INTERNATIONAL COMMISSION FOR  THE NORTHWEST ATLANTIC FISHERIES

REDBOOK 1970 PART I

STANDING COMMITTEE ON RESEARCH AND STATISTICS

PROCEEDINGS

FROM THE

1970

ANNUAL MEETING

Note

REDBOOK 1970 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 1969. The third book contains Part III, Selected Papers from the 1970 Annual Meeting.

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PART I. REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS

Chairman: Sv. Aa. Horsted; Rapporteurs: D.J.Garrod and A.W.May

The Standing Committee on Research and Statistics (STACRES) met in St. John's, Newfoundland, Canada, from Monday, 25 May to Friday, 29 May 1970, in the week preceding and on 4 June in the week of the 20th Annual Meeting of the Commission. The Subcommittees on Assessments and Steering and Publications met in St. John's, 22-23 May and 24 May respectively. The Subcommittee on Assessments also had a mid-term meeting in London, England, 26-30 January 1970 (Comm.Doc.70/3). The ICES/ICNAF Joint Working Group on Selectivity Analysis met at the ICES headquarters in Charlottenlund, Denmark, 2-6 September 1969 (Comm.Doc.70/14) and 5-9 January 1970 (Comm.Doc.70/15). The ICES/ICNAF Joint Working Party on North Atlantic Salmon met in London, England, 2-5 February 1970 (Comm.Doc.70/13). The major items considered at these meetings are summarized below:

1. ASSESSMENTS (APP.I)

(a) Review of Latest Statistics of Nominal Catches and Fishery Trends

The provisional data on landings for Subareas 1-5 in 1969, with comparative data from 1959, are presented in Tables 1 and 2 of App.I. 1969 statistics from non-member countries, Denmark (F), France and Romania are not available at this time, but have been estimated or taken as equal to the 1968 landings and included in the tables.

Subarea 1

Total landings of cod from Subarea 1 (approximately 225,000 tons) were the lowest recorded since ICNAF statistics began in 1952. They were approximately 59% of the 1968 catch and half of the highest catch recorded in 1962. Severe ice conditions, poor recruitment in recent years, and diversion of effort to other areas are the main reasons for the sharp decline.

The decline in redfish catches since 1962 continued to approximately 5,000 tons in 1969.

Subarea 2

More than 90% of the total catch in 1968 and 1969 was made up of cod. Total catches in 1969 may have decreased by some 20,000 tons compared to 1968 when the highest catch (482,000 tons) was recorded. This level of catch is about four times the 1959 level. The high catch level in recent years is due to increased offshore fishing and catches, especially during late winter in Div.2J. This successful offshore fishery continued in 1969, whereas inshore catches continued their remarkable recent decrease to about 25% of the 1967 level.

Subarea 3

Total groundfish landings decreased from about 1,000,000 tons in 1968 to about 870,000 tons in 1969, mainly due to a decrease in cod catches (from over 700,000 to about 600,000 tons). The decrease may be accounted for largely by a decrease in effort.

Herring landings remained at the same level as in 1968 (approximately 145,000 tons).

Subarea 4

Total groundfish landings remained at the 1968 level (about 500,000 tons), which is somewhat below the 1963-66 average. Silver hake increased from 3,000 to 46,000 tons.

Herring catches increased again to a new record level of 422,000 tons taken mainly in Divs.4T and 4X, and with increasing catches in Div.4V and 4W.

Subarea 5

Total catches (all species) declined from about 906,000 tons in 1968 to 838,000 tons in 1969. Herring declined by over 100,000 tons, shellfish by 50,000 tons and haddock by 20,000 tons, while increases were recorded for yellowtail flounder (by about 20,000 tons), mackerel, alewives and some other species.

Subarea 6

Total landings increased from 665,000 tons in 1968 to 721,000 tons in 1969. Increasing catch was recorded for mackerel by Poland, and for herring, alewives and mackerel by USSR.

ICNAF Convention Area (Subareas 1-5)

Total groundfish landings decreased in all subareas except Subarea 5. 1968 landings were about 2,800,000 tons, 1969 landings between 2,500,000 and 2,600,000 tons.

Herring landings decreased in Subarea 5, increased in Subarea 4, and were stable in Subarea 3. 1968 landings were about 879,000 tons, 1969 landings about 786,000 tons.

(b) Status of the Stocks and the Fisheries and New Assessments.

A. COD

1. Subarea 1

Improvements have been achieved in the assessment models which now take into account the age-specific variation of fishing mortality rate due to the recruitment taking place over a span of years (partial recruitment).

Further studies based on these improved models have provided estimates of natural mortality rate consistent with the previous estimate (M = 0.2), and confirmed that overall fishing mortality rate (F) doubled from 1955 to 1965, when it was about 0.8-0.9 for fully recruited age-groups. This level is probably beyond that giving the maximum sustainable yield-per-recruit, and a reduction of fishing effort by up to 25% of this level (F reduced from 0.8 to 0.6) would not result in any significant loss of yield-per-recruit and would increase the catch-per-unit-effort (on a per recruit basis).

Based on 1967 figures and assuming F in 1968 to have increased slightly over that for 1967, the 1968 catch was predicted 349-360,000 tons in two independent studies. Actual catch yielded 382,000 tons.

Estimates of catches for 1970-71 based on 1968 data, and assuming the 1965 year-class to be moderate to good, and the 1966 year-class to be poor, are expected to be less than the 1968 catch. Possible range for catches in 1970 is 175,000-225,000 tons for F = 0.6-0.8, while 1971 catches are expected to be in the range of 140,000-200,000 tons depending on F in 1971 and on fishing in 1970.

Reports of the 1969 fishery point, in fact, to a considerable decrease in catch compared to that in 1968. Part of the decrease is due to lesser abundance of fish (as predicted) but reports indicate that the main part of the decrease was due to a decrease in fishing effort. The reason for the decrease in effort is partly bad ice conditions, and partly better catches-per-unit-effort in other areas.

Although the fishing mortality rate caused by an effort such as that in 1969 is close to that corresponding to the maximum sustainable yield, any improvements in ice conditions or stock abundance (recruitment) relative to other areas will again attract great effort to the subarea. This is especially true should a good year-class recruit to the fishery and might lead to a short-term, very large increase in catch and fishing mortality but also leave a depressed stock when effort is moving elsewhere. This is undesirable, so that the need to regulate fishing, and, more particularly, to prevent sudden expansion of fishing, still exists.

2. Subareas 2 and 3

(i) Yield/effort assessment. New assessments have confirmed previous conclusions that the level of fishing mortality in recent years is beyond that required to give the maximum yield-per-recruit. The high catch level in 1968-69 (1,182,000 and 1,000,000 tons respectively) was the result of rapid increase in effort, and of a favourable recruitment pattern to the stock. The 1964 year-class is a very good one, but was fished heavily at the time of its first recruitment (1967) and is, therefore, not likely to contribute with its full potential to the long-term fishery.

Year-classes since 1964 are poor, and the high catch level of 1968-69 is, therefore, not likely to be maintained except in Div. 3NO where a good 1968 year-class will enter the fishery in the early 1970's.

An appropriate reduction in F would give increased catch-per-unit-effort, although the improvement in yield-per-recruit is probably not more than could be expected for an increase in mesh size at the present level of fishing. If the increased effort of 1967-68 were sustained, it would cause larger year-to-year variations in yield from this stock because of increased dependence of the fishery on one or two recruiting year-classes, especially in Div.3NO where year-class survival is more variable than in the larger, more northern stocks.

(ii) Mesh assessment. In 1969 STACRES reported that for cod in Div.3NO long-term increases in catch-per-recruit would be obtained with mesh size increases to 130 mm, and even to 150 mm.

Assessments undertaken during the past year have been completed for cod in Div.2J, Div.3KL and Div.3Ps assuming mesh size in use in each area during the 1964-68 period to have been 114 mm.

These new assessments, and the previous assessments for cod in Div.3NO, indicate that, in general, small to moderate long-term increases in yield-per-recruit in Subarea 2 and 3 as a whole could be obtained with increases in mesh size from the 114 mm to 130 mm. Short-term losses by such an increase would be small (less than 10%). For increases beyond the 130 mm, there is the prospect of further small gains except in Subarea 2 for 150 mm. In each area, short-term losses would be of the order of 20% for the 150 mm mesh.

No information was available to evaluate the effect of such mesh regulations upon the catch of other species but previous assessments indicate that increases from 76 mm mesh to 114 mm would result in immediate losses to redfish landings of 6% in Div.3KL, 10-15% in Divs.3M and 3Ps, and 50% in Div.3NO. For increases in mesh beyond 114 mm, the immediate losses of redfish would be rather greater.

(iii) Immediate prospects for catch. In Subarea 2 variation in year-classes is of the order of 3 to 4 times. The 1966 year-class is probably very rich but the fish will be too small for intensive fishing in 1971. The stock abundance is, therefore, likely to decrease in 1971, but it is stressed that actual Labrador catches are very dependent on the peculiarities of cod distribution.

On the southern Grand Banks, year-classes may fluctuate by 50 times. The present year-class situation points to satisfactory fishing for cod in 1971-72 in Div.3NO although at a slightly lower rate than in 1967-68.

(iv) Cod stocks at Flemish Cap (Div.3M). This stock is an isolated one. No special assessments have been made, but, because of the isolation from other cod stocks, this stock presents a less complex situation for determining the effect of regulatory measures.

3. General Conclusions concerning ICNAF Cod Stocks

Full assessments for cod in Subarea 1 are given on pages 37, 40-41, App.I. Assessments for cod in Subareas 2 and 3 are not so complete and none are available for Subareas 4 and 5.

The studies presented do, however, substantiate the earlier conclusions that fishing is beyond that required to secure the maximum yield per recruit. The present high yields in 1967-68 have been achieved largely by decreasing the stocks accumulated under previously lower levels of exploitation and a period of good recruitment. The total yield is now expected to decrease further from the 1969 level, and, at best, it is probable that over the long run, no more than the present total catch (1,200,000 tons) would be taken with increased effort, and there might well be a decrease in total catch.

STACRES, therefore, believes that the Commission should give consideration to limitation of fishing on all cod stocks in the ICNAF Area.

B. HADDOCK

1. Div.4VW

STACRES believes that this stock has been fully exploited in recent years. A low 1967-68 abundance of 4 to 12 year-old fish lead to a minimum catch of 10,912 tons in 1967, and a decreasing interest and hence effort in this fishery after the too heavy exploitation on immature fish of the abundant 1962 and 1963 year-classes. The 1969 abundance was the lowest on record.

The optimum level of fishing mortality rate appears to be 0.5 corresponding to a fishing effort of about 60,000 hours trawled (Canadian

large trawler units). Assuming the 1964 and subsequent year-classes are poor (10 million fish at age 4), the catch corresponding to the optimum effort should not exceed 9,000 tons per year in 1970-72, and even this would lead to further decline of stock to possibly 20 million fish. A reasonable management objective would be to encourage the increase of the adult stock to at least 60 million fish capable of giving a sustained yield of 20,000-25,000 tons.

The regulation of the haddock fisheries in Div.4X and 5Z now in force could result in excess effort from these divisions being directed to Div.4VW, particularly during the closed season in former divisions. At this season availability of Div.4VW haddock is often high even at low overall stock abundance. Thus, increased effort at this time could result in a very high fishing mortality of serious effect. Biological arguments for implementation of a closed season are almost identical for the two areas (Div.4VW and Div.4X).

Possible measures to prevent the taking of large numbers of juveniles in incidental catches of fisheries for non-regulated species should receive further consideration. Particularly significant in this regard is the substantial summer silver hake fishery on Sable Island Bank (Div.4W), a nursery ground for young haddock.

2. Div.4X

Recent data from the fishery and the US-USSR groundfish survey were reviewed. Most of these data apply to the area south and east of Nova Scotia and the Bay of Fundy area respectively.

South and east of Nova Scotia. These data indicate that total mortality rate, Z, in 1967-68 was about 0.8 (F = 0.6, M = 0.2). These values combined with estimates of abundance of 1961-67 year-classes have been used to estimate the total stock of age-groups older than two years at the beginning of 1969 and 1970. With a steady fishing mortality of F = 0.6, the stock would yield 17,000 tons in 1969 and 9,000 tons in 1970.

Bay of Fundy. Data here point to the same year-to-year variation in recruitment (in the 1961-67 year-classes) as stated above, but as this stock is normally recruited to the fishery at a younger age than the stock south and east of Nova Scotia changes in catches will occur one or two years earlier in this area than in the latter. 1969 catches are expected to be three-quarters of the 1968 catch (*i.e.* 6,000 tons) and one-third (3,000 tons) in 1970 by constant effort.

Total Div.4X. Catches are thus expected to be of the order of 23,000 tons in 1969, and 12,000 in 1970, compared with 31,000 tons in 1968, provided F remains constant. This suggests that the annual quota of 18,000 tons set by the Commission for the 1970-72 period is too high to ensure that fishing mortality rate will not exceed the 1968 level.

3. Subarea 5

Total catch in 1969 was close to 23,400 tons, compared with 44,477 tons in 1968. This is equivalent to approximately 12 million fish. The bulk of the 1969 catch came from Georges Bank (21,000 tons). The fishery is still dependent mostly on the 1963 year-class, but the 1966 year-class contributed significantly. The 1969 year-class seems to be as poor as the preceding five.

There is some reason to believe that estimates of recruits in 1970 and 1971 presented to ICNAF in Comm.Doc.70/3 may be too high, but this only reaffirms the 1969 recommendation that no fishery take place on this stock if the Commission wish to rebuild it.

C. HERRING

1. Development of the Fisheries

Total herring nominal catches from the ICNAF Statistical Area increased from 180,000 tons in 1960-61 to 951,000 in 1968. This increase was due primarily to the increased fishing for adult herring. The first increase took place on the previously unexploited stock on Georges Bank in the early 1960's (about 100,000 tons annually) increasing further in 1967 (218,000 tons) and 1968 (323,000 tons). In Subareas 3 and 4 development of the fishery on adult herring took place mostly after 1965. In Subarea 3 catches increased from less than 10,000 tons in 1965 to around 150,000 tons in 1968-69 and in Subarea 4 catches increased from less than 100,000 tons in 1965 to over 250,000 tons in 1968-69. Details are given in Tables 6 and 7 of App.I.

2. Identity of Stocks

Data available suggest that the groups of adult herring exploited on Georges Bank (Div.5Z), in the Bay of Fundy, and in the Newfoundland-Gulf of St. Lawrence area are distinct from one another and can be treated separately for assessment purposes. Also, the Georges Bank herring seems to be distinct from adult herring spawning in the Gulf of Maine (Div.5Y) and over the Scotian Shelf (Div.4Vs and 4W), whereas the distinction between the latter groups and the Bay of Fundy spawners is less clear.

Although, at present, it is not possible to define the sources of the juvenile herring stocks off the Canadian and the US coasts and the adult stocks to which they subsequently recruit, most information available suggest that few, if any, of these juvenile herring are derived from and recruit to the Georges Bank stock.

3. Assessments of Adult Stocks

i) Georges Bank (Div.5Z). Catches and effort increased greatly from 1962-63 to 1968-69, but catch-per-unit effort in 1969 was only one-third that of 1962-63 for the USSR fleet. Other European fleets have also experienced significant decrease in catch-per-unit effort in the last three years. This points to a large decrease in the abundance of the herring stock on Georges Bank, especially since 1967. Surveys of egg concentrations over spawning grounds confirm this decrease (probably up to a 90% decrease since 1962-63).

During the period since 1964 catches have been based on the 1960 and 1961 year-classes. Subsequent year-classes recruited to the fishery have all been weak, so unless the year-class recruiting in 1970 is strong, adult stock and abundance and catch-per-unit effort will decline further. The important question now is the effect of stock reduction on recruitment. From studies of other herring fisheries it is concluded that a very small spawning stock may cause sustained low recruitment, and that the value of the total mortality rate for Georges Bank herring ($Z = 0.7-0.8$) is close to or beyond the level giving the maximum sustainable yield-per-recruit.

STACRES, therefore, concludes that reduced fishing intensity will not reduce yield-per-recruit, and will increase catch-per-unit-effort and probably recruitment.

ii) Bay of Fundy (Div.4X). The traditional fishery for juvenile herring along the New Brunswick shore which yielded an average of between 50,000 and 60,000 tons per year in the 1960's have been supplemented by a rapidly increasing fishery for adult herring in the late 1960's with landings of about 150,000 tons in 1968 but decreasing sharply to about 100,000 tons in 1969 despite sustained high fishing intensity. This points to a high rate of exploitation in the years since 1965, and it seems likely that maintaining or increasing the fishing intensity will result in a further decrease in average stock abundance and catch-per-unit-effort.

iii) Newfoundland (Subarea 3 and Div.4R) Gulf of St. Lawrence (Div. 4T) Banquereau (Div.4V). Since 1966 there has been a large increase in fisheries for herring spawning in the spring and summer in the Gulf and occurring in pre-spawning concentrations in winter west and southwest of Newfoundland and in the Banquereau area. Herring fished in the Gulf of St. Lawrence over the summer seem to be exploited outside the Gulf in the fall and winter months both at Newfoundland and in the Banquereau area. Fishing has increased in both of these areas. Too few data are yet available for detailed assessments to be made of the effect of this increased activity. It is essential that good catch and effort data be obtained as soon as possible.

4. Juvenile Herring Fisheries

In the US "sardine" fisheries along the coasts of Maine (Div.5Y) catch and catch-per-unit-effort have declined in the 1960's, whereas the Canadian fishery along the New Brunswick coast (Div.4X) has fluctuated without major trends. In view of the present uncertainty regarding the origin of the juvenile herring and the adult stocks to which they recruit, it is not possible to assess the effect, if any, of the recent increases in exploitation of adult herring on the juvenile herring fisheries or *vice versa*. However, since the juvenile herring catches have not increased since the 1960's, it seems clear that the recent reduction in recruitment to the Georges Bank stock cannot be attributed to the juvenile herring fishery.

5. Research Requirements

STACRES notes that there are a number of important gaps in the present knowledge of the general biology and population dynamics of herring. The two most important are (a) the inter-relationship between the stock of juvenile and adult herring currently exploited in Subareas 4 and 5 which may be solved by serological and biochemical methods, combined with carefully analyzed tagging experiments and larval dispersion studies, and (b) the estimation of changes in stock abundance and mortality rates in the adult stocks, where attention is drawn to the possibilities of quantitative egg production surveys in providing estimates of stock abundance.

6. Herring Scale and Otolith Comparisons

At its mid-term meeting, the Assessment Subcommittee noted that considerable differences in ageing techniques between countries still exist (Res.Doc.69/29), and proposed that a study group examine material during this Annual Meeting.

Experts from Canada, USA and USSR examined material on the USSR R/V *Persey III*. No major disagreement between experienced readers in interpretation of scales was found. An otolith exchange program is now started with the Biological Station, St. Andrews, Canada being responsible for the coordination of the exchange.

D. YELLOWTAIL FLOUNDER IN SUBAREA 5

The fishery for yellowtail flounder is restricted almost entirely to Div.5Z, where two stocks occur, one on Georges Bank (Div.5Ze), and the second along southern New England (Div.5Zw). A steadily increasing fishery has resulted in a catch of about 48,000 tons in 1963, and this level of catch or slightly less has been maintained through 1968, almost entirely by US trawlers. The entry in 1969 into the fishery by USSR trawlers which took about 18,000 tons, resulted in a total catch of 57,000 tons in 1969. The US fishery is directed specifically

toward the yellowtail flounder and uses trawls with 114 mm codend. USSR catches are mainly by-catches in fisheries for other species, *e.g.* hake and herring, which are prosecuted with smaller mesh codends.

It seems reasonable to assume that natural mortality rate (M) is less than 0.3. Present total mortality rate (Z) seems to be about 1.3 so that the exploitation rate $\left(E = \frac{Z-M}{Z}\right)$ is about 0.8. At such a high level of total mortality, annual landings are sensitive to fluctuations in recruitment. Density of mature fish has become relatively low, and a decline in recruitment since 1967 will lead to further reduction in stock abundance unless fishing intensity is reduced.

The effects of regulation of mesh size and fishing mortality in relation to yield-per-recruit have been assessed (Res.Doc.70/86 and 70/87). Based on US data for the 1963-68 fishery, assessments show that an increase in mesh size from 114 mm to 129 and 145 mm would result in long-term gain in yield-per-recruit of 7% and 17%, respectively, after 4 years. Immediate loss would be 4% and 21% respectively. In terms of catch, the US discarding practice would tend to increase the immediate loss and decrease somewhat the long-term gain.

A reduction in effort to about two-thirds of the 1963-68 level would give some increase in yield-per-recruit by a retained 114 mm mesh size.

An appropriate combination of increased mesh size and a reduction in effort would, however, lead to greater benefits (Table 8 in App.I), probably up to 30%. It is estimated that to achieve two-thirds of the 1963-68 level of fishing mortality, the US catch as a whole should have been about 30,000 tons in 1969 compared with the actual total catch of 57,000 tons. The existence of two stocks and the probably uneven distribution of fishing on them complicates the assessment somewhat.

Suitable control of effort and mesh size would also mitigate reduction in spawning stock following recent poor recruitment and high fishing intensity, and would reduce dependence of the fishery on a restricted number of year-classes. Also, such control would decrease the risk of poor recruitment if a stock/recruitment relationship exists.

STACRES stresses the importance for future management of accurate estimates of size and age structure of yellowtail flounder catches being reported by countries which take a significant proportion of the total catch.

E. HAKES

1. Silver hake

i) Subarea 4. No special assessment is available at the present time but the USSR provided information on the current trends in stocks and of the fishery. Both the 1966 and 1967 year-classes seem to exceed the average level of year-class strength so that it is likely that the conditions for exploitation of the silver hake stocks will remain favourable in 1970-71.

ii) Subarea 5. USSR data (Res.Doc.70/20) indicate that the major part of the catches in 1969 was represented by 3- to 5-year-old fish. The corresponding year-classes (1964-66) are considered weak. Preliminary data suggest more abundant 1968-69 year-classes. Stock and catches will, therefore, remain low in 1970, but increases can be expected in 1971-72.

2. Red hake

i) Subarea 5. Red hake landings from Subarea 5 increased to 50,000 tons in 1969 as compared to 18,600 tons in 1968, mainly due to increased effort, but also to slight increase in stock abundance (Res. Doc.70/39). The fishing rate is so high that the stock size is influenced greatly by the recruitment rate. The recent increase in stock abundance which has attracted fishing has been due apparently to improved recruitment (or availability). A slight increase in stocks may occur in 1970-71 as compared to the 1968-69 level.

It was agreed that the stocks of both these species which support major fisheries, should be the object of further study and assessment.

2. STATISTICS AND SAMPLING (APP.II)

(a) Statistical Bulletin

New material in Statistical Bulletin Vol.18 for 1968 includes statistics on catches of harp and hood seals from 1937 to 1968, and data on fish catches and effort in Div.5Ze and 5Zw, as well as Div.6A, 6B and 6C.

(b) ICNAF List of Species

Recommendations 4-7 (App.II, p.66-67) propose small changes and the inclusion of new species, *e.g.* Queen Crab, *Chionoecetes opilio*, in the List of Species. The Executive Secretary will take proper action on these matters.

(c) Species Separation for Flounders

Provisional statistics for 1969 contained substantial catches of unspecified flounders, but a rough breakdown of USSR catches by species might be available when the STANA 1W forms for 1969 are submitted.

(d) Designation of Halibut and Greenland Halibut

USSR catches in 1969, and in previous years, where the two species are reported together, consist of Greenland halibut *(Reinhardtius hippoglossoides)* only.

(e) ICNAF List of Vessels

It was noted that a draft version of a joint ICES/ICNAF list of vessels will be prepared by the CWP Secretary for consideration at the 1971 meeting of the subcommittee. Meanwhile STACRES reaffirms its conclusions of last year relating to preparation of vessel lists and

recommends (11)

(i) that the ICNAF List of Vessels for 1971 be prepared as in the past, and

(ii) that a final decision concerning production of a Joint ICES/ICNAF List of Vessels be made at the 1971 meeting of the subcommittee.

(f) Discards

Res.Doc.70/25 contains a summary of fish discarded at sea or used for industrial purposes in 1968. The document will be published in Redbook 1970, Part III (1969 Rec.13).

Recognizing the importance of improving information on fish used for industrial purposes, STACRES

recommends (12)

that countries make every effort to report quantities of fish used for industrial purposes, especially quantities of the major species individually, in addition to reporting quantities discarded.

(g) Coordinating Working Party on Atlantic Fisheries Statistics (CWP)

The Seventh Session of the CWP will be held in 1971, probably at FAO, Rome. Denmark and the USA will represent ICNAF.

Since a new Assistant Executive Secretary will be appointed soon, the Subcommittee agreed that his attendance at the Seventh Session of the CWP would be appropriate, and

recommends (14)

that, in addition to attendance by the Executive Secretary and the Chairman of the Statistics and Sampling Subcommittee, as previously recommended, the new Assistant Executive Secretary should attend the Seventh Session of the CWP.

(h) Other Statistical Matters

The attention of member countries' statistical offices is drawn to Rec.8 (App.II, p.68) concerning conversion factors, Rec.9 (p.69) concerning fishing effort measures, and Rec.13 (p.71) concerning notes for completion of STANA forms.

It was noted that the report of the ICES Working Group on Vessel Characteristics and Fishing Effort Measurement (Comm.Doc.70/19) when finalized will be considered by the ICES Special Meeting on Measurement of Fishing Effort, 1970.

At the final meeting of STACRES, the Chairman of the Statistics and Sampling Subcommittee informed the meeting that Res.Doc.70/58, a progress report on various statistical matters, prepared by the CWP Secretary, had arrived on the previous day. Several items were pertinent to previous STACRES discussions.

It was noted that a revised list of conversion factors would be issued as an FAO Bulletin of Fishery Statistics early in 1971. It was further noted that the Seventh Session of the CWP would likely be held during the first half of 1971 prior to the 1971 ICNAF meeting. Revisions of STATLANT (STANA) notes are to be submitted to the Seventh Session of the CWP for approval. Existing STATLANT forms are to be used through 1971. By early 1972 it should be possible to complete a number of minor changes, and at the same time to introduce forms that would be compatible for ADP machine processing.

3. ENVIRONMENTAL (APP.III)

(a) Environmental Conditions in the ICNAF Area

National research reports and other pertinent documents were reviewed.

Off West Greenland (Subarea 1), 1969 was one of the most severe ice years of this century. The upper water layers were cooler especially in the southern areas but the deeper water was warmer than in 1968.

In southern Labrador (Subarea 2), in sections across Hamilton Inlet Bank in July and early August and November, temperatures in the upper 200 m were below the long-term average for the period. Temperatures in the 200-500 m layer were higher than average.

In Subarea 3, temperature conditions in July-August were variable. On the southern Grand Bank, temperatures near bottom were lower than in 1968.

In Subarea 4, temperatures on the Scotian Shelf were, on the average, higher than in 1969. Temperatures near bottom in the Scotian Channel were several degress higher than in 1968.

The USSR reported for Subarea 5 that temperatures in the Fundian Channel and in the deep part of the Gulf of Maine were higher than in 1968. Water temperatures over the central part of Georges Bank were close to the 1968 level and on southern Georges Bank lower than in 1968.

The USA reported that water temperatures at 50 m were higher in 1969 than in 1968 in the south central Gulf of Maine; elsewhere temperatures were lower in 1969 than in 1968. The negative anomalies were greatest south of Georges Bank. At Boothbay Harbour, the 1969 annual mean temperature was 0.8° higher than in 1968.

Reports on distribution and abundance of plankton were reviewed.

(b) Environmental Changes in Relation to Fisheries

This subject was discussed by many scientists.

Off Labrador (Subarea 2) cod usually pass to deeper water layers in cold years. They are then distributed in smaller areas and thus denser, whereas in warm years the isotherms and cod are more spread out and the catch per effort declines. The average catch of cod in February in the years 1965 to 1970 in Labrador was inversely related to the temperature in the 50-200 m layer on 1 November of the previous year (Res.Doc.70/20).

The influence of the extreme ice conditions and of the colder waters in West Greenland in 1969 was partly physical with a decrease in effort due to the ice. Also, the survival of cod larvae was apparently reduced by the cold water. It may be possible in the near future to obtain important information on ice quantity through the use of satellites.

(c) Symposium on Environmental Conditions, 1960-69

The Convenor of the Symposium, Dr N.J.Campbell (Canada), could not attend the STACRES meeting, but it was reported that he had arranged for nine speakers to cover the various aspects of environmental conditions outlined by the planning group last year (Redbook 1969, Pt.I, p.56). Two days will be devoted to the symposium: one and a half days for the presentation of papers and one-half day for general discussion.

(d) Reports from Meetings of Other Bodies

Dr H.W.Graham, Chairman of the ICES/ICNAF/IOC Coordinating Group for North Atlantic Oceanography, reported on the second meeting of the Group (Comm. Doc.70/2).

Mr A. Lee reported on the 1969 meeting of the ICES Hydrographic Committee (Comm.Doc.70/17) and the Joint Symposium on Physical Variability in the North Atlantic (Comm.Doc.70/17).

(e) IGOSS (Integrated Global Ocean Station System)

The IOC has asked ICNAF to indicate the kinds of observations from the IGOSS that might be useful to fisheries and fisheries research in the ICNAF Area and to designate a 'liaison' man for IGOSS. Discussions brought out a number of general observations that might be beneficial. For the present, observations in the deep ocean areas could be omitted as far as most fisheries were concerned. STACRES

recommends (16)

that the Chairman of the Environmental Subcommittee serve in a liaison capacity to IGOSS to bring to the attention of IGOSS those properties and conditions which might be most useful to fisheries and fishery research in the ICNAF Area.

4. GEAR AND SELECTIVITY (APP.IV)

The Gear and Selectivity items on the agenda of STACRES were referred to an *ad hoc* Working Group (Chairman: Dr H. Bohl, Germany). The report of this *ad hoc* Working Group as amended after discussion in STACRES is at App.IV.

(a) ICES Gear and Behaviour Committee Report, 1969

The Chairman of the *ad hoc* Working Group reviewed the papers presented to this Committee at the 1969 ICES meeting.

(b) Reports of the ICES/ICNAF Joint Working Group on Selectivity Analysis

Following a recommendation by STACRES in 1968 (Redbook 1968, Rec.6, p.12), an ICES/ICNAF Joint Working Group on Selectivity Analysis was established. The Working Group met twice in 1969. The report from these meetings is distributed as ICNAF Comm.Doc.70/14. This report was reviewed in October 1969 by the ICES Gear and Behaviour Committee. It reported that sound advice could not yet be given which would warrant any major change in NEAFC regulations. As a consequence ICES recommended that the Working Group be reconvened for further consideration of questions posed to it by ICNAF and ICES. The Working Group, therefore, met again in 1970 (Comm. Doc.70/15). The main items considered and the conclusions reached by the ICES/ICNAF Joint Working Party are summarized as follows:

(i) The relation between selectivity and physical properties of the twine. Due to insufficient data the Working Party was unable to make analysis of the relation between selectivity and the physical properties of the twine, except that laboratory tests showed that elongation might affect selectivity. It is concluded, however, that it is impossible to judge twine properties without considering the construction of the twine, particularly with polyamide fibres.

(ii) Summary of selectivity data. The Working Group distinguished between polyamide A and polyamide B according to definition as given in App.IV, p.77, but this distinction was not generally accepted by representatives in the Working Group. The results of the Working Group's analyses are summarized in Tables D-2 of Comm.Doc.70/14, and in Tables 43-47 and Fig. 1-2 in Comm.Doc.70/15. The *ad hoc* Committee draws special attention to Fig. 1 and 2 in Comm.Doc.70/15 in which the length of the line for each material covers the range within which there is a 95% probability that the equivalent for the material lies. Table 54 in Comm.Doc.70/15 shows what acceptance of differentials, based on the *average* equivalents calculated by the Working Group, might imply in terms of mesh sizes in the ICNAF Area.

Although some recommendations concerning mesh size equivalents and a new standard material were passed by the Working Group after its first two meetings (App.IV, p.78), after considering data presented at its third meeting the Working Group felt that, given the variability of the results, it could not recommend any departure from the present system of mesh differentials, which are based on the chemical nature of the twine, insofar as it affects the ICNAF Convention Area, except that it considered that there is no basis for the differential now given to Danish seines and that this should be abolished. Differentials should be based solely on the chemical nature of the twine used in the codend.

Considering, however, that the reports of the Working Group contain valuable information on selectivity data, STACRES

recommends (17)

that after editorial consideration by members of the ICES/ICNAF Working Group on Selectivity Analysis, its reports be summarized for publication as an ICES Cooperative Research Report if ICES so agrees. The published report should include the tables of basic data and the bibliography.

During consideration by STACRES of the report of the *ad hoc* Committee on Gear and Selectivity, USSR scientists informed STACRES that they could not agree with the conclusions brought forward from the third meeting of the ICES/ICNAF Working Group to the effect that it could not recommend any departure from the present system of mesh size differentials for ICNAF.

With reference to the ICES/ICNAF Working Group's recommendation that a new polyamide material be introduced to replace manila as the selectivity standard, STACRES was in some doubt about the implications of the adoption of this new standard, although it agrees that the new standard should be adopted, and

recommends (18)

that the Subcommittee on Assessments examine the requirements for further selectivity experiments in relation to adoption of polyamide as the selectivity standard as described in Comm.Doc.70/14, p.49-50.

(c) Topside Chafers

Res.Doc.70/37 shows that there is no difference between the selectivities of twines of normal thickness (R5000 tex and R6484 tex) and those which are very thick (R18000 tex). Therefore codends made from thick twines can be used to obviate the need for topside chafers. STACRES

recommends (19)

that member countries be encouraged to undertake commercial trials using codends made of thick twines in order to evaluate their durability and practicability with a view to the elimination of topside chafers.

Commercial experience has shown that the Polish-type chafer, as defined in the ICNAF mesh regulations, does not always provide sufficient protection to the codend. Res.Doc.70/60 describes experiments with a Polish-type chafer made of thick (10 mm diameter) twine, knotless construction, and shows that the use of such a topside chafer does not affect selectivity. STACRES

recommends (20)

that the regulations concerning topside chafers be altered to permit the use of a Polish-type chafer as described in Res.Doc.70/60.

It was pointed out that there is a need for further information on twine types and mesh sizes in use. It was noted with regret that only two returns had been received for the trawl material and mesh size sampling summary, and in fact no summary was available for the 1970 meeting.

(d) Other Matters

Dr Bohl, Germany, informed STACRES of recent German experiments using twines with different elongations, but made of the same fibre. Analysis of single hauls is needed. Full details will be presented at the 1971 Annual Meeting of ICNAF.

With reference to earlier years' recommendations, it was pointed out, that there is still a need for data on redfish meshing, catch size in relation to selectivity, and on girth/length relationship.

5. RESEARCH PROBLEMS RELATED TO FISHERIES MANAGEMENT

(a) Coordinated Multilateral Groundfish Surveys

A preliminary discussion of this subject was held by the Subcommittee on Assessments during its mid-term meeting, January 1970 (Comm.Doc.70/3).

Following further discussion, STACRES, acting on the recommendation (2) of the Subcommittee on Assessments (App.I, p.62), set up an *ad hoc* Working Group on Coordinated ICNAF Groundfish Surveys with Dr M. Grosslein (USA) as Chairman. The report of the *ad hoc* Working Group, as amended after discussion in STACRES, is at App.V. The considerations of the *ad hoc* Working Group may be summarized as follows:

It was generally agreed that research vessel surveys are of considerable value in providing the best possible basis for recruitment predictions and for a more complete measure of the effects of fishing on the groundfish communities, and for determining the effects of environmental factors. There was unanimous agreement as to the general desirability of using standardized methods or at least coordinating independent survey operations. Although optimum sample design or objectives may vary between areas, it was noted that some degree of stratification would be desirable in every area.

The present level of accuracy obtained in US groundfish surveys on Georges Bank indicates that such surveys can provide useful information for assessment of fisheries where commercial catch and effort data are not adequate.

It was also generally agreed that there are major benefits to be gained by pooling resources to conduct coordinated groundfish surveys using standardized methods. STACRES, therefore,

recommends (21)

that an ICNAF Working Group be established to investigate problems related to the organization and conduct of coordinated groundfish surveys.

STACRES suggests that it would be advantageous to schedule a meeting of the Working Group immediately prior to the mid-year meeting of the Assessment Subcommittee. It was noted that gear experts, as well as biologists directly involved in the planning and conduct of surveys, should participate in the Working Group.

It is recognized that the responsibility of the proposed Working Group would relate to the coordination of presently available research effort, and hopefully would result in greater benefits from the present research vessel effort. The main items for consideration at a mid-term meeting should be:

(i) Determination of accuracy of abundance indices derived from research vessel surveys;
(ii) Study of survey techniques with special emphasis on standardization of gear.

More specific suggestions for items to be discussed are given in App.V, p. 83.

STACRES was pleased to note the proposed visit of the USSR R/V *Kvant* to St. Andrews, Canada, in August 1970 for the purpose of coordinating USSR and Canadian groundfish survey studies on the Nova Scotian Shelf. These studies will be of great value.

(b) Adequacy of Sampling

The Subcommittee on Assessments discussed this item at its January 1970 meeting, and recommended that the Secretariat take steps to stimulate sampling by member countries. The Subcommittee also recommended that a minimum sampling requirement be adopted by the Commission (App.I, p.61)

STACRES discussed this item further and was informed that following the recommendation of the mid-term Assessments meeting, the Executive Secretary had written to the appropriate authorities in those member countries in which the level of catch sampling for age and length data was considered to be inadequate for part of or all of their fisheries.

STACRES recognized that the minimum level of sampling recommended by the Subcommittee was indeed a minimum rather than an adequate requirement and, as a first step in approaching the problem of inadequate sampling,

recommends (22)

that the Commission adopt, as a minimum sampling requirement for the commercial fisheries, the measurement by each country of 200 fish for every quarter of the year and division for each 1,000 tons of each species caught.

(c) Data Processing and Assessment Work

The Subcommittee on Assessment discussed this item at its mid-term meeting (App.I, p. 63-64).

STACRES gave further consideration to this item and reviewed the continuing problem of adequacy of research and assessment for the various fisheries in the Convention Area, including analysis of basic sampling data for assessment purposes.

STACRES recognizes that, at the current level of research effort in the various countries, assessment scientists could not in any one year provide up-to-date assessments for all the major fisheries in the ICNAF Convention Area, and that it was more desirable to concentrate effort on high priority problems, than to disperse such expertise as is available over a broad front.

STACRES suggests that Panel Advisers might usefully assign priorities for assessment problems within the various areas. Additionally, in order to alleviate some of the present problems with respect to fisheries assessment, STACRES

recommends (23)

(i) that additional staff and money be allocated to the Secretariat to provide for basic data analysis;

(ii) that member countries in each Panel make definite commitments for scientists to initiate studies of the stocks which are deemed to be most crucially in need of assessment, the guidance and coordination of such studies being the function of STACRES through the Assessments Subcommittee

6. PROBLEMS IN QUOTA REGULATION ARISING FROM DISCARDS AND INDUSTRIAL FISHERIES

During its January 1970 meeting, the Standing Committee on Regulatory Measures (STACREM) agreed that STACRES should be invited to give further consideration to the problem in quota regulation arising from discards and industrial fisheries (Comm.Doc.70/6).

The Subcommittee on Assessments discussed these problems during both its mid-term and present meetings (App.I, p.64-65) and agreed that the problem of discards and industrial fish in quota regulations is essentially insoluble unless the amount of fish discarded and reduced to meal can be adequately estimated and reported. The quotas, of course, should be based on total catch but the endeavour in countries to maximize their benefits would tend to promote incomplete estimates of the actual catch. The discard rate, and selection of catches for landings (*e.g.* large fish of greater value per unit weight than smaller fish) becomes greater with greater degrees of allocation of catch down to individual fishermen.

There are certain actions and types of information which would tend to minimize the effects of incomplete reporting:

(1) Quota regulations combined with mesh regulation or appropriate closed seasons and area;
(2) Quota regulations set in terms of landings such that discards added would provide the desired total catch;
(3) Research vessel surveys to give estimate of amount of small fish in catches;
(4) Allocation of quotas by countries would help alleviate the problems because of easier enforcement and observation.

7. AGEING TECHNIQUES

(a) Redfish. Recent German investigations indicate that redfish scales may be superior to otoliths in age determination of this species. Results of recent studies will probably be submitted to the 1970 ICES meeting. In conjunction with the present meeting, scientists from various countries studied redfish ageing on board the USSR R/V *Persey III*.

The redfish otolith and scale exchange will be continued. Participants are asked to indicate (mark) their interpretation of corresponding otoliths and scales on the photographs supplied.

(b) Other Species. Res.Doc.70/55 and 70/69 relating to the herring exchange program, and age determination of argentines, respectively, were reviewed. STACRES noted with satisfaction that Canada (St. Andrews laboratory) currently organizes the herring exchange program. Various scientists met on board the USSR R/V *Persey III* to study and discuss herring ageing.

STACRES was informed that the first exchange of haddock otoliths between Canada and Poland indicate some serious discrepancies in age assignment. Further exchanges are planned.

8. REVIEW OF THE REPORT OF THE ICES/ICNAF JOINT WORKING PARTY ON NORTH ATLANTIC SALMON, FEBRUARY 1970

A. INTRODUCTION

The ICES/ICNAF Joint Working Party on North Atlantic Salmon met in London 2-5 February 1970. Ten countries (7 members of both organizations, 2 of ICES and 1 of ICNAF) were represented at the meeting.

The Report of the Working Party (Comm.Doc.70/13) was presented to STACRES by Dr A.W.May (Canada) in the absence of its Chairman, Mr B.B.Parrish (UK). The report is summarized in Sections A-E below, while the discussion in STACRES is reported in Section F.

During its four-day meeting the Working Party reviewed the latest information available on the salmon fisheries off West Greenland and Norway as well as in home waters. Further consideration was given to the effects of the Greenland fishery on total and home-waters catches and a first, preliminary assessment of the effects of the Norwegian Sea fishery was made.

B. WEST GREENLAND FISHERY

1. Catch and Fishing Effort

Total catch (inshore plus offshore) increased by about 90% from 1968 to 1969 to an estimated 2,100-2,200 tons.

Although an accurate division of offshore and inshore catches cannot be given in 1969 due to some Greenland registered vessels now taking part in the offshore drift-net fishery, the figures show that the offshore catch (drift net) slightly more than doubled from 1968 to 1969, whereas the inshore catch (set gill nets) increased by some 60%. The offshore catch is now the larger component of the total catch (approx. 56%).

The main reason for the doubling of the drift-net catch is the substantial increase in fishing effort. The number of non-Greenland vessels participating in this fishery doubled from 1968 to 1969. Also some individual vessels have increased their fishing power by using nets of monofilament nylon, which are at least twice as effective as the polyfilament nets.

The effort in the set gill-net fishery is unlikely to have increased significantly in 1969, but the availability of salmon in this fishery is known to vary considerably between years and areas.

The report of the Working Party contains a map showing distribution of the fishery in 1969. The inshore fishery, as in previous years, took place near settlements on the west coast between lat. 60°N and 70°N, whereas the offshore drift-net fishery, hitherto mainly having taken place in Divs.1A-1B, extended somewhat to the south so that the 1969 fishery took place in Divs.1A-1C between 65°N and 70°N extending outwards to about 40 nautical miles from the coast. Again, however, Store Hellefiske Bank in Div.1B seems to be the most important area for this fishery.

Exploratory fishing has shown that salmon are present over a wider area than that fished commercially.

As in former years the main part of the catches consisted of fish which had spent one winter in the sea and which, if returning to home-waters, would do so as two or more sea-winter fish.

2. Origin and Destination of Salmon at West Greenland

(a) Tag recaptures at West Greenland were reviewed in the light of new information including a breakdown of smolt tagging experiments into hatchery-reared and natural smolts.

In 1969 tags were again recorded at West Greenland from a number of North American (mostly Canadian) and European (mostly UK) river systems, including, for the first time, single recaptures of fish tagged as hatchery-reared smolts in Norway and Denmark. Also, following tagging in 1968 of adults ascending a Newfoundland river, two of these fish were recaptured at West Greenland in 1969.

Survival in the sea seems to be usually much less for the tagged, hatchery-reared smolts than for tagged, natural smolts. Therefore, the return rates from natural smolts are likely to be a better guide to the relative national contributions to the West Greenland stock. For those countries in which most or all smolts tagged were from hatcheries, the return rates from Greenland may underestimate their relative contributions to the West Greenland stock.

Although the breakdown of tagged smolts into the hatchery-reared and natural smolts eliminates one source of variation in the year-to-year recapture rates a good deal of variation still remains between as well as

within countries. It is, therefore, evident that more detailed evaluation of tag returns in the countries concerned is urgently needed, particularly with respect to possible bias in some years relative to the area of tagging, type of tag, etc.

Also, non-reporting of tags at West Greenland poses a major problem, especially as the non-reporting rate seems to be low in the recently more important drift-net fishery. In view of the importance of tag recapture data in these studies, the Working Party strongly

recommends (24)

that all possible steps be taken to increase the efficiency of reporting of tag recaptures from the drift-net fishery.

Despite the present impossibility of giving accurate figures for the relative contributions of salmon from different countries to the West Greenland stock the data suggest that the major part of the stock is derived from Canadian and UK rivers.

(b) Investigations on biochemical characters and parasites have progressed and provided some promising results. For example, analyses of 242 salmon caught in drift net at Disko Bay (Div.1A) in 1969 indicated that 43% of these fish were of North American origin. The Working Party considers that such investigations should be continued as intensively as possible.

(c) Tagging at West Greenland in 1969 was conducted by Canada, and by Denmark and the UK.

Canada tagged 385 drift-net caught salmon, mainly in Disko Bay. In the joint Danish-UK experiments, 43 longline caught salmon were tagged offshore in Div.1B and 15 gill-net caught fish inshore in Div.1D.

A joint Danish-UK experiment to assess the viability of tagged fish caught by gill net failed due to very low abundance and catch in the inshore area chosen for the experiment.

Although the joint Danish-UK longline fishing caught 65 salmon only, this experiment is noteworthy as these salmon were relatively large-sized (range 60-100 cm, average 76 cm) compared with those taken in drift nets.

A total of 1,817 salmon has been tagged at West Greenland during the period 1965-69. By the end of 1969, 11 of these had been reported in home waters (Canada 5, Scotland 4, Ireland 2).

Fourteen (3.2%) of the 443 fish tagged in 1969 were reported in the West Greenland fishery, but considering only the tagged fish regarded as being "excellent" in respect to condition for being tagged, the recapture rate at West Greenland was 6%. The accuracy with which tag recapture data from these experiments can be used in estimating exploitation rate in West Greenland is governed by the tagging mortality and the efficiency of tag reporting.

Insufficient information is available for both these factors, but as some tagging mortality and a non-reporting is presumably present the 6% recapture rate of "excellent" fish in the Canadian experiment is likely to represent an underestimate of the rate of exploitation for that part of the total fishery within which these tagged fish were present.

3. Assessment of Effects of West Greenland Fishery on Total and Home Waters Salmon Stocks and Yields

(a) Total Salmon Yields

The results of previous assessments reported by the Working Party indicated that the development of the West Greenland fishery has resulted in an increase in the total catch (home waters plus West Greenland) of salmon of European origin* which, if not caught at West Greenland, would return to Europe, and that, with the possible exception of fish in some Canadian river systems with high exploitation rates, this probably also applies to the salmon which, if not caught at West Greenland, would return to North America. The latest data available provide no grounds for modifying these conclusions. It is emphasized, however, that the conclusions are based on the assumption that the possible reduction of spawning stocks of salmon due to the West Greenland fishery has not caused a direct reduction in the number of smolts and subsequent recruitment of salmon. Too few data are available to test the validity of this assumption, especially data on the relationship between adult stock size and smolt production and between smolt production and subsequent recruitment of grilse and salmon. The Working Party therefore stresses the need for such studies, especially in the light of salmon catch data for some home-water fisheries pointing to a reduction in 1968 and 1969 in the quantities of two or more sea-winter salmon entering the rivers.

(b) Home-Waters Salmon Stocks and Yields

The magnitude of the losses (in terms of weight) to the home-water stocks and catches resulting from the West Greenland fishery is governed by

a) the catch in the West Greenland fishery,

b) the increase in weight of salmon between their appearance in the West Greenland fishery and their return to home waters,

c) the natural mortality during the time given in b), and

d) the home-water exploitation rate.

*STACRES points out that this statement is made on the assumption that salmon of European origin, if surviving, will return to European home waters.

On the assumption that the salmon at West Greenland, if surviving, will return to home waters in the following year as two sea-winter salmon, the effect of a West Greenland fishery of the 1969 level is estimated to cause a reduction of salmon stocks for all home waters combined in the range of 1,000-2,700 tons and a reduction in corresponding *catches* in the range of 650-1,600 tons.

These estimates are based on the following values of the parameters used a) West Greenland catch of 2,200 tons; b) a 50% increase in weight between Greenland and home waters; c) a natural mortality rate (M) in the range of 0.02 and 0.1 per month; d) an overall average exploitation rate of 0.6 in home waters.

Although it had no new information to justify any modification of the parameters used, the Working Party noted the conclusions of the Baltic salmon experts that, after Baltic salmon reach exploitable size, the natural mortality rate in the sea is very low, *i.e.* about 10% per year (M=0.1). This value is considerably less than the lower of the values used in the present assessment by the Working Party.

In the absence of accurate estimates of the proportions of salmon which, if not caught and, if surviving, would have returned to each country, it is not possible to estimate reliably the losses in individual countries. However, the latest data available provide no clear grounds for modifying the previous tentative conclusion that the largest proportion of the losses have been experienced in Canada and the UK.

C. HOME-WATER CATCHES

Tables of home-water catches and catch per unit effort have been revised and catch data for France, Northern Ireland and the USSR have been added. Until 1968 only Scottish statistics separated grilse and salmon, but in 1969 England, Wales and Norway have also separated grilse and salmon.

For the most important salmon countries, total catches (grilse + salmon) in 1969 were similar to those in 1968, but data presented from Canada, Scotland and Ireland indicated that the salmon component in these years was lower, although the 1968 and 1969 catches fell within the long-term range in years before high seas fisheries developed.

In the UK and Ireland, data indicated that catches have decreased in the spring fishery, when catch is composed mainly of salmon but increased in the summer fishery when the main component is grilse.

In Scotland, the decrease in the spring fishery has taken place steadily since the early 1950's, in England and Wales mainly since 1965. The Scottish summer fishery, on the other hand, increased markedly for salmon as well as for grilse during the 1960's. These data point, in fact, to a change in the timing of the main salmon runs in Scottish rivers during the 1960's.

The Scottish salmon component may, however, tend to be overestimated by this seasonal change, since the division into salmon and grilse is usually made on a weight basis. Data for 1969 indicate that the salmon component for that year is substantially overestimated whereas the available data for previous years indicate a relatively small over-estimate of the salmon component.

D. RESEARCH PROGRAM

The Working Party considered future research programs in relation to the problem of assessing the effects of the high seas fisheries on total and home-waters stocks and yields.

In 1970 Canada, and Denmark and the UK will extend their research in Greenland waters, Labrador Sea and the Davis Strait concentrating on tagging fish in good condition, on sampling and on surveys to show distribution, abundance and composition of stocks within and outside the exploited area. Also further experiments to determine viability of tagged fish will be conducted.

In the Norwegian Sea researchers will concentrate on sampling and tagging.

Round the Faroe Islands Faroese and Scottish workers will tag salmon.

In home waters work will be concentrated on smolt tagging, sampling of stock and studies on the stock size/smolt production/recruitment relationship.

For assessment work much better knowledge of some of the parameters is needed. In this respect some of the most important parameters are the exploitation rate in Greenland waters, and the destination and mortality of fish leaving Greenland waters. The Working Party considers that, in order to ensure sufficient knowledge on these important parameters, a tagging experiment conducted at West Greenland on a larger scale than those previously carried out is necessary, and that an experiment organized in the same general way as that currently being undertaken on North Sea young herring would be appropriate. It therefore

recommends (27)

that consideration be given by ICNAF and ICES to arranging a large-scale international tagging experiment to be carried out at West Greenland, if possible in 1971.

The Working Party also recognizes that there is an urgent need to improve the efficiency of tag recovery and reporting, and accordingly

recommends (25)

that countries with fisheries at West Greenland and in the Norwegian Sea be urged to take all steps possible to achieve maximum efficiency in tag recovery and reporting.

E. FUTURE MEETING

The Working Party

recommends (26)

that it should meet for four days at a suitable venue in late March-early April 1971.

F. SALMON DISCUSSION IN STACRES

In the discussion following the presentation on the Working Party's report, the USSR delegation informed STACRES that, during the decade 1961-70, the USSR salmon catches in home waters on the Kola peninsula were 31% lower than in the decade 1951-60.

STACRES reviewed three meeting documents on salmon research and fisheries which were not available at the Working Party meeting. Res.Doc.70/56 reports further progress in the study of regional salmon populations by means of serum analysis. Res.Doc.70/42 analyses samples from drift-net catches at West Greenland in the autumn of 1969. The paper confirms statements in reports from the Working Party concerning age-length frequencies of West Greenland salmon caught by drift nets, and also confirms a previous suggestion that the inshore stock is similar to that fished offshore in the fishing area close to West Greenland. Res.Doc.70/65 contains new information on a small-scale longline fishery in January-April 1970 in the southern part of the Davis Strait. It was noted that longlines seem to be more efficient in this fishery than drift nets, while the opposite is the case in the autumn fishery off West Greenland.

In the light of the new age-length-weight data presented in this paper, STACRES considers that it would be appropriate for the Working Party to re-examine the parameters, especially growth rate between Greenland and home waters, used in assessing the effects of the West Greenland fishery on home-water stocks and yields.

STACRES also considered the Working Party's recommendation concerning an international salmon tagging experiment at West Greenland in 1971. While recognizing that a large-scale cooperative program should achieve the desired objective of ensuring a wide distribution of a sufficiently large number of tags, some reservations concerning the proposed timing of the experiment were expressed. Before recommending ICNAF participation, STACRES considers that the Working Party should prepare a more detailed outline and evaluation of the proposed program, especially in relation to the efficiency of reporting of recaptures at West Greenland and the viability of tagged fish. Generally supporting

the idea of an international program and in order not to delay a possible program, STACRES, therefore

recommends (27)

that the ICES/ICNAF Joint Working Party on North Atlantic Salmon meet in conjunction with the 1970 Annual Meeting of ICES to elaborate a proposal for a program for an international tagging experiment on salmon at West Greenland, if possible in 1972, and an evaluation of the possible results from such an experiment; these proposals and the evaluation to be presented to the 1970 ICES meeting and the 1971 ICNAF meeting.

Subject to revision of the Working Party's recommendation for an international tagging program in 1971 as set out above, STACRES adopted the Working Party's report. STACRES asked the Working Party to list documentation (papers) available to the Working Party in future reports.

STACRES decided that it would be appropriate to consider publications of the latest report of the ICES/ICNAF Joint Working Party on North Atlantic Salmon, and would support such a recommendation from the Working Party. STACRES, therefore

recommends (28)

that, at the next meeting of the ICES/ICNAF Joint Working Party on North Atlantic Salmon, consideration be given to publication of the 1970 report of the Working Party, including material from the 1969 report as appropriate, and that if publication is recommended and agreed by ICES, it be as an ICES Cooperative Research Report.

9. PUBLICATIONS AND REPORTS

NORWESTLANT Data. It was noted that all data and papers from the NORWESTLANT Survey, 1963, had now been published. A bound volume of the NORWESTLANT publication was presented to Mr A. Lee (UK) in appreciation of his work in coordinating the surveys and editing the various publications.

10. ORGANIZATION OF STACRES

(a) Officers for 1970/71

Chairman of STACRES: Dr A. Bogdanov (USSR)
" " Subcommittee on Assessments: Mr R. Hennemuth (USA)
" " " " Environmental Studies: Dr N.J. Campbell (Canada)
" " " " Statistics and Sampling: Dr A.W.May (Canada)
" " Working Group on Coordinated Groundfish Surveys: Dr M.D.Grosslein (USA)

Members of Steering and Publications Subcommittee

USSR, Romania, Poland	- Dr F. Chrzan (Poland)
France, Portugal, Spain	- Mr J. Morice (France)
Iceland, Norway, Italy	- Mr G. Saetersdal (Norway)
Germany (Fed. Rep.), Denmark, UK	- Dr A. Schumacher (Germany)
Canada	- Dr W. Templeman
USA	- Mr A. Posgay

(b) Timing of STACRES Meetings

(i) Symposium on Environmental Conditions in the ICNAF Area, 1960-69

The Environmental Subcommittee reported that the Convener of this Symposium, Dr N.J.Campbell (Canada) had so far invited nine speakers to address the Symposium. STACRES

recommends (29)

that scientists invited to address the Symposium on Environmental Conditions in the ICNAF Area, 1960-69, participate at national expense.

(ii) Mid-Term Meetings

In accordance with 1969 Rec.24, the Subcommittee on Assessments will hold a mid-term meeting at a suitable time and place to be arranged by the Chairman of the Subcommittee and the Executive Secretary.

The *ad hoc* Working Group on Coordinated Groundfish Surveys will hold a mid-term meeting in conjunction with the Assessment mid-term meeting. The Chairman of the Working Group and the Executive Secretary will make arrangements for this meeting.

The ICES/ICNAF Joint Working Party on North Atlantic Salmon will meet in conjunction with the 1970 ICES meeting and again in March-April 1971.

11. COORDINATION AND COLLABORATION WITH OTHER ORGANIZATIONS

(a) Stock-Recruitment Symposium

This Symposium, organized by ICES with the collaboration of FAO and ICNAF, will be held at Aarhus, Denmark, 7-10 July 1970. More than 40 papers will be presented and will be distributed to participants in mid-June by ICES. Participants should contact the ICES Secretariat as soon as possible in

order to ensure getting a full set of the papers as only limited numbers of full sets will be available at Aarhus. However, abstracts will be available for all participants.

(b) ICES Special Meeting on Measurement of Fishing Effort

The ICES Special Meeting on Measurement of Fishing Effort will take place at ICES headquarters, Charlottenlund, Denmark, 25-26 September immediately prior to the 1970 Statutory Meeting. Participants should announce their attendance to ICES before 1 August. The deadline for papers is 1 July. The ICES Working Group on Fishing Vessel Characteristics will report to this meeting.

(c) The ICES/ICNAF Joint Working Party on North Atlantic Salmon

See Section 8 of this Summary Report.

12. OTHER MATTERS

(a) World Data Center A, Oceanography

Following 1969 Rec.19, Mr W. Molo, Director of the World Data Center A, Oceanography, Washington, D.C., gave a lecture on the mission and function of the WDC. The many questions posed to Mr Molo in connection with the lecture underlined the need for information among ICNAF member countries of the WDC.

(b) Direct Recording of Fishing Effort

STACRES reviewed Res.Doc.70/84 which reports on tests by the USA of a direct recorder of fishing effort in terms of duration and depth of trawl hauls. It also heard a description of a recorder which is being developed by the Lowestoft Laboratory and operates in conjunction with the trawl winch. A description of the instrument will be presented to the ICES Special Meeting on the Measurement of Fishing Effort, 1970.

(c) Continuous Plankton Recorder Surveys

Following 1969 Rec.18(i), the Oceanographic Laboratory, Edinburgh, presented a paper (Res.Doc.70/85) on the distribution and abundance of redfish larvae as determined by the continuous plankton recorder survey. It was noted that present data indicate that several well-defined populations of redfish may exist over oceanic depths in the North Atlantic.

STACRES was informed that work is continuing in the development of an undulating recorder. It is hoped that, in accordance with 1969 Rec.18 (ii), a representative of the Edinburgh Laboratory will be able to report to the 1971 STACRES meeting on the development of this recorder.

APPENDIX I - REPORT OF THE SUBCOMMITTEE ON ASSESSMENTS

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APPENDIX I - REPORT OF THE SUBCOMMITTEE ON ASSESSMENTS

Chairman: R.C.Hennemuth Rapporteur: D.J.Garrod

A mid-term meeting of the Subcommittee took place in London from 26-30 January 1970 (Comm.Doc.70/3), and further meetings were held at St. John's on 22-23 May and during STACRES. With regard to the report presented below, significant changes or additions to the interim report are contained only in sections A1 (cod, Subarea 1) and A2 (cod, Subareas 2 and 3). Sections ID (yellowtail flounder), IE (hakes) and VA (discarding and quotas) represent new considerations taken up at the Annual Meeting.

I. Review of the Latest Statistics of Nominal Catches and Fishery Trends in the ICNAF Area

The provisional data on landings for Subareas 1-5 in 1969, with comparative data from 1959, are presented in Tables 1 and 2. 1969 statistics from non-member countries, Denmark (F), France and Romania are not available at this time, but have been taken as equal to the 1968 landings and included in the tables.

A. Subarea 1

Total landings of cod from Subarea 1 in 1969 (225,000 tons) decreased to 59% of the 1968 nominal catch. This is one-half of the highest recorded catch in 1962 and the lowest since reporting by ICNAF began in 1952. The reasons for this sharp decline in catches in 1969 are thought to be,

1) severe ice conditions which in April to mid-August reduced the availability of cod, especially of the spawning concentrations;

2) relative poor recruitment of young cod in recent years which had an adverse effect on the fishery in the second half of the year, when younger cod are normally fished;

3) the diversion of fishing effort to other areas.

The decline in redfish catches since 1962 continued in 1969 when only 5,000 tons were reported.

B. Subarea 2

In 1968 total landings had increased by about four times against 1959 to 482,000 tons and reached the highest annual yield recorded so far in Subarea 2. This increase was mainly due to increased offshore cod catches taken mostly from Div.2J in late winter and spring, whereas the inshore fishery decreased remarkably by 50% from 1967 to 1968. Preliminary statistics indicate a further sharp decrease in the landings

of the inshore fishery in 1969, to 4,600 tons, some 25% of the 1967 level. The successful offshore fishery was continued during the late winter season as in 1968. Total landings are believed to have decreased by some 20,000 tons. In fact, catches of those countries which have reported catches and which caught more than 10% each of the total landings in 1968 increased or at least held the same level in 1969. Cod catches amounted to over 90% of the total landings of 1968 and 1969 as well.

C. Subarea 3

Total groundfish landings in 1969 fell to approximately 870,000 tons, compared with slightly less than 1,000,000 tons in 1968. This decrease was accounted for almost solely by a decrease in cod landings from about 700,000 tons in 1968 to about 600,000 tons in 1969. The decrease in cod landings took place in all divisions of the subarea but was most marked in Div.3K, L and N. In particular the cod catch in Div.3NO which had increased to three times the 1962-66 average by 1967, but decreased 30% in 1968, again decreased by 30% in 1969. This decrease may largely be accounted for by a decrease in effort, particularly by USSR.

Herring landings remained at the same level as in 1968.

D. Subarea 4

Provisional groundfish catches for 1969 are approximately equal to those of 1968. In both years this represents an annual increase of about 20%, but the catch is still below the 1963-66 average.

From 1968 to 1969, cod and flounder catches declined, haddock and redfish catches remained about the same, while silver hake catches increased from 3 to 46 thousand tons.

Herring catches increased 14%, continuing the trend of recent years, reaching a new record level of 430 thousand tons in 1969. Most of the catch was taken from Div.4T and 4X, but the catch in Div.4V increased from 20 thousand tons in 1968 to 82 thousand tons in 1969. In 4W the catch increased from less than 4 thousand tons in 1968 to 40 thousand tons in 1969.

E. Subarea 5

The total catch for all species declined from 906,000 tons in 1968 to 838,000 tons in 1969. The largest decline (over 100,000 tons) occurred in herring. Shellfish catches dropped 50,000 tons and haddock by about 20,000 tons.

These decreases were offset by increases in other species. Mackerel increased by 13,000 tons and alewives by 4,000 tons. Among the flounders, yellowtail rose from 32,700 tons in 1968 to 52,600 tons in 1969, because primarily of the entry of USSR in the fishery.

Though the effort of some countries apparently decreased, effort of other nations increased in Subarea 5 and also in the adjacent Subarea 6 to which herring and other species migrate from Subarea 5.

F. Subarea 6

Total landings by all countries in Subarea 6 increased from 665,000 metric tons in 1968 to 721,000 metric tons in 1969. The increase was due to increases in the Polish and Soviet catches; the US catch remained about the same. The Canadian catch decreased from 4,000 tons to 580 tons. The Polish catch increased from 13,000 to 20,000 tons due primarily to an increase in the mackerel catch; the Soviet catch increased from 53,000 to 107,000 tons, the increase consisting primarily in increases of 12,000 tons of herring, 9,000 tons of alewives and 31,000 tons of mackerel.

II. Status of the Fisheries

A. Cod

1. Subarea 1 (Res.Doc.70/73)

In the Assessment Report for 1969 (Redbook 1969, Pt.I, App.I), the Subcommittee pointed out that assessment of Subarea 1 cod should take into account the evident age-specific variation of fishing mortality rate because recruitment takes place over a span of years. Furthermore, the Subcommittee noted that changes in the pattern of fishing itself - especially the recent tendency of trawler fleets to concentrate their effort on spawning grounds to obtain higher catch-per-unit effort - would tend to increase the variation of fishing mortality rate among age-groups.

Two independent analyses have been carried out since the last meeting using different techniques. These have provided estimates of M=0.2 consistent with the previous estimate, and confirmed that fishing mortality (F) on younger age-groups (3-6) is only about one-quarter that on age-groups 7+. There is also some indication that F continues to increase with age beyond age 7 owing, in part at least, to the pattern of fishing described above.

The studies also confirmed that F had doubled from 1955 to 1965, when it was about 0.8-0.9 for fully recruited age-groups. It has been reported previously that this level of F is probably beyond that giving the maximum sustainable yield-per-recruit. As pointed out in the 1969 report, a reduction of fishing effort by up to 25%

Table 1. Landings (nominal catches) in 000's metric tons by main species from Subareas 1, 2 and 3, 1959-1969.

			1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969[a]
Subarea 1	All Gears	Cod	234	243	245	451	406	350	360	366	429	382	225
		Redfish	33	44	54	60	47	30	19	17	13	10	5
		Total Groundfish	273	295	414	526	475	409	399	396	454	401	236
	Otter Trawl	Cod	110	101	171	247	244	250	209	188	269	299	172
		Total Groundfish	143	147	236	318	306	290	238	209	288	312	176
	Total groundfish landings relative to 1959		100	108	151	193	174	150	146	145	166	147	86
Subarea 2	Cod	(Otter trawl	41	171	246	230	191	197	307	313	268	427	
		(Inshore fishery	19	17	19	25	25	16	26	24	27	13	4
		(Other Gears				+		+		1	3	9	
		(Total	60	188	265	255	216	213	333	338	298	449	422
	Haddock		+		+	+	+	+	+	+	+	+	
	Redfish		53	83	26	8	6	27	23	14	17	9	
	Halibut (including Greenland halibut)		+	+	+	+	+	+	1	1	3	8	
	Flounders		+	2	1	+	+	3	7	3	5	3	
	Other Groundfish		1	6	4	2	1	2	12	9	4	12	
	Total Groundfish		114	279	296	265	223	245	376	365	327	481	
	Other Fish		+	1	1	1	+	6	1	1	1	1	
	Total Fish		114	280	297	266	223	251	377	366	328	482	463
	Total Groundfish landings relative to 1959		100	245	260	233	196	215	330	320	287	422	407
Subarea 3	Cod	(Otter trawl	160	186	235	175	223	307	261	283	473	424	
		(Inshore fishery	180	184	136	150	155	144	114	112	102	114	
		(Other Gears	85	101	90	64	88	130	121	104	146	195	
		(Total	425	471	461	389	466	581	496	499	721	733	604
	Haddock		35	67	80	35	15	12	9	10	11	7	4
	Redfish		246	99	90	61	69	95	112	79	89	53	93
	Halibut (including Greenland halibut)		3	3	2	2	1	2	1	1	7	25	19
	Flounders		25	35	30	27	34	54	81	111	151	133	125
	Other Groundfish		19	17	11	8	7	7	17	11	23	41	25
	Total Groundfish		753	692	674	522	592	751	716	711	1,002	992	870
	Herring		5	5	4	5	6	3	8	23	78	145	145
	Other Pelagic Species		+	+	1	1	1	2	1	1	2	1	2
	Total Pelagic Species		5	5	5	6	7	5	9	24	80	146	147
	Other Fish		6	7	5	5	6	14	6	7	11	5	8
	Total Fish		764	704	684	533	605	770	731	742	1,064	1,143	1,025
	Total Groundfish landings, relative to 1959		100	91	90	69	79	100	95	94	133	129	114

a) Landings in 1969 include estimated landings for Denmark (Faroes), France, Romania and non-member countries which have been estimated on the basis of their catches = 1968.

Table 2. Landings (nominal catches) in 000's metric tons by main species in Subareas 4 and 5, 1959-1969.

		1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969[a]
Subarea 4	Cod	214	218	212	219	218	229	225	215	204	247	214
	Haddock	53	46	47	44	51	60	85	66	49	46	42
	Redfish	42	50	42	43	59	53	68	106	87	104	110
	Halibut	2	3	2	2	2	2	2	2	2	2	2
	Flounder	20	26	27	25	30	34	48	55	41	72	52
	Silver hake	-	-	-	9	123	81	50	10	2	3	46
	Total Groundfish	395	406	387	412	586	548	565	541	419	512	504
	Groundfish landings relative to 1959	100	103	98	104	148	139	143	137	106	130	128
	Herring	102	105	81	116	111	140	180	236	261	370	430
Subarea 5	Cod	16	14	18	26	30	28	42	57	42	49	45
	Haddock	41	46	52	59	60	70	155	127	57	44	25
	Redfish	16	11	14	14	10	8	8	9	11	7	12
	Flounders	25	27	29	38	48	58	57	54	49	53	78
	Silver hake	50	47	42	86	147	220	323	162	101	81	87
	Total[b]	276	221	228	300	391	475	728	613	389	401	495
	Groundfish landings relative to 1959	100	80	83	109	142	172	260	222	141	132	179
	Herring Inshore 5Y	48	69	27	71	70	28	34	29	31	63	46
	Herring Offshore 5Z	-	-	68	151	97	131	40	137	213	364	211
	Herring (5Y + 5Z)								250			
	All species								866	732	906	838

a) Landings in 1969 include estimates for non-member countries and France, which in 1968 took 34,000 tons of all species in Subarea 4

b) Includes all species except shellfish and herring

of this level (*i.e.* reducing F from 0.8 to 0.6) would not result in any significant loss of yield-per-recruit and would increase the catch-per-unit effort (on a per-recruit basis). Based on 1967 figures for catch and age composition and assuming F in 1968 to be slightly increased over that in 1967, two more or less independent studies predicted the 1968 catch to be 360,000 and 349,000 tons, respectively. The actual catch in 1968 was reported to be 382,000 tons.

Catches for 1970-71 have been estimated for different levels of F based on the 1968 data, assuming the 1965 year-class was moderate to good and the 1966 year-class was poor. The catches in 1970 and 1971 will be highly dependent on the results of the fishery in 1969 and 1970, but, whatever their abundance, the year-classes recruiting in 1970 and 1971 will be of minor importance for the yield in those years because of the relatively low fishing mortality in the two years after first (partial) recruitment.

The 1962-1966 year-classes, making the largest contribution to the fishery in 1970 and 1971, are far weaker than the preceding ones. Consequently, the catch in 1970 and 1971 will decrease from the 1968 level even if fishing mortality should be increased to the level F=0.8.

Estimated catch for 1970 and 1971
at different level of F in '000 tons
(corresponding F in brackets)

1968	1969	1970	1971
			159 (0.6)
		178 (0.6)	
			203 (0.8)
382 (0.8)	225* (0.6)		
		224 (0.8)	143 (0.6)
			182 (0.8)

*Preliminary figure, including an estimated catch for Faroes, France and non-member countries not yet reported.

Preliminary reports of the 1969 fishery indicate a considerable decrease - probably more than 150,000 tons - in catch compared to that in 1968. Part of this decrease is due to a lower abundance of fish as indicated in the predictions for 1970 and 1971 catches, but reports indicate that the main part of the decrease was due to a reduction in fishing effort. The reason for this seems to be the extremely bad ice conditions in the first half of 1969 (otter trawlers fishing on spawning grounds) and the better catches-per-unit-effort in other areas.

Although the apparent reduction in fishing activity in 1969 has reduced the fishing mortality rate to 0.6 (which corresponds to the level giving maximum sustainable yield), any improvement in ice conditions and stock abundance relative to other areas will again attract greater effort to the subarea. This is especially true if a good year-class should recruit to the fishery and might be followed by the events that were experienced in the Georges Bank haddock fishery - a short-term, very large increase in fishing mortality leading to reduced yield-per-recruit and leaving a depressed stock when the effort moved elsewhere. This is undesirable, so that, although F in Subarea 1 may have returned temporarily close to the optimum level, the need to regulate fishing, and, more particularly, to prevent sudden expansion of fishing, still exists.

2. Subareas 2 and 3 (Res.Doc.70/67, 70/68)

a) Yield/effort assessment

Previous assessments have indicated that the level of fishing for the major cod stocks in Subareas 2 and 3 in recent years has been close to, or beyond that, generating the long-term maximum sustainable yield-per-recruit. The total catch in Subareas 2 and 3 in 1968 was 1,182,000 tons and in 1969 provisional figures indicate that it was about 1,000,000 tons. A rapid increase in effort and a favourable recruitment pattern contributed to this increase over the catches obtained before 1967, but it is unlikely that the long-term yield can be maintained at this level because of the consequent depletion of the standing population.

In Div.3NO, the cod catch in 1967 of 222,000 tons was about three times greater than the 1962-66 average. A reduction to 160,000 tons in 1968 and, provisionally, to 110,000 tons in 1969 may reflect a reduction in effort. However, in both 1967 and 1968, landings consisted largely of the abundant 1964 year-class, and year-classes since 1964 have been considerably less abundant. Total yield from the 1964 year-class will be less than it would have been if these fish had not been fished so heavily at the time of first recruitment to the fishery (1967 - age 3). New assessments of the effects of a reduction in fishing mortality in Subarea 2 have confirmed the previous results (see above). Similar new assessments have also been carried out for cod in Subarea 3. In principle these indicate that the level of fishing mortality is well beyond that required to give the maximum yield per recruit. An appropriate reduction in F would give increased catch per unit effort, although the improvement in yield per recruit is probably not more than could be expected for an increase in mesh size at the present level of fishing. If the increased effort of 1967-68 were

sustained, it would cause large year-to-year variations in yield from this stock because of increased dependence of the fishery on one or two recruiting year-classes, especially in Div.3NO where year-class survival is more variable than in the larger, more northern stocks.

b) Mesh assessments

At the 1969 Annual Meeting, the Subcommittee examined a mesh assessment for cod of Div.3NO. This was based on 1963-66 data, and confirmed previous mesh assessments which indicated long-term increases in catch-per-recruit would be obtained with mesh size increases from 76 mm to 130 mm (5 inches), and even to 150 mm (6 inches). In 1967 the landings increased three-fold over the 1962-66 average. Although they decreased somewhat in 1968 and 1969 they were still above the 1962-66 level. A marked increase in effort (and presumably F) also occurred at this time. A new assessment has not been completed, but it may be inferred that the benefits from mesh increases beyond 114 mm would be greater at the 1967-69 level of F than those calculated for the 1963-66 period.

Assessments for Div.2J, Div.3KL and 3Ps have now been completed by St. John's Biological Station based on data collected during 1964-68. In each area, effective mesh size in use during the period was assumed to have been 114 mm (4 1/2 inches).

Table 3. Summary of mesh assessments for Subareas 2 and 3. Cod 1964-68 (M=0.2).

		2J	3KL	3NO*	3Ps	Total Subarea 3 (weighted by 1968 landings)
130 mm	Immediate Loss %	-7.5	-4.2	-3.8	-4.6	-4.1
	Long-term gain					
	0. Trawlers	+4.2	+4.0	+7.0	+4.5	+4.9
	Total	+4.5	+4.2	+7.3	+4.4	+5.0
140 mm	Immediate Loss %	-22.8	-13.3	-11.2	-14.4	-12.8
	Long-term gain					
	0. Trawlers	+5.8	+6.8	+15.8	+6.3	+9.4
	Total	+7.0	+8.5	+16.7	+7.8	+10.4
150 mm	Immediate Loss %	-37.2	-22.5	-18.0	-23.8	-21.3
	Long-term gain					
	0. Trawlers	+3.3	+6.8	+22.1	+5.7	+11.3
	Total	+5.8	+10.9	+23.8	+9.7	+13.9

*1963-66 data

In general, small to moderate long-term increases in yield-per-recruit in Subarea 2 and 3 could be obtained with increases in mesh size from 114 mm (4 1/2 inches) presently in use to 130 mm (5 inches). Short-term losses for such an increase would be small (less than 10% in all areas). For increases up to 150 mm, there is the prospect of further small gains except in Subarea 2 for 150 mm. In each area, short-term losses would be of the order of 20% for the 150 mm mesh.

No information was available to evaluate the effect of such mesh regulations upon the catch of other species but previous assessments indicate that increases from 76 mm mesh to 114 mm would result in immediate losses to redfish landings of 6% in Div.3KL, 10-15% in Div.3M and 3Ps; and 50% in Div.3NO. For increases in mesh beyond 114 mm, the immediate losses of redfish would be rather greater.

c) Immediate Prospects for Catch

In Subarea 2, variation in year-classes is of the order of 3 to 4 times. Strong 1961-63 year-classes contributed to the growth of cod catches in 1968-1969 but the following 1964 and 1965 year-classes are less abundant. The 1966 year-class is probably very rich but the fish will be too small for intensive fishing in 1971. The stock abundance is, therefore, likely to decrease in 1971 but it must be stressed that at Labrador actual catches are very dependent on the peculiarities of cod distribution.

On the southern Grand Banks, year-classes may vary by 50 times. Strong year-classes of 1964 and to some extent 1965 and 1966 contributed to the high cod catches of 1967 and 1968. Judged from the abundance of 1-3 year-old cod in USSR surveys in Div. 3N, the 1967 year-class will be poor followed by a strong 1968 year-class. The success of fishing for cod in Div.3NO in 1971-72 is, therefore, likely to be satisfactory though at a slightly lower rate than in 1967-68.

d) Div.3M (Res.Doc.70/46)

This division contains the Flemish Cap fishery which takes place on an isolated stock of cod. Although the total catch has fluctuated around 30,000 tons since 1963, excluding a peak year in 1968, the total fishery has increased and catch-per-unit-effort has decreased. At the same time, the average age of the catches has decreased and the fishery has become more dependent on newly recruited age-groups. It is hoped that a further assessment of this fishery will be made available in 1970. The status of this stock is of especial interest because, being completely isolated, and with apparently low fluctuation in recruitment (comparable to Subarea 2), it presents a less complex situation for determining the effect of regulatory measures.

3. General Conclusions

Full assessments for cod in Subarea 1 are given in Section II A1. Assessments for cod in Subareas 2 and 3 are not so complete, and though none are available for Subareas 4 and 5, the studies presented do substantiate the earlier conclusions of the Subcommittee that the available fishing capacity capable of being deployed on cod stocks is beyond that required to secure the maximum yield-per-recruit. The present high yields of 1967-68 have been achieved largely by decreasing the stocks accumulated under previously lower levels of exploitation and a period of good recruitment. The estimates made by the Subcommittee indicate that yield will decrease further from the 1969 level, barring short-term increases due to expansion of effort.

Any further increases in effort on any of the cod stocks (particularly Subareas 1-3) will cause a deterioration in the fisheries and the stocks. At best, it is probable that over the long run, no more than the present total catch (1,200,000 tons) would be taken with increased effort, but it is possible, depending on the stock-recruitment relation, that there might be a decrease in total catch.

The Subcommittee believes that the Commission should give consideration to limitation of fishing on all cod stocks in the ICNAF Area.

B. Haddock

1. Div.4VW (Res.Doc.70/74, 70/75)

The Subcommittee believes that this stock has been fully exploited in recent years. Abundance of 4-12 year-old fish declined by over two-thirds from 1957 to 1969. The 1969 abundance was the lowest on record. During 1958-68, landings from this stock averaged 27,500 tons annually, reaching a maximum of 55,518 tons in 1965 and a minimum of 10,912 tons in 1967. Landings in 1969 were 11,146 tons. Fishing effort on the adult stock fell with declining abundance. However, the 1962-64 year-classes were heavily exploited as immature fish in 1965, reducing considerably the yield of these year-classes over that obtainable if they had not been fished until 4 years of age and older.

A fishing mortality (F) of 0.5 is estimated to result in maximum yield to the traditional fishery. This is obtained with a fishing effort of about 60,000 hours (Canadian large otter trawl units), which is slightly below the level obtaining in 1968-69. However, the abundance of the exploited population declined from 33 million fish in 1967 to 25.5 million fish in 1969 due to the low level of recruitment. Predictions of the abundance of the 1966-68 year-class which will recruit at age 4 in 1970-72 indicate that these also are poor year-classes and should average about 10 million fish

at age 4. Thus, an F of 0.5 in 1970-72 will result in yields of approximately 9,000 tons and a further stock decline to about 20 million fish. It is obvious that, to maintain the population at its 1967-69 level in 1970-72, catches should be substantially less than 9,000 tons. Historical data on landings indicate that this stock is capable of giving a sustained yield of 20,000-25,000 tons. Thus, a reasonable management objective would be to encourage the increase of the adult stock to at least 60 million fish.

Regulation of the haddock fisheries of Div.4X and Subarea 5 could result in increased effort in Div.4VW, particularly during the closed season (March-April) in the former divisions. Availability of Div.4VW haddock in those months is frequently high even at low levels of abundance. Thus, increased effort at this time could result in an undesirably high fishing mortality rate. Peak spawning in Div.4VW occurs at the end of April, the spawning season (April-May) being closely similar in timing to that in Div.4X. Maximum availability also occurs at similar times (March-April). Thus, biological arguments for implementation of a closed season are almost identical for the two areas.

Possible measures to prevent the taking of large numbers of juveniles in incidental catches of fisheries for non-regulated species should receive further consideration. Particularly significant in this regard is the substantial summer silver hake fishery on Sable Island Bank, a nursery ground for young haddock. Large catches of these young haddock, particularly in 1965 and 1966, were a major factor contributing to the current low abundance of the stock. The silver hake fishery collapsed in 1967-68, but recovered strongly in 1969. Thus, should a strong haddock year-class appear, it may well be subjected to substantial fishing mortality prior to maturity and entry to the traditional fishery.

2. Div.4X

At its 1969 meeting, ICNAF recommended that catches of haddock in Div.4X should not exceed 18,000 tons in each of the three years 1970-1972. This Subcommittee reviewed the previous estimates of possible catches from Div.4X in the light of the most recent data from the fishery and groundfish surveys. Most of these data apply to the area to the south and east of Nova Scotia, called Sampling Area 42, but the results have also been extrapolated to include the Bay of Fundy area - Sampling Area 41.

Sampling Area 42. Analysis of commercial catch-per-unit-effort data indicate that total mortality (Z) on fully recruited age-groups (6+) averaged about 0.8 in 1967-68. US groundfish survey data was used to estimate M=0.2, so that F=0.6. These values have been used in conjunction with the age composition of the total catch and estimated recruitment of 3-year-olds to estimate the total stock of age-groups greater than two at the beginning of 1969 and 1970, presuming fishing mortality to have remained steady.

The surveys indicate consistent differences in the strength of the 1961, 1962 and 1963 year-classes in the ratio 1:2:4, respectively. Subsequent year-classes have been much weaker and are taken as 10% of the 1963 year-class, though this may be too generous.

Year-Class	61	62	63	64	65	66	67
Index	1.0	2.0	4.0	0.4	0.4	0.4	0.4

Actual numbers of fish in the population at age 3 were estimated for the year-classes subsequent to 1964 by direct comparison of the indices with the stock of 3-year-olds of the 1961-1963 year-classes as estimated from the commercial catch data.

The estimated available stock in 1969 and 1970, with a fishing mortality of F=0.6, would yield 17,000 tons in 1969 and 9,000 tons in 1970.

Sampling Area 41. Catches in Sampling Area 41 have not been evaluated in detail. Stock data indicate variations in recruitment are broadly similar to those recorded for haddock in Sampling Area 42, but the fish are recruited at a younger age. It follows that if mortality has not changed, the catches in Sampling Area 41 will show much the same proportional changes as those expected in Sampling Area 42, but would occur a year or two earlier. For example, catches in Sampling Area 41 fell from 17,000 tons in 1967 to 8,000 tons in 1968, whereas in Sampling Area 42 this change, which stems from the passage through the fishery of the 1963 year-class, is expected to become evident in 1969. It is, thus, estimated that haddock catches in Sampling Area 41 in 1969 will be about three-quarters of the catch in 1968 (*i.e.* 6,000 tons) and one-third in 1970 (3,000 tons), presuming constant fishing mortality.

Total catches from Div.4X are expected to be of the order of 23,000 tons in 1969, and 12,000 tons in 1970, compared with 31,000 tons in 1968, provided F remains constant.

This analysis suggests that the annual quota of 18,000 tons set for the period 1970-72 is too high to ensure that fishing mortality will not increase beyond its 1968 level.

3. Subarea 5. The US catch of haddock from Subarea 5 in 1969 was 18,845 metric tons compared with 28,906 tons in 1968. An additional 4,568 metric tons was reported to have been removed by other fishing fleets, so that total removals were close to 23,400 metric tons for 1969, compared with 44,477 in 1968. This is equivalent to about 12.1 [illegible]ion fish using the mean weight per fish of 2.0 kilos in the U[illegible]ndings to convert the other countries landings.

The bulk of the catch, 21,000 metric tons, came from Georges Bank. The US fleet caught 2.5 tons per day on the average in 1969 compared to 3.2 tons in 1968, a decrease of 22%. Comparison of catch in the autumn survey cruises of 1968 and 1969 indicate a decrease of 40%.

The age composition of catches in 1969 and 1968 is presented below. The fishery is still dependent mostly on the 1963 year-class, but the 1966 year-class (3-year-olds) contribution was significant.

	% Age Composition								
	1	2	3	4	5	6	7	8	9+
1969	0	0	16	4	6	54	14	2	5
1968	0	11	3	8	57	14	3	2	3

The autumn survey of the US *Albatross IV* indicated that the 1969 year-class was as poor as the preceding five.

The estimates of available population, recruitment and removals through 1971 are presented in Table 4. If the proposed regulations on limitation of catch become effective in 1970, there may be some small improvement in stock by 1972, depending on the 1970 year-class.

Direct estimates of population numbers from the trawl surveys (Table 5) are somewhat lower than those of Table 4. Thus the estimate of about 13 million fish in 1969 (spring) compares to an estimate of about 16 million fish, adjusted for four months catch, based on commercial data. This could be due to the fact that the trawl survey would underestimate to some extent the population because less than 100% of the fish in its path would be captured. The difference may also be due to errors of estimation. The landings of 3-year-olds (1966 year-class) in 1969 was only about 1.9 million fish. If there were 16 million recruited in 1968, as estimated in Table 1, leaving about 11 million available for 1969, considerably more should have been caught considering the fishing rate and desirability of smaller-sized fish (scrod) on the US market. This might mean that the accruitments used for estimating population in 1970 and 1971 are too high.

The fact that existing estimates presented to ICNAF may be too high only reaffirms our 1969 recommendation that no fishing take place on this stock.

Table 4. Estimates of available population and recruitment for Subarea 5 haddock (in millions of fish).

	1935-60	1968	1969	1970	1971	
Available Pop. (age 2+)	145	52	20	21	28	21+ recruitment
Removals:						
Total	63	33	15	9	9	
Fish.	41	28	12	6*	6*	
Nat.	22	5	3	3	3	
Recruits (age 2)	54	16	1	16	16	

*Under regulation, 2 kilo per fish

Table 5. Estimated total numbers of haddock (in millions) from research vessel surveys.

Year	Season	Age 2+			Total		
		Georges Bank	Gulf of Maine	Total	Georges Bank	Gulf of Maine	Total
1963	Summer	19.6	14.7	34.3	117.1	18.9	136.0
	Autumn	45.9	20.5	66.4	186.5	65.5	252.0
1964	Winter	52.7	19.5	72.2	111.6	30.0	141.6
	Summer	82.2	22.4	104.6	552.0	73.5	625.5
	Autumn	100.3	8.3	108.6	248.6	12.2	260.8
1965	Winter	267.6	25.7	293.3	276.6	26.6	303.2
	Summer	339.3	15.3	354.6	369.3	21.2	390.5
	Autumn	117.3	16.0	133.3	130.8	16.4	147.2
1966	Winter	73.2	13.4	86.6	73.3	13.4	86.7
	Autumn	33.7	11.0	44.7	42.8	11.0	53.8
1967	Autumn	13.9	11.5	25.4	21.8	11.5	33.3
1968	Spring	17.4	5.5	22.9	17.5	5.5	23.0
	Autumn	7.3	8.0	15.3	7.4	8.0	15.4
1969	Spring	9.3	3.4	12.7	9.3	3.4	12.7
	Summer				9.9	3.7	13.6
	Autumn				4.4	5.1	9.5

C. Herring

1. Development of the Fisheries

In its 1969 report, the Subcommittee drew attention to the rapid increase in recent years, and especially since 1966, in the exploitation of herring in Subareas 3, 4 and 5 (extending into Subarea 6 in 1966-67). The total herring catch from the ICNAF Area (adults and juveniles combined) increased from 180,000 tons in 1960-61 to 951,000 tons in 1968 (Tables 6 and 7). This increase was due primarily to the growth of fisheries on adult herring. The first major development in the fishery on adults took place on a previously unfished stock on Georges Bank in the early 1960s when annual catches rose to over 100,000 tons. They remained near that level until 1967 when they increased to 218,000 tons, with a further increase to 323,000 tons in 1968. In Subareas 3 and 4, the development of the fishery on adults took place later than on Georges Bank, mostly after 1965. In Subarea 4, catches increased from less than 100,000 tons in 1965 to over 250,000 tons in 1968 (and from provisional data, also in 1969), and in Subarea 3 from less than 10,000 tons in 1965 to around 150,000 tons in 1968 and 1969.

Table 6. Herring landings (thousand tons) by area (stock). Juvenile catches are in parentheses where known.

Year	Div.5Z + Subarea 6	Div. 5Y	Div. 4X	Div. 4VW	Div. 4T	Subarea 3	Div. 4R	Total
1960[a]	...	70(69)	...	...	...	6	...	180
1961	68	26(24)	58	3	19	4	1	179
1962	151	72(71)	68	12	34	5	2	344
1963	97	70(69)	65	5	40	6	2	285
1964	130	29(28)	93	3	39	3	5	302
1965	41	34(32)	124	7	44	8	5	263
1966	143	29(26)	189	3	37	23	7	431
1967	219	36(29)	190	2	63	79	6	595
1968	373	63(32)	227	24	112	145	7	951
1969*	264	46(24)	142	123	154	145	3	878

[a] Subarea 4: 105 *provisional

Table 7. Herring landings (thousand tons) in Subareas 1-5 and Subarea 6 by year and country (juvenile catch in parentheses where available).

Year	Canada	USA	USSR	Fed.Rep. Germany	Ice-land	Nor-way	Romania	Poland	Non-Member	Total
					Subareas 1-5					
1960	110	70(69)	-	-	-	-	-	-	-	180
1961	85	26(25)	68	-	-	-	-	-	-	179
1962	112	72(71)	160	-	-	-	-	Ø	-	344
1963	115	70(69)	100	-	-	-	-	Ø	-	285
1964	141	28(28)	133	-	-	-	-	Ø	-	302
1965	183	35(32)	42	-	-	-	2	1	-	263
1966	256	31(26)	119	-	-	-	3	15	1	425
1967	345	32(29)	124	28	-	-	2	38	21	590
1968	528	42(32)	130	81	-	-	2	64	75	922
1969*	482	31(24)	166	96	13	1	Ø	37	NK	826
					Subarea 6					
1966	-	3	3	-	-	-	-	-	-	6
1967	-	1	3	-	-	-	-	-	1	5
1968	-	Ø	16	Ø	-	-	-	12	1	29
1969*	-	1	38	-	-	-	-	13	NK	52

*provisional

2. Identity of Stocks

In assessing the state of the exploited stocks of adult and juvenile herring in each of the main fishing areas and the effects of fishing on them, it is important to know (a) the extent to which the main exploited groups of adults can be treated as independent stocks, and (b) the adult stocks from which the concentrations of juveniles exploited along the Canadian and US east coasts are derived and the stocks to which they subsequently recruit on reaching maturity.

Information relating to (a) is available from Canadian and US investigations of biological characters of adult herring spawning in Subareas 3, 4 and 5. These results show that the total population in this area is composed of a number of distinct stocks (or groups of stocks). In particular, they indicate that the groups of adult herring exploited on Georges Bank (Div.5Z), in the Bay of Fundy, and in the Newfoundland-Gulf of St. Lawrence area, on which the recent large increases in fishing have been centred, are distinct from one another and can be treated as separate stocks for assessment purposes. They also indicate that the Georges Bank stock is distinct from adult herring spawning in the Gulf of Maine (Div.5Y) and over the Scotian Shelf (Div.4Vs and 4W), which have recently been subject to limited exploitation. However, the distinction between the Gulf of Maine and Scotian Shelf groups and the Bay of Fundy spawners is less clear.

It is not possible at present to define with any certainty the sources of the juvenile herring concentrations off the Canadian and US coasts and the adult stocks to which they subsequently recruit. However, most of the information currently available suggests that few of these herring are derived from and recruit to the Georges Bank stock. Further detailed studies such as biochemical and meristic analysis to determine the inter-relationships between the juvenile and adult stocks are currently in progress. There is a specific need for more detailed information on catches of both adults and juveniles within Div.4X.

3. Assessment of State of Adult Stocks

a) Georges Bank (Div.5Z)

The data in Tables 6 and 7 show that, apart from 1965 when fishing effort was diverted from herring to other species, the annual catch after 1961 fluctuated between 97,000 and 150,000 tons until 1967 when it increased sharply to over 200,000 tons. It increased again to over 370,000 tons in 1968 and provisional data indicate that it remained at about this level in 1969.

Average catch-per-hour for USSR medium and large trawlers for the years 1962-1969 are tabulated below, together with estimates of total fishing effort, obtained by dividing total catch by catch-per-hour.

	Catch all countries	Catch-per-unit-effort (tons/hr fishing)		Estimated total international fishing effort (000's of hours)	
Year	(000's tons)	USSR medium trawlers	USSR large trawlers	Medium trawlers units	Large trawlers units
1962	151	1.16	1.19	130	127
1963	97	1.77	1.06	55	92
1964	131	1.01	0.67	130	196
1965	40	(0.27)*	(0.23)*		
1966	137	(0.12)*	0.89		154
1967	218	0.82	0.67	266	325
1968	373	0.64	0.65	583	574
1969**	350	0.41	0.5-0.6	854	600-700

* Estimates for 1965 and 1966 not representative due to diversion of main fishing to other species

** Preliminary

These data show that the catch-per-unit effort of both the medium and large trawlers decreased after 1963, to reach in 1969 a level approximately one-third of that in 1962-1963. At the same time the estimated total international fishing effort increased greatly.

Herring fishing on Georges Bank by other European countries started later than that of the USSR, but their fisheries have also experienced a decrease in catch-per-unit-effort during the past three years. Catch-per-unit-effort for Polish trawlers decreased sharply from 13.2 tons per day fishing in 1967 to 6-7 tons per day fishing in 1969. German trawlers, which only commenced fishing on Georges Bank in 1967, experienced a decrease from 50 tons per day to 38 tons per day between 1967-1969.

These data point, therefore, to a large decrease in the abundance of the herring stock on Georges Bank during the period and especially since 1967. This is confirmed by independent estimates of spawning stock size obtained by Soviet investigators from surveys of egg concentration over the spawning grounds in 1964-1969. The decrease in egg production which they have observed indicates a 90% decrease in spawning stock size during this period.

German and USSR commercial data, and US survey sampling data on the age composition of the exploited stock during the period since 1964 indicate that the exploited stock has consisted mainly of the 1960 and 1961 year-classes, both of which were of above average strength, and that all year-classes recruiting subsequently have been weak. It is clear, therefore, that unless the year-class recruiting to the fishery in 1970 is strong, adult stock abundance and catch-per-unit-effort will decline further.

Estimates of the annual total mortality rate (Z) from the abundance-at-age data for the years 1967-69 were between 0.7-0.8. It is likely that these are underestimates because of apparent bias in catch-per-unit-effort as a measure of stock abundance.

The above information describes the effects of a rapid and intense exploitation of a virgin population, leading to a 70-90% decline in spawning stock density. Part of this decline may be attributed to poor recruitment since the entry of the 1960 and 1961 year-classes in 1963 and 1964. The important question is the effect of stock reduction on recruitment. It is not possible with the evidence at hand to specify the possible relation. But, it has been concluded from studies of other herring fisheries that a very small spawning stock may cause sustained low recruitment. Studies of other herring fisheries also imply that the value of Z estimated for Georges Bank is such that no increase in yield-per-recruit would result from further increases in fishing intensity.

The Subcommittee concludes from this preliminary analysis that reduced fishing intensity a) will not reduce yield-per-recruit; b) will increase catch-per-unit-effort; and c) may provide for increased recruitment.

b) Bay of Fundy (Div.4X)

The fishery for juvenile herring along the New Brunswick shore of the Bay of Fundy has been in existence for many years yielding an average of between 50,000 to 60,000 tons per year through most of the 1960's. Recently a fishery for adult herring has developed in the southeastern part of the Bay off the coast of Nova Scotia, and in 1965-1968 fishing effort in this fishery increased markedly to give in 1968 landings of about 150,000 tons of adult herring. In 1969, however, landings decreased sharply to just over 100,000 tons despite a continued high fishing intensity. In both 1968 and 1969, the fishery exploited also the juvenile stages of the large 1966 year-class to some degree. A marked decrease in stock abundance was reflected in a 30% decrease in the catch-per-unit-effort in the fishery from 1968 to 1969. In recent years, a large proportion of landings, *e.g.* 45,000 tons landed in 1968, cannot be classified by size or area of origin. Hence, any conclusions drawn about trends in this fishery must be provisional. Data on the abundance of the fully recruited age-groups in the exploited stock are insufficient to allow estimates to be made of the changes in total and fishing mortality rates during the period of rapid growth of the fishery in this area. However, the rapid increase in fishing effort and catch and the accompanying decrease in catch-per-unit-effort point to a high rate of exploitation in the years since 1965. It seems likely that maintaining or increasing the rate of exploitation will result in a further decrease in average stock abundance and catch-per-unit-effort.

c) Newfoundland (Subarea 3 and Div.4R)-Gulf of St. Lawrence (Div. 4T)-Banquereau (Div.4V)

Since 1966 there has been a large increase in the exploitation of herring spawning in the spring and autumn in the Gulf of St. Lawrence and occurring in pre-spawning concentrations in winter off the west and southwest coasts of Newfoundland and in the Banquereau area. The exact relation between the stocks supporting these several fisheries is not yet determined, but there is good evidence that herring fished in the Gulf of St. Lawrence over the summer are exploited outside the Gulf in the fall and winter months both at Newfoundland and in the Banquereau area. Fishing has increased in both of these areas as shown in Table 6.

Like the Bay of Fundy fishery, the major increase has taken place very rapidly. Too few data on changes of stock abundance, mortality rates, recruitment levels, etc. are yet available for detailed assessments to be made of the effect of the recent increase in fishing. It is essential, in view of the large removals, that good catch and effort data be obtained in order to permit determination of the effects of fishing.

4. Juvenile Herring Fisheries

Fisheries for "sardine" herring (age-groups 1-3) have been conducted along the coasts of New Brunswick (Canada, Div.4X) and Maine (USA, Div.5Y) for many years. The landings for the latter fishery in the years 1960-1969 are presented in Tables 6 and 7. Up to and including 1967, landings in New Brunswick were mostly sardine from the Bay of Fundy. In 1968 and 1969, a proportion of these landings, at present unknown, was from other fishing areas and included adult fish.

In the US fishery, the catch and catch-per-unit-effort has declined during this period. This has been most marked in the western (southern) sector of the fishery, where the catch-per-unit-effort has declined steadily since 1962 to a level in 1966-68 which was about one-half that of 1962. This was due to a progressive decrease in the abundance of the herring stock in this area which reflected a decline in the strengths of year-classes entering the coastal waters off the western Maine coast; indeed, no strong year-class has appeared there since the 1961 year-class recruited in 1963.

The total landings and landings per weir in the Canadian fishery in the Bay of Fundy have fluctuated without major trend during this period due to variations in the abundance and/or availability of successive year-classes recruiting to the juvenile stock: no marked decline in the strengths of year-classes, as has occurred in the western Maine area can be detected in recent years, although catch-per-unit-effort data for 1969 indicate that stock abundance in that year was relatively low.

In view of the present uncertainty regarding the origin of the juvenile herring and the adult stocks to which they subsequently recruit, it is not possible to assess the effect, if any, of the recent increases in exploitation and the decrease in stock abundance in the adult stocks on Georges Bank and the Bay of Fundy on the quantities of herring recruiting to the exploited juvenile stocks or the effect of the juvenile fishery on the exploited adult stocks. However, since no increase in the catch of juvenile herring has taken place since the mid-1960s at least up to 1968, even if all of the recruits to the Georges Bank stock were derived from the stock exploited along the Maine and New Brunswick coasts, it is clear that the recent reduction in recruitment to the Georges Bank stock cannot be attributed to the juvenile herring fishery.

5. Research Requirements

The Subcommittee noted a number of important gaps in the present knowledge of the general biology and population dynamics of the juvenile and adult components of the exploited herring stocks on which research effort should be concentrated. There are two aspects

of paramount importance of which the first is the inter-relation between the stocks of adult and juvenile herring currently exploited in Subareas 4 and 5. The Subcommittee considers that particular attention should be given to extending the application of serological and biochemical methods of analysis in association with meristic character analysis to this problem. In addition, consideration should be given to a) determining the effectiveness in relation to the range of possible loss and recovery rates of conducting large-scale tagging experiments on juvenile herring to identify the adult stocks to which they subsequently recruit, and b) studies of the dispersal of larvae and early 0-group fish from the main centres of spawning, especially on Georges Bank and in the Bay of Fundy, but also at the entrance to and within the Gulf of St. Lawrence.

The second important aspect is the estimation of changes in stock abundance and mortality rates in the adult stocks. The Subcommittee considers that, in addition to the continued use of data on catch, fishing effort and age composition from the commercial fisheries for this purpose, attention should be given to quantitative egg production surveys, including evaluation of accuracy and precision, as conducted on Georges Bank by USSR investigators in recent years, to provide estimates of absolute stock abundance.

6. Herring Scale and Otolith Comparisons

The results of the most recent herring scale and otolith comparison involving seven countries and reported in Res.Doc.69/29, show that considerable differences in ageing techniques still exist.

A study group which included experts from Canada, USSR and USA examined otolith material provided by Canada on the USSR R/V *Persey III* during the 1970 Annual Meeting. There was no major disagreement between experienced readers on the identification of growth zones and winter or "spawning" rings. It was decided that consistency of reading and interpretation of otoliths would best be achieved by regular interchange of selected material between experts in individual laboratories. The Canadian St. Andrews Biological Station agreed to coordinate the interchange of material and will inform member countries and individual experts of arrangements as they are made.

It was agreed that, because of the difficulties of collecting and reading herring scale material, validation of ageing techniques would be confined to otolith studies.

D. Yellowtail Flounder Fishery in Subarea 5

This fishery is confined almost entirely to Div.5Z. There are two independent stocks, one on Georges Bank (Div.5Ze), and the second along southern New England (Div.5Zw). The fishery expanded during the early 1940's, primarily in southern New England, reaching a level of landing

of about 12,000 tons annually in 1943-1947. Landings decreased thereafter until the fishery began to expand again in the late 1950's. At this time, the fishery on the Georges Bank stock also became important. For both stocks, the catch rose to 48,000 tons in 1963, and remained there until 1965 when catch dropped somewhat to an average of about 42,000 tons through 1968. The fishery was conducted almost entirely by US trawlers until 1969, when the USSR harvested about 18,000 tons, bringing the total catch to 57,000 tons.

The US trawl fishery is directed specifically toward the yellowtail flounder resource and uses predominantly 114 mm codends with some by-catches of other species. US landings are primarily 3-5 year-old fish; a large share of 2-year-old fish which are caught are discarded. The USSR catches are taken as by-catch in fisheries for other species, *e.g.* hake and herring, which are prosecuted with smaller mesh codends. No data are available on either the species or age composition of such catches in 1969. However, estimates of the proportion of yellowtail taken by both the US (76%) and USSR (70%) agree very well. Previous to 1969, however, only very small amounts of flounders have been taken as by-catch in this fishery.

Analysis of US data indicate an overall total mortality, Z=1.3 (70%) in 1963-1968, being somewhat higher on the southern New England stock and lower on Georges Bank. The partition of mortality due to natural causes and fishing is not exactly known. However, the lack of evidence of high predation and comparison of estimated total mortality in 1943-1947 (0.78), when fishing effort was 30% lower, with the more recent period makes it reasonable to assume natural mortality is less than 0.3.

Taking M = .2 implies that fishing mortality, F=1.1 and gives an exploitation rate $E > 0.80$. At this high level of total mortality, annual landings are sensitive to fluctuations in recruitment and the density of mature fish has become relatively low. Apart from the possibility of improving productivity in this fishery, a cause for immediate concern follows from the decline in recruitment since 1967 which will lead to a further reduction in stock abundance unless the current high fishing intensity is reduced. This concern is accentuated by the obviously higher fishing intensity generated by the increased catch in 1969. The Subcommittee has, therefore, assessed the effects of regulation of mesh size and fishing mortality in relation to the yield-per-recruit, and as a way to mitigate the anticipated decline in spawning stock.

Judged from the characteristics of the total US fishery in 1963-1968, an increase in mesh size to 129 or 145 mm would give long-term increases in yield-per-recruit of 7% and 17%, respectively, four years after an immediate loss to landings of about 4% and 21% (Res.Doc.70/86). In terms of catch, the long-term gains would be somewhat less and the immediate losses greater. This results from the present discarding practice of the US fishery.

A reduction in fishing mortality to about two-thirds of its 1963-1968 level would be expected to give some additional increase in yield-per-recruit with the present mesh size. However, potentially larger benefits may be gained by an appropriate combination of both regulations. These are summarized in Table 8 with the qualification that the method of computation underestimates benefits given for the decrease in fishing mortality. Two other methods of computation based on utilization of landings data directly gave estimated benefits up to 30% (Res.Doc.70/87).

The expected catch at particular levels of fishing mortality in 1970-71 have not been calculated, but, as an indication of magnitude, the level of catch required to secure a one-third reduction in fishing mortality in the US fishery as a whole in 1969 would have been about 30,000 tons compared with the actual catch of 57,000 metric tons. The analysis indicated that this catch should be divided about equally between the two stocks. But, because the increased catch in 1969 was taken primarily from the southern New England stock, it is probable that a greater reduction in catch from this stock would be required to achieve the benefits which have been indicated above.

The proportion of smaller fish (ages 2 and 3) is somewhat greater on the southern New England grounds than on Georges Bank. However, there are no distinct manageable areas where juvenile fish or spawners concentrate which might provide an effective means of regulation.

The available evidence indicates the yield-per-recruit of the yellowtail flounder fishery could be improved by suitable control of effort and change in mesh size. Moreover, although detailed computations are not available, either of these measures would have the additional advantage of mitigating the reduction in spawning stock that will follow recent poor recruitment and high fishing intensity, they would reduce dependence of the fishery on a restricted number of year-classes, and, for the US fishery, they would increase the proportion of catches suitable for human consumption. Although there is no evidence of a stock/recruitment relation in this stock, and though recently poor recruitment might be a temporary natural fluctuation, the beneficial effects of regulation upon the spawning stock should not be underestimated in these circumstances where there is a risk that the present fishery could induce a poor recruitment over a longer term.

The Subcommittee wishes to note also that it is especially important for future management that accurate estimates of the size and age structure of yellowtail catches should be reported by countries taking a significant proportion of the total catch.

Table 8. Yellowtail flounder. Changes in yield-per-recruit at selected levels of mesh size and fishing mortality (as percentages of 1963-1968 level, 114 mm mesh, F=1.1).

Fishing mortality / Mesh	1963-68 F = 1.1		F = 0.8
	Immediate Loss	Long-term Gain	Long-term Gain
114 mm	-	-	+4
129 mm	-4	+7	+10
145 mm	-21	+17	+19

E. Hakes

1. Silver hake

a) Subarea 4

Assessment of the silver hake stocks in Subarea 4 is not available at the present time but the USSR, which conducts the major fishery for this species, was able to provide information on the current trends of the fishery and stocks.

The increased fishery in 1969 in Subarea 4 is attributed to the fact that unlike the period of 1966-1968 some commercial concentrations of silver hake were detected on the shelf slopes and Middle and Sable Island Banks (over 100 m) of Div.4W, which were exploited by the large-size Soviet trawlers from spring throughout the fall. In 1969 the stocks of silver hake increased markedly due to the recruitment of the 1966 year-class. According to preliminary assessments both the 1966 and 1967 year-classes exceed the average level.

The bulk of the commercial stocks of silver hake was represented by 3- and 4-year-old fish. The resources for 1970-1971 will consist mainly of these comparatively large 1966-1967 year-classes. Therefore, it is likely that the conditions for exploitation of the silver hake stocks will remain favourable in 1970-71.

b) Subarea 5

According to USSR data (Res.Doc.70/20) the major part of the catches in Subarea 5 was represented by 3- (33%), 4- (31%) and 5- (14%) year-olds. These age-groups refer to weak 1964, 1965 and 1966 year-classes. Preliminary data suggest more plentiful 1968-1969 year-classes. In 1970 the stocks and landings of silver hake will remain at a lower level, but an increase can be expected in 1971-1972 when the 1968 and 1969 year-classes will enter the fisheries.

The Subcommittee noted (Res.Doc.70/91) that *M. albidus* may be included in the reported catches of *M. bilinearis* because of overlapping distribution and difficulty in distinguishing between them in commercial operations. They may be distinguished by shape of otolith in samples collected for age composition studies. It was pointed out that *M. albidus* inhabits rather deeper waters than *M. bilinearis* and is by far the least abundant. These two factors suggest the problem as regards assessment of effects of fishing on *M. bilinearis* may not be too serious.

2. Red hake

Subarea 5

The red hake landings from Subarea 5 increased to 50,000 metric tons in 1969 as compared to 18,600 tons in 1968. This upward trend resulted from intensification of the red hake fishery by the large-size Soviet trawlers. A slight increase of red hake stocks was noted in 1969 (Res.Doc.70/39). At the 1968 level of exploitation (a rate of fishery of $0.50 = (1 - e^{-z})\frac{F}{F+M}$) in 1968 the stock size is influenced greatly by the recruitment rate. The rate of recruitment is not known sufficiently to determine the effects of fishing on variations in stock density but, for example, the recent increase in stock which has attracted increased fishing has been due apparently to improved recruitment (or availability). The bulk of the catches is represented by 4- to 6-year-olds (average of 75%). The red hake stocks in 1970 and 1971 may increase slightly as compared to 1968-1969 level.

The Subcommittee agreed that the stocks of both silver and red hake which support major fisheries, should be the object of further study and assessment.

III. Adequacy of Sampling

This problem was referred to the Subcommittee by STACRES at the 1969 Annual Meeting. Several summaries of sampling adequacy relative to 1966 and 1967 were prepared and discussed.

One of the major problems stems from the difficulty of sampling at sea, which is required because a large share of the fish is processed before landing. There are two solutions available: i) send special technicians with the fleet, or pay reliable crew members to sample, or ii) arrange to have special samples of whole fish frozen and brought back to port. These may have to be purchased at the going price. In any case, the government bureaus concerned need to allocate more resources to this activity.

Most major species, except cod, *i.e.* haddock, redfish, yellowtail flounder, hake, are sampled with a reasonable degree of adequacy. An exception is redfish in Div.3NO by the USSR and Div.4RT by Canada. Haddock catches by

the USSR in 1966 were not sampled, but research vessel catches were sampled and reported. The desirability of the latter type of data is discussed elsewhere, but samples of the actual commercial catches (landings) are important.

The length sampling summary for cod in 1966-67 is presented in Table 9. It is obvious that, for too many stocks and countries, the proportions of landings that are adequately sampled (category 4) are very small. For example, over 40% of the total catch was not sampled at all, or only on a token basis, and only 34% falls in the adequate classification. For some important stocks - Div.1A-1D, Div.3NO, Div.4VsW - adequate samples are reported for less than 15% of the catch. Four countries - Fed. Rep. Germany, France, Portugal and Spain - had from 56 to 87% of their catch falling in the inadequate category. If the distribution of samples among seasons and divisions were considered, the situation would appear even worse.

Table 9. Percentage of total cod catch (average for 1966 and 1967) by sampling category (1=0-50 fish/1,000 tons; 2=51-100 fish/1,000 tons; 3=101-150 fish/1,000 tons; 4=over 150 fish/1,000 tons).

	Sampling Category				
By Country	1 (Not adequate)	2	3	4 (Adequate)	Total Catch 1966 and 1967 (thousand tons)
	%	%	%	%	
Denmark (F)				100.0	129
" (G)				100.0	57
Germany	56.5	28.8	8.7	6.0	368
Iceland				100.0	1
Norway		56.2	31.3	12.5	32
UK	14.7	3.1	16.3	65.9	129
Poland	5.6		48.9	45.5	90
France (M)	73.9		7.6	18.5	291
Portugal	56.5	28.3	15.2		435
Spain	87.3			12.7	474
Canada (N)	0.3	1.4		98.3	363
Canada (M)	3.5	20.8	23.4	52.3	226
USSR	25.0	46.3		28.7	268
USA				100.0	25
Non-member	100.0				126
Total	43.4	14.2	8.2	34.2	3,014

(continued)

Table 9 (continued)

By Stock Divisions					
1A-1D	70.6	18.3	1.5	9.6	677
1E-1F	6.3		33.3	60.4	96
2G-3K	54.1		12.5	33.4	824
3L	14.5	28.3	9.9	47.3	434
3M	52.3	7.7	10.8	29.2	65
3N-3O	60.7	34.9	-	4.4	341
3Pn	53.8			46.2	26
3Ps	11.1			88.9	72
4R	43.6	4.3		52.1	94
4S	46.7	46.7		6.6	15
4T-4Vn	7.4	4.6		88.0	108
4Vs-4W	69.3		14.9	15.8	114
4X	10.3	41.4	48.3		58
5Z	45.5	17.8	8.9	27.8	90
Total	47.7	14.2	8.2	29.9	3,014

The more detailed analyses from which this summary was taken are available for examination, but the gross deficiencies are great enough to emphasize the severity of the problem.

The Subcommittee, therefore,

recommends (1)

(i) that the Executive Secretary contact the appropriate personnel in each country that has not provided adequate samples by the Subcommittee's criteria in order to determine the causes thereof and stimulate solution, in accordance with the recommendation by STACRES in 1969;

(ii) that, where inadequate sampling is indicated, the Panels for each of the subareas take up the problem so as to assure administrative support of adequate sampling;

(iii) that the Commission adopt as a minimum sampling requirement the measurement by each country of 200 fish for every quarter of the year and division in which 1,000 or more tons of fish are caught.

The Subcommittee noted that data on age composition are also vital to assessment, but must be reviewed in the light of accuracy of ageing. This is therefore a special problem not dealt with by the Subcommittee at this meeting.

IV. Research Vessel Surveys

The value and feasibility of utilizing research vessel surveys to provide information for assessment and management was discussed at some length.

Most countries have conducted surveys for various purposes, and a considerable background of experience was thus available within the group. The comprehensive, seasonal groundfish surveys which have been carried out since 1963 in Subareas 4, 5 and 6 by the USA, and which have been conducted jointly with the USSR in the last three years, were reviewed to provide specific information about costs, precision, accuracy and planning.

The kinds of data that can be obtained from such surveys depend to a large extent on the design. The US survey, for example, has provided seasonal estimates of population density of haddock which have led to prediction of recruitment two years in advance and estimates of mortality rates - both natural and fishing. This information, obtained independently of the commercial fishery, has led to increased confidence in the application of regulatory measures. Similar information for many other species of groundfish is being obtained. This kind of data reflects the primary, immediate needs of ICNAF for the other major stocks of fish. Indeed, for several species, *e.g.* silver and red hake, survey data may provide the only means of accurate assessment.

The USSR presented a preliminary plan for an integrated, area-wide survey, designed to provide data on the entire life history process from egg to spawning, exploited adults. It was agreed that such an undertaking was, of course, ideal from the point of view of a more complete understanding of the processes of fish production and recruitment. The plan is somewhat beyond the scope presently being considered, but represents a needed view over the current valley of research efforts.

The required scope of a groundfish survey effort applied to the whole of the ICNAF Area implies the necessity for an integrated multi-nation effort. The costs of such surveys will have to be borne by all ICNAF countries, and to be most effective, surveys will have to be closely coordinated through ICNAF. The successful performance at the present time of periodic surveys in the southern half of the ICNAF Area, and the fact that other, albeit less comprehensive, surveys in other subareas are undertaken from time to time indicates that the integration and extension of effort to cover the whole of ICNAF is not unreasonable. A gain in information is likely just from the coordination of present survey cruises, which would include a standardized survey procedure. However, the importance of additional effort, particularly in Subareas 2 and 3, for accurate assessment of the status of fisheries must be stressed. In addition, it is important to maintain such surveys, on an annual basis at least, for several years to provide a time series of observations.

The Subcommittee

recommends (2)

that a detailed evaluation of an ICNAF groundfish survey be undertaken as soon as possible, and that this best be accomplished by a Working Group at the next Annual Meeting. The success of this Group depends on the attendance of qualified scientists.

V. Adequacy of Research and Assessment

The foregoing assessment of stocks shows rather clearly that the status of fisheries is known with some degree of confidence only for the haddock stocks and perhaps for cod in Subarea 1. However, it is the opinion of the Subcommittee, based on past studies and judgements of stock productivity evaluated against current fishery development, that many of the important groundfish and herring stocks are heavily exploited - in all likelihood at or beyond the level of effort which provides for maximized yield and economic return. All of the cod stocks, herring in Subarea 5, silver hake, yellowtail flounder in Subarea 5, and perhaps other flounder stocks are of particular concern.

The current state of ignorance is due to one or more of the following reasons: 1) Very rapid development of fishing; 2) Inadequate data; 3) Inadequate assessment efforts.

Removals from a given stock have more than doubled within one year in some cases, but have commonly changed from 20 to 50% annually. If the status is not determined prior to such increases, it is very much more difficult to obtain the necessary assessment in time to prevent possible serious over-exploitation.

A summary of inadequate length composition data is given in Table 9. For example, in 1967 only three countries (Denmark, UK and Canada) sampled more than half of their cod catches adequately. For specific stocks, the situation is even more serious - only 5% of the landings from the major cod fishery in Div.3NO are adequately sampled (the term adequate really means bare minimum for assessment). Data on age composition, pre-recruit strength of year-classes, and abundance are even more inadequate.

Perhaps most important of all is the lack of adequate assessment studies. Eight of the fourteen member countries sent scientists to this meeting, and of these none are working full time on assessment of the major fish stocks of the ICNAF Area. For Subarea 1 cod, projections had to be based on 1967 data, because the 1968 data, which were available, could not be processed rapidly enough due to lack of staff. For cod in Subareas 2, 3, 4 and 5, for which landings in 1968 of 1,400,000 tons amounted to 38% of total ICNAF landings of all species, no valid assessment of current status is available, and no country (with the exception of Canada for Div.4T-4Vn stocks) has scientists assessing the status of these stocks at the present time. The situation is much more bleak when species other than cod and haddock are considered.

The Subcommittee believes that the present level of assessment studies and associated research is much too low in relation to the needs of the Commission and to the benefits which will be obtained from good management based on sound scientific advice. The cost of such advice is insignificant in relation to expected economic gains. At the present level of research, which seems if anything to be decreasing, the guiding principle of the

Commission that no regulatory action be taken until clear and definite scientific studies of the effects are available cannot work to provide for rational exploitation.

The solution to this problem depends on the recognition of the inadequacies as outlined above, and a commitment to rectify them. The Subcommittee therefore,

recommends (3)

(i) *that additional staff and money be allocated to the Secretariat to provide for basic data analysis, and*

(ii) *that member countries in each Panel make definite commitments for scientists to initiate studies of the stocks which are deemed to be most crucially in need of assessment, the guidance and coordination of such studies being the function of STACRES through the Assessment Subcommittee.*

VI. Other Matters

A. Problems in Quota Regulation arising from Discards and Industrial Fisheries

Many of the countries conducting fisheries in the ICNAF Area discard certain species of fish or smaller sizes of certain species, or reduce them to meal while at sea. A very practical problem arises as to how to accommodate such practices under quota regulation. The Assessment Subcommittee held discussions on this matter during both the mid-year and Annual Meetings.

The problem is essentially insoluble unless the amount of fish discarded and reduced to meal can be adequately estimated and reported. The quota, of course, should be based on total catch but the pressures on fishermen, industry and perhaps even governments to maximize their benefits would tend to promote incomplete estimates of the actual catch.

In the type of regulation at present envisaged, *i.e.* lack of allocation to countries with the season limited by quota completion, discard could be low in that fishermen will compete against each other for quota and will not sacrifice anything of value. But within this situation the discard rate will be higher at high stock densities, when fishermen may have glut markets, a premium on large fish and an improved prospect of being able to catch them. The discard rate, and selection of catches for landing becomes greater with greater degree of allocation of catch down to individual fishermen. Concealment of high discard/moil (meal and oil) would in principle have an adverse effect on long-term quota but this is not likely to be considered by fishery interests and would be difficult to detect within the accuracy of techniques available.

There are, however, certain actions and types of information which would tend to minimize the effects of incomplete reporting:

(i) Quota regulations combined with mesh regulations or closed seasons and areas to reduce the catch of undesirable sizes and species;

(ii) Quota regulations set in terms of landings (of unreduced fish) such that the discarded amounts added to the landings would provide the desired total catch. Observations on discarding practices would then have to be made from time to time to check on changes;

(iii) The monitoring of the abundance and recruitment to adjust quotas annually will tend to adjust for the under-estimated catch. Different segments of the fishery might not be equally treated in this manner; *e.g.* compare small trawl fishing with line fisheries;

(iv) Independent estimates of size composition obtained from the survey cruises, compared with samples of landings taken with known mesh size would provide an estimate of the portion of catch which was not landed. It would also provide data for estimating probable discards during a subsequent period: in fact, this method of adjustment could be a cheaper method of study than is direct sampling and reporting of discard data. However, use of this system would require an improved sampling for recruit year-class strength and implies a need for countries to commit themselves to improve such sampling;

(v) In any of the above, allocation of quotas by countries would help alleviate the problems because of easier enforcement and observation. This would also reduce advantage to countries capable of deploying large mobile fleets early in the quota season.

B. Future Work

In accordance with previous recommendations adopted by the Commission, the Assessment Subcommittee will convene a mid-year meeting. Specific items of special interest include assessments of herring, cod in Subareas 2-5, and silver hake.

There have been suggestions that special working groups on Greenland cod and herring be convened in the near future. The Subcommittee feels, however, that with reference to herring, a special group within the Assessments Subcommittee is a more satisfactory way of dealing with the required studies.

The exact nature of work to be done cannot be ascertained until the full deliberations of the various Panels are completed.

APPENDIX II - REPORT OF THE STATISTICS AND SAMPLING SUBCOMMITTEE

Chairman: A.W.May Rapporteur: A.T.Pinhorn

The Subcommittee met during the morning and afternoon of 26 May. The following documents were reviewed during the meeting: Res.Doc.70/23, 25, 28, 29, 30, 31, 35, 53, 57, 58; Comm.Doc.70/16, 17 and 19.

1. Report on Statistical Activities of the Secretariat

The Assistant Executive Secretary reviewed Res.Doc.70/23 concerning statistical activities of the Secretariat in 1969/70. He reported that recommendations from last year's meeting had been put into effect, and drew the attention of the Subcommittee to several statistical problems. These were considered under other agenda items. Dr Kowalewski informed the meeting that he had left the employ of the Secretariat as of 30 April, and expressed his appreciation for the advice and help of the Subcommittee during the past four years. The Chairman, on behalf of the Subcommittee, thanked Dr Kowalewski for his excellent work during these years in the compilation and production of various statistical summaries.

2. Statistical Bulletin Vol.18 for 1968

Due to late submission of data by a non-member country, Statistical Bulletin Vol.18 was not submitted to the printer until mid-January 1970. However, due to production of the plates directly from typescript, it was possible to provide advance copies of the Bulletin to some members of the subcommittee several weeks in advance of the meeting.

New material this year in the Statistical Bulletin included statistics on catches of harp and hooded seals from 1937 to 1968, and data on catch and effort in Div.5Ze and 5Zw, as well as Div.6A, 6B and 6C.

3. ICNAF List of Species

The Subcommittee noted the arrangement of the species list in accordance with 1969 Rec.3 and 4 (*Redbook* 1969, Pt.I).

A proposal by the Secretariat with reference to the placement of the frigate mackerel, *Auxis thazard* (Lacepede), was adopted by the Subcommittee, which accordingly

recommends (4)

that the frigate mackerel, Auxis thazard (Lacepede), be introduced into the ICNAF List of Species in the "Other Fish" group in position 113.

Following discussion of a suggestion by Canada (Maritimes) that the basis for separation of red and white hakes be re-examined, the Subcommittee concluded that the 1967 recommendation on this subject should be modified, and accordingly

recommends (5)

that, for purposes of statistical reporting, hakes of the Genus Urophycis be designated as follows:

(i) any hake reported for Subareas 1, 2 and 3, and Div.4R, 4S, 4T, 4Vn and 4Vs be designated as white hake, Urophycis tenuis;

(ii) any hake taken by hook and line or any hake greater than 55 cm standard length regardless of how caught, from Div.4W, 4X and Subareas 5 and 6 be designated also as white hake, Urophycis tenuis;

(iii) except as noted in (ii) above, other hake of the Genus Urophycis taken in Div.4W, 4X and Subareas 5 and 6 be designated as red hake, Urophycis chuss;

(iv) the footnotes to the ICNAF List of Species, as published in the Statistical Bulletin, be altered accordingly.

The Subcommittee examined FAO Fisheries Circular FEs/C208, dated October 1968 (Res.Doc.70/30), and noted that the next revision of this Circular should include "blueback" *(Pomolobus aestivalis)*, "rough scad" *(Trachurus lathami)* and frigate mackerel *(Auxis thazard)* in the "Other Fish" group. The Subcommittee also noted that, with the addition of seals to the ICNAF List, a further revision of the notes for the completion of STANA forms is necessary and

recommends (6)

that a new group "SEALS" be added to FAO Fisheries Circular FEs/C208 following "SHELLFISH", (etc) and that the footnote (b) as contained in the ICNAF List of Species in the 1968 Statistical Bulletin be also included.

The Subcommittee reaffirmed its decision of last year that no rearrangement of species groupings be made, pending completion of an FAO study, probably before the 1971 meeting.

It was noted that provisional statistics for 1969 included substantial Canadian landings of "Crustaceans", presumably Queen Crabs *(Chionoecetes opilio)*. The Subcommittee, therefore,

recommends (7)

(i) that the ICNAF List of Species be amended to include Queen Crab (Snow Crab), Chionoecetes opilio, under the heading "SHELLFISH", (etc) as species number 114;

(ii) that the appropriate notes for completion of STANA forms (FAO Fisheries Circular 208) be revised accordingly.

4. Species Separation for Flounders

Although provisional statistics for 1969 contained substantial catches of unspecified flounders, the Subcommittee was informed that a rough breakdown of USSR catches by species might be available when the STANA 1W forms for 1969 are submitted, and a more exact breakdown should be possible in future years.

5. Designation of Halibut and Greenland Halibut

The Subcommittee reviewed Res.Doc.70/57 containing information from various member countries on designation of these species. It is apparent that species designation is not a major problem in most cases. The Subcommittee was informed by USSR that catches in 1969, and in previous years, where the two species are reported together, consist of Greenland halibut *(Reinhardtius hippoglossoides)* only. The Assistant Executive Secretary was asked to introduce the required changes into the next issue of the Statistical Bulletin.

6. Conversion Factors

The Subcommittee was informed that a revised list of conversion factors was presented to the 1969 meeting of ICES. This list was not available for the subcommittee meeting, but the General Secretary of ICES outlined its contents in general terms. The Subcommittee

recommends (8)

(i) that the CWP Secretary present the revised document on conversion factors to the 1971 ICNAF meeting;

(ii) that meanwhile the document be circulated to national statistical offices by the CWP Secretary, pointing out those cases where conversion factors appear to be outside the normal range;

(iii) that countries investigate the accuracy of the conversion factors in such cases and report to the 1971 ICNAF meeting through the CWP Secretary.

7. Fishing Effort Statistics

The Subcommittee reviewed the replies (Res.Doc.70/29) from member countries to the request of the CWP Secretary to define their interpretation of the effort measure "days on grounds". It was noted that some countries do not adhere strictly to the definition as contained in the notes to STANA forms. Pending information from the Faroe Islands as to whether "days fished" or "hours fished" might be reported instead of "days on grounds", the Subcommittee

recommends (9)

(i) that countries reporting "days on grounds" adhere as closely as possible to the definition given in the notes to STANA forms, i.e. to include, in addition to the days fishing and searching, all the other days while the craft was on the ground, and

(ii) that the question of whether "days on grounds" might be deleted from the list of effort measures be considered by the Subcommittee at its 1971 meeting.

Notes by various countries concerning amounts of effort arrived at by means of estimates (Res.Doc.70/29) were reviewed by the Subcommittee. It is clear that in some cases recorded effort and estimated effort is reported together. It was noted that the STANA 2W forms contain a line for the recording of amounts of effort estimated, but that this information does not appear in the Statistical Bulletin. After some discussion, the Subcommittee concluded that a tabulation of the amounts of effort arrived at by means of estimates might usefully be included in the Statistical Bulletins, and as a preliminary step

recommends (10)

that the Secretariat prepare a tabulation from 1969 submissions of the proportion of effort data derived by means of estimates, by species, division, country, gear, and tonnage category, and that this be made available as a document for the 1971 meeting.

The Subcommittee reviewed the summary of effort data for 1966, 1967 and 1968 contained in the List of Vessels for 1968. This was prepared in accordance with earlier subcommittee recommendations. A summary document for 1969 effort data was not prepared as only a few submissions have been received to date.

Notes on classification, definition and codification of fishing effort measures, submitted by member countries through the CWP Secretary (Res. Doc.70/29), were reviewed. The subcommittee was informed that Item 3.2(c) of the Canadian submission should read as follows:

"...harpooning should not only refer to sea mammals but also to swordfish".

The Subcommittee deferred further comment on this document pending its consideration by the ICES Special Meeting on the Measurement of Fishing Effort, and the Seventh Session of the CWP.

The report of the ICES Working Group on Vessel Characteristics (Comm.Doc. 70/19) was reviewed by the subcommittee. It was noted that this is a progress report, and that the Working Group would meet again before the 1970 ICES meeting. The final report will be considered by the ICES Special Meeting on Measurement of Fishing Effort. Further documents relating to this subject were the OECD report on fishing vessel characteristics (Res.

Doc.70/53) and a USSR paper on fishing effort measures (Res.Doc.70/35). The subcommittee felt that the OECD vessel classification appeared to be related more to economic than to biological requirements. It was noted that the OECD document would be considered at the next CWP meeting and that the USSR document has been submitted for the Special Meeting on Measurement of Fishing Effort.

In further discussion of fishing effort statistics, the Subcommittee was informed that the US interpretation of "days fished" differs from that given in the notes for completion of STANA forms. Mr Hennemuth (USA) promised to document the US interpretation and method of estimating of "days fished" for the 1971 meeting of the subcommittee.

8. ICNAF List of Vessels

The ICNAF List of Vessels for 1968 was distributed late in 1969. Earlier recommendations relating to deletion of certain items were implemented. It was noted that a draft version of a joint ICES/ICNAF list of vessels will be prepared by the CWP Secretary for consideration at the 1971 meeting of the subcommittee. Meanwhile the subcommittee reaffirms its conclusions of last year relating to preparation of vessel lists and

recommends (11)

(i) that the ICNAF List of Vessels for 1971 be prepared as in the past, and

(ii) that a final decision concerning production of a joint ICES/ICNAF list of vessels be made at the 1971 meeting of the Subcommittee.

9. Discards

A summary of quantities of fish discarded at sea or used for industrial purposes in 1968 was prepared by the Secretariat (Res.Doc.70/25). In accordance with last year's recommendation, this will be published in *Redbook*, Part III, for 1970. It is apparent that data on fish discarded are relatively satisfactory: however, information on quantities of the major species used for industrial purposes could be improved. Recognizing the importance of this information to the Commission, the Subcommittee

recommends (12)

that countries make every effort to report quantities of fish used for industrial purposes, especially quantities of the major species individually, in addition to reporting quantities discarded.

10. STANA Forms and Notes

On reviewing Notes for the Completion of STANA Forms (Res.Doc.70/30), the Subcommittee noted that it was no longer necessary to include Div.3P and 4V in the list of ICNAF fishing areas, as statistics for these areas are now reported for northern and southern subdivisions in each case, and

recommends (13)

that the entries 3P and 4V be deleted from "Divisions" column in the List of ICNAF Fishing Areas in FAO Fisheries Circular FEs/201, and that the column be retitled to read "Divisions and Subdivisions".

There was no report on progress in modifying STANA forms for ADP machine processing. This item will be considered at the next CWP session.

11. Year of Catch and Year of Landings

The Subcommittee reviewed a document (Res.Doc.70/28) prepared by the CWP Secretary concerning possible discrepancies in annual statistical reports due to differences between the year of catch and year of landing. This did not seem to be a major problem for any countries.

12. Seventh Session of CWP

The Subcommittee was informed that the Seventh Session of the CWP would be held later this year, after the ICES meeting, and probably in Rome. It was concluded that a period no later than the second half of November would be appropriate for this meeting. Denmark and USA will participate as representatives of ICNAF.

Since a new Assistant Executive Secretary will soon be appointed, the Subcommittee agreed that his attendance at the Seventh Session of the CWP would be appropriate and

recommends (14)

that, in addition to attendance by the Executive Secretary and the Chairman of the Statistics and Sampling Subcommittee, as previously recommended, the new Assistant Executive Secretary should attend the Seventh Session of the CWP.

13. Sampling

Sampling Yearbook Vol.13, Part I, for 1968 has been produced and will soon be generally distributed. Part II will contain sampling data for herring for the years 1961-1968. Subsequently this data will be included on a routine basis. It was concluded that a summary of sampling in relation to catch would be desirable and the Subcommittee

recommends (15)

that, beginning with the 1969 Sampling Yearbook, the Secretariat prepare and include a table showing for each species, division, country and gear the numbers of fish sampled for length and age in relation to total catch. This summary table should also include a list of data available, but not contained in the Sampling Yearbook, for those species for which sampling data is regularly reported.

14. Cooperation with other International Organizations

Information from FAO and ICES on statistical matters of mutual interest was contained in Comm.Docs. 70/16 and 70/17. The subcommittee was pleased to note that liaison with these organizations, within the CWP framework, is being maintained to the mutual advantage of the various agencies.

APPENDIX III - REPORT OF THE ENVIRONMENTAL SUBCOMMITTEE

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

The Environmental Subcommittee met on 25 May with Dr H.W.Graham as Chairman. Dr W. Templeman was appointed Rapporteur. The Agenda was adopted with the addition of IGOSS under other matters.

1. Environmental Material in National Research Reports

The environmental sections of the national research reports and of related documents (Res.Docs.70/10-22, 36, 49, 50, 59, 69 and 72) were reviewed.

Off West Greenland (Subarea 1), 1969 was one of the most severe ice years of this century. The upper layers were cooler especially in the southern areas but the deeper water was warmer than in 1968.

In southern Labrador (Subarea 2), in sections across Hamilton Inlet Bank in July and early August and November, temperatures in the upper 200 m were below the long-term average for the period. Temperatures in the 200-500-m layer were higher than average.

In Subarea 3, temperature conditions in July-August were variable; in some areas, depths, and months, higher and in others lower than the average. On the southern Grand Bank, temperatures near bottom were lower than in 1968.

In Subarea 4, temperatures on the Scotian Shelf were, on the average, higher than in 1968. Temperatures near bottom in the Scotian Channel were several degrees higher than in 1968.

The USSR reported for Subarea 5 that temperatures in the Fundian Channel and in the deep part of the Gulf of Maine were higher than in 1968. Water temperatures over the central part of Georges Bank were close to the 1968 level and on southern Georges Bank lower than in 1968.

The USA reported that water temperatures at 50 m were higher in 1969 than in 1968 in the south central Gulf of Maine; elsewhere temperatures were lower in 1969 than in 1968. The negative anomalies were greatest south of Georges Bank, and increased with distance from shore. At 100 m temperatures were of the same general pattern as at 50 m. At Boothbay Harbour the 1969 annual mean temperature was 0.8°C higher than in 1968.

Mr Lee reported that by 1971 the UK should have an expendable BT program down to 500 m across the North Atlantic and through the ICNAF Area. Surveys with Continuous Plankton Recorders showed extremely abundant phytoplankton over the Grand Bank with a maximum in April in 1969. Young stages of *Sebastes* were abundant in the oceanic area east of the Grand Bank (Div.3M) in April and June. Elsewhere, as in 1968, they were scarce. Mr Skud reported that zooplankton volumes in the Gulf of Maine greatly

decreased from west to east. Similar trends were found in each of the years 1967-69. Herring larvae collected from hatching in October 1968 to the juvenile stage in May 1969 were preying principally on the eggs, nauplii, young and adult copepods, and in spring on larval cirripeds as well. The timing of the secondary peak of zooplankton abundance in autumn could be important to the survival of larval herring which hatch in this season. The developmental stages of a single species of copepod *Pseudocalanus minutus* appears to be the prey most closely synchronized with the development of larval herring.

2. Environmental Changes in Relation to Fisheries

This subject was discussed by many scientists. The ice conditions in 1969 in Subarea 1 had a drastic effect on the fisheries. Also in Labrador in winter-spring 1969, fishing for cod was very successful as the very great volume of cold water restricted the fishery to the edge of the Shelf with resulting great concentrations.

In cold years, cod usually pass to the deeper layers and concentrations are in a smaller area and thus denser, whereas in warm years the isotherms and cod are more spread out and the catch per effort declines. The average catch of cod in February in the years 1965 to 1970 in Labrador was inversely related to the temperature in the 50-200-m layer on 1 November of the previous years (Res.Doc.70/20).

The influence of the extreme ice conditions on the fisheries in West Greenland in 1969 was partly physical with the ice preventing normal operations. Also, the survival of cod larvae was apparently reduced by the cold water. It may be possible in the near future to obtain important information on ice quantity through the use of satellites.

3. Georges Bank-Gulf of Maine Environmental Survey

Mr Posgay reported that the plankton collections made on the 1968 surveys by the USA and USSR were not yet completely analyzed. The 1969 surveys were designed to compare results obtained by a random sampling design with the results from a grid pattern of stations. The analysis of these samples is also incomplete. The US is now collecting plankton samples in conjunction with its groundfish surveys which occupy a stratified random set of stations.

Mr Posgay also reported the relation of number of eggs in the plankton to the number of spawning fish in the area in respect to Georges Bank haddock (Res.Doc.70/83). The results indicate a considerable disparity between the estimates of the population of spawning fish by egg survey and the estimates of the population as calculated from research vessel surveys or population studies of the landed catch: the estimates from the egg surveys being lower. It is assumed that the egg survey did not sample the entire spawning stock.

4. Symposium on Environmental Conditions, 1960-69

Since the Convenor of the Symposium, Dr N.J.Campbell (Canada), could not attend the meeting, the Chairman reported that Dr Campbell had arranged for nine speakers to cover the various aspects of environmental conditions outlined by the planning group last year. Two days will be devoted to the symposium: one and a half days for the presented papers and one half day for general discussion.

5. Reports from Meetings of Other Bodies

Dr H.W.Graham, Chairman of the ICES/ICNAF/IOC Coordinating Working Group for North Atlantic Oceanography reported on the second meeting of the Group (Comm.Doc.70/2).

Mr A. Lee reported on the 1969 meeting of the ICES Hydrographic Committee (Comm.Doc.70/17) and the Joint Symposium on Physical Variability in the North Atlantic (Comm.Doc.70/30).

6. IGOSS (Integrated Global Ocean Station System)

The IOC has asked ICNAF to indicate the kinds of observations from IGOSS that might be useful to fisheries and fisheries research in the ICNAF Area and to designate a 'liaison' man for IGOSS. Discussions brought out a number of general observations that might be beneficial. These included bottom temperatures, general distribution of temperature from surface to bottom, depth of thermocline, mixed layer depth, and position of fronts. It was generally agreed that observations on the Continental Shelf were of prime importance and that, for the present, observations in the deep ocean areas could be omitted as far as most fisheries were concerned. It was pointed out that continuous observations at stations on the Shelf were needed and that the spacing of the stations should be as close as possible. The Subcommittee

recommends (16)

that the Chairman of the Environmental Subcommittee serve in a liaison capacity to IGOSS to bring to the attention of IGOSS those properties and conditions which might be most useful to fisheries and fishery research in the ICNAF Area.

Dr Graham thanked the members of the Environmental Subcommittee for their cooperation and help during the past three years.

Dr Cole expressed the appreciation of the Committee members to Dr Graham for his hard and successful work as Chairman.

The meeting adjourned at 1:30 p.m.

APPENDIX IV - REPORT OF THE AD HOC WORKING GROUP ON GEAR AND SELECTIVITY

Item 6 (Gear and Selectivity) of the agenda of the Standing Committee on Research and Statistics was considered by an *ad hoc* Working Group which met at 1500 hours on 25 May.

Chairman: Dr H. Bohl Rapporteur: Mr M.J.Holden

Item 6a. ICES Gear and Behaviour Committee Report, October 1969

The Chairman reviewed the papers presented to this Committee at the 58th Statutory Meeting.

Item 6b. Reports of ICES/ICNAF Working Group on Selectivity Analysis (Comm. Doc.70/14 and 15)

At the 18th Annual Meeting of ICNAF, the Standing Committee on Research and Statistics (STACRES) recommended that an ICNAF Working Group on Selectivity Analysis be set up and at its 56th Statutory Meeting, ICES accepted ICNAF's invitation to participate in the activities of the Working Group. The Working Group met twice in 1969 with the following terms of reference.

The Working Group was to prepare working papers covering the following subjects:

(i) Comparison of the properties of net materials of trawls in the North Atlantic and investigation of the effect of trawl construction on selectivity;

(ii) Analysis of the variability of marine experiments on selectivity and the validity of selectivity data;

(iii) Compilation of the selectivity data for cod, haddock and redfish, including a tabulation of equivalents for different net materials.

The Working Group met again in 1970 with the following terms of reference:

(i) to extend the work of the 1969 ICES/ICNAF Joint Selectivity Analysis Working Group to include data relating to NEAFC Region 2 and ICNAF Subareas 4 and 5;

(ii) to investigate further all factors (including physical properties of net twines, biological factors, etc.) which cause, or may cause, differences in mesh selection;

(iii) to examine the adequacy of the system of mesh differentials used by NEAFC and ICNAF in relation to the principle of equivalent selectivity.

The reports of the ICES/ICNAF Working Group's activities are given in ICNAF Comm.Doc.70/14 and 70/15. The results of selectivity experiments, grouped together as follows, were considered:

1)	ICNAF Subareas 1, 2, 3	1a Cod
	ICES Subarea 1 (except Division Vb)	1b Haddock
	ICES Divisions IIa, IIb, Va	1c Redfish
2)	NEAFC Region 2	2a Haddock
		2b Whiting
3)	ICNAF Subareas 4, 5	3a Cod
		3b Haddock
4)	ICES Division Vb	4a Haddock

1. The relation between selectivity and physical properties of the twine

Insufficient data on the physical properties of the twines used in selectivity experiments have been tabulated in the past, so that the Working Group was unable to make an analysis of the relation between selectivity and the physical properties of the twine used. Neither could it find any indication from laboratory tests as to what physical properties, other than elongation, might affect selectivity.

However, it did note that the physical properties of a twine of any particular chemical nature could be varied by its method of construction, *e.g.* starting with the same type of fibre a double-twisted twine has less elongation than one which is cable-laid (three times twisted). This is due only to the last (third) twist of the twine. This also means that it is impossible to judge twine properties without considering the construction of the twine, particularly with polyamide fibres.

2. The relation between biological factors and selectivity

The Working Group had insufficient data to investigate this point.

3. Summary of selectivity data

[Note on terminology: The terminology polyamide A and polyamide B was used to distinguish between polyamide twines with an elongation of more than 25% at the load of the half knot breaking load (polyamide A) and polyamide twines with an elongation equal to, or less than 25% at this load (polyamide B). This distinction was not accepted by the delegates from either the Federal Republic of Germany or the Netherlands. In the absence of specific data on the nature of the polyamide twine used in a selectivity experiment, an assumption had to be made about the type of twine used from knowledge of the type of polyamide twine generally in use in the country undertaking the experiment. This fact should be borne in mind when considering the tables of data.]

The results of the ICES/ICNAF Working Group's analyses are summarized in Tables D-2 (Comm.Doc.70/14), Tables 43 to 47 and Fig. 1 and 2 (Comm.Doc. 70/15).

Particular attention is drawn by the *ad hoc* Working Group to Fig. 1 and 2, in which the length of the line for each material covers the range within which there is a 95% probability that the equivalent for the material lies. Although some materials, notably polyamide, have equivalents which are, on average, higher than the standard (manila) there are no clear cut differences between materials from which it is possible to determine reliably the magnitude of differentials which should be given to different netting materials. While it may be possible to do this for specific experiments carried out on a single stock, at a given season and time, it is not possible to do this for the actual fishery conditions existing in a Convention Area in which there is considerable variation in both the biological characteristics of the fish caught and the physical properties of the twines used in the codends; the analyses made by the ICES/ICNAF Working Group correspond to the situation existing in the fisheries. (Table 54, Comm.Doc.70/15, shows what acceptance of differentials, based on the average equivalents calculated by the Working Group, might imply in terms of mesh sizes in the ICNAF Convention Area.)

At the end of the second meeting of the ICES/ICNAF Working Group, the following recommendations were made:

1. The selectivity equivalents for mesh sizes of trawls made from different materials obtained as a result of the analysis of selectivity data, and of the tests of the physical properties of trawl twines, and mentioned in the conclusions, are recommended to be introduced in the Conventions for the Northeast and Northwest Atlantic Fisheries in place of the present rules for establishing mesh sizes of trawls made from synthetic materials, insofar as the Commissions consider these groupings enforceable (Comm.Doc.70/14, p.48).

2. That the modified ICNAF form of tabulation used in the First Report of the ICES/ICNAF Working Group should be adopted, and, in addition, that all future selectivity experiments should include data (as tabulated on p.49 of Comm.Doc.70/14) about the codend material used.

3. That, as manila is no longer commercially used and because it is not readily available, a new standard polyamide material be introduced (full details are given in Comm.Doc.70/14, p.49-50).

4. That further work is needed to determine the relationship between elongation and selection factors (Comm.Doc.70/14, p.50: for full details of proposed experiments see Comm.Doc.70/15, p.4).

5. That, if the relevant committees of ICES and ICNAF agree to adopt the new standard net yarn, the committees take steps to determine whether a standard netting can also be manufactured, and, if so, that it be introduced for selectivity experiments.

During the 1969 meeting of ICES the report of the second meeting of the ICES/ICNAF Working Group including the recommendations was reviewed by the ICES Gear and Behaviour Committee. After examining the conclusions and recommendations from the report, the Gear and Behaviour Committee reported that it was not satisfied that sound advice could yet be given warranting any major change in NEAFC mesh regulations. After considering new data presented at the third meeting, the ICES/ICNAF Working Group felt that, given the variability of the results, it could not recommend any departure from the present system of mesh differentials which is based on the chemical nature of the twine, insofar as it affects the ICNAF Convention Area, except that it considered that there is no basis for the differential now given to Danish seines and that this should be abolished. Differentials should be based solely on the chemical nature of the twine used in the codend.

The *ad hoc* Working Group

recommends (17)

that after editorial consideration by some members of the ICES/ICNAF Working Group on Selectivity Analysis, the Working Group's report be published as an ICES Cooperative Research Report. The published report should include the tables of basic data and the bibliography.

During consideration by STACRES of the report of the *ad hoc* Working Group on Gear and Selectivity, USSR scientists informed that they cannot agree with the conclusions brought forward from the third meeting of the ICES/ICNAF Working Group to the effect that it could not recommend any departure from the present system of mesh differentials for ICNAF.

With reference to the ICES/ICNAF Working Group's recommendation that a new polyamide material be introduced to replace manila as the selectivity standard, STACRES was in some doubt about the implications of the adoption of this new standard, although it agrees that it should be adopted, and, therefore,

recommends (18)

that the Subcommittee on Assessments examine the requirements for further selectivity experiments in relation to adoption of the polyamide standard twine as described by the ICES/ICNAF Working Group on Selectivity Analysis (ICNAF Comm.Doc.70/14, p.49-50).

Item 6c. Trawl material and mesh size sampling for 1966-68 (*Redbook* 1970, Pt. III) and for 1969 (Res.Doc.70/26).

Res.Doc.70/26 was not available for consideration.

Item 6d. Topside chafers (Res.Doc.70/37 and 60).

Res.Doc.70/37 shows that there is no difference between the selectivities of polyamide twines of normal thickness (R5000 tex and R6484 tex) and those which are very thick (R18000 tex). Therefore codends made from thick twine can be used to obviate the need for topside chafers.

The *ad hoc* Working Group

recommends (19)

that member countries be encouraged to undertake commercial trials of codends made with thick twines in order to evaluate their durability and practicability because it views this as a step towards the elimination of topside chafers.

Commercial experience has shown that the Polish-type chafer, as defined in the ICNAF mesh regulations, does not always provide sufficient protection to the codend. Res.Doc.70/60 describes experiments with a Polish-type chafer made of thick (10 mm diameter) twine, knotless construction, and shows that the use of such a topside chafer does not affect selectivity. The *ad hoc* Working Group draws the attention of STACRES to this document and

recommends (20)

that the Polish-type chafer as described in Res.Doc.70/60 be adopted by the Commission.

The Chairman gave a verbal report on German selectivity experiments carried out in Div.4Vn in 1970. A mean selection factor of 3.51 was obtained for cod using a codend made of R18000 tex polyamide twine and mean selection factors of 3.38 and 3.45 for codends made of standard twine (R6484 tex). These results conform with those from earlier experiments (Res.Doc.70/37).

Item 6e. Other Matters

Continuing his verbal report, the Chairman gave results of experiments carried out with polyamide twines with different elongations, but made from the same fibre. The mean cod selection factor of a twine with about 42% elongation was 3.49 and that of a twine with about 20% elongation was 3.15. Although at first sight these results appear to show that high elongation is associated with high selection factors, comparison with the results verbally reported under Item 6d (that is, the German experiments carried out in 1970 at the same time and place, and on the same stock) shows that the selection factor of 3.49 is similar to those reported for these experiments, which were made with twines with low elongation. Dr Bohl stated that catches in all the hauls carried out with the twine with about 20% elongation were large, and that the low selection factor could probably be attributed to catch size. Analysis of single hauls is needed and full details will be presented at the 1971 Annual Meeting of ICNAF. In the meantime the attention of STACRES is drawn to these results in relation to Item 6b.

There being no other matters, the meeting closed at 1730 hrs.

APPENDIX V

REPORT OF AD HOC WORKING GROUP ON COORDINATED ICNAF GROUNDFISH SURVEYS

Chairman: M. Grosslein Rapporteur: R. Halliday

An *ad hoc* Working Group composed of representatives from nine countries (Canada, Denmark, Iceland, Romania, Poland, UK, US, USSR and the Federal Republic of Germany) met on 26 May to consider the feasibility of coordinated ICNAF groundfish surveys by research vessels. General benefits and requirements, and logistic and technical problems of such surveys were reviewed briefly and are outlined in Res.Doc.70/81. Major points of the discussions and conclusions are summarized below.

1. Value of Research Vessel Surveys

It was generally agreed that research vessel surveys are of considerable value in providing a much more complete picture of the total groundfish biomass, than is available from commercial statistics alone. In fact for many stocks, surveys may be the only feasible way of obtaining the data on population structure which is needed for assessment.

By providing abundance data on all sizes and species of fish available to a trawl surveys provide a better basis for recruitment predictions and a more complete measure of the effects of fishing on the groundfish community as a whole. Furthermore, the synoptic nature of surveys provides a more complete picture of seasonal and geographic variations in abundance, and hence a better basis for determining effects of environmental factors. Finally, survey abundance indices have the important advantage of being free from the inherent bias in commercial indices of unknown changes in efficiency of a unit of effort.

2. Requirements of Coordinated Surveys

There was unanimous agreement as to the general desirability of using standardized methods or at least coordinating independent survey operations insofar as this was practical and consistent with national and ICNAF priorities. It was recognized, however, that optimum sampling design and choice of trawl probably would not be the same in all ICNAF areas because of practical problems, or because of different objectives and different sources of error. For example, behaviour of priority species in one area might require a sample design and an allocation of sampling effort quite different from another area with different species composition. Regardless of such differences it was noted that some degree of stratification would be desirable in every area, and randomization of stations within strata would also be desirable as far as practical. Standardization of methods of sampling catches and processing data were discussed briefly, as were logistic requirements in terms of personnel, vessel time, data processing, etc.

3. Accuracy of Survey Abundance Indices

Considerable discussion focussed on the accuracy of abundance indices. It was noted that given proper sample design, valid estimates of sampling error can be obtained readily for survey abundance indices, but the difficult problem is to translate variance estimates into terms of the actual change in abundance which it is possible to detect with some specified probability.

Comparisons of fourth quarter US commercial and survey abundance indices for cod, haddock, and yellowtail on Georges Bank for the period 1963-1968, have shown fairly good agreement in the year-to-year percentage change for both sets of indices; that is, the survey indices show the same trends as well as roughly the same relative magnitude of change as the commercial indices. Variance estimates for abundance indices of these and other species in the same surveys indicate that for a combined Georges Bank index based on 65-70 hauls, it appears possible to detect proportional changes in abundance of about 30 percent or greater.

This level of precision is more than adequate to provide a good picture of the general seasonal and geographic distribution of groundfish (Res.Doc. 70/79, 70/80). A higher level of accuracy obviously would be necessary for very precise short-term assessments. However, even the level of accuracy noted above would be sufficient to provide very useful guidelines in cases where fishing effort fluctuates widely and abruptly; and it is important to remember that the likelihood of bias in commercial indices is greater when stock size fluctuates widely.

In any case, further study of the accuracy of abundance indices will be necessary to evaluate their potential for assessment purposes.

4. Conclusions and Recommendations

The consensus of the committee was that groundfish surveys provide at the very least valuable data on distribution and abundance of fishes, and that there are major benefits to be gained by pooling resources to conduct coordinated groundfish surveys using standardized methods. It was concluded, however, that it would be desirable to examine more thoroughly the logistic requirements of past and prospective surveys and the accuracy of available abundance indices, to provide a firmer basis for estimating requirements of a coordinated survey and for assessing potential benefits in relation to cost. In addition, it was noted that the problems of standardization, particularly the choice of a standard trawl and fishing methods, should be examined further.

The Working Group

recommends (21)

that an ICNAF Working Group be established to investigate problems related to the organization and conduct of coordinated groundfish surveys, and that the Working Group should hold a mid-year meeting to review the results of its investigations.

It is recognized that the responsibility of the proposed Working Group would relate to the coordination of presently available effort, and hopefully would result in greater benefits from the present research vessel effort. The main items for consideration at a mid-term meeting should be:

(1) Determination of accuracy of abundance indices derived from research vessel surveys;

(2) Study of survey techniques with special emphasis on standardization of gear.

Within this broad division, specific suggestions for items to be discussed included:

(i) Review of present and prospective survey plans relative to sampling design for different areas and stocks, logistic requirements of ships, personnel and data processing;

(ii) Accuracy of abundance estimates in terms of variance. Estimates and comparison of research and commercial abundance indices;

(iii) Comparisons of relative efficiency of different trawls for major species.

INDEX OF RECOMMENDATIONS