity data, including the scientific basis of mesh size differentials for different twine materials;

(ii) that the Chairman of R&S appoint a Convener for this Working Group;

(iii) that experts be appointed to the Working Group by interested member countries;

(iv) that ICES be invited to participate, in order to make a joint study of these problems;

(v) that the Working Group meet at a mutually convenient time and place after the ICES meeting in 1968, but before the NEAFC meeting in 1969, so that its report could be available to NEAFC as well as ICNAF.

4. Length, weight and girth data

The Subcommittee expressed its appreciation to the Secretariat for preparation of the bibliography of currently available data on girth-length and weight-length (Res.Doc.68/23). It was obvious from this presentation that more such data were required, at least for species other than cod, and authors were reminded of the standard way in which girth measurements should be taken (Rec.4, Redbook 1963, Part I). Weight-length data and weight conversion factors were presented for Greenland halibut in Res.Doc. 68/47.

5. Meshing of Redfish

No new data were available, but the Subcommittee reaffirmed its interest in the redfish meshing problem, and would welcome reports on this topic whenever available.

6. Catch Size and Selectivity

Again, no new data were available, but it was noted that information on this subject was also required, particularly for redfish.

7. Summary of trawl material and mesh size sampling data

Submissions for 1967 were reviewed (Res.Doc.68/25). It was noted that NEAFC has now adopted a form similar to that used in ICNAF for reporting this data. It is evident that manila codends are now very seldom used in the Commission Area, though mesh regulation is based on manila mesh sizes.

8. Adoption of standard gauge for enforcement

The Subcommittee has no new advice to offer the Commission on the subject. As noted in last year's report, there is no scientific basis for preference of either of the gauges considered at that time (ICNAF gauge or modified NEAFC gauge) and the choice of gauge for enforcement purposes must be based on other than scientific principles.

9. Topside Chafing Gear

Further experiments on Polish chafers (Res.Doc.68/100, Comm.Doc.68/14) confirmed all previous evidence that this chafer has no appreciable effect on codend selectivity, thus proving effective in protecting small fish. USSR informed the Subcommittee that this chafer seemed to be effective in practical use, and that it is now widely used on USSR ships.

The Subcommittee recognized that this chafer has not been in use for a very long period, and difficulties with respect to its strengthening function might arise. Further experiments with Polish chafers having twine size greater than codend twine size (Res.Doc.68/4) indicate that increased twine size in the chafer may not materially reduce codend selection, but that more information concerning this modification is required.

Progress toward means of elimination of topside chafers by means of heavier netting twines in the codend was reported by UK (Res.Doc.68/16). The Subcommittee welcomed this report, and urged further work along these lines because of the importance of this topic to the Commission.

10. Field identification of Net Materials

One contribution on this topic (Res.Doc.68/94) was presented and discussed, but it is clear that no foolproof means of identifying various synthetics in the field has yet been described. It is possible that some simple chemical test might be devised. Anticipating possible future difficulties in this regard, the Subcommittee would welcome descriptions of procedures now in use, particularly for polypropylene, polyethylene and polyamide twines.

11. Hook Selection

Data relating to hook selection were presented in Res.Doc.68/2 and 68/10. No definite conclusions were drawn from these studies, but the Subcommittee noted that differences in hook selectivity were more easily demonstrated for longlines than for various handline gears.

12. New Selectivity Data

The Subcommittee welcomed a contribution (Res.Doc.68/91) on selectivity of yellowtail flounder, particularly as available data for this and other flounder species are not extensive.

APPENDIX IV - SUBCOMMITTEE ON ENVIRONMENTAL STUDIES

Chairman: H.W.Graham; Rapporteur: W. Templeman

The Subcommittee met 29 May at 1400 hours.

1. Report on NORWESTLANT Surveys (ICNAF Special Publication No.7)

Mr Lee reported on the four parts of the publication.

Part I. Text. This is completed including Mr Horsted's note on the 1963 year-class of cod in West Greenland. Final typing of the report will be completed by the end of 1968; the printed version will be ready by the 1969 meeting.

Part II. Atlas. There are 270 charts. These are now at the ICNAF Secretariat and this part also should be available for the 1969 meeting.

Part III. Oceanographic data. This is being prepared by the Canadian Oceanographic Data Centre in 3 volumes which will go to the printer in August 1968.

Part IV. Biological Studies. Mr Corlett has completed the checking of all tables except those for phytoplankton which are numerous. The production of this part will be slower than for Parts I-III, but Parts I-III should proceed and not be delayed by waiting for the production of Part IV.

2. Report of the ICNAF Georges Bank-Gulf of Maine Environmental Survey

Mr Posgay reviewed progress made during the year on preparations for the fish egg and larvae survey in Subarea 5. Res.Doc.68/85 describes two new zooplankton samplers (Bongo nets) developed in the USA and gives the results of tests designed to measure their efficiency. Briefly, these samplers give a numerical catch-per-unit volume filtered which is not affected by speed of tow, length of tow, or mouth area. One of these samplers was also compared to a Gulf III sampler (Res.Doc.68/34); the Bongo net took more than 8 times as many copepods as the Gulf III sampler during simultaneous tows.

A joint USA-USSR exercise on the design, conduct, and analysis of a zooplankton sampling program was held in Subarea 5 during 1967 (Res.Doc.68/88). The results are not yet fully analyzed but, in brief, they show large significant differences in the estimates of abundance between ships, between areas, and between times. Another joint exercise between the USA, USSR and Canada is planned for 1968 to further investigate these problems. The USA has collected a series of samples on Georges Bank at 2-week intervals during March, April and May of 1968 in an attempt to define an egg production curve for spawning haddock. These samples are not yet fully analyzed

but seem to show that the peak of spawning occurred 5-6 weeks later in 1968 than it did in 1953 to 1955. There is a possibility that Canada, USSR, and USA will be able to participate in an enlarged version of this experiment in the spring of 1969.

Dr Bogdanov said that the USSR attaches great importance to joint surveys such as that carried out by the USSR and USA. He also looked forward to continuation of these researches with the additional cooperation of Canada.

Dr Cole reported that the UK will test the Bongo sampler described in Res. Doc.68/85 against the plankton samplers presently in use.

3. Environmental aspects of the National Research Reports

Scientists from Canada, Denmark, Germany, Poland, Romania, USSR, UK and USA reported on hydrographic and plankton research in the ICNAF Area - Res.Doc.68/3, 5, 6, 8, 11, 13, 15-17, 34, 37, 39, 85, 88, 90, 96 and 97. The reports by France (Res.Doc.68/7) and Norway (Res.Doc.68/10) were also considered.

In West Greenland, temperatures over the banks and on the slope of the shelf were lower in 1967 than in recent years.

In the Labrador-Newfoundland area the coastward colder part of the Labrador Current had lower temperatures and the offshore slope water at the edge of the Continental Shelf higher temperatures than usual.

For Subareas 4 and 5, Canadian and US data indicated that sea temperatures in 1967 continued the decline observed since 1952.

The USSR on the other hand found that on the Scotian Shelf, Georges Bank and in the Gulf of Maine sea temperatures were higher than in 1966.

Mr Horsted informed the Subcommittee that the major part of Danish research in Subarea 1 in 1968 with the new research vessel *Adolf Jensen* will be a study, throughout the year, of hydrographic conditions in Davis Strait. Four oceanographic sections will be worked so far as ice conditions permit.

4. Report on activities of IOC and SCOR

Mr Lee drew the attention of the Subcommittee to IOC Resolution V/13 set out in Comm.Doc.68/3. This resolution invites ICNAF to establish together with ICES and IOC a joint coordination body for the North Atlantic. After considerable discussion the Subcommittee agreed that such a body would be useful and

recommends (7)

(i) that ICNAF reaffirm the conclusions reached at the discussion in 1967 of the proposal for large-scale hydrographical surveys of the North Atlantic (Redbook 1967, Part I, pp.69-70, No.7);

(ii) that, nevertheless, the invitation to send two representatives to a Coordinating Group with IOC and ICES should be accepted on the understanding that the main purpose of the group will be the co-ordination of hydrographic work being undertaken under the auspices of the various international bodies and not the planning of new large-scale programs of investigation;

(iii) that ICNAF be represented at the first meeting of the Group which may be held at the forthcoming ICES meeting in October 1968 by the Executive Secretary and one other member.

Mr Lee reported that SCOR had not met.

5. Consideration of the Report of the ICES Hydrographic Committee, October 1967

Mr Tambs-Lyche summarized the Report of the ICES Hydrographical Committee, October 1967, and also provided information on the Symposium on Physical Variability of the North Atlantic. This symposium will be held on 25-27 September 1969 at Dublin immediately preliminary to the ICES Annual Meeting. UNESCO, SCOR and IAPSO will take part in the planning with ICES and there is a scientific planning group with Prof. Dietrich as Chairman.

On behalf of ICES, Mr Tambs-Lyche extended an invitation to ICNAF to co-sponsor the symposium and to appoint one member to the scientific planning group. The Subcommittee

recommends (8)

that ICNAF accept this kind offer of ICES and that a member of the planning group be nominated by R&S.

6. Environmental changes in relation to fisheries

Res.Doc.68/36 on "Change in cod distribution in the Labrador area in relation to changes in hydrographical conditions" was presented by Dr Alexeev. Soviet work on this subject will be continued.

7. Reviews of environmental conditions

There was a discussion on the usefulness of providing summaries of environmental conditions in the ICNAF Area, especially in relation to trends in temperature. It was generally agreed that reviews such as that produced in 1967 are extremely useful and should be produced at intervals of every few years as the need becomes apparent.

8. The Subcommittee adjourned at 1700 hours.

APPENDIX V - REPORT OF SUBCOMMITTEE ON HERRING AND OTHER PELAGIC FISHES

Chairman: G.J.Ridgway; Rapporteur: Y. Jean

The Subcommittee met on Monday, 27 May, at 10:30 a.m.

A. Herring

1. Review of pertinent documents

The Chairman listed the following documents of interest to the Subcommittee: Res.Doc.68/5, 68/8, 68/11, 68/13, 68/15, 68/17, 68/18, 68/22, 68/30, 68/35, 68/49, 68/50, 68/53, 68/60, 68/62, 68/67, 68/68 and 68/69.

2. Review of Fisheries and Research

Canada reported that Newfoundland herring landings, mainly from Subarea 3, rose sharply from 28,000 tons in 1966 to 83,000 tons in 1967. This is due mainly to a great increase in purse seining. In Subareas 4 (excluding Div. 4R) and 5, herring landings amounted to more than 263,000 tons, an increase of about 42,000 tons over 1966.

Egg and larval surveys and observations on spawning were made by Canada in the Gulf of Maine, the Gulf of St. Lawrence and off Newfoundland. The herring were sampled for age, length, weight, sex, maturity and vertebral numbers. Ages were estimated from otoliths. Movements of herring stocks in the Newfoundland area were also studied. Fecundity studies are in progress for all major herring stocks. Preliminary results show a mean of 55,000 eggs for 32.4 cm (mean length) herring from spring spawning stocks in Div. 4T (Res.Doc.68/62). Other Canadian research documents on herring include 68/49, 68/67 and 68/68.

West Germany's (Res.Doc.68/8) total catch increased to about 26,350 tons, most of which came from Subarea 5. Vertebral counts made in various areas fished showed no significant differences. The catches presumably came from one stock. Age composition showed the 1960 year-class as the most abundant, followed by the 1961 year-class.

Poland's (Res.Doc.68/11) total catch increased to 37,711 tons in 1967 compared with 14,600 tons in 1966. All but 34 tons came from Subarea 5. Lengths ranged from 26.0 to 36.5 cm. The predominant year-class was also that of 1960. Res.Doc.68/53, giving more detailed information on Polish research, was not available at the time of the Subcommittee meeting.

Romania (Res.Doc.68/13) reported catches of 1,729 tons of all clupeoids in 1967 compared with 2,400 tons in 1966. Dispersal of herring shoals was related to oceanographic conditions in the Georges Bank area.

USSR (Res.Doc.68/15) reported a total catch of 127,340 tons. Of these, 124,153 tons come from Subarea 5 and 3,187 tons from Subarea 6. This is a slight increase over 1966 when 122,340 tons were landed. Age composition of the catch was determined from samples. The 1960 year-class was dominant (42.2 percent), followed by the 1961 year-class (36.6 percent of the catch). Research on the food of larval herring was reported; 84.5 percent of the larvae contained no food in September and October. Major food items included nauplii, larval lamellibranchs and copepods.

USA (Res.Doc.68 17) catches came from Subarea 5 and 6. They amounted to 32,353 tons compared with 33,673 in 1966. The catch of young herring in Div.5Y increased slightly to 29,302 tons in 1967 from 27,200 tons in 1966. The decline in abundance in western Maine continued. The 1967 catch was the smallest in this district since 1951. The age composition of the sardine catch remained unusual: 2-year-old fish made up only 51 percent and 3-year-old fish 22 percent of the catch. Four-year-old fish represented 15% of the catch, the highest percentage on record in the Maine sardine fishery.
In samples taken from Georges Bank by US research vessels, the 1961 year-class was dominant, followed by the 1960 year-class (Res.Doc.68/35).

Research was continued on abundance and distribution of pre-recruits, behaviour, races, food of larval and sardine-size herring and population dynamics of the Div.5Y stock. In Res.Doc.68/50, it is shown that the composition of the food of herring larvae varies seasonally.

Nominal catches of herring for 1967, the largest on record for the Statistical Area, are compared with those for 1966 in Table 1.

Table 1. Summary of nominal catch (tons) of herring by country in 1966 and 1967.

	1966	1967
Canada (M)	228,178	263,082
Canada (N)	28,058	81,883
Denmark (G)	6	-
Germany	-	26,350
Poland	14,663	37,711
Romania	2,677	332
USSR	122,340	127,340
USA	33,673	32,353
Non-Members	1,133	17,000
Total	430,728	585,051

3. Sampling Results from Georges Bank area

The sampling results from the Georges Bank area are summarized in Table 2.

Table 2. Age and size compositions of herring samples taken in the Georges Bank area.

Country	Year-class (%)							Length (cm)	
	'64	'63	62'	'61	'60	'59	<'59	Range	Mean
Germany	1	8	16	18	45	4	6	24-35	30.41
Poland					D*			26-36.5	-
Romania		0.6	1.3	18	29	26	25	26-31**	-
USA				D	2ndD			20.3-35.0	
USSR		3.6	11.8	36.6	42.2	5.0	0.2	no report	

*D = dominant
** = most abundant length

The Subcommittee

recommends (32)

that all countries report mean lengths as well as size ranges of herring caught.

The Subcommittee discussed the otolith exchange program (Res.Doc.68/60). It was felt that, as in the case of cod, an exchange of herring otoliths and otolith photographs was the best way to resolve the problem of discrepancies in readings by different countries. The Subcommittee

recommends (33)

that the herring otolith exchange program be continued and, if possible, an exchange of scales and photographs of otoliths be made in order to allow comparing criteria for herring age determination.

Canada agreed to coordinate an additional exchange of otoliths and to look into the feasibility of using photographs of otoliths for exchange purposes.

Interest in this program was shown by Canada, Germany, Poland, Romania, USA and USSR. Persons to be contacted in this regard are Mr Tibbo, Dr Schubert, Dr Draganik, Dr Niculescu Duvaz, Mr Skud and Dr Noskov.

4. Georges Bank catch/effort data 1967

Catch/effort data for herring in the Georges Bank area were provided by Germany (Res.Doc.68/8). Catches per trawler per day were 54.2 tons in August, 23.8 tons in September, 50.0 tons in October, 40.9 tons in November and 41.3 tons in December. The overall average was 41.8 tons per trawler per day. It was pointed out that the catch by German trawlers was often limited by the freezing capacity of the vessel. Therefore, these figures do not provide a good index of abundance.

Poland provided catch/effort data for a variety of vessel types. The factory trawlers took 3.14 tons of herring per trawling hours in 1967 compared with 4.24 tons per trawling hour in 1966 (Res.Doc.68/11).

USSR reported catch/effort data for all pelagic species combined (including some incidental catches of groundfish) for BMRT vessels: 2.69 tons per hour in 1967, 2.78 tons in 1966 and 3.11 tons in 1965.

USSR will attempt in the future to provide catch/effort data by species and by month. Some difficulty is anticipated because of the rapid changes in the fishery.

5. Year-class changes on Georges Bank

USSR observations show that the 1960 and 1961 year-classes have dominated the Georges Bank catches since 1964 (Res.Doc.68/13 and Table 2 above). The 1967 results indicate that the 1967 year-class was not a particularly good one and that the 1963 year-class was a poor one.

6. Year-class changes in coastal waters

The 1964 year-class was apparently a poor one in coastal waters of Div.5Y. The 1965 year-class was also below par. As a result, the percentage of 2-year-olds in the sardine (young herring) catch was lower than usual. In southern New Brunswick (Div.4X) stocks, the 1965 year-class was predominant (69.9 percent) in the landings until September when the 1966 year-class entered the fishery. From October through December 71.4 percent of the fish examined were of this year-class. The 1963 and 1966 year-classes which had contributed most of the 1966 fishery were relatively unimportant in 1967. Off southwest Nova Scotia (Div.4X) both juvenile and adults contribute to the fishery. A slight increase in mean size and age is consistent with the continued dominance of the 1963 and 1961 year-classes.

7. Review of length measurements used for herring

The Subcommittee referred to the 1967 Redbook, Part I, Appendix II, item 2(b) and to Res.Doc.68/30. In the latter document is outlined procedures for reporting herring lengths by ICES countries. Because of the general uniformity of the use of total length and reporting to the nearest half centimetre below by ICES countries, the Subcommittee

recommends (9)

that all herring length measurements made by ICNAF countries be total length and be reported to the half centimetre below.

8. Other Matters

The question of whether sampling data on herring should be published in the Sampling Yearbook was referred to this Subcommittee by the Statistics and Sampling Subcommittee. The question was discussed and the Subcommittee

recommends (10)

that sampling data on herring be published in the Sampling Yearbook and that the Secretariat develop a suitable format after consultation with herring workers.

B. Swordfish and Tuna Catch and Research

Catches of swordfish and tuna in the statistical area in 1967 are reported in Res.Doc.68/18. Canada's catch of swordfish amounted to 4,794 tons. The catch of swordfish by USA was 184 tons. Catches of bluefin tuna by all countries in the statistical area were 394 tons. The catch of mixed tuna species by all countries was 297 tons. Canadian research on swordfish was reported in Res.Doc.68/5 and 68/69. Studies were made on size, sex, food, parasites, tagging, abundance and distribution. Tagging of tuna was continued by both Canada and the USA in 1967.

Mr Gulland, the FAO observer, reported to the Subcommittee on the Atlantic Tuna Commission and on a tuna stock assessment meeting to be held in Miami in August 1968.

Mr Tambs-Lyche, the ICES observer, summarized the results of trans-Atlantic migration of tunas reported at the last ICES meeting.

C. Porbeagle and other sharks

There were no separate statistics on the porbeagle fishery available at the time of the Subcommittee meeting. Catches of sharks amounted to 2,899 tons in the statistical area in 1967.

Research carried out by USA on dogfish is reported in Res.Doc.68/40. Tagging of sharks was also carried out by the USA in 1967.

D. Mackerel fishery

Total landings of mackerel in the statistical area were 32,656 tons in 1967, an increase of about 6,000 tons over 1966. Canadian research involving age composition, migrations and location of spawning stocks is described in Res.Doc.68/5.

E. Other Matters

The ICES Symposium on the Biology of Early Stages and Recruitment Mechanisms of Herring to be held in Copenhagen, 26-28 September 1968, was brought to the attention of the Subcommittee. Mr Saville of the Aberdeen Laboratory is the Convener.

The decrease in catches of argentines by the USSR in 1967 was explained by a lack of commercial interest.

The meeting adjourned at 12:35 p.m.

APPENDIX VI - REPORT OF THE SUBCOMMITTEE ON AGEING TECHNIQUES

Chairman: J. Messtorff; Rapporteur: R.W.Blacker

The Subcommittee met on 27 May 1968, 1400 hrs. Delegates of the following member countries were present: Canada, Denmark, Germany, Poland, Portugal, UK, USA and USSR. The General Secretary of ICES, Mr H. Tambs-Lyche, attended the meeting as observer.

The following documents were referred to: Res.Doc.68/24, 68/29, 68/38, 68/68, 68/73, 68/74 and 68/89.

The agenda as given by the Standing Committee on Research and Statistics was adopted without alteration and discussed and commented on as follows:

1. Review of results of cod otolith photograph exchange program (Res.Doc.68/74)

Mr Blacker summarized and commented upon his report on the cod otolith photograph exchange 1963-67. The Subcommittee expressed its thanks to him for his most valuable contribution as well as for his continued services in supervising the exchanges.

The Subcommittee felt that the exchange had fulfilled its objective in showing the extent and some of the causes of discrepancies in cod age-determination in the ICNAF Area. It was agreed that all discrepancies could not be eliminated, but the exchanges showed that there had been a considerable improvement in otolith readings. However, the measure of agreement varied for different subareas. The average percentages of readings giving complete agreement in age of cod of the subareas sampled were:

Subarea 1	:	82.2 percent
Subarea 2	:	63.0 percent
Subarea 3	:	63.5 percent
Subarea 4	:	42.8 percent

But nearly 90 percent or even more of the readings were within one year of the "best age" for all subareas, except Subarea 4 for which the corresponding figures were only 75 to 85 percent.

The Subcommittee agreed that it was unlikely that further improvement would be obtained by continuing the exchange scheme, but that exchanges of routine otolith samples between laboratories could be helpful. In certain cases exchange visits of otolith readers would also be useful. Therefore the Subcommittee

recommends (11)

that the cod otolith photograph exchange program be discontinued and replaced by an informal exchange of routine otolith samples between laboratories or individual consultation of otolith readers whenever required.

2. Report of the Working Group of Redfish Experts convened at Lowestoft, 20-22 May 1968 (Annex I)

The Chairman of the Working Group, Dr Messtorff, presented the report, which is appended as Annex I, to the Subcommittee. The report was adopted without further comments and following the proposal of the Working Group therein the Subcommittee

recommends (12)

that an exchange of redfish otoliths and scales be started as outlined in Annex I and a report be submitted to the 1969 ICNAF Annual Meeting.

The Subcommittee gratefully acknowledged the contribution that the Fisheries Laboratory, Lowestoft, will continue to make in preparing the photographs and supervising the exchange.

3. Review of information on silver hake age reading problems including otolith photograph exchange

The Subcommittee took notice that there was only one document (Res.Doc. 68/89) available in which reference was made to the basic techniques used in ageing silver hake. This had been submitted last year by F.E.Nichy (USA) as Res.Doc.67/109. But the Subcommittee was informed by Mr Hennemuth (USA) that basic problems of silver hake age determination are being studied by the USA and it was noted that age compositions for Subarea 5 reported by the USA and USSR indicated good agreement. The Subcommittee agreed that for the time being no further action is required.

4. Age validation of ICNAF species

(a) No validation studies were presented at this meeting but the Subcommittee noted that Res.Doc.67/78, 67/87 and 67/109 should be added to the Inventory Of Age Validation Studies on ICNAF Species compiled and submitted by the Secretariat at the 1966 Annual Meeting (Res.Doc. 66/57).

(b) Distribution of type otoliths from validation studies

The Subcommittee noted that no otoliths or photographs of type otoliths have been received as yet by the Secretariat (according to Recommendation 39, 1966). The Subcommittee reaffirmed that photographs and (or) transparencies should be circulated amongst interested countries. It was noted that suitable photographs are already available from the cod otolith exchange program. The Subcommittee therefore

recommends (13)

that Mr Blacker of Lowestoft be requested to provide the Secretariat with a set of transparencies of type otoliths of the recent exchange program, and that these be available at the request of interested countries.

(c) Further additions to inventory of validation studies

The Subcommittee agreed that it would be useful to maintain this inventory and

recommends (34)

that the pertinent documents and published papers be brought to the attention of the Secretariat each year to allow it to maintain an inventory of publications on age reading validation studies and that this be updated and documented every five years.

5. Information on further results of herring otolith exchange among Canada, Poland and USA

As the results (Res.Doc.68/60) had already been considered by the Herring Subcommittee, it was not necessary to further discuss this, although Dr Messtorff drew the Subcommittee's attention to the general conclusion which pointed up the necessity of frequent and direct communication and consultation between scientists of the various laboratories.

6. Other Matters

(a) The Subcommittee took notice of Res.Doc.68/38 in which data were presented on the ageing and growth rate of red hake, *Urophycis chuss* W., Mr Hennemuth (USA) noted that US workers were not yet at the point where they can assess the ages of red hake with confidence, and welcomed the progress of USSR scientists in this matter. The Subcommittee affirmed that an exchange of materials between the experts concerned might be a useful means of making further progress in this problem.

(b) As a matter of interest, the Subcommittee noted Res.Doc.68/73 concerning standardization of methods of age designation in Atlantic salmon.

(c) The Chairman of R&S, Mr Horsted, suggested that the Subcommittee might consider whether it was necessary to maintain the Subcommittee on Ageing Techniques as a separate standing subcommittee of R&S, and that perhaps any matters appropriate to this subcommittee in future might be better dealt with by *ad hoc* subcommittees or working groups, which would be set up by R&S when required.

There was some discussion about the problems which might arise if this Subcommittee was discontinued and how its responsibilities might be adequately maintained. The Subcommittee agreed that in principle simplification or streamlining of the committee work was most desirable and that the proposal should be referred to R&S for further discussion and decision.

Report of the ICNAF Working Group of Redfish Experts

Lowestoft, 20-22 May 1968

The Working Group was convened on 20-22 May 1968 at the Fisheries Laboratory, Lowestoft, following the recommendation (No.15) of the Research and Statistics Committee at the ICNAF 1967 Annual Meeting.

Experts from the following member countries were present: Canada (St. John's) (Mr E.J.Sandeman), Denmark (Dr P.M.Hansen), Germany, Fed. Rep. (Dr J. Messtorff, Dr K. Kosswig, Dr F. Mombeck), USSR (Dr A. Alexeev, Mr Zheltov), UK (Mr R.W.Blacker), USA (Mr R.C.Hennemuth).

Dr A. Meyer, who convened the meeting, was unfortunately unable to attend and Dr Messtorff agreed to be Chairman.

Dr H.A.Cole welcomed the delegates.

Mr Sandeman submitted his paper "Age determination and growth rate of redfish (*Sebastes* sp.) from selected areas around Newfoundland" (ICNAF Res. Doc.68/29).

There was a short discussion of the problems involved in the determination of redfish age and the group reviewed some of the information available on other methods independent of scale and otolith readings. These included Dr Hansen's excellent series of data from Godthaab Fjord on length distribution of small redfish (Petersen method) and the tagging experiments of both Dr Hansen and Mr Kelly (USA). It was noted that more validation studies are needed and, especially, information on post-larval and pre-settlement stages is required.

The following two days were spent in examination of material brought by the delegates. At present all the experts use otoliths except USSR experts who use scales. Several different techniques for otolith reading are in use: whole otoliths cleared and uncleared and broken otoliths viewed by transmitted or reflected light.

Comparisons were made of cleared whole otoliths, cut otoliths (burnt and unburnt) and scales from the same fish, but scales as well as otoliths were available only for a small number of fish and did not include fish older than twenty years.

It was agreed that the otoliths of redfish from Subarea 5 (Gulf of Maine) presented little problem because of their regular growth pattern. The main difficulty in otoliths from other areas was the interpretation of the innermost zones, but scales from small fish were valuable in helping the interpretation of these early growth zones. In fish older than fifteen years, the

outer zones also caused some difficulty. However, it was found that the discrepancies that did exist were much smaller than had been anticipated and the differences in age were usually only one or two years.

Thus the basic methods of interpretation seemed to give excellent agreement in ages as determined from otoliths and (or) scales up to fifteen years on these selected samples. It was felt that greater discrepancies would occur in ages as determined by scales and otoliths in older fish and that otoliths were more likely to yield the better estimates of age. An exchange of otoliths and scales is needed to check this and see how far agreement is maintained in representative random samples which cover the complete range of lengths in several stocks. The Working Group agreed that such an exchange is desirable and the Soviet experts expressed their particular interest in gaining more experience at reading otoliths and that this could be achieved by an exchange of this type.

It is suggested that samples from Subareas 1, 2, 3 and 4 should be exchanged. The samples should include whole otoliths and scales from ten to twelve fish. Germany will provide the sample from Subarea 1, USSR that from Subarea 2 and Canada (St. John's) those from Subareas 3 and 4. Mr Blacker agreed to prepare photographs to accompany the otoliths and scales and to supervise the exchange, and therefore the samples should be sent to him. The initial exchange should be restricted to members from the Working Group and every endeavour should be made to complete it so that a report can be submitted to the 1969 ICNAF Annual Meeting.

The Group expresses its appreciation and thanks Dr Cole and his staff, particularly Mr Blacker and his colleagues, who contributed so much to the success of the meeting.

APPENDIX VII - STANDING COMMITTEE ON RESEARCH AND STATISTICS - AGENDA

1. Introduction

   (a) Adoption of Agenda
   (b) Appointment of Rapporteur
   (c) Plan of work of Research and Statistics, its subcommittees and Scientific Advisers to Panels

2. Reports from:

   (a) ICNAF observer to ICES (Dr H.A.Cole)
   (b) ICNAF observer to SCOR and IOC (Mr A. Lee)

3. Assessments (Chairman: B.B.Parrish)

   (a) Trends in total catch and fishing effort
   (b) Review of latest statistics of catches and fishing activity
   (c) Further assessments of ICNAF fish stocks with special reference to recommendations from Standing Committee on Regulatory Measures
   (d) Review of reports of ICES/ICNAF Joint Working Party on North Atlantic Salmon, Hamburg, October 1967, and London, May 1968
   (e) Assessments of harp seal fisheries
   (f) Future assessment work
   (g) Other items

4. Statistics and Sampling (Chairman: F.D.McCracken)

   (a) Sampling

      (1) Review of Sampling Yearbook Vol.11, 1966
      (2) Herring sampling data for Sampling Yearbook
      (3) Transfer to data processing cards and first analyses of age/length data for 1961, 1962 and 1963 (Redbook 1967, Pt.I, p.53)
      (4) Review of 1966 sampling in relation to 1966 catch to highlight problems

   (b) Consideration of recommendations of Joint ICES/ICNAF Sampling Meeting, Rome, 1-2 October 1965 (Res.Doc.66/13 and 66/45)

      (1) Review of decisions made at 1967 meeting (Redbook 1967, Pt.I p.53)
      (2) Consideration of herring measuring differences (Redbook 1967, Pt.I, p.53)

   (c) List of Vessels

      (1) Review of national views regarding ICNAF List of Vessels (Rec.5, 1967)
      (2) Review of ICES List of Vessels in relation to joint ICES/ICNAF list (Rec.14, 28, 1966)

(d) Statistical reporting

(1) Report on statistical activities by the Secretariat
(2) Evaluation of 1966 discard data (ICNAF Stat.4) (Rec.23, 1967)
(3) Review of Statistical Bulletin 16 for 1966 and format of future Statistical Bulletins (Rec.26, 27, 28, 1967)
(4) Evaluation of 1966 and 1967 effort data (ICNAF Stat.3)
(5) Common and scientific names of ICNAF species (Rec.29, 1967)
(6) Standard abbreviations and symbols in international use of statistics
(7) FAO fisheries statistics activities

(e) Consideration of the report of the ICES Statistical Committee, October 1967
(f) Progress report on extension of ICNAF statistics collection southward (Rec.9, 1967)
(g) Results of FAO Questionnaire on Biological Statistics for Fish Stock Assessment (Redbook 1967, Pt.I, p.59-60)
(h) Designation of Atlantic and Greenland halibuts
(i) Other matters including

(1) FAO proposals for reorganization of the CWP
(2) Species sought or species caught
(3) Definition of effort

5. Gear and Selectivity (Chairman: A.W.May)

(a) Review of the report of the ICES Gear and Behaviour Committee, October 1967
(b) Tabular summary of selectivity data (Redbook 1967, Pt.III) and possible joint ICNAF/ICES summaries
(c) Selectivity of different codend materials (Redbook 1967, Pt.I, p.63)
(d) Length, weight and girth data - Bibliography and current data (Rec. 32, 1967)
(e) Meshing of redfish (Rec.33, 1967)
(f) Catch size and selectivity, particularly for redfish (Redbook 1967, Pt.I, p.64)
(g) Summary of trawl material and mesh size sampling data, 1967 (Rec.34, 1967)
(h) Adoption of standard gauge for enforcement (Redbook 1967, Pt.I, p.65)
(i) Topside chafing gear

(1) Review of further experiments with Polish and other chafers (Redbook 1967, Pt.I, p.66)
(2) Elimination of topside chafers (Rec.13, 1967)

(j) Field identification of net materials (Redbook 1967, Pt.I, p.67)
(k) Other matters

6. Environmental (Chairman: H.W.Graham)

   (a) Report on NORWESTLANT Surveys (ICNAF Sp. Pub. No.7)
   (b) Preliminary Report of the ICNAF Georges Bank-Gulf of Maine environmental survey (Redbook 1967, Pt.I, p.69)
   (c) Environmental aspects of the national research reports
   (d) Report on activities of IOC, SCOR and ACMRR
   (e) Cooperative systematic studies in the North Atlantic, IOC Resolution V-13, October 1967
   (f) Consideration of the report of the ICES Hydrographical Committee, October 1967
   (g) Environmental changes (atmospheric and oceanic) in relation to fisheries
   (h) Other matters

7. Herring and Other Pelagic Fish (Chairman: S.A.Studenetsky)

   (a) Herring

      (1) Review of pertinent documents
      (2) Review of fisheries and research
      (3) Sampling results from Georges Bank area
      (4) Georges Bank catch/effort data, 1966
      (5) Year-class changes on Georges Bank (Rec.20, 1966)
      (6) Year-class changes in coastal waters (Redbook 1966, Pt.I, p.79)
      (7) Review of length measurements used for herring
      (8) Other matters

   (b) Swordfish and tuna catch and research
   (c) Porbeagle and other shark fisheries
   (d) Mackerel fisheries
   (e) Other matters

      (1) ICES Symposium on the Biology of Early Stages and Recruitment Mechanisms of Herring, October 1968 (ICNAF Circular Letter 66/21 dated 29 November 1966)

8. Ageing Techniques (Chairman: J. Messtorff)

   (a) Review of results of cod otolith photograph exchange program (Redbook 1967, Pt.I, para.1, p.76)
   (b) Report of the Working Group of Redfish Experts, Lowestoft, 20-22 May 1968 (Rec.15, 1967)
   (c) Review of information on silver hake age reading problems including otolith photograph exchange (Redbook 1967, Pt.I, para.3, p.76)
   (d) Age validation of ICNAF species

      (1) Reports of further validation studies (Rec.38, 1966)
      (2) Distribution of type otoliths from validation studies (Rec.39, 1966, and Rec.16, 1967)
      (3) Further additions to inventory of validation studies (Res.Doc. 66/57; Rec.37, 1966)

(e) Information on further results of herring otolith exchange among Canada, Poland and USA (Re.: Herring Subcomm., Redbook 1967, Pt.I, p.74, 1st section)
(f) Other matters

9. Steering and Publications (Chairman: Sv. Aa. Horsted)

(a) Future work of R&S in relation to the new Standing Committee on Regulatory Measures
(b) Review of function and composition of S&P Subcommittee
(c) Review of fisheries in ICNAF Statistical Subarea 6
(d) Consideration of Reports of

(1) ICES/ICNAF Joint Working Party on North Atlantic Salmon
(2) Panel A (Seals) and Scientific Advisers
(3) Working Group of Redfish Experts

(e) Review of ICNAF publications 1967/68
(Res.Bull. 4 and 5; Ann.Proc. Vol.17; Redbook 1967; Sampling Yearbook Vol.11; Stat. Bull. Vol.16; Sp. Pub. 7; FAO/ICES/ICNAF Joint Index of North Atlantic Publications; ICNAF Handbook)
(f) Progress reports on

(1) preparations for FAO/ICES/ICNAF/UNESCO/IBP Marine Food Chains Symposium, Aarhus, Denmark, 23-27 July 1968
(2) printing of new ICNAF coloured map

(g) Proposals for comprehensive index of ICNAF publications and documents
(h) Consideration of papers for Redbook 1968, Pt.III, and Research Bulletin
(i) Other matters

10. Mid-year meetings

11. Coordination and cooperation with other organizations

12. Election of officers for the ensuing year

13. Arrangements for the 1969 meetings

14. Other matters

INDEX OF RECOMMENDATIONS