INTERNATIONAL COMMISSION

FOR THE

NORTHWEST ATLANTIC FISHERIES

REDBOOK 1973, PART I

STANDING COMMITTEE ON
RESEARCH AND STATISTICS

PROCEEDINGS OF
SPECIAL MEETING JANUARY 1973
AND
ANNUAL MEETING JUNE 1973

Dartmouth • Canada
August, 1973

PREFACE

REDBOOK 1973 is issued in three parts: PART I (this volume) contains the 1973 Proceedings of the Standing Committee on Research and Statistics (STACRES); PART II contains Research Reports by Member Countries for the year 1972; and PART III contains Selected Papers from the 1973 Annual Meeting.

This volume (PART I) includes the Proceedings of the Mid-term (January 1973) Meeting and of the Annual (June 1973) Meeting of STACRES, together with a list of Recommendations from, and lists of Research and Summary Documents presented at, the Annual Meeting.

The preparation and printing was carried out in the Secretariat largely through the efforts of Mrs E. R. Cornford who did the typing and Messrs G. Moulton and R. Meyers who did the multi-graphing.

31 July 1973

V. M. Hodder
Assistant Executive Secretary

REDBOOK 1973, PART I

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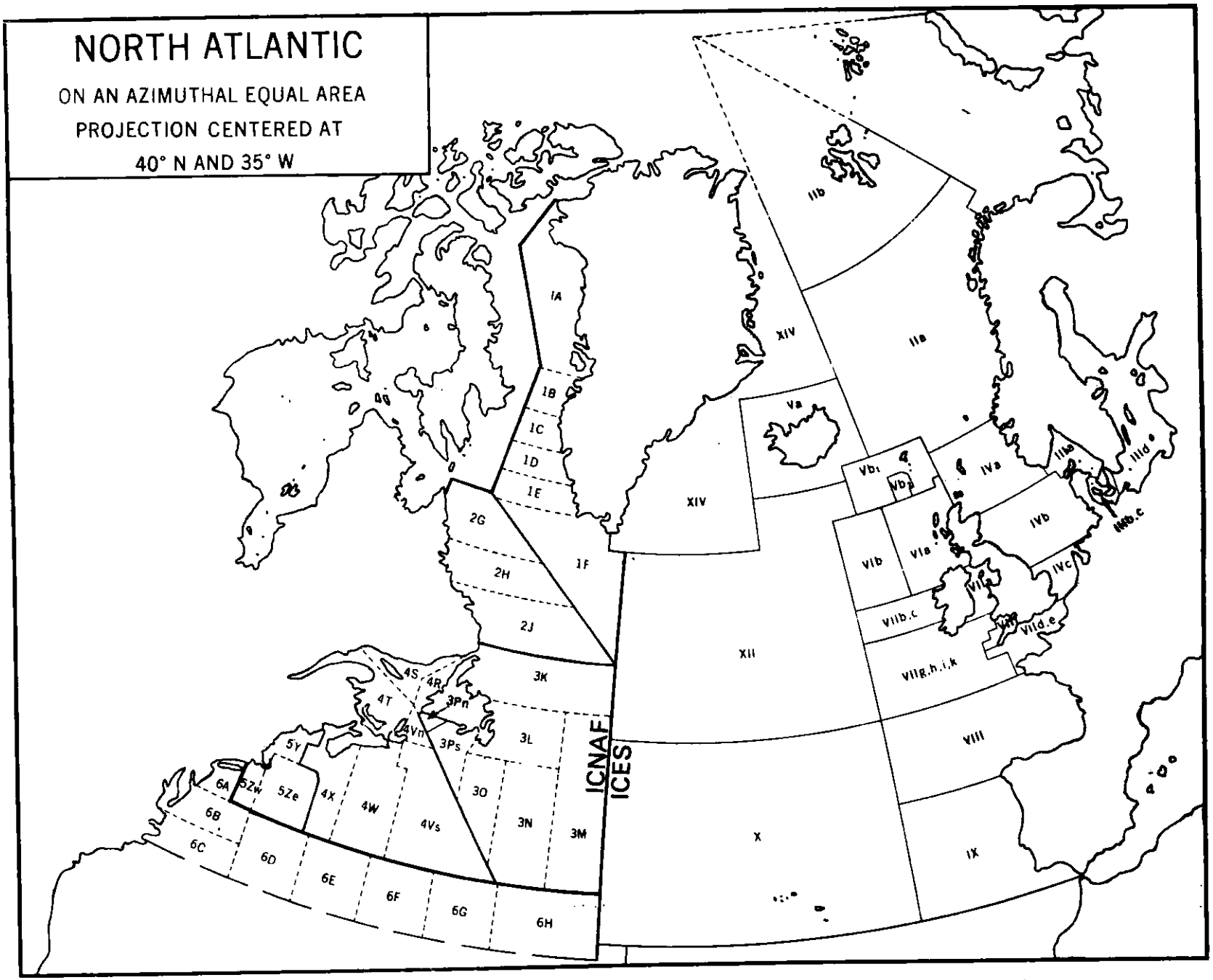
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STACRES
JANUARY 1973

A. REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Special Commission Meeting - January 1973

Chairman: A. S. Bogdanov

Rapporteur: V. M. Hodder

STACRES convened at FAO, Rome, Italy, on Monday, 15 January 1973, with representatives present from 11 Member Countries of ICNAF and observers from FAO and ICES. Bulgaria, Iceland, Italy and Romania were not represented at this Meeting. The main task of STACRES was to consider the Reports of the Assessments Subcommittee and the Herring Working Group, both of which met during the week of 8-14 January 1973. These Reports, presented by their respective Chairman, Mr D.J. Garrod and Mr T. D. Iles, were adopted by STACRES and are included as Appendices I and II to this Report. Summaries of the two reports and a brief section on other business of STACRES follow.

I. Summary of Assessment Subcommittee Report (App. I)

1. The Regulation of Mixed Fisheries: US Memorandum on the Regulation of Fishing Effort in Subarea 5 and Statistical Area 6 and the Related Canadian Questions (Comm.Doc. 73/3 and 73/4).

The general problem of the effective regulation of mixed fisheries was reviewed in relation to the US proposal to identify what form of management regime could overcome the difficulties created by the by-catch of regulated species in other fisheries for both regulated and unregulated species. The expansion of fishing in Subarea 5 and Stat. Area 6 and the current status of both the total resource and of its individual components were reviewed. This involved analysis of the interaction between fisheries for the separate resources and the development of an acceptable estimate of fishing directed to them on a standardized basis that would permit comparisons to be made.

Fishing effort was standardized to the days fished by US side otter trawlers in the 0-50 tonnage class, the unit most consistently available over the years, the average vessel comparabilities being used to judge the development of the fishery. Relationships between proposed objectives for 1973 and the 1971 situation were calculated by making comparisons of the catch-per-day of different fleets on a monthly basis for 1971 only. Other choices of standard vessel might have been made, but in effect this choice has no bearing on the answers to the questions posed, because

a) the relationships between fleets are retained irrespective of the standard;

b) proportional changes in fishing effort to meet Commission objectives for controlling fishing mortality are established by the independent measurement of this mortality, not the effort standard chosen.

The variability of vessel comparisons were studied and the conclusion reached was that they are not precise enough to measure exactly the national contributions to the fishery on a historic basis.

The current status of the resources is shown by the estimates of catches in Tables 4 and 9 of the Assessments Subcommittee Report (App. I).

The analysis of the species mixture, providing the estimate of fishing effort in particular fisheries and on particular species, is given in Table 10. These show that the overlap between groundfish fisheries is considerable. The pelagic and semi-pelagic (silver hake) fisheries are more distinct, especially in Stat. Area 6, but nevertheless they take a significant by-catch of groundfish species. The importance of mackerel and the tentative nature of the existing assessment of this species has influenced the precision of the conclusions that have been drawn in relating the 1973 situation to the level of exploitation in 1971.

In the light of these considerations the answers to the questions posed in the Canadian Memorandum (Comm.Doc. 73/4) are as follows:

Q.1 Subject to the qualification necessitated by lack of data on mackerel, three estimates of resource potential indicate the level of fishing intensity associated with the MSY of finfish resources to be 70-80% of the 1971 level.

Q.2 Presuming mackerel catches in 1973 to be close to the 1971 level, the surplus yield as defined in the Assessments Subcommittee Report, is 846,000 tons, plus whatever catch is allowed for herring. The fishing intensity associated with this catch will be 80-100%, depending on the quota for herring.

Q.3 The effect of maintaining fishing intensity at the 1972 level varies between species owing to the different levels of exploitation and recruitment prospects, and so it can only be expressed in qualitative terms. For resources having average recruitment and already exploited at or beyond the level associated with the MSY, maintaining fishing intensity at the 1972 level does imply a reduction in the stock, catch and catch-per-unit effort.

Q.4 Maintaining the catch at the 1972 level for stocks that are expected to decrease will necessitate an increase in effort and intensify present problems. For stocks that might increase, effort would need to decrease and need to divert to other species/areas.

Q.5 & 6 The higher the initial change, the shorter the recovery period, but the adjustment should be sufficient to be detectable. For most stocks recovery would be complete after five years.

Q.7 Days fished, monitored through days on grounds, would be the most efficient units for achieving regulation of fishing mortality in Subarea 5 and Stat. Area 6. A calculation is given in the Assessments Subcommittee Report to illustrate the conversion of standard to national units.

Q.8 A first approximation indicates the 1973 level of fishing required to catch the established quotas for regulated species to be 62% of the 1971 level.

Q.9 If estimates are pessimistic, when the error is detected (after 2-3 years) and the regulation amended, both stocks and catches will be better than anticipated, but, if estimates are optimistic, the resources will have deteriorated by the time the error is detected.

Presuming the desirability of protecting mackerel, pending its precise evaluation, and bearing in mind earlier assessments of other stocks, the conclusions presented are consistent with earlier advice. There seems to be no way in which freedom of fishing for mackerel could at the same time adequately conserve other regulated species (particularly herring). If a catch quota were to be put on mackerel, the exploitation of all finfish resources known to attract a major commercial fishery would be regulated by catch, and, since neither total catch nor total effort regulations by themselves solve the by-catch problem, the relative merits of the two approaches cannot be decided on scientific grounds. However, because this problem tends to generate over-exploitation, total catch or total effort regulations taken alone would need to be set at a level below that necessary to achieve the estimated MSY of each stock that would obtain if they could be fished independently.

2. The Status of Other Resources in the ICNAF Area.

The Assessments Subcommittee indicated that it is not yet aware of any significant unforeseen changes in the 1972 fisheries for regulated species. A review of Subarea 1 cod showed the expected catch of cod in 1974 to be about 75,000 tons, when fishing at a level appropriate to the MSY. This estimate may need to be modified slightly at the Annual Meeting.

II. Summary of Herring Working Group Report (App. II)

1. The total herring catch in the ICNAF Area (including Stat. Area 6) declined from 729,000 tons in 1971 to 475,000 tons (with some non-member catches still to come) in 1972. This is only about one-half of the peak 1968 catch. The largest declines occurred in the Gulf of St. Lawrence stocks (Subarea 3 and Div. 4RST) because of continued poor recruitment, and in the Georges Bank fishery which was under quota regulation. It is likely that catches from this latter stock would have declined in 1972 even without catch limitation. The estimated fishing mortality in 1972 was 0.8. In the southern stocks (Div. 4W-X, Div. 5Y, Div. 5Z and Stat. Area 6) the 1970 year-class provided some improvement in recruitment prospects, but quantitative estimates could not be made with confidence.

2. The answers to the Commission's questions given in the Resolution on Herring Research Program (Special Commission Meeting on Herring, January - February 1972, Proc. No. 4, App. VI), insofar as they can be answered, are as follows:

   a) It is impracticable to rely on closed areas and closed seasons to regulate the ICNAF herring fisheries, because the conservation effect depends critically on the behaviour of the fishing fleets (which is not regulated) outside the closed areas and closed seasons.

   b) The 1972 quotas resulted in a 34% decline (by weight) in each of the Gulf of Maine and Georges Bank stocks; the effect on the Nova Scotia stock cannot be assessed with any precision.

   c) The effect of the minimum size limit of 9 inches (22.86 cm) cannot be estimated.

   d) The level of catch in 1973 to maintain stock size (age 4 and older) at the level at the beginning of 1973 for Div. 5Y is 20,500-30,000 tons, and for Div. 5Z and Stat. Area 6 is 175,000-225,000 tons. However, this criterion is not satisfactory, as the 1973 stock level was reduced even under quota regulation. Stock rebuilding is possible only by fixing the 1973 catch below replacement levels. For the Div. 4W-X stock, recruitment prospects are probably better and no change from the 1972 catch level is recommended.

   e) For the Div. 5Z - Stat. Area 6 stock, if the 1970 year-class is as good as the 1966 year-class, the 1973 catch at the equivalent of MSY is 135,000 tons. This would result in a stock increase to the level obtained at the beginning of 1972. If the 1970 year-class is 75% of the size of the 1966 year-class, the corresponding 1973 catch would be 115,000 tons, which would result in a stock level of 85% of the stock size at the beginning of 1972.

   f) For the Div. 5Y stock, the 1973 catch equivalent to MSY is 27,500 tons for the higher recruitment level and 24,500 for the lower recruitment levels. The effects on stock sizes of various catches in 1974 depends on the catches agreed to for 1973 and on the sizes of the 1970 and 1971 year-classes.

3. Assessment of herring stocks in the ICNAF Area is critically dependent on knowledge of future recruitment. No reliable method of determining this is available at the present time. The highest priority should be placed on research programs, especially juvenile and larval surveys, which help to develop a predictive capability. Improvements in statistics and sampling are also required.

III. Other Business

1. STACRES considered an invitation from ICES to participate in or contribute to the Northeast Arctic Fisheries Working Group, 12-17 February 1973 at Charlottenlund, under the chairmanship of Mr A. Hylen. It was agreed that Dr A. Meyer be asked to represent STACRES and to provide a report of the meeting to the May 1973 Meeting of STACRES.

2. STACRES considered an invitation to an ICES Working Group to be held in IJmuiden, 7-8 May 1973, to deal with the statistical aspects of measuring fishing effort in relation to stock assessments. It was agreed that the Secretariat, after consultation, ask two representatives (one from USA and one other) to attend the meeting at national expense.

APPENDIX I - REPORT OF ASSESSMENTS SUBCOMMITTEE

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APPENDIX I - REPORT OF THE ASSESSMENTS SUBCOMMITTEE

Chairman: D. J. Carrod

The Assessments Subcommittee met during 8-13 January 1973 with representatives present from all member countries except Bulgaria, Iceland, Italy and Romania. The main tasks of the Subcommittee were to consider the matters given in the US Memorandum (Comm.Doc. 73/3) and the questions posed in the Canadian Memorandum (Comm.Doc. 73/4) relating to the regulation of fishing effort in ICNAF Subarea 5 and Statistical Area 6.

A. Consideration of the US Memorandum in Support of the US Proposal for the Regulation of Fishing Effort in ICNAF Subarea 5 and Statistical Area 6[1] and the Related Canadian Memorandum (Comm.Doc. 73/3 and 73/4)

1. Introduction

The US Memorandum (Comm.Doc. 73/3) proposes the regulation of total effort in SA 5 and 6. So far as the regulation of a single stock fished in isolation is concerned, the question of regulating the amount in terms of effort, rather than catch, has been examined at length in the past, both by the Bio-economic Working Group and by the Research and Statistics Committee. Although both methods have disadvantages, the balance was considered to be in favour of regulation by catch. The Subcommittee found no reason at the present meeting to change this opinion, so far as isolated stocks are concerned.

In areas where several stocks occur it is highly desirable that the regulations should ensure that each stock is exploited at the proper rate. However, such separate regulations should not ignore the biological interactions that must occur to some extent whenever two or more species occur in the same area. These interactions must be taken into account in making assessments and in setting annual catch quotas. Provided that this is done, the best way, from the biological point of view, to manage a multi-species fishery would be to set individual quotas for each stock.

Such catch quotas now exist for many of the major stocks in SA 5 and 6. However, the current regime has several disadvantages; these include:

i) by-catch of regulated species taken in other regulated and unregulated fisheries;

ii) the danger, especially with highly mobile fleets, that particular stocks can be depleted before appropriate regulations are introduced; and

iii) difficulties of enforcement, particularly of ensuring not only that the regulations are obeyed, but also that they are clearly seen to be obeyed. While fishermen will always suspect records of catch made by other countries, they can check for themselves whether or not the numbers of foreign vessels on the grounds have changed in accordance with agreements.

These disadvantages relate to the content of the US Memorandum, as a result of which the Subcommittee has considered at length the problems involved in the regulation of fishing mortality in the mixed fisheries of SA 5 and 6.

Catch and standardized effort statistics (see Section 5 below) for these areas are given in Tables 1 and 2 by country for the period 1961-71 and are summarized in Table 3. The total annual catches in Table 1 are the aggregate of catches from a number of different species fisheries, most of which have been assessed by the Subcommittee at previous meetings. The combining of these individual assessments into a single assessment of the total resource is described below.

2. The Current Status of Finfish Resources in SA 5 and 6

a) Catch/effort yield curves

The Subcommittee reviewed an assessment by Brown *et al.* (Res.Doc. 73/8) of the total finfish yield in relation to effort.[2] A Schaefer-type analytical procedure was used. The reasons and necessity for employing this approach and also the inherent problems were discussed. The finfish biomass expressed in this way necessarily involves interactions between species. The

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1 Subarea 5 and Statistical Area 6 are hereinafter referred to as SA 5 and 6.

2 This yield does not include large pelagic fishes - sharks (other than dogfish), tunas, billfish and menhaden. The first three species contribute small catches (17,000 tons in 1971); the menhaden catch is a substantial one (240,000 tons in 1971), taken almost exclusively in a relatively small area of coastal waters in the southern part of SA 6. This stock is not considered to make a significant contribution to the biomass of the offshore resources, although some biological interaction may occur.

Table 1. Annual nominal catches (tons) by country associated with the total standardized effort in Subarea 5 and Statistical Area 6.

Year	BUL	CAN	FRA	FRG	ICE	JAPAN[1]	NOR	POL	ROM	SPAIN	USSR	UK	USA	NON-M	TOTAL
1961	-	846	-	-	-	-	140	-	-	-	68521	-	273491	-	342998
1962	-	7087	-	-	-	-	-	535	-	-	209370	-	317303	-	534295
1963	-	17958	-	-	-	-	-	-	-	-	238732	-	329262	-	585952
1964	-	23988	-	-	-	-	-	723	-	22	364023	1050	369717	-	759523
1965	-	29265	-	-	-	-	-	4543	-	69	534086	-	348399	3081	919443
1966	-	41639	-	-	-	-	-	16103	-	9531	587433	107	274172	5648	934633
1967	-	37086	-	28288	-	452	-	41264	1766	16250	314753	48	260115	22978	723000
1968	-	58793	53	71512	292	7260	-	92493	2892	18016	334670	-	183086	71702	840769
1969	-	18548	5	73797	12786	16922	-	66821	621	15526	482514	-	162962	91742	942244
1970	-	12142	-	92842	-	29659	-	143714	2720	8163	267405	-	157840	70905	785390
1971	44892	21668	-	59661	-	27909	-	220587	8694	13373	404646	-	148655	108035	1058420

Table 2. Fishing effort (days fished)[2], standardized to US small OT and adjusted for learning, in Subarea 5 and Statistical Area 6.

Year	BUL	CAN	FRA	FRG	ICE	JAPAN[1]	NOR	POL	ROM	SPAIN	USSR	UK	USA	NON-M	TOTAL
1961	-	88	-	-	-	-	16	-	-	-	2255	-	36592	-	38951
1962	-	720	-	-	-	-	-	96	-	-	18583	-	47813	-	67212
1963	-	1670	-	-	-	-	-	-	-	-	19689	-	39739	-	61098
1964	-	2437	-	-	-	-	-	239	-	3	47117	129	43494	-	93419
1965	-	2930	-	-	-	-	-	1136	-	6	59397	-	46801	303	110573
1966	-	4272	-	-	-	-	-	816	-	1288	81603	15	40063	440	128497
1967	-	4951	-	1278	-	72	-	2579	86	2689	54584	7	34695	2421	103362
1968	-	6953	8	9796	46	1164	-	12039	419	2712	62492	-	27787	9002	132418
1969	-	2939	1	14312	2691	3405	-	12282	191	2928	121387	-	25447	11791	197374
1970	-	2033	-	19380	-	3369	-	28459	764	1874	59192	-	27741	8563	150875
1971	7258	3165	-	11483	-	4750	-	38875	1568	3081	79093	-	25519	18884	193676

[1] Japanese figures adjusted during Subcommittee Meeting, January 1973, causing slight changes (1%) in the totals differing from those in Table 3.

[2] These estimates include the fishing effort of trawls and purse seines fishing for the catches given in Table 1.

Table 3. Estimates of unadjusted effort, standardized effort without learning, standardized effort with learning, total catch, catch/unadjusted effort, catch/standardized effort without learning, and catch/standardized effort with learning for the years 1961-1971 in SA 5 and 6 (from Res.Doc. 73/8).

Year	Unadjusted effort	Effort without learning	Effort with learning	Catch	Catch per unadjusted effort	Catch/effort without learning	Catch/effort with learning
1961	36998	43710	38951	342998	9.27	7.85	8.81
1962	53555	67764	67212	534295	9.98	7.88	7.95
1963	48875	78121	61097	585952	11.99	7.50	9.59
1964	60831	97466	93418	759523	12.49	7.79	8.13
1965	64518	103550	110573	919443	14.25	8.88	8.31
1966	64513	114305	128497	934633	14.49	8.18	7.27
1967	63978	95845	103027	723027	11.30	7.54	6.99
1968	69776	121712	132887	840769	12.05	6.91	6.33
1969	88486	163938	198315	942244	10.65	5.75	4.75
1970	67824	127083	151883	782690	11.54	6.16	5.15
1971	71999	154415	191389	1065713	14.80	6.90	5.57

exact nature of these relationships is not explicit but it is desirable to somehow include them. Utilizing the total yields and total effort does, to some degree, accomplish this, albeit with several simplifying assumptions. To what extent the model does approximate the true underlying system cannot be very strictly evaluated, but the model does represent the first approximation.

A second aspect is the inter-calibration of different types of vessels and gears of different countries with respect to their ability to generate a unit fishing mortality. Some critical remarks were presented regarding the accuracy of the model used to estimate standardized days fished, but, taking into account the data available, it was agreed that these were the best estimates which could be provided at present. It was pointed out that the "standardized" effort derived for this study is really an index of fishing intensity appropriate for the period concerned, and not necessarily a measure of "fishing power" which might be desired for other purposes.

The effort was also adjusted for a learning factor. The discussion indicated that learning was a factor which had to be taken into account. Many options are available for doing this; the method used incorporates US research vessel survey data, and hence is as independent and unbiased as evaluation as is possible. The learning factor was estimated for several countries to give a mean value, but it was recognized that the factor may vary between countries, and an opinion suggesting a lower factor for Polish vessels was given by the Polish member of the Subcommittee.

Because learning tended to be higher in the early part of the 1961-71 period, the effect of using the learning factor actually reduces the estimated rate of increase in effort over years. However, in terms of conclusions, the effect is not to change the direction of indicated action, but rather the degree by about 50%. Overall, the possible inaccuracy appears less if the learning factor is used, and the main conclusions are based on this.

A third aspect of the method that was discussed was the length of time in which a species contributed to the fishery, and, hence, the "lag time" effect in trying to assess the equilibrium conditions from annual data over a period of continuing increase in fishing effort. This problem may be overcome by using a running average of effort over the appropriate time-span. In view of the species involved, the three-year running average seemed the most appropriate.

The yield-effort curves are given in Figs. 1 and 2, and the indicated current status of the total resource in Table 4.

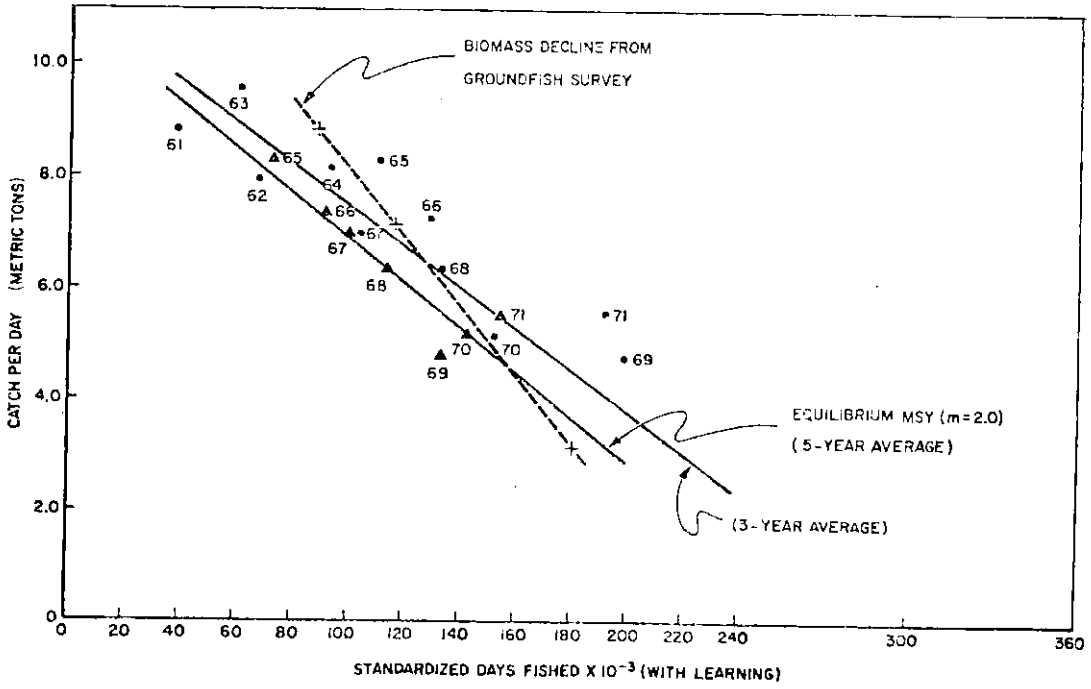

Fig. 1. Abundance of finfish biomass versus total fishing effort in SA 5 and 6.

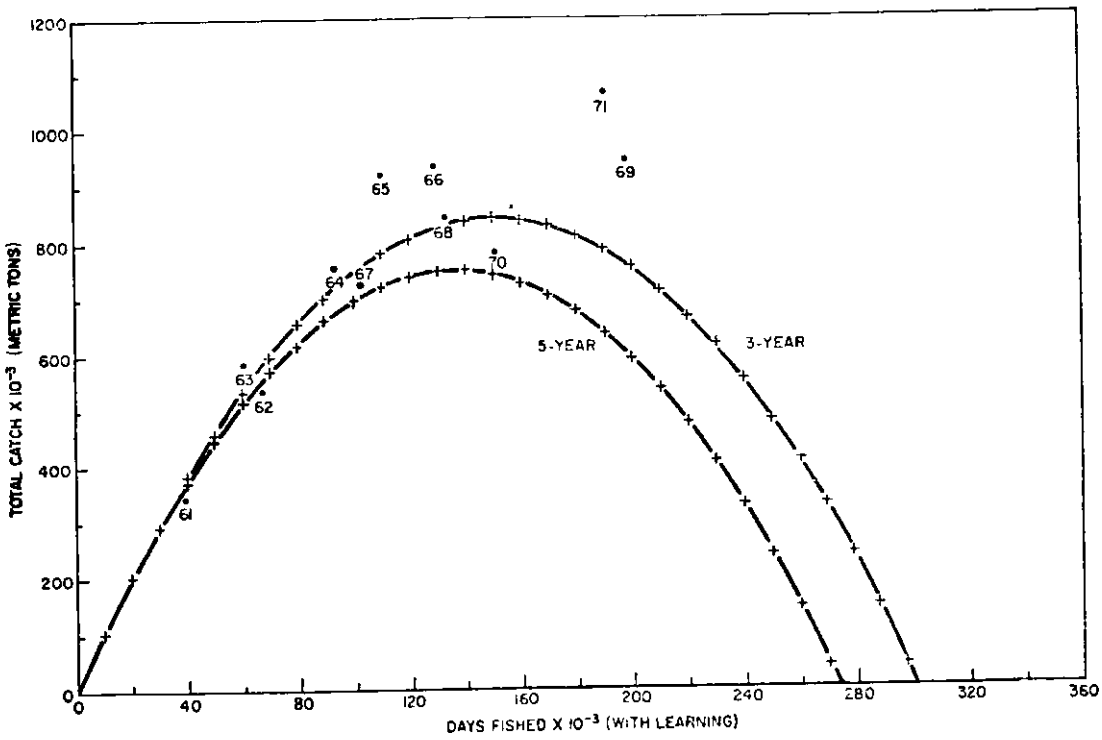

Fig. 2. Total finfish yield versus total fishing effort in SA 5 and 6.

Table 4. Summary of estimates of finfish maximum sustainable yield and effort.

Source	Max. Sust. Level: Yield ('000 tons)	Max. Sust. Level: Standardized effort	Ratio of MSY to 1971 catch	Standardized effort at MSY relative to standard effort for 1971
Catch/effort yield curve	843	151[2]	843/1066 = 0.79	151/191 = 0.78
Yield per recruit curve	855	120[2]	855/1066 = 0.80	120/155 = 0.77
Sums of species assessments	1202[1]	215[2]	1202/1066 = 1.13	215/287 = 0.75
Primary productivity	1000	-	1000/1066 = 0.94	-

1 Includes 600 for herring and mackerel, and an allowance of 100 for other pelagics and other fish (see Table 9).
2 These estimates cannot be directly compared with each other.

b) Yield-per-recruit assessment

Advice to the Commission is often given on the basis of consideration of yield-per-recruit. In particular, the Report of the Assessments Subcommittee in 1972 (*Redbook* 1972, Part I, p. 15-42) indicates that two points of reference are available: F_{max} and $F_{0.1}$, the latter being related to economic optimization. In Table 4 the yield and effort are related to the mid-point of these two values, which is probably very near the maximum sustainable yield. The curve is shown in Fig. 3.

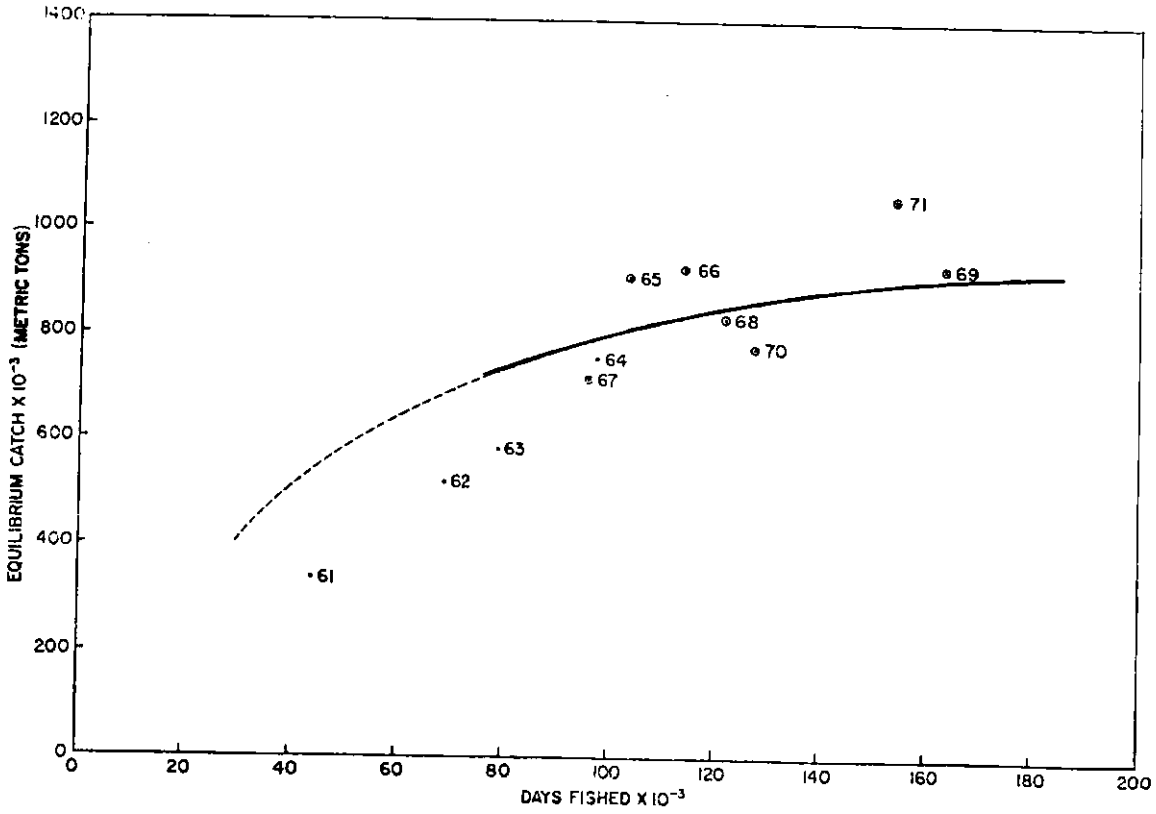

Fig. 3. Estimated equilibrium yield versus days fished for SA 5 and 6.

c) Individual species assessments

The assessments of yields of individual species have been obtained from analysis of catch/effort data and research vessel survey data. These data were given in previous Assessments Subcommittee Reports and in Research Documents. Also, the Subcommittee at this meeting prepared an analysis taking into account the aspects of mixed fisheries and the best available estimates of fishing mortality and effort.

The discussions related to this analysis clearly indicated that the variability of allowable effort in 1973 to achieve sustainable yields depended almost solely on the mackerel stock, but the level of effort required to achieve the MSY for mackerel was less critical to the MSY of the total resources because it could be taken from long-term considerations. Also, the effort was expressed in terms of that employed in 1971, rather than the 10-year average, and hence is more realistic. The relevant data are given in Table 4.

It should be noted that this type of estimation does not take into account the effect of species interrelationships. It was noted that mackerel and herring are interrelated to some extent, such that the potential total MSY of mackerel and herring may be less than the sum of the MSY of the individual species, when these are based on assessment of data collected over a short period.

d) Primary productivity

The USA presented an analysis of finfish productivity based on consideration of primary production. The values were taken from the estimation of previous studies and applied according to the method of Ricker. The estimate is given in Table 4. Previous studies have shown that this type of estimation can give an indication of production. It is, in any case, a useful reference point in relation to the subject of unexploited resources.

e) Trends in fishing effort in 1972

The USA conducts weekly overflights of the area which record the numbers and kinds of all fishing vessels. Tables 5A and 5B give the results of analysis of these data. In terms of vessels on the grounds, the number of vessel-months increased by 7% from 1971 to 1972 over the first 11 months of the year. The estimate for the year, based on vessel weeks, indicated an increase of about 10%. Virtually all of the increased effort appears to have occurred in the first half of the year (Table 5B).

The composition of the fleet in terms of size and type of vessel also changed. In particular, the ratio of large stern trawlers to medium side trawlers increased from 0.7 in 1971 to 1.02 in 1972. It has been estimated that large stern trawlers are about 3.5 times as effective as medium side trawlers. To evaluate the vessel increase in terms of effective fishing effort, the raw data of days fished for trawlers observed in 1971 and 1972 were converted by using the estimated ratio. The resultant increase in total effort was about 25% between 1971 and 1972.

Bearing in mind the variability of power factors and the increased proportion of stern trawlers in 1972, the Subcommittee concluded that the increase in fishing effort from 1971 to 1972 was considerably in excess of 10%. However, it is not possible to state to what extent the extra effort might have been diverted towards regulated or unregulated species.

The reduction from 1972 required to implement a given management policy based on the 1972 effort would need to be greater than the changes from the 1971 effort level set out in Table 4.

Table 5(A). Estimates of 1972 fishing effort, based on vessel sighting by USA flights.

Procedure

1) Vessels were identified by flights which occurred 2 to 3 times each week.
2) Vessel sight weeks were tabulated giving days on ground observed.
3) Days fished in 1972 were obtained by adjusting days observed by the ratio of days observed in 1971 to days fished reported to ICNAF in 1971.

Results

All countries: Days fished Jan-Dec 1972 - 79,000
Days fished Jan-Dec 1971 - 72,000
= 9.7% increase

However,

Ratio of stern to side trawlers in 1971 was 0.7

Ratio of stern to side trawlers in 1972 was 1.02

Assuming all effort but Canada and USA to be in this ratio and these figures adjusted by relative catchabilities of 7.0 : 2.0 : 1.0 for stern : side : USA and Canada, then "effective" effort increased from 192,000 in 1971 to 240,000 in 1972, an increase of 25%.

Table 5(B). US overflight observations in 1971 and 1972 (all countries except USA and Canada).

Month	1971	1972	%
Jan	124	258	+108
Feb	257	291	+ 13
Mar	258	306	+ 19
Apr	288	329	+ 14
May	310	267	- 14
Jun	185	216	+ 17
Jul	126	165	+ 31
Aug	241	241	0
Sep	277	294	+ 6
Oct	271	272	0
Nov	274	147	- 46
Dec	?	?	?
Total Vessel Months	2,611	2,786	+ 7[1]

[1] The equivalent % increase on the basis of vessel weeks is 10%.

f) Unexploited species potential

The Subcommittee reviewed the available information related to possible elements of the finfish biomass that might provide significant increases in catch. There are two sources of information: research vessel surveys and commercial catches. A large number of research vessel surveys have been conducted by various countries in the area. The results of these have been presented in a number of publications and in Research Documents. These surveys of the continental shelf down to 250 fm (457 m) have not produced evidence of significant resources that are not now included in the estimates of potential yield. The area is now comprehensively fished by the commercial fisheries. On the continental shelf there are no areas containing large resources which are not now fished. If there were such a large biomass of fish, some evidence of this would most likely show up in the catches. The fact that this has not been demonstrated is further evidence of the absence of any large finfish resources not now included in assessments.

The main conclusion to be drawn from Table 4 is that the 1971 catch was taken at or beyond the MSY and the effort was significantly beyond the level corresponding to the MSY. Thus, continuing the fishing at the 1971 level or greater would in the long term reduce stock abundance, catch/effort and total catch. However, it is evident that the overlap between the various fisheries would create considerable difficulties in controlling the fishing mortality on each species separately. The magnitude of this overlap is shown in the next Section.

3. The Overlap Between Fisheries Directed at Particular Species

The Subcommittee studied at some length the magnitude of the by-catch problem, using the detailed statistics for SA 5 and 6 in 1971 given in the Statistical Bulletin. In cases where no "main species sought" was indicated or it was shown as "mixed", the effort was allocated to species according to catch on a monthly basis. In virtually all cases this could be done without any doubt. Tabulations were made of the quantities taken of one species in a fishery apparently directed to other species (Supplement Tables 1 and 2). As an example, the data for Subarea 5 were summarized according to the impact of the fishery directed towards one species upon the by-catch of the first (incidentally sought) species, and classifications were made of the occasions on which (during 1971) the by-catch of a certain species formed a given percentage of the total catch, in all fisheries, of that species. The results are summarized in Table 6, in two parts. The first (Table 6A) gives, for each fishery, the species for which the by-catch of that species falls into certain percentage categories. Thus, for example, the silver hake fishery takes more than 10% of the total catch of each of the four categories of flounder, other groundfish, other pelagic fish, and other fish. The other part (Table 6B) shows, for each species, those fisheries which take a given percentage as a by-catch. For example, more than 10% of the total haddock catch is taken as by-catch in each of the cod and flounder fisheries.

The effects of by-catch on the potential yield depend on the sizes of fish taken as well as on the quantities caught. If the individual fish in the by-catch are the same size as in the directed fisheries, the effect of the by-catch is the same as if the same quantities were taken in the directed fisheries. The sustainable yield would be unaltered, although the magnitude of the by-catch should be taken into account in setting the quotas. However, the individuals in the by-catch are often smaller than those in directed fisheries and below the optimum size at first capture. This would tend to reduce the sustainable yield.

4. Methods of Regulating Fishing Mortality in a Mixed Fishery

In principle, the second objection referred to in the Introduction (Section 1) could be overcome by greater readiness on the part of the Commission to set preliminary and precautionary quotas before the detailed assessments are available; and it might be noted here, as an example, that in retrospect it might have been highly desirable to have set such quotas for mackerel in 1971. It may however be doubted whether the Commission will find it easy to reach such agreements. Also, if the present species quotas were extended to cover all the large number of species that occur in the southern part of the ICNAF Area in significant quantities, the problems of implementing and enforcing the regulations would become extremely complex. At the same time the Subcommittee noted that there was little evidence of any large unexploited resources of finfish in SA 5 and 6. Therefore there would be no losses (in terms of missed opportunities for expansion) by putting some limit on the overall amount of fishing in SA 5 and 6, but such a limit, considered as a supplement to the species quotas, could overcome some of the objections outlined in the US Memorandum.

An overall limit in terms of catch would be a partial solution. In effect it would be a combined quota for all unregulated species, which could be increased to the extent that quotas for the regulated species are not reached. If properly enforced it would reduce many of the problems concerning by-catches and rapidly developing fisheries, while still allowing a good deal of flexibility in actual operations. However, some of the questions of enforcement would still remain.

Alternatively, the overall limit could be set in terms of fishing effort. Two possibilities were considered: a limit on total effort (excluding certain fisheries, such as those for shellfish), and separate limits for separate fisheries, such as those for particular species or groups of fish; for example, pelagic and demersal. Undoubtedly the unavoidable by-catch (*i.e.* fish taken incidentally and unintentionally in an operation directed wholly at another species) would be better controlled by separate limits on each type of fishery; for example, a limit on demersal fishing controls haddock by-catches better than a limit on all types of fishing. However, a significant source of by-catches (and one that is important to the economic success of some fisheries) is the more deliberate opportunistic switching of attention from one (usually commoner) species to another more preferred species whenever concentrations of the latter are detected. For example, a vessel fishing mixed groundfish may change to herring if a school of herring is detected or good concentrations are reported by other vessels.

This adaptability, particularly marked in the fleets of large mobile vessels, makes difficult the enforcement of separate effort limits for different groups of species. Also, such separate limits might be less attractive than an overall limit; for example, 2,000 days fishing, which may be directed in the optimum manner under the conditions experienced in the year concerned (provided catches are kept within such species quotas as exist), are more valuable than 2,000 days fishing, 1,000 of which must be directed to pelagic fish and 1,000 to demersal fish. Therefore, if an effort limit is set, it should preferably be an overall limit of all types of fishing. Exceptions should, however, be made for certain specific fisheries (*e.g.* scallop) which are quite distinct from the major finfish fisheries in SA 5 and 6.

Table 6. Interrelationships between main species fisheries and the associated by-catch of other species based on 1971 data for Subarea 5.

A. Species affected, *i.e.* for which given percentage of total catch is taken as by-catch in fishery considered.

Fishery (main species sought)	>10	5-10	2-5
Cod	Had		Red,Flo,OG
Haddock	Cod		Cod,Had
Redfish			Red
Silver hake	Flo,OG,OP,OF	Cod,Had,Her	
Flounder	Cod,Had,Red	OG	
O. Groundfish		SHa,OF	Cod,Had,OP
Herring	OP,OF	Red,SHa,OG	Cod,Flo
Other Pelagic	Red,OF	SHa,Flo,OG	Her
Other Fish		OG	SHa,Flo

Note: For example, the silver hake fishery takes more that 10% of the total catch of each of the four categories of flounder, other groundfish, other pelagic fish, and other fish.

B. Fisheries which take given percentage of species considered.

Species	>10	5-10	2-5
Cod	Had,Flo	SHa	Red,OG,Her
Haddock	Cod,Flo	SHa	Red,OG
Redfish	Flo,OP	Her	Had,SHa
Silver hake		OG,Her,OP	OF
Flounder	SHa	OP	Had,Her,OF
O. Groundfish	SHa	Flo,Her,OP,OF	Had
Herring		SHa	OP
Other Pelagic	SHa,Her		OG
Other Fish	SHa,Her,OP	OG	

Note: For example, more than 10% of the total haddock catch is taken aa by-catch in each of the cod and flounder fisheries.

5. Relative Performance of Fishing Vessels

An essential requirement in the derivation of a fishing effort regulation, as proposed in the US Memorandum for multi-national, multi-species, multi-gear and vessel type fisheries, such as those operating in SA 5 and 6, is the determination of the total fishing effort on a standardized basis. This necessitates the estimation of relative fishing performance factors for each of the main components of the total fishery, which can be used in computing total standardized effort and its allocation between countries.

Factors were estimated for each main component of the SA 5 and 6 fisheries for 1971, using the monthly catch and fishing effort data reported in Table 4 of the ICNAF *Statistical Bulletin*, and using the US class 2 (0-50 tonnage class) side trawlers as standard. Data for fishing directed specifically to shellfish and those for specialized fisheries for finfish (*e.g.* menhaden, and such large species as swordfish and tuna) were omitted from the analysis. Factors representing the ratios of the catch-per-unit-effort, in days fished, of the different components to the standard unit were first estimated for each month (Table 7), and the monthly values were then averaged to give for each component an unweighted mean annual estimate. These estimates are summarized in Table 8.

Table 7. Fishing performance factors relative to US OTSI Class 2 (0-50 tonnage class) in 1971.

Month	Catch/day fished US OTSI 2	Relative fishing performance: US OTSI 3	US OTSI 4	CAN OTSI 4	USSR OTSI 4	POL OTSI 5	USSR OTSI 5	CAN OTST 5	POL OTST 6	FRG OTST 6	USSR OTST 7
Jan	4.91	1.27	1.15	-	1.00	1.27	1.88	-	11.59	8.59	8.45
Feb	5.11	1.09	0.98	-	0.82	0.99	1.46	1.31	3.28	-	6.57
Mar	4.94	1.06	1.56	-	1.44	2.13	1.80	2.02	7.69	-	6.89
Apr	3.91	1.48	1.83	-	1.60	2.98	2.36	-	8.35	-	11.14
May	3.86	1.53	1.96	1.52	1.81	2.61	2.68	2.10	6.24	-	8.93
Jun	4.48	1.23	2.22	1.38	2.26	1.43	2.83	1.44	5.78	-	8.81
Jul	6.99	0.98	1.14	0.75	1.02	1.21	1.38	0.81	4.04	-	4.98
Aug	7.90	1.06	0.95	0.75	0.80	4.98	1.10	0.95	2.20	4.42	4.42
Sep	5.63	0.97	1.32	0.92	1.28	1.57	1.44	-	7.84	4.98	4.80
Oct	4.03	0.93	1.66	1.39	1.65	1.30	2.06	2.54	7.76	15.28	6.46
Nov	4.57	0.95	1.40	1.02	1.25	1.11	2.03	1.60	6.86	10.46	7.03
Dec	3.98	0.90	1.16	1.04	0.95	1.69	1.86	0.46	11.45	8.57	8.38
$\bar{x}$		1.12	1.44	1.09	1.32	1.57	1.91	1.83	6.92	8.72	7.26
s^2		0.04	0.16	0.09	0.19	0.49	0.61	1.23	8.36	15.70	4.01
$e^{\overline{\ln x}}$		1.10	1.40	1.06	1.26	1.42	1.84	1.61	6.28	7.99	7.00
$e^{\text{var } \overline{\ln x}}$		1.03	1.08	1.08	1.11	1.25	1.08	1.31	1.28	1.24	1.08

Month	Relative fishing performance: POL OTST 7	FRG OTST 7	ROM OTST 7	BUL OTST 7	SPAIN PT 4	US PS 2	US PS 3	US PS 4	USSR PS 4	USSR PS 5
Jan	12.71	4.33	-	8.76	-	-	-	-	-	-
Feb	5.66	-	-	8.34	3.37	-	-	-	-	-
Mar	9.01	-	8.19	10.23	2.63	-	-	-	-	-
Apr	9.06	-	5.12	12.70	-	5.11	-	29.40	-	-
May	8.15	-	7.59	9.53	1.81	-	-	-	4.01	4.71
Jun	7.38	-	3.33	9.20	1.19	-	-	-	5.09	5.00
Jul	3.98	7.76	2.87	4.36	1.88	11.59	-	-	2.68	3.17
Aug	2.02	4.16	2.38	3.33	3.23	4.60	16.30	26.80	-	-
Sep	6.91	7.90	2.47	3.79	4.57	2.13	38.40	44.00	-	8.13
Oct	10.35	18.46	4.25	6.43	5.13	-	-	94.30	-	6.02
Nov	7.77	9.52	3.66	6.12	4.66	2.40	-	51.00	-	5.03
Dec	15.49	9.60	5.29	9.42	-	-	-	-	-	14.40
$\bar{x}$	8.29	8.82	4.52	7.68	3.16	5.16	27.40	49.10	3.93	6.63
s^2	12.02	23.00	4.18	8.29	1.97	-	-	-	-	-
$e^{\overline{\ln x}}$	7.59	7.87	4.14	7.12	2.86	4.25	25.00	44.10	3.80	5.95
$e^{\text{var } \overline{\ln x}}$	1.23	1.30	1.20	1.20	1.28	-	-	-	-	-

The Subcommittee wishes to draw attention to the following points:

i) The principle of standardization of fishing effort is crucial to the conclusions of this report, but the choice of a particular national unit is not. As they have been calculated, the relativities between vessel types would not change if some other standard vessel had been chosen.

ii) The estimates of percentage change in fishing effort from the 1971 level to meet a Commission objective depend primarily on the level of fishing mortality in that year and the relative size of the different species fisheries. They are not sensitive to the choice of vessel standard.

iii) With regard to the implementation of a fishing effort regulation, the variability of the vessel comparisons between years and between countries would make it impossible to define the historic performance of a particular vessel/country category in precise terms. This again does not invalidate the overall proportional changes in effort necessary to achieve a Commission objective.

Table 8. Relative fishing performance factors for SA 5 and 6 fisheries in 1971 with US 0-50 vessel class side otter trawlers (OTSI 2) taken as the standard.

Component of fishery	Mean annual factor	Component of fishery	Mean annual factor	Component of fishery	Mean annual factor
USA OTSI 3	1.12	POL OTSI 5	1.57	BUL OTST 7	7.68
USA OTSI 4	1.44	POL OTST 6	6.92	USA PS 2	5.16
CAN OTSI 4	1.09	POL OTST 7	8.29	USA PS 3	27.40
CAN OTST 5	1.83	FRG OTST 6	8.72	USA PS 4	49.10
USSR OTSI 4	1.32	FRG OTST 7	8.82	USSR PS 4	3.93
USSR OTSI 5	1.91	ROM OTST 7	4.52	USSR PS 5	6.63
USSR OTST 7	7.26	SPAIN PT 4	3.16		

OTSI - side otter trawler
OTST - stern otter trawler
PT - pair tralwer
PS - purse seine

2 - vessel tonnage category 0-50 tons
3 - vessel tonnage category 51-150 tons
4 - vessel tonnage category 151-500 tons
5 - vessel tonnage category 501-900 tons
6 - vessel tonnage category 901-1800 tons
7 - vessel tonnage category over 1800 tons

Note: It must be streased that these factors do not represent relative fishing powers of the different country, gear and vessel type categories for individual species or groups of species, since they are based on ratios of catch rates of vessels fishing in different parts of SA 5 and 6 on different species and fish densities. Instead, they constitute measures of the relative amounts of fish caught per unit of effort (measured as days fished) within SA 5 and 6 in 1971. They therefore provide a basis for computing total standardized fishing effort on all fish resources combined in 1971, and for determining the total effort, and its allocation between countries and major fishery components, under a regulation involving a reduction in total fishing effort, provided that the distributions and patterns of fishing remain the same as in 1971.

6. Consideration of Questions Posed in the Canadian Memorandum (Comm.Doc. 73/4)

a) Preamble

Some of the methods used in this first assessment of mixed fisheries do not yet have a well-tried theoretical background; the attempt to aggregate features from diverse fisheries into a single estimate necessarily involves extensive assumptions and simplifications. The details of the results achieved depend on the exact nature of these adjustments, but, nevertheless, the Subcommittee feels that the assessments represent the overall situation and provide an adequate basis to advise in general terms on the questions posed.

An attempt has been made to relate the estimates of fishing mortality, as prepared at the 1972 Annual Meeting for stocks in 1971, to the nominal catches in that year and to new estimates of the overall standardized fishing effort in SA 5 and 6. These estimates (Tables 9 and 10) are subject to two qualifications:

i) Ststements based on these relationships will be influenced by the fishery in 1972, for which no complete catch and effort data are yet availahle.

ii) It is also evident that the appropriate level of overall fishing effort is critically determined by the state of the fisheries for herring and particularly (because it is presently unregulated) for mackerel. The Subcommittee has been able to carry out only a very preliminary assessment of the mackerel stock, and estimates of MSY, the associated fishing effort and current status for this stock are tentative.

b) Question 1: What was the magnitude of fishing intensity in 1971 and 1972 relative to that corresponding to or needed to produce the maximum sustainable yield of finfish?

As noted above, the potential of the mackerel fishery has a critical bearing on the level of fishing intensity necessary to produce the MSY of finfish (mackerel represented 33% of total finfish catch as given in Table 1 for 1971). The level of fishing associated with the MSY on this fishery is not known precisely, but, on the basis of the age compoaition of the stock in 1972 and the principle that it is undesirable to reduce the mackerel stock to a level lower than that which existed in 1971, the Subcommittee considered that, for the time being at least, the fishing effort should not exceed the 1971 level. The problems in assessing mackerel are such that not all members of the Subcommittee could agree on its present status; therefore, the best advice that the Subcommittee can provide for the Commission in regard to this Question is that the level of fishing intensity associated with the MSY of finfish is estimated to be of the order of 70-80 percent of the 1971 level (which was estimated for 1971 to be 213,830 days fished, standardized to US OTSI 0-50 tonnage class vessels). At the same time the Commission should note that, in a mixed fishery of this type, the interactions hetween fisheries directed towards particular species are so complex that it may prove impossible to exploit all of them simultaneously at the MSY level. The MSY of the total finfish resource is expected to be lower than the sum of the MSY's of the individual resources, but at present we do not know how much lower.

c) Question 2: What is the harvestable surplus yield for 1973 and the magnitude of fishing intensity required to produce it?

Table 9 compares the nominal catches in 1971 with the long-term maximum sustsinable yield of individual resources and with potential catches in 1973. For regulated species (except herring), these 1973 catches correspond to the quota (and in some instances exceed scientific estimates of the surplus yield); for unregulated species for which the MSY's are given (except mackerel), the potential catches are equivalent to the MSY's; for mackerel the potential catch is given as slightly lower than the 1971 catch but higher than the MSY; and for other unregulated groups of species the potential catches are taken to be equivalent to those in 1971. The potential yield of finfish in 1973 amounts to 846,000 tons (exclusive of herring, the catch of which in 1973 has yet to be determined by quota). The magnitude of fishing intensity associated with this total will be within 80-100 percent of the 1971 level, depending on the quota to be determined for herring.

Table 9. Estimates of catch characteristics of resources in SA 5 and 6.

Species	Long-term MSY	Long-term F	1971 Catch	1971 F	1973 (See Sect. 6, Quest. 2)	1973 F
Cod	45	.3	35	-	45	.3
Haddock	50	.5	12	.5	6	.5
Silver hake	200	.5	108	.8	170	.5
Red hake	40	.5	40	.5	40	.5
Yellowtail	37	.8	38	.9	31	.8
Herring	350	.5	326	.8	?	.5
Redfish	30		20		30	
Pollock	(50)[3]		15		(50)[3]	
Mackerel	(250)[3]		349		(300)[3]	
Dogfish	50		1		50	
Other Flo.	20		27		27	
Other Pel.	?		17		17	
Other Fish	?		80		80	
Total			1,068[1]		846[2]	

[1] This total differs slightly from 1,066 in Table 1 due to rounding error.
[2] Excludes herring.
[3] Estimate very uncertain.

Table 10. Estimates of fishing effort in SA 5 and 6.

Species or species group	Fishing effort ('000 standard days fished) In the directed fishery	Fishing effort ('000 standard days fished) On the species (Includes effort in the by-catch of other fisheries)
Cod	2,824	7,851
Haddock	4,475	11,588
Silver hake	28,697	41,630
All Flounders	14,754	21,486
Redfish	1,478	2,421
Other Groundfish (incl. Red hake)	11,442	33,581
Herring	63,351	76,266
Other Pelagic (mainly mackerel)	82,360	95,111
Other Fish	4,449	31,341
Total	213,830	

Note: Some of the species listed in Table 9 cannot be identified as separate fisheries within the ICNAF statistics and therefore do not appear separately in Table 10.

d) Question 3: What is the consequence over the next 3 years, 1973-1975, of maintaining the fishing intensity at the 1972 level?

It is impossible to estimate the effect of maintaining the fishing intensity at the 1972 level in 1973 to 1975 in terms of the potential catches in these years, because data are not yet available to determine the effective fishing effort in 1972 or the recruitment to the stocks in the immediate future. Taking into account what little is known about recruitment, the following summary indicates the expected status of the resources in 1975 relative to that in 1971 for individual species, if fishing intensity remains at the 1971 level:

Species	Status
Cod	same
Haddock	lower
Silver hake	same, but depends critically on effect of fishery in 1972
Red hake	slightly higher, but depends critically on effect of fishery in 1972
Yellowtail	same, or perhaps lower
Redfish	same
Herring	much lower
Mackerel	unknown
Other demersal finfish	probably lower
Other finfish	unknown

An inference as to the effect of maintaining the fishing intensity over the next three years can be obtained from the yield curves (Fig. 1 and 2), assuming an average level of recruitment. Assuming a level of effort in 1972 which is 25% greater than in 1971, continuation at the 1972 effort through 1975 would imply that at the end of that period the catches would be approaching the equilibrium level, only 65% of MSY. However, the effort required to do this would then be 40% in excess of that which would produce MSY under equilibrium conditions, and catch-per-unit-effort would be only 41% of that MSY and equilibrium effort level.

e) Question 4: What is the consequence over the next 3 years, 1973-1975, of maintaining the catch at the 1971 or 1972 level?

The implications involved in maintaining the catch at the 1971 or 1972 level are very complex, because for several species this implies a level of exploitation well in excess of the MSY and recruitment must also be taken into account.

It is possible that such a regulation would involve further increase in the amount of fishing in SA 5 and 6. The expected effects of maintaining the catch at the 1971 level, on both the stocks and the fishing associated with them, are as follows:

Species	Stock level	Fishing effort
Cod	same	same
Haddock	decrease	increase
Silver hake	increase	decrease
Red hake	increase (?)	decrease (?)
Yellowtail	same	same
Redfish	same	same
Herring	decrease	increase
Mackerel	unknown	unknown
Other demersal fish	decrease	increase
Other finfish	unknown	unknown

The exact effects depend on the by-catch of other species in fisheries directed toward particular species.

If the stock (of a species) increases through favourable recruitment, then the existence of a quota at the 1971 level of catch would in effect require less fishing effort to acquire the quota. Therefore, if the quota regulation is adhered to, there would be a surplus of fishing effort available to divert to other fisheries; but within SA 5 and 6 the only major unregulated finfish resource is mackerel (and possibly some dogfish and pollock). So the implication of

maintaining the catches of particular species at the 1971 catch level could lead to an undesirable increase in fishing directed toward mackerel (or one or two other minor species) or diversion of effort to other areas. Thus, if an increase in fishing on mackerel is to be avoided, it would be preferable to regulate the amount of fishing in SA 5 and 6 or to introduce a catch quota regulation on mackerel.

An inference as to the consequence of maintaining the catch at the 1971 or 1972 level over the next three years can be obtained from the yield curves (Fig. 1 and 2). Assuming that effort increased 25% in 1972 over 1971, to maintain the catch would require further increases over the next three years. Such an increase in effort may only in the short term be productive of more fish. In the long run the current level of catch would not be maintained even with increases in effort.

f) Question 5: What are the consequences of adjusting fishing intensities to the level corresponding to the maximum sustainable yield in one or in more steps?
Question 6: What is the time period required to bring catches back to the maximum level under the schemes considered in Question 5?

In principle, the fishing intensity could be adjusted in such a way that there would be no detectable effect on total catches over and above the normal annual fluctuations. But this would imply such gradual adjustments that it would be imposaible to sscertain if the regulation was being effectively implemented, especially since these small reductions in overall fishing effort could easily be offset by improvements in efficiency. It is necessary, therefore, that any reduction in fishing intenaity should be set at a level that can be detected. This implies a more substantial immediate loss in catch but at the same time a shorter period for the stocks to recover to the intended level (regulation objective). This time period has not been estimated exactly, but in theory it would be expected to be about one-half of the period during which year-classes make a significant contribution to the fishery (in practice this would be somewhat less than 5 years for most species).

Inferences drawn from the yield/effort curves imply that the difference between one- and two-step adjustments is relatively small at the levels of reduction indicated. If, for example, a 25% decrease below 1971 is indicated, then the two-step values could be 15 and 12 percent. By comparison with a one-step reduction, increasing the number of steps beyond two or three would probably cause significant loss in interim potential catch, depending on the difference between the number of years that it takes to reach equilibrium MSY.

g) Question 7: What are the options for selection of units of effort for management purposes, evaluated in terms of efficiency in achieving regulation of fishing intensity?

The rapid evaluation of the effects of fishing requires that the effort be determined from that measure most closely related to fishing mortality. This has been done through the use of days fished, because it is the measure generally available in the ICNAF *Statistical Bulletin*. However, the implementation of an effort regulation requires enforceability and credibility. The need for the first is obvious. The second can be just as important, for, if fishermen of one country or group within a country do not believe that the regulation is being enforced, then they themselves may all seek to disobey it and/or destroy the conservation measure.

Several other effort measures have been reported to ICNAF, *i.e.* vessels fishing in the area, days on grounds, and hours fished.

Regulation on the basis of days fished has the advantage of being the same measure as used in the assessments of SA 5 and 6, and thus should relate most closely to fishing mortality. There are, however, two drawbacks. One is the inability to monitor closely through international inspection the number of days being fished, without an extremely elaborate system of daily reports being made to ICNAF. The second is the credibility problem since fishermen from one country, although observing other vessels on the grounds, cannot determine whether a vessel is fishing, and thus may make erroneous conclusions concerning adherence to regulations. It should also be noted that "hours fishing" suffers from both these drawbacks in an accentuated form. Finally, there is the possibility of countries making changes in their methods of calculating days fished. Such changes should not be made without first relating the new method to the previous one. It is also true that the introduction of a regulation might change the seasonal pattern of fishing by a country, with a consequent effect on the conversion factors and the fishing mortality that can be generated.

The number of vessels fishing in the area is the easiest statistic to monitor. There will be small fishing vessels that are limited to fishing in SA 5 and 6, and for these the number of vessels fishing might be a reasonable measure, because the relationship between days fished and number of vessels would be fairly constant for given classes of vessels. However, for

distant-water fleets this freezes the option to utilize a vessel, because it makes no distinction between one day and 365 days in the area. Under an effort regulation of this type, countries would undoubtedly maximize the time per vessel while minimizing the number of vessels, thus altering previous relationships between days fished and number of vessels. Therefore, to ensure achievement of a reduction in fishing intensity by regulating the number of vessels, the number would have to be that which would be allowed if the vessels fished continuously throughout the year; this would thus be in reality a maximum days on grounds figure.

Days on grounds offers an alternative to the previously discussed measures. It may lack the precision of days fished in relation to fishing mortality but does not have the wide margin of potential deflection inherent in number of vessels. Days on grounds could be easily monitored for veasels of the distant-water fleets by requiring the reporting to ICNAF of the times of entrance and leaving the fishing area. These are easily observed by fishermen and thus such regulation would be credible. The lack of precision in relation to effective fishing effort is a drawback. In Table 11 are given the days-on-grounds/days-fished ratios for countries reporting such statistics to ICNAF in 1967, 1968, and 1969. There are obviously country and vessel-type differences, and thus each country would have to supply an acceptable conversion. There is also some indication (see data for Polish vessels) of a trend with time, increasing the number of days fished relative to days on grounds. It may therefore be possible for countries to optimize this ratio, thus reducing the effect of an effort regulation based on days on grounds. In Table 12 are given some monthly values computed for categories in which the amount of effort was reasonably large (*i.e.* close to or exceeding 100 days on grounds). It can be observed that changing seasonal fishing patterns will alter the yearly days-fished/days-on-grounds relationships. These ratios can, however, be adjusted yearly, giving only a minimum time-lag period. If days-fished/days-on-grounds relationships can be obtained, a regulation based on days on grounds appears to be feasible.

Another aspect of this question involves balancing the factors of precision in regulating the magnitude of fishing mortality with the practical task of managing and monitoring the actual performance of the fishing fleet. A method of calculating the actual allowable fishing effort of a particular fleet (country Z) from an allocation of standard allowable effort is illustrated by an example in Table 13. For convenience the US OTSI 0-50 tonnage class has been used. The calculation supposes, as an example, that the fishing effort of country Z is to be reduced by 25% as a result of Commission agreement. This country had the fleet composition shown in the column 1.

h) Question 8: What is the fishing intensity required to catch the quotas of fish established for 1973?

For the reasons discussed above, the by-catch of other species in the mackerel fishery makes it impossible to define a fishing intensity that would harvest the quotas of regulated species alone in 1973. Our best estimate of this would be the amount of fishing on all species (100%) less the fishing directed toward mackerel (38%), *i.e.* 62% of the standardized fishing effort. However, it is important to note that, in the event of such a regulation, the pattern of fishing between fisheries might well change unless further regulations constrained the direction of the fisheries.

i) Question 9: Within the probable range of scientific estimates concerning the status of resources, how will variations in these estimates change the impact on the resources of regulatory decisions?

The assessments of the status of the resource, and of the effect of different management measures, and also the answers to the preceding questions, depend on estimates of a range of different parameters (magnitude of current standing stock, fishing mortality coefficient, etc.), all of which are subject to error; also, the models used do not provide a completely accurate description of the biological situation. The possible errors in the estimates will have complex effects on the assessments which are not easy to describe in detail. Generally, however, the effect will be to make the assessments either too optimistic (*e.g.* the strength of currently recruiting year-classes is over-estimated, or the current fishing mortality under-estimated relative to the optimum fishing mortality), or too pessimistic (recruitment under-estimated, or fishing mortality over-estimated). The range of possible error varies with the stock, being least for these stocks with a long history of fishing and research (*e.g.* haddock) and greatest in newly developed fisheries (*e.g.* mackerel). For the former, the important quantities (fishing mortality, potential) are probably estimated with a margin of error of ± 10%; for the latter the error might be as much as ± 50%. For both, the errors concerning the current situation would be substantially reduced by more complete statistical data for the most recent year.

Table 11. Ratio of days on grounds to days fished, as reported in Table 5 of ICNAF *Statistical Bulletin* for SA 5 and 6.

Country	Gear	Tonnage Class	SA	Days on Ground/Days Fished 1967	1968	1969
Poland	OTSI	5	5	1.83	1.63	1.63
		6	6	-	1.77	1.45
			5 & 6	1.83	1.66	1.57
	OTST	7	5	1.60	1.50	1.43
			6	-	1.20	1.62
			5 & 6	1.60	1.47	1.44
Romania	OTST	7	5	1.09	1.13	1.08
Spain	PT	4	5	1.23	1.36	1.26
USSR	OTSI	4	5	1.25	1.20	1.25
			6	1.22	1.28	1.38
			5 & 6	1.25	1.20	1.30
	OTST	7	5	1.25	1.16	1.27
			6	1.27	1.48	1.42
			5 & 6	1.24	1.24	1.29
	OTSI	5	5	1.30	-	1.14
			6	1.32	-	1.34
			5 & 6	1.30	-	1.27
	PS	4	5	-	-	1.71
		5	5	-	-	1.51

Note: Ratios of "Days of Grounds" to "Days Fished" for other countries are not available because "Days on Grounds" were not reported in 1967-69. The category "Days on Grounds" has not been a requirement in reporting statistics since 1970.

Table 12. Ratios of "days on grounds" to "days fished" from ICNAF *Statistical Bulletin*, Table 4, for 1969.

Month	Spain PT 5Z	USSR OTSI 4 5Ze	USSR OTSI 4 5Zw	USSR OTSI 5 5Ze	USSR OTSI 5 5Zw	USSR OTST 7 5Ze	USSR OTST 7 5Zw	Poland OTSI 5 5Ze	Poland OTST 7 5Ze
Jan	-	-	-	-	-	-	1.3	-	-
Feb	1.4	-	-	-	-	-	1.6	2.5	-
Mar	1.2	-	-	-	-	-	1.4	2.2	-
Apr	1.1	-	1.3	-	1.4	-	1.4	1.6	-
May	-	1.3	1.2	1.6	1.2	1.1	1.3	1.5	-
Jun	-	1.3	1.2	1.4	1.2	1.2	1.3	2.3	1.4
Jul	-	1.2	1.1	1.5	1.2	-	1.1	2.0	2.0
Aug	-	1.1	1.1	1.1	1.1	-	1.2	1.4	1.7
Sep	1.1	1.4	1.2	1.1	1.1	1.2	1.3	1.1	1.1
Oct	1.3	1.6	1.4	1.4	1.2	1.1	1.2	1.4	1.5
Nov	-	-	1.5	-	1.4	1.4	1.2	1.8	1.6
Dec	-	-	-	-	-	-	-	-	1.6

Table 13. Example of the conversion of fishing effort in standard units into fishing effort in national units (Z refers to the hypothetical country).

Column Nos.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			Relative performance ratio			Standardized days fished				Standardized days on ground			Choice of reduced effort			
Vessel Class	No. of vessels	No. of trips	To USA OTSI 2	To Z OTSI 5	Actual days fished	To USA OTSI 2	To Z OTSI 5	Ratio days on ground to days fished	Actual days on ground	To USA OTSI 2	To Z OTSI 5	% by tonn. class	Days on ground: To USA OTSI 2	Days on ground: To Z OTSI 5	Days on ground: Actual	Actual days fished
OTSI 5	28	330	1.57	1.00	5,852	9,188	5,852	1.69	9,890	15,527	9,890	20	10,801	6,880	6,880	4,071
OTST 6	8	100	6.92	4.41	1,873	12,961	8,260	1.60	2,997	27,039	13,217	40	21,601	13,761	3,120	1,950
OTST 7	12	144	8.29	5.28	2,874	23,825	15,174	1.50	4,311	35,738	22,762	40	21,601	13,761	2,606	1,737
Total 1971	48	577			10,599	45,974	29,286		17,198	72,004	45,869					
Total 1973 (25% less)						34,480	21,964			54,003 TAE_s	34,402 TAE_c		54,003 TAE_s	34,402 TAE_c	12,605	7,758

Explanatory Notes

Col. 1-5: would be given.

Col. 6: converts the days fished (Col. 5) to standard US days fished using the conversion factors in Col. 3 (Col. 5 × Col. 3).

Col. 7: converts the days fished (Col. 5) to days fished by a standard vessel within the fleet of country Z by the conversion factor in Col. 4 (Col. 5 × Col. 4).

Col. 8: is the given factor for converting days fished to days on grounds for country Z.

Col. 9: gives the actual days on grounds (Col. 5 × Col. 8).

Col. 10: converts days on grounds (Col. 9) to standard US days on grounds, again using the conversion factor in Col. 3 (Col. 9 × Col. 3).

Col. 11: converts days on grounds (Col. 9) to days on grounds by a standard vessel of country Z using the conversion factor in Col. 4 (Col. 9 × Col. 4).

The sums of effort for 1971 (Col. 10 and 11) might then be reduced by a specified proportion, giving a total allowable days on grounds in the standard US units (TAE_s) at the bottom of Col. 10, or to a total allowable days on grounds in terms of the standard vessel of country Z (TAE_c) at the bottom of Col. 11.

Col. 12: gives the hypothetical choice of the proportional allocation of TAE_s or TAE_c between vessel categories.

Col. 13: applies these proportions (Col. 12) to TAE_s to give the total allowable days on grounds in US standard units (Col. 12 × TAE_s of Col. 10).

Col. 14: applies these proportions (Col. 12) to TAE_c to give the total allowable days on grounds in terms of the standard vessel of country Z (Col. 12 × TAE_c of Col. 11).

Col. 15: reconverts the allowable efforts per vessel category (Col. 13 or 14) to actual allowable days on grounds for country Z using the appropriate conversion factors of Col. 3 or 4 (Col. 13/Col. 3 = Col. 14/Col. 4).

Col. 16: converts the actual allowable days on grounds (Col. 15) for each class of vessel to actual allowable days fished (Col. 16) using the conversion factors of Col. 8 (Col. 15/Col. 8).

The effect of possible errors on the future trends in the fishery will depend on the speed with which they are detected, and the necessary revisions which have to be made to the regulations. The most significant errors are likely to be those concerning the strength of the newly entering year-classes, and the current value of the fishing mortality. Both of these are likely to be detected within one or two years.

If regulatory decisions are taken on too pessimistic estimates, the immediate effect will be that the effort will be restricted more than is actually necessary, and the catches will also be less. However, when the errors are detected and the regulations amended, catches will be increased, and, if the adjustment is made reasonably quickly (say, within two years), the accumulated catch over a period will be little altered.

On the other hand, if action is taken on the basis of estimates that are too optimistic, then the stocks will decline. When the error is detected, there will need to be a cutback in effort and catch, almost certainly considerably more severe than the cutback that would have been needed earlier, if action had been taken sooner on the basis of more correct estimates. If the decline in stock causes a drop in recruitment, there will be a drop in the accumulated catch over a period.

7. Other Effects of the Regulation of Fishing Effort in SA 5 and 6

If an effort regulation was introduced involving a reduction of fishing in SA 5 and 6, then it is probable that a proportion of the surplus effort might be deployed in SA 1-4. Previous asaessments indicate that the majority of stocks in SA 1-4 are fully exploited, and for several the amount of fishing mortality is already regulated by catch quotas. Other resources remain for which no data have been presented and which may or may not be fully exploited at the present time; these include silver hake and sand launce in SA 4, and sand launce, redfish, capelin, grenadiers and Greenland halibut in SA 1-3. Relevant information must be presented before the Subcommittee can express an opinion on their potential to absorb increased fishing without detriment to the resources already fully exploited.

8. Other Methods of Regulation

The Subcommittee has not examined the implications of other methods of regulation (*viz.* further regulation of the mesh size for species in SA 5 and 6, minimum sizes of fish, closed seasons, and closed areas).

9. Summary Remarks

The Subcommittee has reviewed and updated assessments of many stocks in SA 5 and 6 in recent years. The consensus of all these assessments has been that the resources are now fully exploited and some, notably haddock and herring, are over-exploited. Nevertheless, fishing activity has continued to increase in recent years, the increase being directed primarily at unregulated species, specifically mackerel and, to a lesser extent, squid. Having regard to the desirability of forestalling for mackerel the pattern of rapid over-exploitation which has been a feature of other species fisheries, and the need to reduce effort on other species to the MSY level, it is consistent that the present estimates should indicate some reduction in the overall level of fishing effort in the area.

The main problem lies in the need to allow continued exploitation in recently developed fisheries (*e.g.* mackerel) while controlling the exploitation of other species. In view of this, it might be considered more efficient to regulate fishing on the two resource components separately. But, because of the by-catch problem and the absence of a geographical separation of the mackerel stock from all other regulated species, the Subcommittee sees no way in which complete freedom of fishing for mackerel could at the same time enable the Commission to conserve adequately the other regulated species (particularly herring) according to its current objectives. Bearing in mind the history of exploitation of some of the other regulated resources, there is justification for a pre-emptive catch quota regulation of mackerel, pending a better assessment of its potential.

In that event all the resources known to attract a substantial commercial fishery would be regulated by catch, and, since overall effort regulation does not in itself solve the by-catch problem, the relative merits of the two approaches to regulation are difficult to decide on scientific grounds. However, because of the by-catch problem, catch quotas for the individual species would tend to generate over-exploitation, which could only be mitigated by total catch or effort regulation set below the level estimated to achieve the summed MSY's of individual resources, when these resources are fished independently.

B. Other Assessments

1. Known changes in the fisheries for regulated groundfish stocks in 1972 in relation to TAC's[1] for 1973.

Due to the emphasis on consideration of matters relating to effort regulation, the Subcommittee had no time to consider in detail the assessments of regulated species. However, the remarks in the following Table reflect the consensus of the Subcommittee at this time:

Species	Subarea/ Division	TAC ('000 tons) 1972	TAC ('000 tons) 1973	Remarks
Cod	2J-3L	-	575.5	The TAC for 1973 was based on evidence of an above-average 1968 year-class. Data from 1972 confirm this; the stock is developing as expected.
	3N-O	-	103.5	
	3Ps	-	50.5	
	4Vs-W	-	60.5	
	5Y	-	10.0	
	5Z	-	35.0	
Haddock	4W	4.0	4.0	Removals should be minimal.
	4X	9.0	9.0	Removals should be minimal.
	5Y-Z	6.0	6.0	TAC for 1972 over-fulfilled (6,232 tons by 15 December 1972). Stock continues to decline. Removals should be minimal.
American Plaice	3L-N-O	-	60.0	
Yellowtail	3L-N-O	-	50.0	
	5Ze	16.0	16.0	Fishery appears to be steady.
	5Zw	10.0	10.0	TAC for 1972 set to provide improvement in the stock. TAC was over-fulfilled by 1,000 tons by 15 December 1972.
Silver hake	5Y	-	10.0	Abundant 1971 year-class. Validity of TAC for 1973 depends on exploitation of the 1971 year-class as 1-year-old fish in 1972.
	5Ze	-	80.0	
	5Zw-6	-	80.0	
Red hake	5Zw-6	-	40.0	USSR 1972 catch increased over 1971.

2. Regulated species

The Subcommittee is not aware of any significant unforeseen changes in the 1972 fisheries for regulated species. So far as can be judged, except for haddock in SA 4 and 5 and yellowtail in 5Zw, the TAC's for 1973 are expected to achieve their objectives. But it has to be stressed that, for some stocks, we shall not be able to verify this properly unless countries participating provide more sampling information and more refined catch and effort statistics. An immediate improvement in the reporting of biostatistical data is required for 1973 and this is the subject of a Circular Letter to be distributed by the Secretariat in February 1973.

3. Unregulated species

a) Cod - Subarea 1

As stated in the Assessments Report (*Redbook* 1972, Part I, p. 20), the greatest uncertainty in the assessments at that time was connected with mean weight for the various age groups.

[1] TAC = The total catch that has been agreed by the Commission.

Samples from 1972, some of which were presented at this Assessments Subcommittee Meeting (January 1973), indicate that weight data as used in the 1972 Report were generally too high for age-groups dominating in landings (*i.e.* age-groups 5 to 7).

The actual level of fishing mortality in 1971-72 is not known precisely at present, and the same applies to strength of year-classes to recruit to the fishery in 1973-74. More precise assessment has to await the 1972 catch statistics and results of surveys in late 1972, but it is expected that this material can be taken into account at the 1973 Annual Meeting. However, as a preliminary guide to the Commission, the Subcommittee is confident that updated figures at the 1973 Annual Meeting will not differ significantly from present catch estimates, which (assuming F in 1971 to be 0.55 in Div. 1A-1D and 0.65 in Div. 1E-1F) for levels of F_{max} and F_{opt} as set by the ICES/ICNAF Working Group on Cod Stocks in the North Atlantic Area are (in thousand tons):

	Div. 1A-D		Div. 1E-F		Subarea 1	
	F_{max}	F_{opt}	F_{max}	F_{opt}	F_{max}	F_{opt}
$F_{1972-74}$	0.56	0.35	0.65	0.45		
Catch 1972	72	48	26	20	98	68
Catch 1973	66	51	20	17	86	68
Catch 1974	62	54	20	17	82	71

The difference between this level and the level given in the 1972 Report (1972: 97; 1973: 102 for Subarea 1 as a whole) are to some degree due to the differences between values of weight in the 1972 Report and those of the present assessment.

Also, there is some uncertainty as to a breakdown of the stock in Div. 1E-F plus Southeast Greenland in components inside ICNAF and NEAFC Areas. In the present estimates it has been considered that roughly half of the stock, the size of which is estimated in the Report of the ICES/ICNAF Working Group on Cod Stocks in the North Atlantic, is exploited inside the ICNAF Area (Div. 1E-F).

b) Cod - Div. 2GH, 3M, 4Vn

No detailed assessments.

c) Cod - Div. 4X

Canadian research vessel survey data presented in Res.Doc. 73/7 suggest that fishing intensity remains high and that recruitment is not improving. It may thus be desirable at the 1973 Annual Meeting to consider an appropriate level of catch quota for this stock.

d) Redfish - All Areas

No detailed assessments.

e) Other Species

Available information on mackerel and squid in SA 5 and 6 will have to be supplied at the Annual Meeting if adequate assessments of these species are to be made. Countries are also asked to submit information on unregulated stocks in other Subareas, for example, silver hake and pollock in SA 4, redfish in SA 1-4, and Greenland halibut, grenadiers, capelin and sand launce in areas where they occur.

SUPPLEMENT

Supp. Table 1. Estimated days fished for main species in SA 5 in 1971, standardized to US OTSI 0-50 tonnage class.

Main species sought	Stand. days fished[1]	Species Caught										% f as by-catch[3]
		Cod	Had	Red	SH	Flo	OG	Her	OP	OF	Total	
Cod	2,824	2,824	2,279	34	130	378	483	6	0	3	6,137	54.0
Had	4,475	1,629	4,475	76	9	828	1,307	0	0	0	8,324	46.2
Red	1,478	238	310	1,478	86	180	452	13	0	1	2,758	46.4
SH	28,697	488	803	115	28,697	2,124	7,920	3,530	3,817	5,366	52,860	45.7
Flo	14,754	2,139	3,010	251	634	14,754	2,685	88	118	148	23,827	38.1
OG	11,442	194	332	11	3,066	561	11,442	904	881	2,140	19,531	41.4
Her	63,351	253	253	127	3,611	507	2,217	63,351	7,539	5,068	82,926	23.6
OP	82,360	82	82	329	4,365	1,647	4,530	8,236	82,360	14,166	115,797	28.9
OF	4,449	4	44	0	1,032	507	2,545	138	39	4,449	9,115	51.2
Total	213,830	7,851	11,588	2,421	41,630	21,486	33,581	76,266	95,111	31,341		
% f as by-catch[2]		64.0	61.3	39.0	31.1	31.3	65.9	16.9	13.4	85.8		

[1] Actual standardized fishing effort in directed fisheries.
[2] Percent fishing effort on the species when it is taken as by-catch in other fisheries.
[3] Percent of total fishing effort generated by a species fishery which has an effect on species taken as by-catch in that fishery.

Supp. Table 2. Landings standardized days fished, and C/E in SA 5 and 6, 1971.

Main species sought		Std.[1] days	Species Caught									
			Cod	Had	Red	SH	Flo	OG	Her	OP[2]	OF	Total[3]
Cod	OT	1,397	2,501	865	268	324	835	865	18	-	5	5,681
	PT	1,427	7,619	1,336	-	-	-	184	-	-	-	9,139
	Total	2,824	10,120	2,201	268	324	835	1,049	18	-	5	14,820
	C/E	-	3.584	.779	.095	.115	.296	.371	.006	-	.002	-
Had	OT	4,475	5,836	4,319	599	25	1,830	2,844	-	3	-	15,456
	C/E	-	1.304	.965	.134	.006	.409	.636	-	.001	-	-
Red	OT	1,478	855	300	11,727	215	396	984	53	1	6	14,537
	C/E	-	.578	.203	7.934	.145	.268	.666	.036	.001	.004	-
SH	OT	28,697	1,716	776	802	71,321	4,684	17,187	13,862	14,043	14,461	167,549
	C/E	-	.060	.027	.028	2.485	.163	.599	.483	.489	.504	-
Flo	OT	14,754	7,688	2,906	1,987	1,569	32,527	5,835	328	445	385	68,424
	C/E	-	.521	.197	.135	.106	2.205	.395	.022	.030	.026	-
OG	OT	11,442	707	317	43	7,627	1,240	24,879	3,561	3,255	5,768	58,839
	C/E	-	.062	.028	.004	.666	.108	2.174	.311	.284	.504	-
Her	OT	57,857	868	238	1,173	8,933	1,124	4,882	201,554	26,506	13,661	258,939
	PS	5,494	-	-	-	-	-	-	47,666	1,259	-	48,925
	Total	63,351	868	238	1,173	8,933	1,124	4,882	249,220	27,765	13,661	307,864
	C/E	-	.014	.004	.018	.141	.018	.077	3.934	.438	.216	-
OP	OT	81,610	233	80	2,669	10,849	3,565	9,848	32,389	301,296	38,046	398,975
	PS	750	-	-	-	-	-	-	82	1,855	-	1,937
	Total	82,360	233	80	2,669	10,849	3,565	9,848	32,471	303,151	38,046	400,912
	C/E	-	.003	.001	.032	.132	.043	.120	.394	3.681	.462	-
OF	OT	4,449	18	46	2	2,572	1,117	5,536	546	1,465	11,975	22,731
	C/E	-	.004	.010	.001	.578	1.251	1.244	.123	.329	2.692	-

Supp. Table 2. Continued.

Main species sought		Std.[1] days	Species Caught: Cod	Had	Red	SH	Flo	OG	Her	OP[2]	OF	Total[3]
Total	OT	206,159	20,422	9,847	19,270	103,435	47,318	72,860	252,311	347,014	84,307	956,784
	PT	1,427	7,619	1,336	-	-	-	184	-	-	-	9,139
	PS	6,244	-	-	-	-	-	-	47,748	3,114	-	50,862
	Other	-	7,542	986	767	1,957	3,614	8,231	17,119	14,246	6,068	60,530
	Total	213,830	35,583	12,169	20,037	105,392	50,932	81,275	317,178	364,374	90,375	1,077,315

1 Standardized to US OTSI 0-50 tonnage class.
2 Does not include menhaden (240,751 tons).
3 Does not include shellfish (564,957 tons).

Supp. Table 3. Relative catchabilities based on $\frac{\Sigma C}{\Sigma E}$ for each year.

		1963	1964	1965	1966	1967	1968	1969	1970	1971
USA										
OTSI	0-50	1(7.3)	1(8.3)	1(6.0)	1(6.8)	1(7.6)	1(6.7)	1(5.4)	1(4.1)	1(5.2)
	51-150	1.06	0.86	0.85	0.81	0.66	0.77	0.94	1.72	1.21
	151-500	0.99	0.83	0.95	1.01	0.81	0.91	1.28	2.26	1.66
OTST	0-50	-	-	-	-	4.25	11.90	4.83	10.85	3.60
	51-150	-	-	-	-	1.75	3.80	1.96	2.36	5.19
	151-500	-	-	-	-	0.93	1.04	-	2.65	1.88
PS	0-50	-	-	-	-	5.47	-	-	47.40	15.11
	51-150	14.65	6.90	-	10.00	16.00	12.32	20.14	25.05	38.48
	151-500	-	30.00	-	24.50	39.24	24.57	20.84	55.40	64.88
CANADA										
OTSI	51-150	0.84	-	0.71	0.84	0.35	0.63	0.44	0.87	0.78
	151-500	1.34	1.18	1.34	1.39	0.93	1.16	1.16	1.62	1.30
OTST	501-900	-	-	-	1.41	1.63	1.62	1.63	2.42	1.82
GERMANY (FR)										
OTST	901-1800	-	-	-	-	5.77	5.60	5.93	10.56	9.76
	>1800	-	-	-	-	6.95	6.50	7.70	14.92	11.94
JAPAN										
OTST	901-1800	-	-	-	-	-	-	-	0.36[1]	0.16
	>1800	-	-	-	-	-	-	-	0.60	0.32
POLAND										
OTSI	501-900	-	-	1.28	-	1.64	1.04	1.51	2.69	1.82
OTST	901-1800	-	-	-	-	-	-	-	-	8.06
	>1800	-	2.56	3.98	5.80	2.75	2.55	4.06	8.96	9.16
ROMANIA										
OTST	>1800	-	-	-	-	3.13	2.95	-	4.17	4.73
SPAIN										
PT	151-500	-	-	1.99	3.22	2.35	2.15	2.75	5.26	4.36
USSR										
OTSI	151-500	0.84	0.86	1.29	1.51	1.11	1.03	1.07	1.95	1.43
	501-900	-	1.04	2.68	2.35	1.70	-	2.69	2.66	1.98
OTST	>1800	4.96	5.00	6.81	9.20	5.26	6.64	6.98	11.10	8.23
PS	151-500	-	-	-	-	-	-	2.06	3.22	4.51
	501-900	-	-	-	-	-	-	2.41	5.37	5.26

1 Hours fished.

APPENDIX II - REPORT OF THE HERRING WORKING GROUP

Chairman: T. D. Iles

Rapporteur: D. S. Miller

The Herring Working Group met during 8-14 January 1973 with representatives present from Canada, Federal Republic of Germany, Japan, Poland, USSR and USA. The main tasks of the Group were to revise the assessments made at the 1972 Annual Meeting for the Nova Scotia, Gulf of Maine and Georges Bank herring stocks, to advise the Commission on 1973 catch quotas for those stocks and to answer questions posed in the Resolution re Commission's Herring Research Program (Special Meeting on Herring, January - February 1972, Proceedings No. 4, Appendix VI). A small group of assessment biologists met at Hamburg, Fed. Rep. Germany, on 4-6 January 1973 to undertake analysis of any available preliminary data on the status of these stocks from the 1972 fishery. However, response to an earlier request that Member Countries forward any available data for 1972 to Hamburg was poor, and consequently much time was spent at the Rome meeting on the collation of data and making stock assessments, thus restricting the time available for detailed consideration of other aspects of the biology of herring stocks in the ICNAF Area.

On 17 January and again on 20-22 January *ad hoc* meetings of the Working Group were held to consider specific questions raised in Panel Meetings. Reports of these meetings, although not adopted by STACRES, are appended as Supplements 1 and 2 to this Report.

1. Stock Identity, Relative Size and Inter-relationships

a) Adult Stage

No additional information on stock identity and inter-relationships were available for consideration at this meeting.

b) Juvenile Stage

Although no new direct information on the relationship between juvenile and adult population was available, analysis of mortality coefficients based on various assumptions as to the way in which the juvenile and adult stocks are related does give a picture which is consistent enough to justify using working hypotheses. This information is given in Table 1.

Table 1. Fishing mortality coefficients calculated on different assumptions as to the relationship between adult and juvenile populations in the Gulf of Maine - Georges Bank area.[1]

Juvenile (Age 2) catch from	Juvenile catch assumed to be associated with		
	Gulf of Maine adults (5Y)	Georges Bank adults (5Z+6)	Gulf of Maine and Georges Bank combined
Western and Central Maine (5Y)	0.62	0.19	0.14
All of Maine (5Y)	0.87	0.26	0.20
New Brunswick (4Xb)	2.62	0.85	0.64
Maine and New Brunswick combined	3.49	1.11	0.84

[1] Calculated from a division of catch by mean stock size averaged over the 1960-1965 year-classes for M increasing with age.

The working hypotheses are that abundance of juveniles in the Gulf of Maine fishery can give *reasonable estimates* of future recruitment to the Gulf of Maine (Div. 5Y) adult stock, and the abundance of juveniles in the New Brunswick (Div. 4Xb) fishery may indicate, in a more general way, future recruitment to the Georges Bank (Div. 5Z + Stat. Area 6) stock. It has already been established as a working hypothesis that juveniles in the Nova Scotia fishery recruit to the Nova Scotia (Div. 4Xa + 4Wb) adult stock, but at the present time the juvenile (weir) fishery of Nova Scotia does not necessarily reflect year-class abundance because of economic factors. While this

does not lessen the need for more research on the distribution, abundance and stock relationships of juvenile stages (see Section 4(c) below), there is no reason to believe that the conclusions reached in this report would be seriously affected by any new information that might become available. This is particularly so, when it is realized that the 1970 year-class was reasonably good in all areas covered by catch quotas.

c) Larval Stage

The ICNAF larval herring survey program was continued in 1972. Offshore cruises with standardized sampling methods at standard stations were carried out by the following vessels:

Miecano (Poland)
Albatross IV (USA)
Argos (USSR)
Walther Herwig (Fed.Rep. Germany)
E. E. Prince (Canada)

The US vessels, *Albatross IV*, *Lucille B*, and *Duchess II* carried out four coastal cruises during the autumn of 1972 to study the coastal distribution, abundance, and dispersion of larval herring, and the Canadian vessel *E. E. Prince* surveyed the Bay of Fundy area in late autumn.

Preliminary reports containing some qualitative and quantitative results were available as follows:

Georges Bank: Larvae were detected over the entire area of the Bank with evidence that the spawning was most concentrated on the northern edge. Some larvae were found in waters north of the Bank, suggesting the influence of the counterclockwise gyro of the Gulf of Maine. Salinity isopleths on the southern edge of the Bank indicated the possibility of a dynamic boundary of seaward dispersal.

Nova Scotia: Larvae taken in this area were larger than those in the offshore area confirming that the Nova Scotia spawning was earlier in the autumn than that on Georges Bank.

Nantucket Shoals: Significant numbers of larvae were detected here in early October of 1972 compared with their occurrence in mid-November of 1971.

Coastal Gulf of Maine Area: There is an indication of five spawning areas as delineated by the occurrence and distribution of recently-hatched larval herring: east of Penobscot Bay, south of Boothbay Harbor, south of Portland, Jeffrey's Ledge and Stellwagen Bank.

A more complete analysis of the data will be presented at the 1973 Annual Meeting.

2. Fisheries Trends

Table 2 lists the herring catches by country and area for 1972; these data are comparable with those given in Tables 2 to 5 of the Report of the Herring Working Group at the 1972 Annual Meeting (*Redbook* 1972, Part I, p. 46-47). The total catch for 1972 of 475,000 tons is 65% of the 1971 catch of 729,000 tons and only 49% of the 1969 peak catch of 965,000 tons.

There was a marked decline in catches from the Newfoundland and Gulf of St. Lawrence stocks (Subarea 3 and Div. 4RST) from 264,000 tons in 1971 to 99,000 tons in 1972. This involved both the summer fishery in the Gulf of St. Lawrence and the winter fishery of migrants to southwestern Newfoundland. The decline was due to continuing low recruitment which has not been high enough to replace losses from fishing and natural mortality. Catches from the Ranquereau stock (Div. 4V and 4Wa) were 38,000 tons in 1972, a decline from the 1971 catch of 66,000 tons.

Three major stocks were under quota regulation in 1972 and the catches for these stocks are given in Table 3.

The total catch from the Nova Scotia stock (Div. 4Xa and 4Wb) is estimated to be 90,000 tons, about the same as that for 1971, but this excludes gillnet catches in inshore waters by Canada, for which 1972 data are not yet available. Catches in the Gulf of Maine (Div. 5Y and 4Xb) were 111,000 tons (Table 2), an increase of 48,000 tons over the 1971 level. This was mainly attributable to an increase in catches in the juvenile fisheries of New Brunswick and Maine. The fishery on the Georges Bank stock (Div. 5Z and Stat. Area 6) declined from 251,000 tons in 1971 to 139,000 tons in 1972.

In the southern part of the ICNAF Area (from Div. 4Wb southward to Stat. Area 6), the most significant development of 1972 was the appearance of relatively good year-classes. In the Gulf of Maine and Bay of Fundy areas increases in catches of the juvenile fisheries tended to confirm the indication, as provided by the appearance of juvenile herring on the offshore banks in the early part of the year, that the 1970 year-class was larger than the three preceeding ones. In the Nova Scotian area, in addition to an apparent abundance of the 1970 year-class, three-year-old herring of the 1969 year-class were

Table 2. Provisional herring landings ('000 tons) by country and area (stock) in 1972. (A = adults, J = juveniles)

Country	Subarea 3	Div. 4RST	Div. 4Vn	Div. 4Vs	Div. 4Wa	Div. 4Wb	Div. 4Xa		Div. 4Xb		Div. 5Y		Div. 5Z	S.A. 6	Total
							A	J	A	J	A	J			
Canada (M)	-	40	12	-	25	-	47	15	4	52	11	-	-	-	205
Canada (N)	49	10	-	-	-	-	-	-	-	-	-	-	-	-	59
Germany (FR)	-	-	-	-	-	-	-	-	-	-	3	-	28	-	31
Japan	-	-	-	Ø	-	-	1	-	-	-	-	-	1	-	2
Poland	-	-	-	-	-	-	-	-	-	-	-	-	41	8	49
Romania	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
USSR	-	-	-	1	-	21	4	-	-	-	-	-	43	4	73
USA	-	-	-	-	-	-	-	-	-	-	19	20	3	Ø	42
Other Members	-	-	-	-	-	1	-	-	-	-	-	-	1	-	2
Non-member[1] (GDR)	-	-	-	-	-	1	?	-	-	-	2	-	8	-	11
Total	49	50	12	1	25	23	52	15	4	52	35	20	126	12	475
	Gulf of St. Lawrence		Banquereau				Nova Scotia		Gulf of Maine				Georges Bank		

[1] Non-member catches were assumed from the 1972 quota proposals, or from USA surveillance flights, or, in the case of 4X, could not be estimated.

4Wa = Chedabucto Bay area
4Wb = Div. 4W offshore
4Xa = Div. 4X offshore and Nova Scotia inshore
4Xb = New Brunswick side of Bay of Fundy

Table 3. Herring catches and quota allocations (tons) for 1972.

Country	4Xa-4Wb		5Y		5Z+6	
	Catch	Quota	Catch	Quota	Catch	Quota
Canada	47,329[1] (62,626)[5]	35,700	11,357[1]	6,000 (9,000)[3]	0	5,800
USA	-	-	18,989[1] (38,494)[5]	21,000 (18,000)[3]	3,813	4,000
Poland	-	-	-	-	49,492	49,400
Japan	924	1,000	-	-	1,161	1,200
USSR	24,882[4]	26,300[4]	-	-	47,089[4]	48,200[4]
Germany (FR)	-	-	2,936	2,500	27,704	31,600
Non-members	1,000[2]	1,000	2,000[2]	250	8,200[2]	8,200
Romania	-	-	-	-	600[2]	600
Other contracting governments	1,000[2]	1,000	-	250	1,000[2]	1,000
Total	75,135 (90,432)[5]	65,000	35,282 (54,787)[6]	30,000	139,059	150,000

[1] Catches from adult fishery.
[2] Assumed catches; no data available.
[3] Adjusted quota - 3,000 tons assigned by USA to Canada.
[4] USSR data for first 10 months only.
[5] Total catch including juvenile fisheries.
[6] Total catch including juveniles for Div. 5Y only; see Table 2 for Div. 4Xb catches.

abundant and were heavily exploited. The 1969 year-class in the Gulf of Maine and the Georges Bank areas were very small, and this marked lack of year-class parallelism tends to confirm the validity of the stock division boundary between the Nova Scotia stocks and those to the south and west.

3. Herring Assessments

a) Definition of stock size and recruitment for purposes of herring assessment

The term "stock size as at the beginning of the year...." has been referred to often, both in reports of the Herring Working Group and in Commission proposals and resolutions. There is a possibility of misunderstanding as to precisely what is meant by this term. In this report the stock size is defined as that for herring of age 4 and older at the beginning of the calendar year, This is the adult (spawning) population remaining after the previous year's fishing.

This definition differs from a commonly used conventional definition which includes also the potential recruits during the year, i.e. in this context, 3-year-old fish. It is also necessary to bear in mind the distinction between recruitment to the fishery and recruitment to the adult (spawning) population. In some areas there is no difference; the fishery exploits only adults. In other areas, e.g. Jeffreys Ledge (Div. 5Y) and Nova Scotia (Div. 4X), juvenile fish which will not spawn during the fishing year may be in the same general area as adults and can be fished at the same time.

b) Div. 5Y Herring Assessment

Catch statistics: The total catch of herring by the USA, Canada and Fed. Rep. Germany was 52,787 tons in Div. 5Y in 1972 (Table 3). Non-member countries fished in the quota area but no catches have been reported. A 2,000-ton catch by non-members was assumed for assessment purposes, giving an estimated total catch of herring from the Div. 5Y adult fishery of 35,282 tons or 18% more than the allowable quota of 30,000 tons and 53% more than the catch of 23,000 tons recommended by the Herring Working Group at the 1972 Annual Meeting. The total (adults and juveniles) catch in 1972 from Div. 5Y was at least 3,000 tons higher than the 1971 catch of 50,000 tons. While the 1972 adult catch was lower than that in 1971, the reduction was more than compensated for by an increase in the juvenile catch from 12,400 tons in 1971 to 19,500 tons in 1972.

Year-class abundance: The age composition of the Div. 5Y adult fishery (Table 4) indicates the continued decline in older fish and the greater dependence of the fishery on current recruitment. The good year-classes of 1960 to 1963 constituted 53%, 21% and 3% of the total catch (by weight) in the years 1970, 1971 and 1972 respectively. The very poor year-classes of 1968 and 1969 produced 2%, 13% and 23% in the same years. In 1972, age 2 herring were taken in significant numbers (about 2,000 tons) in the adult fishery. The catches of the 1966 year-class (the best since 1963) has also declined, so that recruitment to the adult spawning stock (age 4 and older) will continue to be very poor until the 1970 year-class recruits in 1974 and 1975. The increase in catch in the Maine fishery in 1972 was due to the fairly good 1970 year-class (Table 5). This year-class appears to be less abundant than the 1966 year-class but larger than the 1967, 1968 and 1969 year-classes.

Table 4. Percentage age composition of herring (by number) in the Div. 5Y adult fishery.

Year	Age							
	2	3	4	5	6	7	8	8+
1967	0.06	0.94	8.75	21.95	39.59	24.28	1.95	2.48
1968	0.38	11.95	11.77	19.85	19.73	18.85	12.39	5.08
1969	1.21	27.43	4.35	6.92	15.79	18.70	14.84	10.76
1970	1.91	5.21	14.73	10.25	14.99	15.05	13.04	24.82
1971	0.35	12.77	12.52	13.76	20.29	14.54	8.84	11.93
1972	11.85	8.24	19.65	18.95	20.49	13.96	4.89	1.97

Table 5. Total herring catches (millions of fish) by region and age in the Maine (Div. 5Y) fishery, 1968-1972.

Region	Year	Age 1	2	3	4	5	6	7	8	8+	Total
Western Maine	1968	4.6	128.0	36.7	1.6	0.2	-	-	-	-	171.1
	1969	3.0	52.6	63.9	3.8	-	-	-	-	-	123.3
	1970	0.4	65.4	17.8	3.0	1.9	-	-	-	-	88.5
	1971	38.5	38.7	4.0	0.3	0.8	1.2	0.5	0.4	0.3	84.7
	1972	0.1	85.6	5.9	1.5	1.0	0.5	0.3	-	-	94.9
Central Maine	1968	8.4	195.4	59.8	1.1	1.2	-	-	-	-	265.9
	1969	1.1	60.2	93.9	3.0	0.6	0.5	0.3	0.2	0.2	160.0
	1970	1.4	104.9	24.4	9.8	5.6	1.2	0.3	0.3	-	147.9
	1971	26.9	21.3	12.2	20.7	7.0	0.4	-	-	-	88.5
	1972	-	202.7	1.2	1.7	0.4	0.9	0.6	-	-	207.5
Eastern Maine	1968	3.9	307.4	160.4	5.6	8.8	-	-	-	-	486.1
	1969	1.6	103.8	91.1	4.7	-	-	-	-	-	201.2
	1970	0.1	12.8	3.0	4.4	1.0	2.3	1.4	1.3	0.5	26.8
	1971	43.6	1.9	1.4	-	-	-	-	-	-	46.9
	1972	0.1	49.7	0.2	0.0	-	-	-	-	-	50.0

Estimates of fishing mortality: Sampling of the Div. 5Y adult fishery in 1972 produced sufficiently accurate estimates of catches by year-class to provide the basis for a virtual population analysis (Tables 4-8). The age composition data prior to 1972 were limited and the estimates of fishing mortality (Table 6) are therefore approximate. The average F (based on age 4 and all older fish) increased from 1967 to 1971 and then declined slightly from 0.63 to 0.53 in 1972. Estimates of F for ages 4-8 only (which are probably more reliable) increased to 0.52 by 1971 and 0.50 by 1972. From yield-per-recruit considerations, this fishing mortality on the stock should not exceed those latter values. Fishing mortality estimates (Table 7) were also made for the Maine juvenile fishery (specifically on age 2 fish) using age 2 sotck sizes as determined from the adult fishery and the catches of age 2 fish from Maine juvenile fishery. For the 1960 to 1962 year-classes the estimates of F are in reasonable agreement with previous ones, but estimates for the 1965 to 1968 year-classes (F about 0.6) are smaller than previous estimates (about 0.8); however except for the 1965 year-class, all estimates exceed 0.5.

Table 6. Estimates of fishing mortality for the ICNAF Div. 5Y adult herring fishery from virtual population analysis assuming a constant M of 0.2.

Year	Year-Class 1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Average F for ages 4 and older
1967	3.23[1]	.25	.12	.10	.22	.19	.10	.04	-	-	-	-	-	-	-	.13
1968	-	3.43	.74	.37	.38	.30	.29	.26	.14	.09	-	-	-	-	-	.27
1969	-	-	2.58	.57	.42	.38	.45	.33	.11	.04	.18	.01	-	-	-	.24
1970	-	-	-	3.01	1.52	1.34	.94	.83	.46	.16	.18	.06	.02	-	-	.48
1971	-	-	-	-	3.88	2.17	2.17	2.43	1.18	.57	.37	.19	.15	.05[4]	-	.63
1972	-	-	-	-	-	1.92[2]	3.27[2]	3.42[2]	1.53[2]	.79[2]	.70[2]	.40[2]	.30[2]	.25[3]	-	.53

[1] Average of mortalities at age 11 for 1968-1971.

[2] From iteration of exploitation rate where N_i for 1972 = $N_{i-1}e^{-Z_{i-1}}$

[3] From iteration of exploitstion rate with N_3 determined from $N_2e^{-.63-.2-.11-.05}$ where .63 is F from the the Maine juvenile fishery, .2 is M at age 2, .11 is F age age 3 in the Maine fishery and .05 is M for the first quarter of age 3.

[4] Assumed same proportional change in 1971 over 1970 as occurred with age 3.

Table 7. Estimates of fishing mortality in the Maine juvenile fishery from a comparison of stock sizes calculated from the Div. 5Y adult fishery and the Maine juvenile catch.

Year-class	Age 4 year class size of adult fishery (millions)	Age 3 catch		Total age 3 catch (millions)	Maine fishery (age 2)		
		Maine fishery (millions)	Adult fishery (millions)		Catch (millions)	Year-class size (millions)	Fishing mortality
1960	211.1[3]	497.9	0.0	497.9	2,238.4	3,460.8	1.20
1961	288.1[3]	22.5	0.0	22.5	771.8	1,313.1	1.02
1962	227.2[3]	57.8	-	57.8	474.9	941.8	0.80
1963	178.2[3]	208.5	0.0	208.5	932.9	1,578.3	1.02
1964	147.2[3]	122.1	0.6	122.1	292.7	708.7	0.71
1965	174.1[3]	256.9	17.7	256.9	268.1	926.7	0.38
1966	176.1[3]	249.0	39.0	249.0	631.4	1,349.3	0.71
1967	144.1[3]	45.2	9.3	45.2	218.3	529.8	0.60
1968	128.8[3]	26.8	23.1	26.8	186.5	465.6	0.58
1969	40.8[4]	7.3	12.7	20.0	73.7	172.2[2]	0.63[1]
1970	?	82.7[5]	-	-	338.0	789.6[2]	0.63[1]

1 Assumed from an average over year-classes 1966-1968.

2 From $N_o = \frac{Z\,C}{\hat{F}(1-e^{-Z})}$ assuming an average F over the 1966-1968 year-classes of 0.63 at age 2.

3 From $N_o = \frac{Z\,C}{\hat{F}(1-e^{-Z})}$ with $\hat{F}$'s estimated from virtual population method.

4 Assuming F at age 2 of 0.63 with known catches at age 2 and 3, and F at age 3 in the juvenile fishery of 0.11 and in the adult fishery of 0.25.

5 Assuming F at age 3 to be the same as the average for the 1966-1969 year-classes.

Estimates of stock size: Due to low recruitment, the adult stock size in Div. 5Y has been declining (Table 8). The stock size (age 4 and older) for 1973 is estimated to be about 33% by weight of that estimated for 1967. The decline was especially rapid after 1970 due to the poor 1967 and 1968 year-classes and recruitment in 1973 will be low due to the poor 1969 year-class. However, recruitment should improve substantially in 1974 due to the relatively good 1970 year-class. If the fishing mortality in 1973 lies between 0.1 and 0.5, the recruitment should vary between limits of 15,000 and 33,000 tons giving a stock size in 1974 of from 43,700 to 75,000 tons (Fig. 1). The stock sizes (age 4 and older) in 1972 and 1973 were estimated to be 77,000 and 50,000 respectively.

Estimation of recruitment: The relative year-class size, as determined from the Maine juvenile fishery, is assumed to provide a quantitative measure of recruitment to the Div. 5Y adult fishery. Two levels of the 1970 year-class size at age 3 were determined, assuming fishing mortality rates of 0.63 and 0.80 in the juvenile fishery. The average fishing mortality for age 2 of the 1966, 1967 and 1968 year-classes was 0.63 which, with a fishing mortality of 0.29 at age 3 (averaged over the 1966-1969 year-classes in the juvenile fishery), produced a maximum year-class size entering the Div. 5Y adult fishery in 1973. An F of 0.8 in the juvenile fishery produced the assumed minimum estimate of recruitment for 1974.

Catch quotas: Figure 1 shows the relation of a range of 1973 catches to resulting 1974 stock sizes (age 4 and older) based on the two estimates of recruitment. To maintain the stock size in 1974 at the same level as at the beginning of 1972, a maximum of 5,000 tons should be harvested, if recruitment is assumed to be the larger of the two levels and all age 3 fish are available to the fishery. An F slightly less than 0.5, the maximum (according to yield per recruit considerations) that should be placed on the total stock (age 3 and older), would allow a catch of 30,000 tons but would, at best, maintain the very low 1973 stock size of 50,400 tons. If recruitment were at the lower of the two levels, the catch should be only 20,500 tons (F = 0.36) to maintain the 1973 stock level. Since the 1970 year-class appears to be the best year-class since that of 1966, the catch in 1973 should be reduced perhaps to no more than 7,500-17,500 tons, which would allow this year-class to increase the stock size toward the 1972 level, i.e. to regain 50% of the loss in stock size from 1972 to 1973.

Table 8. Stock sizes of the Div. 5Y herring fishery (millions of fish).

Year-class	Year 1967	1968	1969	1970	1971	1972	1973
1956	0.4	-	-	-	-	-	-
1957	3.5	2.1	-	-	-	-	-
1958	7.2	5.0	1.9	-	-	-	-
1959	16.3	11.2	6.6	3.0	-	-	-
1960	97.9	63.8	35.2	19.0	3.5	0.1[1]	-
1961	182.2	118.5	73.3	40.9	8.8	0.8[1]	0.1[3]
1962	184.0	131.7	80.4	41.6	13.3	1.1[1]	0.05[3]
1963	178.2	141.3	87.7	52.0	18.7	1.3[1]	0.05[3]
1964	-	147.2	104.2	79.7	41.2	10.4[1]	1.8[3]
1965	-	227.0	174.1	136.6	92.4	42.8[1]	15.9[3]
1966	-	-	260.7	176.1	120.5	68.1[1]	27.7[3]
1967	-	-	190.9	176.5	144.1	97.6[1]	53.6[3]
1968	-	-	-	190.5	182.7	128.8[1]	78.1[3]
1969	-	-	-	-	-	64.0[2]	40.8[3]
1970	-	-	-	-	-	-	245.2[4]
Total stock size age 4 and older	669.7	620.8	563.4	548.9	442.5	351.1	218.1

[1] From $N_i e^{-(F_i + 0.2)}$ where i refers to the year-classes in the year 1971; F_i from virtual population analysis.

[2] Assuming F at age 2 in Maine juvenile fishery of 0.63 (the average over the 1966-1968 year-classes).

[3] From $N_i e^{-(F_i + 0.2)}$ where i refers to the year-classes in the year 1972.

[4] Assuming F at age 2 in Maine juvenile fishery of 0.63 and F at age 3 of 0.29 (the average over the 1966-1969 year-classes).

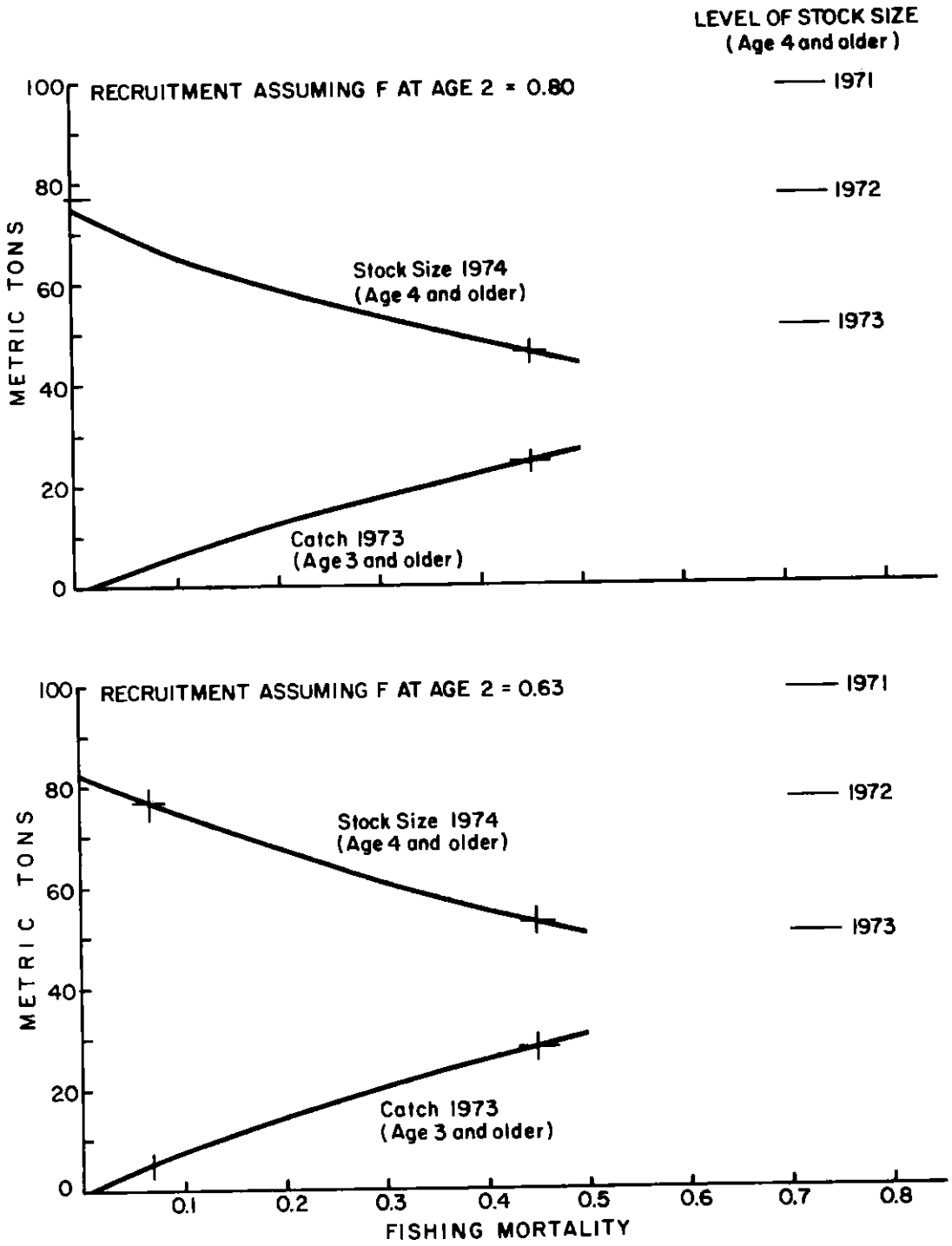

Fig. 1. Catch quota options and resulting stocks for Div. 5Y.

c) Division 5Z - Statistical Area 6 Herring Assessment

At its mid-term meeting in January 1972, the Herring Working Group indicated that an allowable catch of 95,000 tons in 1972 would result in no increase in stock size (age 3 and older) from the level at the beginning of 1972. This assumed that recruitment in 1972 would be the same as in 1971. However, an allowable catch of 150,000 tons was adopted by the Commission for 1972, a catch which was considerably greater than that which would have allowed stock replacement. In addition, it is now known that recruitment in 1972 was less than that which was assumed, so that the stock size at the beginning of 1973 is estimated at 158,000 tons compared with 240,000 tons at the beginning of 1972, i.e. a 34% decline in one year.

The Commission's Resolution on the herring research program (Special Meeting on Herring, January - February 1972, Proceedings No. 4, App. VI) specified that the Working Group provide an estimate of the level of catch in 1973 that would maintain the stock size at the level obtaining in the beginning of 1973. This implies that the deterioration of the stock situation during 1972 is acceptable to the Commission, whereas it was stressed in the 1972 Report of the Herring Working Group, and is re-emphasized here, that stock level was already so low as to cause concern about the possibility of maintaining optimum recruitment. It is for this reason and for others which will be dealt with in their proper place, that the advice to the Commission, in regard to the Div. 5Z - Stat. Area 6 stock, is framed in such a way as to indicate a wide range of optional actions which allow the possibility of stock rebuilding.

The method for the assessment of the Div. 5Z - Stat. Area 6 herring stock was substantially as described in the 1972 Annual Meeting Report of the Working Group (*Redbook* 1972, Part I, page 53). Data from the 1972 fisheries were collated and incorporated into the analysis. Age frequencies from individual countries were weighted by catch to derive the final age composition of the catch by numbers for age groups.

Fishing mortalities for three years prior to 1972 (1969-1971) were averaged for each age group to determine the distribution of F by age groups. The age group contributing most to the 1972 catch was adopted as the standard and values of F on other age groups were expressed as percentages of this standard.

A mean F for all ages from 3 years was derived by applying the 1972 catch data in Fig. 6 of the 1972 Working Group Report (*Redbook* 1972, Part I, page 65). This value was F = 0.8, and it was adjusted for each age group from the percentages derived from the 1969-1971 data. These values for F were applied to individual age groups in the 1972 catch to determine year-class abundance for 1972 and total stock size for 1972. Cohort analysis then gave estimates of stock size and fishing mortality for earlier years.

The results of this analysis are presented in Table 9, and these form the basis for catch prediction in 1973 and stock size estimates at the beginning of 1974, which are illustrated in Fig. 2 at two assumed levels of abundance for the 1970 year-class and summarized in Table 10. For the two assumptions as to the size of the 1970 year-class, Table 10 gives the initial 1973 stock size (age 4 and older), the 1973 recruitment of 3-year-old fish, the resulting 1973 stock size (age 3 and older), the 1973 catch which includes that of the recruiting 1970 year-class, the resulting initial 1974 stock size (age 4 and older) and the F values associated with the catch.

Concerning the Commission's request that the Working Group provide the best possible information on the level of catch in 1973 that will maintain the stock size at the level obtaining in the beginning of 1973 (Special Meeting on Herring, January - February 1972, Proceedings No. 4, App. VI, item 2(d)), the Working Group considered two options:

i) if the 1970 year-class is the same size as the 1966 year-class, the 1973 catch level to maintain the 1973 stock size is 225,000 tons; and

ii) if the 1970 year-class is 75% of the size of the 1966 year-class, the corresponding catch level is 175,000 tons.

However, these catches achieved only at values of F (0.92 and 0.82 respectively), which are much higher than the F equivalent to MSY (F = 0.45). Such heavy exploitation of 3-year-old herring is biologically wasteful. Moreover, even if a high proportion of 3-year-olds matured in 1973 (and this cannot be guaranteed), they would be contributing to the stock's spawning at considerably less than their maximum reproductive potential, since egg production per unit weight of fish increases with size and age over the life span of the fish. Because the stock size has been markedly reduced in recent years, the question of ensuing future recruitment potential must be considered.

A proportion of the 1970 year-class will not exceed the minimum size limit of 9 inches (22.86 cm) total length, and these would be protected particularly in the early months of the year, i.e. before the main period of growth. Table 11 gives mean lengths of 3-year-old herring in the Gulf of Maine inshore juvenile fishery and in the Georges Bank fishery; these indicate that during the first six months of the year a substantial proportion of the 1970 year-class could be under the size limit. In the last six months of the year, when the main fishery occurs, the majority of age-3 fish are likely to exceed the size limit of 22.86 cm and are likely to contribute substantially to the fishery even if the minimum size limit is adhered to. Finally, there can be no guarantee that the 1971 year-class will be large; if it is significantly smaller than the 1970 year-class, then the 1974 prospects could be very poor unless part, at least, of the potential of the 1970 year-class is reserved.

Table 9. Herring stock size (millions), catch (millions), and fishing mortality for the Georges Bank stock (Div. 5Z + Stat. Area 6).

		Age									Stock size for age 3 and older		Stock size for age 4 and older	
	Year	9+	9	8	7	6	5	4	3	2	Number (millions)	Wt('000 tons)	Number (millions)	Wt('000 tons)
Stock														
	1967[1]	20	23	133	1100	1302	973	1402	1201	-	6154	1322	4953	1136
	1968[1]	13	64	557	839	699	1093	977	1454	-	5696	1232	4242	1007
	1969[1]	47	152	295	361	591	735	1143	1627	-	4951	988	4324	4072
	1970[1]	35	67	125	232	351	745	1291	1012	-	3858	761	2846	604
	1971[1]	43	56	106	177	365	649	715	565	-	2676	550	2111	462
	1972	33[1]	41[1]	51[1]	140[1]	274[1]	336[1]	162[1]	565[3]	-	1602	328	1037	240
	1973	25[2]	10[2]	45[2]	113[2]	124[2]	55[2]	333[2]	1220-1627[4]	-	1925-2332	347-410	705-705	158-158
Catch														
	1967	10	11	49	379	251	108	61	7	2	878	219		
	1968	7	22	337	433	233	336	72	52	3	1494	373		
	1969	24	110	191	189	278	277	210	46	-	1324	306		
	1970	18	30	52	93	122	270	451	125	13	1173	247		
	1971	22	14	50	104	176	285	276	333	13	1271	263		
	1972	17	23	36	79	125	170	87	28	22	587	138		
F														
	1967	-	0.74	0.53	0.48	0.24	0.13	0.05	0.01	-	0.18[5]			
	1968	-	0.46	1.10	0.85	0.46	0.41	0.08	0.04	-	0.40[5]			
	1969	-	1.61	1.25	0.86	0.74	0.54	0.23	0.03	-	0.42[5]			
	1970	-	0.63	0.60	0.58	0.48	0.51	0.49	0.15	-	0.41[5]			
	1971	-	0.33	0.75	1.04	0.76	0.66	0.56	1.05	-	0.74[5]			
	1972	-	0.95	1.41	0.94	0.69	0.80	0.88	0.33	-	0.64[5]			

[1] Stock size calculated from $\frac{C\ Z}{F(1-e^{-Z})}$

[2] Stock size calculated from $N_{i+1} = N_i e^{-Z_i}$

[3] Assumed to be the same as for 1971.

[4] Assumed to be within the range of 75% to 100% of the 1966 year-class at age 3.

[5] The average F is weighted over year-classes by stock size in number.

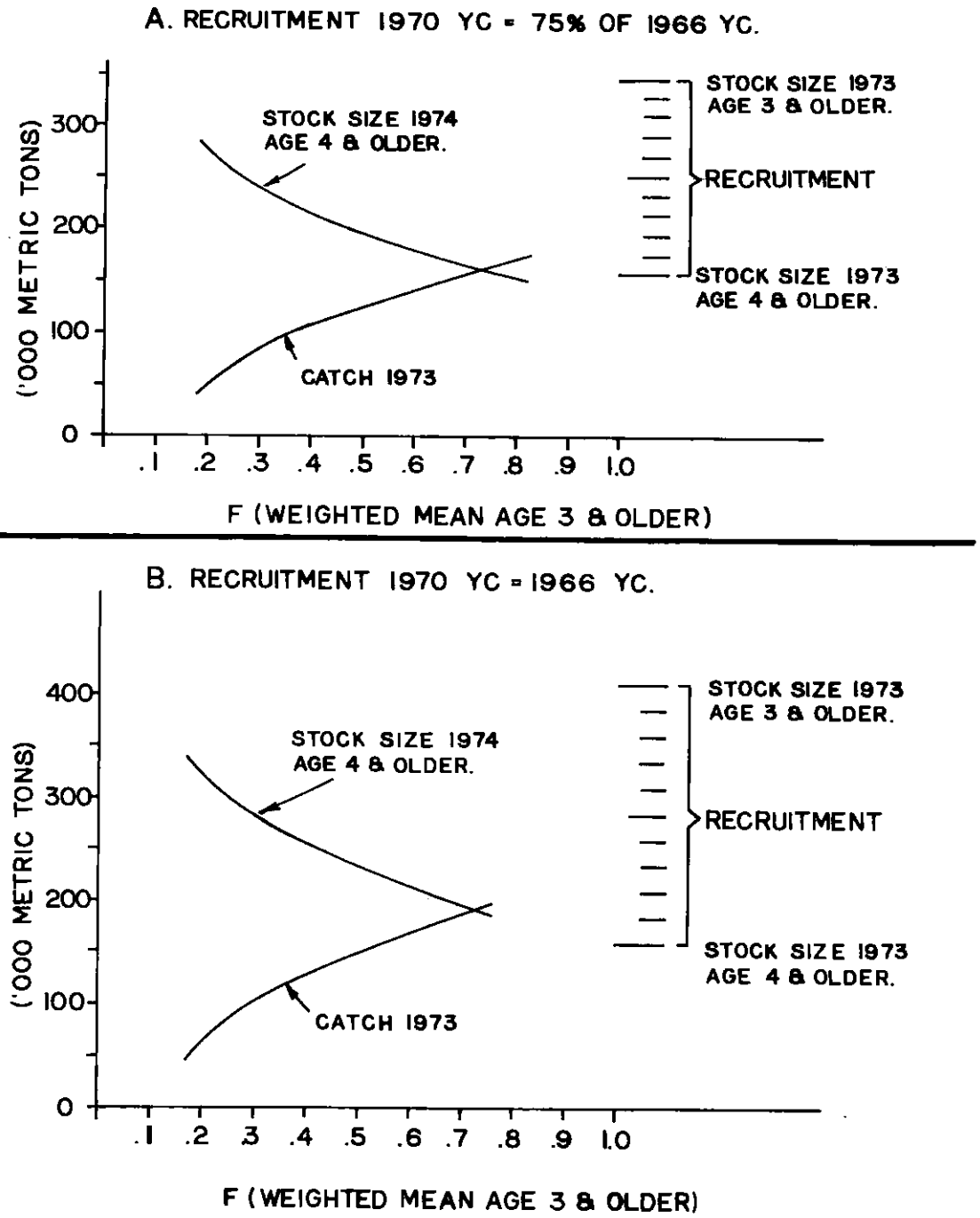

Fig. 2. Georges Bank herring (Div. 5Z and Stat. Area 6): stock sizes at beginning of 1973 and 1974 in relation to 1973 catches, assuming two estimates for recruitment (1970 year-class) in 1973.

As a guide to the Commission in interpreting these factors in conjunction with the data in Table 10, and in answer to the Commission's question concerning yield-per-recruit considerations, the following facts can be pointed out:

1) Assuming that the 1970 year-class is about equal to the 1966 year-class, with F = 0.45, i.e. corresponding to MSY, the 1973 catch would be 135,000 tons, the 1974 stock size would be 250,000 tons, i.e. about that for 1972 (240,000), and just over 60% (by numbers) of the 1970 year-class would survive into 1974.

ii) Assuming that the 1970 year-class is 75% of the size of the 1966 year-class, with F = 0.45, the 1973 catch would be 115,000 tons, the 1974 stock size would be 204,000 tons, and again, just over 60% of the 1970 year-class would survive. On the same assumption as to 1970 year-class size, to regain the 1972 stock level (age 4 and older) would involve an F of 0.29 and a catch of 83,000 tons.

Table 10. Effect of the 1973 catch in Div. 5Z and Stat. Area 6 on stock size at beginning of 1974 with associated F values.

Stock size 1973 (Age 4 and older) ('000 tons)	Recruitment 1973 ('000 tons)	Stock size 1973 (Age 3 and older) ('000 tons)	Catch 1973 ('000 tons)	Stock size 1974 (Age 4 and older) ('000 tons)	F
(Assuming 1970 year-class is same size as 1966 year-class)					
158	252	410	225	158	0.92
158	252	410	197	186	0.76
158	252	410	174	209	0.63
158	252	410	149	234	0.50
158	252	410	121	263	0.37
158	252	410	88	297	0.25
158	252	410	47	340	0.17
(Assuming 1970 year-class is 75% of 1966 year-class)					
158	189	347	175	149	0.82
158	189	347	155	169	0.68
158	189	347	132	191	0.54
158	189	347	108	216	0.40
158	189	347	79	246	0.27
158	189	347	42	285	0.18

Table 11. Monthly mean lengths of herring at age 3.

Year \ Month	1	2	3	4	5	6	7	8	9	10	11	12
Western Maine (US data)	21.0	22.6	21.2	21.8	22.8	23.1	24.1	25.4	25.0	25.1	24.6	24.3
Georges Bank (US data)	20.8	20.2	19.4	21.2	22.8	22.8	25.1	24.8	24.6	24.6	24.5	24.8
Georges Bank (USSR data)	-	-	-	-	-	-	24.2	24.2	24.2	-	-	-

d) Division 4X Assessment

It is not yet possible to complete a formal assessment of the Nova Scotia stock. Sufficiently detailed information on catch location for mobile fleet operations is not yet available and, in any case, cannot now be provided for earlier years for comparison. Because the same fishing areas in the Canadian fishery may contain juvenile, pre-spawning and spawning fish in proportions which vary from year to year and from week to week within a fishing season, the problems of determining the numerical exploitation of individual year-classes are great. Recommendations to the Commission as to catch level can therefore be framed only generally, and for 1973 are best defined in terms of recruitment prospects.

Fig. 3 shows the Div. 4X portion of the areas where the Canadian mobile fleet effort is concentrated in fishing for herring. Area A also contains much of the inshore weir fishery (which extends somewhat further into the Bay of Fundy) and is also the area where a discrete section of the Canadian fleet, mainly small boats of about 20 m, concentrates its activity in the early and late part of the season. Herring in Area C are exploited mainly by larger vessels (based at Yarmouth and East Pubnico), usually in the early part of the season. Area B is the spawning area for the stock to which effort is diverted from Areas A and C during the main spawning season in August (see Res. Doc. 72/11).

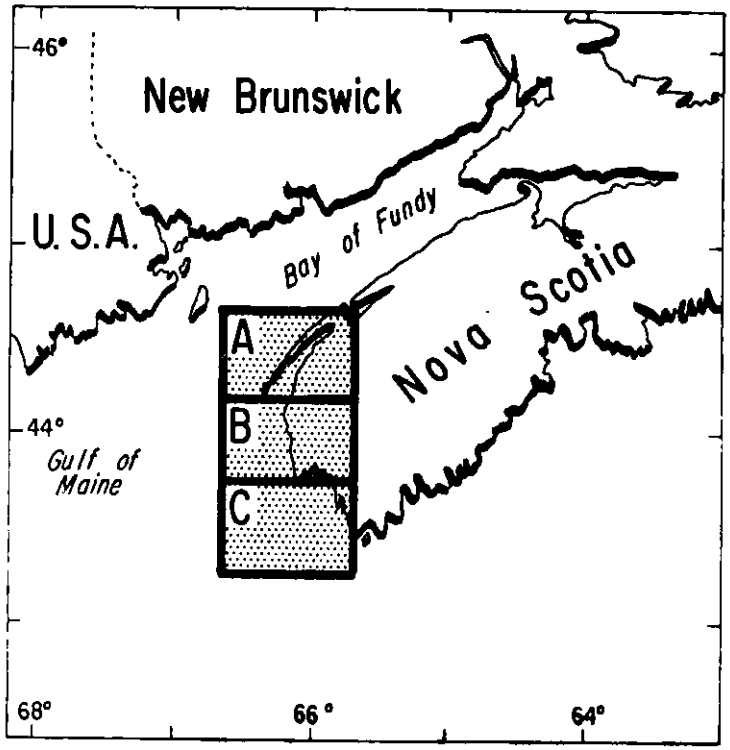

Fig. 3. The area covered by the Canadian purse seine fishery for herring in Div. 4X.

The main features of the 1972 season were the occurrence of 2-year-old herring (1970 year-class) in considerable numbers in Area A (along Digby Neck) where they were caught in the purse seine fishery, and the presence of large concentrations of 3-year-old fish (1969 year-class) in Area C. The average catch rate in Area A was about 20 metric tons/boat night, i.e. almost the same as that for 1971 for the same area (Res.Doc. 72/11). However, 1972 catches in this area contained higher proportions of 2-year-old fish. Preliminary age-composition data indicate a relatively high abundance of 2-year-old fish in the area. There is, therefore, some indication that the 1970 year-class is reasonably large for the Nova Scotia stock, as it may also be for the Georges Bank (Div. 5Z and Stat. Area 6) and Gulf of Maine (Div. 5Y) stocks.

Of more immediate importance is the 1969 year-class, which seems to be of reasonable size in the Nova Scotia stock whereas it was relatively small in both the Gulf of Maine and Georges Bank stocks. USSR data presented at this meeting gave the distribution of young herring in the offshore areas from Middle Bank in Div. 4W to south and west of Cape Cod in Stat. Area 6. On the Nova

Scotia shelf, to the south and east of Area C, there was a wide distribution of juvenile herring in the period January to April 1972. Of three length-frequency samples, two gave a range of 14-22 cm with means of 17.3 and 17.8 cm. The third gave a range of 12-17 cm with a mean of 14.1 cm. Since these samples were taken before the growing period the larger fish in the samples are of a size that would indicate they belong to the 1969 year-class.

Table 12 gives length frequencies of catches in Area C for July and August 1972 when the largest catches were made, and a large proportion of the Canadian catches were 3-year-old herring. Catch-per-effort data are available for this area in 1972 from log-book records of individual vessels, many of which can be identified as having fished in the same area in 1971. The 1972 catch-per-boat-night (m tons) was 67.1 m tons compared with a figure of 31.5 tons per boat night for the same area in 1971 (Res.Doc. 72/11). Bearing in mind that the 1972 catch consisted mostly of 3-year-olds of 1969 year-class whereas the bulk of the 1971 catch was 4-year-old fish and older, the 1969 year-class would appear to be quite abundant. Indeed the 1972 catch-per-effort in this area was nearly as high as the peak level of 64.7 tons per boat night recorded in Area B in 1966. This year-class also occurred in high larval concentrations inside the Bay of Fundy in late 1969, some months after the spawning period (Res.Doc. 71/32).

Table 12. Length frequency distribution (per mille) of berring in the Canadian fishery in Div. 4Xa, 1972.

		Length (cm)																
		<18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Area C (see Fig. 3)	July	-	16	77	226	319	192	75	11	21	22	11	8	11	3	2	4	2
	Aug	1	5	19	142	277	316	201	26	7	5	1	1	-	-	-	-	-

The fishing mortality rate to which the 1969 year-class was subjected to in 1972 is not yet known. The number of Canadian vessels fishing in the area has declined in recent years, and there was no appreciable increase in the number in 1972, although accurate data are not yet available. However, a large non-Canadian fleet of midwater trawlers and purse seiners, together with factory ships, was reported in Area C in late July and early August of 1972 about 20 miles from shore. Reports to date indicate that only 3,000 tons were taken in the area, but non-member countries (known to have vessels in the area) have not yet submitted data.

Although a virtual population analysis has not yet been done for this stock, preliminary estimates indicate that about 200 million fish of the 1969 year-class were removed in 1972 (includes only recorded catches). This number is about the same as that estimated to have been removed from the 1966 year-class as 3-year-old fish in 1969. However, while the 1966 year-class was heavily exploited also as 2-year-olds in 1968 (500 million fish), relatively few of the 1969 year-class were caught in 1971, for reasons which are not understood. Total removals from the 1969 year-class at ages 1, 2 and 3 are thought to be considerably less than those from the 1966 year-class over the same ages.

Although the relative size of the 1969 year-class and the degree of escapement to the 1973 fishery cannot be quantified with certainty, there is sufficient evidence to indicate that prospects are reasonable and no reason to suggest that the allowable catch be decreased for 1973. Furthermore, the 1969 year-class was abundant enough on the grounds to divert some Canadian effort from the pre-spawning adult fishery, so that effort on the 1972 adult stock may have been lower, thus resulting in more adults surviving at the end of 1972 than would normally be the case, and there are at least reasonable prospects for the 1970 year-class as well. It must be pointed out that exploitation of juvenile fish in the area was too high in 1972, and, while the biological situation makes this difficult to avoid since adult and juvenile year-classes are found in the same general fishing area, attempts to overcome this problem must be made if the fullest potential of the stock is to be realized.

e) Prediction of Year-class and Quota Levels

The Working Group wishes to make some observations on the US proposal that quota levels for the herring stocks for 1974 be decided at the 1973 Annual Meeting and not at a Special Meeting of the Commission in January 1974 (Comm.Doc. 73/2).

Advice to the Commission on catch levels is greatly dependent on estimates of future recruitment, which for the 1973 quota year were derived mainly from the results of the 1972 juvenile fisheries as indicating the size of the 1970 year-class. No information on the 1973 juvenile fisheries will be available at the 1973 Annual Meeting; nor will there be sufficient information on the adult fisheries to confirm estimates of 1973 recruitment of the 1970 year-class made at this meeting.

Juvenile surveys are expected eventually to make a contribution to predicition, but it is not likely that reliable estimates will be available in 1973. The results from larval surveys are expected to throw light on stock identification, relative adult stock abundance and dispersion of larvae from the spawning grounds, but their importance for predicting future year-class abundance is being investigated. The importance of developing predictive capabilities by extending the scope of surveys for larvae and juvenile stages will be discussed below. However, it must be mentioned that assessment will be difficult at Annual Meetings until these surveys are producing reliable results, and even then it may be necessary to make assumptions as to the size of incoming year-classes as a basis for assessment, e.g. that the year-class size is the average for the last five years.

It is suggested, therefore, that the possibility of modifying agreements reached at Annual Meeting by the incorporation of the results of Mid-term Meetings of the Herring Working Group be explored. Alternatively, modifications in administrative procedures could be considered which might solve the problem that would be caused by the adoption of the US proposal.

4. ICNAF Herring Research Requirements

a) Tagging Experiment

US scientists reported on the availability of tag detection machines. However, it was felt that the question of estimation of year-class size in the early stages of the life history to assess recruitment prospects is of much higher priority at this time, and no tagging program is recommended for the present. The importance of tagging experiments is realized and the subject will be kept under review.

b) Larval Surveys

It was agreed that continuation of the ICNAF Herring Larval Survey Program is desirable. The value of these surveys lies in the contribution they can make to estimation of adult stock size, to stock identification by following larval dispersion, and to understanding the factors influencing larval survival which will affect year-class size. The methods used in the 1971 and 1972 surveys should be reviewed in order to explore the possibility of developing prediction capabilities for future year-class strength.

c) Surveys for Juvenile Herring

The results of juvenile surveys by USSR research vessels in the offshore areas in early 1972 and the tentative confirmation of good year-classes indicate that coordinated juvenile surveys are valuable. Initial plans were made for a winter survey in the period from the last week in February to the third week in March 1973. Countries expected to participate are Fed. Rep. Germany, Poland and USSR. The area from the Nova Scotia shelf to Long Island was chosen and tentatively subdivided into areas each of which would be covered by a research vessel from a member country. It was recognized, and is stressed here, that surveys of inshore areas should be carried out over the same period, and Canada is requested to make a special effort to provide survey-vessel facilities for this purpose.

It was considered that the development of a juvenile survey program was of the greatest importance in providing information on future stock prospects.

d) Sampling and Statistics

The assessment responsibilities of ICNAF scientists and the need to provide regular, up-to-date and increasingly-precise advice for management demands an increasingly effective and comprehensive system of statistics and sampling. The present situation for herring is poor, both as to quantity and quality and as to timeliness of presentation, and improvement in the reliability of advice now depends on improvement in the provision of basic catch statistics and adequate sampling.

Attempts will be made during 1973 to standardize reporting formats, but these will not be effective unless a special effort is made by all member countries to improve the present standards of collection and reporting.

e) Otolith Exchange Program

An ageing workshop proposed for early January 1973 at Hamburg did not materialize. Instead, the USA and Canada held a meeting at St. Andrews, Canada, for standardizing methods and conventions in using otoliths for ageing purposes. A document reporting the results of this meeting was presented to the Herring Working Group (Res.Doc. 73/2).

SUPPLEMENT 1. REPORT OF *ad hoc* MEETING OF HERRING WORKING GROUP, 17 JANUARY 1973

The Joint Meeting of Panels 4 and 5 requested the Working Group to review the assessment for the Nova Scotia stock (Div. 4Wb and 4Xa) with particular reference to the size of incoming year-classes.

The Working Group concluded that the 1969 year-class in Div. 4Wb - 4Xa appeared to be larger than those immediately preceding it, possibly as large as the 1966 year-class, although a more precise estimate is not possible at this time. It was also agreed that the evidence to support this statement is at least as good as that supporting the assumption that the 1970 year-class in Div. 5Z - 6 was as good as the 1966 year-class of that stock, although some representatives pointed out that the evidence for the Nova Scotia stock is more qualitative that quantitative.

Assuming that the 1969 year-class in Div. 4Wb - 4Xa is as good as the 1966 year-class, an increase in the allowable catch to 90,000 tons for 1973 would not cause a decline in stock size during 1973, and would likely result in an increase compared with that existing at the beginning of 1972. Also, an increase in catch to 90,000 tons would not necessarily lead to an increase in F.

Assuming that the 1969 year-class is one-half the size of the 1966 year-class, the stock size in 1973 would probably be maintained even with an allowable catch of 90,000 tons.

SUPPLEMENT 2. REPORT OF *ad hoc* MEETING OF HERRING GROUP, 20-22 JANUARY 1973

The instructions to the Working Group from the *ad hoc* Committee on Herring Quotas and their Allocation were related to three specific problems: (1) to indicate a stock size at which recruitment could be expected to be at optimum levels; (2) to indicate what the mean MSY would be at the optimum stock size; and (3) to relate stock size (age 4 and older) at the start of 1974 to catches and assumed recruitment in 1973 and 1974.

1. Stock size

   a) For the Div. 5Y stock the size is estimated at 100,000-120,000 tons. It was pointed out that preliminary larval survey data indicated that the Div. 5Z and Stat. Area 6 stock was of the order of 10 times that of the Div. 5Y stock, but this is only a very preliminary estimate, and a range of 100,000-120,000 tons was agreed as the best estimate.

   b) For the stock in Div. 5Z and Stat. Area 6 the optimum size is estimated at 500,000 tons. This is based on the average stock size in the early 1960's which was known to give good recruitment and the stock size in 1970 which produced the relatively good 1970 year-class. Between these two periods stock size increased markedly as the two very large 1960 and 1961 year-classes made their maximum contribution to the stock. Other estimates lower than 500,000 tons and also higher were given, based on different lines of argument; the figure of 500,000 tons was the consensus of the Group.

2. MSY of optimum stock size

   a) For Div. 5Y stock the best estimate of MSY is 50,000-60,000 tons.

   b) For Div. 5Z and Stat. Area 6 stock, the best estimate is 250,000 tons. This question was dealt with in the 1972 Annual Meeting Report of the Herring Working Group (*Redbook* 1972, Part I, page 56).

3. Catch and recruitment, and their effect on the 1975 stock size

   The information relating to this question is given for each of the two stocks in the following Tables. In addition, for the Georges Bank stock the difference in stock size (in % and by weight in 1,000-ton units) is given for different catch levels in 1973.

For the Div. 5Y stock assumptions were made as to the effects of the juvenile fisheries. For both stocks, it was assumed that the 1973 catch will include 3-year-old fish.

It must be pointed out that, while some information is available as to the size of the 1970 year-class, none is available that allows estimates for the 1971 year-class size. The calculations are based entirely on the assumption concerning the latter year-class. It is unlikely that further information will be available by the time of the 1973 Annual Meeting at which time advice on the 1974 catch levels will be expected from the Herring Working Group. The information given here is essentially that which will be used in May 1973.

Table 1. Div. 5Y stock: prediction of 1975 stock size at different assumed levels of 1973 and 1974 recruitment and of 1973 and 1974 catch ('000 tons).

HIGHER LEVEL RECRUITMENT IN 1973[1]

Catch in 1973	F in 1973	Recruitment in 1974 as % of 1966 year-class[2]						
			50%		100%		125%	
		F	Catch	Stock[3]	Catch	Stock	Catch	Stock
17.5	.25	.25	16	61	19	78	22	86
		.30	19	59	23	74	27	81
		.45	25	50	33	62	37	68
20.0	.30	.25	15	59	18	77	21	83
		.30	18	57	22	72	25	79
		.45	25	49	32	60	36	67
27.5	.45	.25	14	49	18	64	19	72
		.30	16	46	21	61	23	67
		.45	21	41	28	52	31	58
LOWER LEVEL OF RECRUITMENT[4]								
15.0	.25	.25	15	59	17	71	21	80
		.30	18	53	21	68	25	75
		.45	24	45	31	57	35	64
18.0	.30	.25	13	54	18	69	19	77
		.30	17	51	21	66	23	73
		.45	24	45	30	56	33	63
24.5	.45	.25	12	46	17	61	18	68
		.30	15	42	20	57	22	64
		.45	20	37	26	48	29	54

1 Based on 1972 juvenile catch, ½ of 1968 juvenile catch, and using the best estimate of recent mortality (F) as juveniles.

2 Since not as good an estimate of 1966 year-class strength was available to use procedure as was done for 1970, the value of 1966 year-class in Table 8 in Report of Herring Working Group (*Redbook* 1972, Part I, page 50) was used.

3 Optimum stock assumed to be 100,000-120,000 tons.

4 Based on 1972 juvenile catch, ½ of 1968 juvenile catch, and F as juveniles 1.33 tomes best recent estimate.

Table 2. Div. 5Z - Stat. Area 6 stock: prediction of 1975 stock size at different assumed levels of 1973 and 1974 recruitment and of 1973 and 1974 catch.

1973 Catch (tons)	Recruitment in 1973 as % of 1966 year-class	Recruitment in 1974 as % of 1966 year-class								
		50%			100%			125%		
		F	Catch	Stock	F	Catch	Stock	F	Catch	Stock
100,000	75	.33	105	240	.28	120	341	.26	130	393
		.49	130	203	.42	153	297	.40	167	344
		.65	158	176	.56	190	262	.53	207	304
	100	.35	113	274	.30	130	376	.29	139	429
		.52	154	232	.45	179	326	.43	191	374
		.69	187	197	.60	219	282	.57	235	327
	125	.36	132	315	.31	149	415	.30	159	466
		.53	180	267	.47	205	361	.44	218	407
		.71	218	223	.62	251	308	.59	267	352
115,000	75	.32	90	229	.27	110	330	.26	118	381
		.47	121	194	.41	145	288	.38	158	336
		.63	147	168	.54	180	254	.51	197	298
	100	.34	107	265	.29	125	366	.28	134	416
		.51	147	226	.44	172	318	.41	184	366
		.68	178	191	.58	210	277	.55	226	321
	125	.35	127	305	.30	145	407	.29	154	457
		.53	174	256	.46	200	351	.44	212	397
		.70	212	216	.61	244	302	.58	260	347
135,000	75	.31	79	215	.26	97	316	.25	106	367
		.47	110	184	.39	135	278	.38	147	325
		.62	135	159	.52	168	246	.50	184	290
	100	.33	100	354	.29	117	354	.27	126	405
		.50	136	216	.43	161	308	.40	174	355
		.66	167	184	.57	199	270	.54	215	314
	125	.34	119	291	.30	137	393	.28	146	443
		.51	165	245	.44	191	339	.42	203	386
		.68	200	208	.59	233	294	.56	249	338
150,000	75	.31	75	207	.26	93	308	.25	106	367
		.47	103	172	.39	128	271	.38	147	325
		.62	128	155	.52	159	241	.50	184	290
	100	.33	95	244	.29	111	345	.27	121	396
		.50	129	208	.43	154	302	.40	167	348
		.66	160	178	.57	191	265	.54	207	309
	125	.34	114	280	.30	132	382	.28	141	433
		.51	158	237	.44	184	330	.42	196	378
		.69	192	203	.60	224	288	.57	240	332

Table 3. Div. 5Z - Stat. Area 6 stock: difference in stock size (in % and by weight in 1,000-ton units) for different catch levels in 1973.

Recruitment as % of 1966 year-class in		Catch in 1973	Catch in 1973 ('000 tons)			
1973	1974	('000 tons)	100	115	135	150
125	125	100		3	5	8
		115	10		3	5
		135	25	11		2
		150	29	19	8	
125	100	100		3	6	9
		115	10		4	6
		135	22	12		3
		150	31	21	9	
125	50	100		4	9	13
		115	11		4	8
		135	22	11		3
		150	30	19	8	
100	125	100		2	5	7
		115	7		3	5
		135	17	10		2
		150	24	17	7	
100	100	100		3	6	8
		115	7		3	5
		135	18	11		2
		150	25	18	7	
100	50	100		3	7	12
		115	6		5	9
		135	16	10		4
		150	24	18	8	
75	125	100		6	13	18
		115	8		7	12
		135	19	11		4
		150	26	18	7	
75	100	100		6	13	19
		115	9		7	13
		135	19	10		5
		150	26	17	7	
75	50	100		7	18	26
		115	9		10	17
		135	19	10		7
		150	31	22	12	
Effect of different levels of catch in 1973 on stock size in 1975, using F = 0.4			Change in 1,000-ton units			Percentage change

STACRES
JUNE 1973

B. REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Annual Meeting - June 1973

Chairman: A. S. Bogdanov

Rapporteur: V. M. Hodder

Meetings of STACRES and its Subcommittees were held at Copenhagen, Denmark, during 22 May - 2 June 1973. A further meeting was held on 14 June 1973 to complete consideration of deferred agenda items and to approve the STACRES Report. The ICES/ICNAF Joint Working Group on North Atlantic Salmon met at Copenhagen during 19-23 March 1973 and its Report is given in Summ.Doc. 73/7. The complete reports of the Subcommittees, as adopted by STACRES, are given at Appendix I (Assessments), Appendix II (Statistics and Sampling) and Appendix III (Environmental). Brief summaries of these reports, together with other matters considered by STACRES, are given below.

I. ASSESSMENTS (APP. I)

1. Fishery Trends

The total nominal catches in 1972 from the Convention Area and Statistical Area 6 of 3.15 million and 1.06 million tons respectively was almost the same as that recorded in 1971. The nominal catches for the main species listed below show a marked reduction in catches of haddock and herring offset by increases in catches of mackerel and other pelagic fish (menhaden).

	Nominal catches ('000 tons)	
	1971	1972
Cod	1,056	1,037
Haddock	49	29
Redfish	274	281
Silver hake	237	229
Flounders	297	283
Other groundfish	237	216
Herring	747	548
Mackerel	373	408
Other pelagic fish	257	341
Other fish	188	265
Total finfish	3,715	3,637
Shellfish, etc.	626	575
Total all species	4,341	4,212

2. Assessments (Comm.Doc. 73/11, 12, 13, 14)

In addition to updating assessments of stocks regulated in 1973, particular attention has been given to an assessment of mackerel and to new assessments of some groundfish species, notably redfish and flounders, and to a review of the potentisl of the squid and capelin fisheries which have been developing in recent years. In Table 1 the TAC's[1] recommended for 1974 are compared with the nominal catches in 1972. The species and stocks listed make up about 75% of the total catch of finfish other than herring, "other groundfish", "other pelagics" and "other fish" in the Convention Area and Statistical Area 6 in 1972.

The inclusion of a species stock in Table 1 should not be taken to indicate that each one requires regulation to restore the productivity of the resource. For some, e.g., particular stocks of cod, redfish and flounders in Subareas 2 to 4, the TAC indicates a level of catch that would stabilize fishing mortality at or slightly below the level of recent years, and for many the estimate of TAC at the appropriate level of fishing mortality is very similar to the 1972 level of catch. The comparison does, however, show that the haddock resources remain at a very low level throughout the Convention Area.

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[1] Total allowable catches.

Table 1. Summary of recommended TAC's ('000 tons) for 1974 with annual catches for 1972 in parenthesis.

Sub-area	Division	Cod	Haddock	Redfish	Silver hake	Red hake	Pollock	Amer. plaice	Yellowtail	Witch	Flounder except yellowtail	Mackerel	Capelin
1	A - F	80 (111)											
2	GH	20 (13)											
	J												
3	K	650 (453)											250 (73)
	L			20 (28)				60 (59)	40 (39)				
	N	85 (102)											
	O			15 (16)									
	M	35 (56)											
	Ps	70 (46)		23 (25)									
	Pn												
4	RS												
	T												
	Vn												
	Vs	60 (62)	0 (5)	30 (50)	50-100 (114)		50 (33)	← 32 (24) →					
	W												
	X		0 (13)										
5	Y	10 (7)			10 (6)								
	Ze	35 (25)	0 (7)	30 (19)	80 (77)	50-70 (75)			16[1] 10[2] (30)		25 (24)	245 (386)	
	Zw				80 (31)								
6													
Totals		1045 (875)	0 (25)	118 (138)	220-270 (228)	50-70 (75)	50 (33)	← 183 (176) →				245 (386)	
Overall Total		← 1911-1981 (1936) →											
% 1972 catch by stock		85%	86%	49%	100%	97%	97%	← 62% →				94%	

[1] East of 69°
[2] West of 69°

N.B. TAC's for herring in 1974 were not considered at this meeting, except for the Banquereau stock (4Vn, 4Vs and 4W(a)) for which a TAC of 45,000 tons is recommended.

The assessment of the mackerel stock suggests that previous expectations of potential catch at the level of fishing mortality of 1971 and 1972 have been optimistic. Some scientists disagreed with the estimate of TAC given in Table 1, and STACRES has invited them to submit, for consideration at the Mid-term Meeting in January 1974, other estimates of TAC, supported by data which will permit critical evaluation by the Assessments Subcommittee of the parameters upon which the present estimate is based, and to participate in a reassessment of mackerel.

3. Timing of the Setting of Herring TAC's (Comm.Doc. 73/14)

For the reasons set out in Appendix I (Section 7(c), p. 85), it was agreed that the best estimates of TAC's for herring could be achieved at the Annual Meeting for implementation in a quota year beginning shortly after the Annual Meeting.

4. The By-catch Problem

STACRES reviewed the by-catch problem in Subarea 5 in relation to the efficient management of mixed fisheries. The proposed alteration in mesh regulations for that subarea (Comm.Doc. 73/18) was also discussed to indicate the implications of such regulations, but no specific advice on this matter can be given at present. Problems pertaining to the regulation of effort have been considered by another ICNAF working group (Summ.Doc. 73/5) and these have not been discussed in detail by STACRES.

5. Minimum Mesh Size

The introduction of a 130-mm minimum mesh for trawls in the fisheries for regulated species in Subarea 4, including Div. 4X, should result in an increase in yield of cod, haddock and flounders.

6. Future Herring and Mackerel Assessments

Discussions concerning the adequacy of statistical and sampling data have indicated that some of the technical difficulties in providing assessments may arise through variations between countries in the sampling techniques employed in the collection of the basic data. Accordingly, and bearing in mind the need to reassess the herring and mackerel stocks at the Mid-term Meeting, STACRES

recommends (1)

that member countries, whose vessels exploit the herring and mackerel stocks in Subareas 4 and 5 and Statistical Area 6, provide the following information on their national fisheries for herring in 1973 and for mackerel in 1969 to 1973 such that the data reaches the Secretariat not later than 1 December 1973 (data for November and December 1973 to be brought to the Mid-term Meeting):

i) Provisional estimates of catch and fishing effort by fishing gear, subdivision and months.

ii) Length and age samples by months, with age-length keys, stating for each (a) the method of sampling, (b) the number of samples, (c) the size of each sample, (d) the length composition of each sample, and (e) the age composition of the landings in each month.

iii) Haul-by-haul records of research vessel survey data that may be used to estimate the abundance of young fish or of the exploited stock.

Countries are also requested to collect information on the weight at age (by months), the age at maturity, and the fecundity of mackerel (and herring).

II. STATISTICS AND SAMPLING (APP. II)

1. Discards and Industrial Fish Information

STACRES noted the inadequacies in the data supplied by some countries and the complete lack of data from others, and urged that all countries carefully review their statistical collecting procedures and arrange for reporting to the Secretariat annually the necessary information on discards and industrial fish.

2. Timeliness and Adequacy of Reporting Statistical Data

STACRES was extremely concerned about the delays in reporting of, and the many inadequacies in, national statistical data, as outlined in Summ.Doc. 73/2, and noted that the Commission's introduction of regulatory measures imposed demands on the Assessments Subcommittee of STACRES to assess many stocks about which statistical data is very inadequate or lacking. STACRES accordingly

recommends (4)

i) that the Commission take the necessary steps to ensure that all member countries fishing in the ICNAF Area establish and adequately maintain within their national administrations the resources necessary to provide the statistical data required by the Commission for effective implementation of its management program.

ii) that the Commission request all member countries to provide the monthly catch data for all TAC species and other important species (e.g. capelin, argentines, squids) immediately after the end of each calendar year in time for use by the Assessments Subcommittee at its Mid-term Meeting.

In recommending that member countries be required to provide selected advance statistics in sufficient detail for assessments, STACRES wishes it to be made clear that the submission of the "selected advance statistics" does in no way preclude the prompt reporting of data on STATLANT 21A and 21B forms with deadlines of 15 April and 30 June respectively.

3. Days on Grounds

STACRES noted a recommendation from the Special ICNAF Meeting of Experts on Effort Limitation (Summ. Doc. 73/5) that the CWP be requested to provide a more precise definition of the effort concept "days on grounds", and accordingly

recommends (11)

that prior to the next session of the CWP the Secretary of the CWP obtain from member countries comments and suggestions for improving the definition of the effort concept "days on grounds".

4. Adequacy of Sampling Data

STACRES expressed concern about the sampling data inadequacies, as outlined in Summ.Doc. 73/2, and emphasized the urgency for substantial improvement in the collection and reporting of sampling data by all member countries. STACRES accordingly

recommends (12)

that the Scientific Advisers to Panels bring to the attention of the various Panels the inadequacies of sampling data as presented in Summ.Doc. 73/2 and the need for positive action on the part of the Panels to ensure that member countries, which catch significant quantities of fish in the various subareas, provide sampling data in sufficient quantity and detail to enable the calculation of the length and age composition of the commercial catches by stock/area on a monthly basis.

5. ICNAF Data Base (Comm.Doc. 73/19)

STACRES reviewed the need for a much improved ICNAF data base. There was considerable discussion on the nature of the deficiencies in the present data base and on ways and means of improving it. There was general agreement on the need for a more refined breakdown of catches by species, gear and vessel classes, and smaller statistical subdivisions. It was noted that the desired level of precision may vary from subarea to subarea, with the requirement for more detailed information (e.g. catch and effort dsta on a bi-weekly basis from unit areas not larger than 30-minute rectangles, by more refined tonnage and gear classes) on the fisheries in the southern part of the ICNAF Area (Subareas 3-5, Statistical Area 6), where mixed fisheries are most prevalent.

STACRES also noted that, with few exceptions, the current level of sampling data is very inadequate for assessment purposes and indeed the present system of reporting and processing sampling data do not permit evaluation of how representative the sampling data, as currently reported, are of the compositions of the removals from the regulated stocks.

There being insufficient time to adequately consider these problems in detail at this meeting, STACRES

recommends (15)

i) that a Special Working Group be established to

a) formulate a detailed general plan for the finer breakdown of catch and effort statistics in the ICNAF Area along the lines noted above,

b) conduct a detailed study of the sampling methods used by member countries for estimating age-length compositions of catches, and document the sources and magnitude of sampling errors in past estimates of stock structure for major fisheries through analysis of past sampling,

c) investigate the advantages as well as costs of an expanded central data processing unit in the Secretariat with respect to processing more refined data on catch and effort, as well as

providing increased capability for analysis of commercial and research sampling data; and

ii) *that a Chairman for the Working Group be appointed at this meeting to organize the Group so that it can begin work immediately and meet prior to the Mid-term Assessments for an in-depth review of progress, and that a representative from each member country participate in the meetings of the Working Group.*

6. Other Statistical Matters

Various other statistical matters were considered and recommendations made for action by the ICNAF Secretariat or the CWP Secretary. These recommendations are given in the Report of the Statistics and Sampling Subcommittee at Appendix II.

III. ENVIRONMENTAL (APP. III)

1. Review of Environmental Conditions in 1972

The review of environmental conditions in the ICNAF Area in 1972 indicated some rather uneven changes in the latter part of the year, the southern areas being over 2°C warmer while the northern areas were about 3°C colder. The much lower temperature and the strong increase in the Labrador Current in spring and fall were early indicators of continuing severe ice conditions in early 1973, as was the case for the preceding four years. Temperature anomalies in the 0-500 m layer in the Labrador - Newfoundland areas were the lowest over the entire period of observations since 1936. The intensity of the Labrador Current in the Hamilton Inlet Bank area in October 1972 was higher than in any previous year on record, causing negative anomalies and a strong drift of ice.

2. Ice Conditions and Forecasting Techniques

Formal presentations were given on ice conditions and forecasting techniques prepared by ice experts from Canada, Denmark, Japan and USA. An *ad hoc* panel of ice experts discussed with ICNAF scientists the application of ice research and forecasting practices to fisheries needs, and it was suggested that any fishing vessels, operating in the northern part of the ICNAF Area when ice is present, could assist by providing coastal weather stations with daily ice and weather reports.

3. Hydrography of Newfoundland - Grand Bank Area

STACRES noted with interest the extremely anomalous environmental conditions which prevailed over the Newfoundland - Grand Bank area in 1972 and the unusually extensive hydrographic coverage of the area, and accordingly

recommends (16)

that a series of papers on the hydrography of the Newfoundland - Grand Bank area and its effect on fishery trends be presented at a special session of the Environmental Subcommittee during the 1974 Annual Meeting.

4. Standardization of Hydrographic Sections

Noting that several countries have for some years been carrying out extensive hydrographic studies in the ICNAF Area, STACRES considered the need for standardization of hydrographic sections, stations and methodology and agreed that the problems be studied by two *ad hoc* Working Groups, one to deal with the West Greenland area, and the other to deal with the Canadian shelf area. To assist in the exchange of hydrographic data, STACRES accepted the offer by Canada to identify the Canadian Oceanographic Data Centre as a regional data centre for the ICNAF Area.

5. Joint US-Polish Plankton Sorting Centre

STACRES was advised of the pending establishment of a joint US-Polish plankton sorting centre at Gdynia, Poland, and recommended that a report be prepared outlining the techniques, and types of analyses that will be adopted by the Institute for the sorting of plankton samples.

6. Continuous Plankton Recorder Program

STACRES welcomed the presentation of a special paper on the Continuous Plankton Recorder surveys of the ICNAF Area by a representative of the UK Institute of Marine Environmental Research. Recognizing the utility of plankton data in the prediction of year-class strength of fish, STACRES recommended that the results of the Continuous Plankton Recorder surveys, insofar as they cover the ICNAF Area, be reported to ICNAF annually. STACRES also supported the Environmental Subcommittee's recommendation

that a representative of the UK Institute be invited to present a paper to the 1974 Annual Meeting on plankton studies in the ICNAF Area in 1972 with emphasis on long-term trends and anomalies.

IV. GEAR AND SELECTIVITY

Except for a provisional report on trawl materials and mesh size sampling in 1972 (Summ.Doc. 73/25), there were no research documents on gear and selectivity and there was no discussion on the subject.

V. AGEING TECHNIQUES

STACRES took note of a document prepared by a small study group on herring ageing (Res.Doc. 73/2) which met in December 1972 to draw up a set of conventions for use in ageing herring. It was also noted that the report on the herring otolith exchange carried out in 1971/72 and presented at the 1972 Annual Meeting (Res.Doc. 72/92) was incomplete (the age readings from one country were received too late for inclusion). It was agreed that the Herring Working Group consider these matters at its next meeting.

VI. ICES/ICNAF JOINT WORKING PARTY ON NORTH ATLANTIC SALMON

STACRES considered the report of the latest meeting of the Working Party (Summ.Doc. 73/7) held at Copenhagen, Denmark, during 19-23 March 1973. Items of special relevance to ICNAF are summarized below.

1. West Greenland Fishery

The most recent information on 1972 salmon catches (Summ.Doc. 73/17) are as follows (corresponding data for 1971 in brackets):

Drift-net			Gill-net and Drift-net	Total
Norway	Faroes	Denmark	Greenland	
158 (340)	144 (255)	401 (645)	1,410 (1,448)	2,113 (2,689)

These figures differ slightly from the provisional data available to the Working Party in March 1973.

The decline in catches from the drift-net fishery between 1971 and 1972 was mainly due to lower catch rates on the offshore grounds after August, because of poor weather conditions and changes in surface temperatures. On the inshore grounds the catches by Greenlanders were distributed fairly uniformly throughout the fishing season and the 1972 catch was almost the same as that of 1971. Following the decrease in catch rates after August some commercial vessels undertook exploratory surveys in the regions of Davis Strait, Labrador Sea and coastal waters of East Greenland. Although some salmon were caught in these regions, in none of them were commercially satisfactory catch rates obtained.

2. Origin and Destination of Salmon at West Greenland

Further recaptures at West Greenland in 1972 of salmon tagged as smolts in home waters, and of recaptures in home waters of salmon tagged in the West Greenland fishery in 1971, together with further results of biochemical and serological studies, showed that, as in previous years, the exploited stock in 1972 was composed of fish originating from North American (mainly Canada) and European (mainly Great Britain and Ireland) rivera. These data and home-water recaptures of salmon tagged in the Norwegian Sea fishery again suggested that fish of Norwegian origin make up s very small part of the exploited stock at West Greenland, and that most of the salmon originating from Norwegian and USSR rivers have a different distribution in their second sea-year than those from other major European salmon-producing countries.

3. International Salmon Tagging Experiment at West Greenland

The international salmon tagging experiment, previously approved by the Commission, was carried out successfully between 2 August and 16 October 1972 in the main fishing area at West Greenland. A total of 2,364 tagged salmon were liberated, 811 from research vessels and 1,553 by scientific personnel aboard commercial drift-net vessels, and data of relevance to the Working Party's work were collected during the experiment. STACRES endorsed the Working Party's acknowledgement of the important co-ordinating role palyed by the staff of the Greenland Research Institute throughout the experiment and especially its appreciation of the willing cooperation of the crews of the commercial fishing vessels which took part in it.

A total of 170 recaptures of fish tagged during the experiment have been reported to date, mostly from the West Greenland fishery in 1972, but 17 were reported from the home waters of European countries. No recaptures have yet been reported from Canada, where the fishing season had not opened until 15 May.

4. Assessment of Effects of West Greenland Fishery

No new assessments of the effects of the West Greenland fishery on home-waters stocks and fisheries have been made, pending the results of the analysis of the data from the international tagging experiment. On the basis of the same method of assessment as used previously the estimated direct losses to the combined North American and European catches and stocks of two or more sea-winter salmon, resulting from the West Greenland fishery in 1972, were of approximately the same magnitude as in 1971. The results of detailed Canadian investigations of the decline in, and effects of fishing on, the salmon stocks in the Miramichi river system were also noted. These suggest that fishing outside the river, including that at West Greenland, has been a contributory cause of the decline in recent years.

5. Home-waters Fisheries

Provisional statistics indicate that total (salmon and grilse) catches in the main European salmon producing countries were higher in 1972 than in 1971. This was due principally to an increase in the salmon component, especially in Scotland and Norway. In contrast, the Canadian catch, especially of salmon, was substantially lower than in 1971 due, at least in part, to the introduction of a ban on commercial salmon fishing in the most productive fishing areas of New Brunswick and Quebec.

6. Future Work

STACRES endorsed the Working Party's plans to meet at Copenhagen, Denmark, during 15-22 March 1974 to appraise the results of the tagging experiment and to update its assessment.

STACRES also noted the Working Party's proposal that the results of the analyses of the tagging experiment should be published in a special volume of the ICES Rapports et Proces Verbaux or the ICNAF Research Bulletin, utilizing the surplus funds from the experiment. It was agreed that definitive plans for this publication should be drawn up by the Working Party in consultation with the ICES and ICNAF Secretariats.

VII. COLLABORATION WITH OTHER ORGANIZATIONS

1. The Executive Secretary represented ICNAF at the ICES/ICNAF/IBP Symposium on the Biology of the Seal, which was held at Guelph, Ontario, Canada, on 14-17 August 1972. Preparation of the papers for publication by ICES is in progress.

2. STACRES received a brief verbal account of the proceedings of the Symposium on Salmon, organized by the Atlantic Salmon Foundation and the Atlantic Salmon Research Trust and held at St. Andrews, New Brunswick, Canada, on 20-22 September 1972. Among the items considered was the effect of high seas fisheries on the Atlantic salmon stocks, and a contribution on the work of the ICES/ICNAF Joint Working Party on North Atlantic Salmon was presented by its Chairman, Mr B.B. Parrish.

3. The Report of the Fifth Meeting of the Joint ICES/ICNAF/IOC Coordinating Group for the North Atlantic held at Charlottenlund, Denmark, 23 September 1972 (Summ.Doc. 73/6) was received by STACRES, noting that ICNAF was represented at the meeting by the Chairman of the Environmental Subcommittee (Dr N.J. Campbell) and the Assistant Executive Secretary.

4. STACRES took note of Summ.Doc. 73/16 (Extracts from resolutions passed at the 1972 ICES Meeting relevsnt to the research and statistical activities of ICNAF) and Summ.Doc. 73/21 (Extracts from ICES Liaison Committee Report to NEAFC, 1973). The Secretary General of ICES commented briefly on the continuing close collaboration between ICNAF and ICES in research activities.

5. STACRES noted that ICNAF has committed financial support for and will be represented by Mr K.A. Smith (Woods Hole, USA) at the ICES/FAO/ICNAF Symposium on Acoustic Methods in Fisheries Research to be held at Bergen, Norway, on 15-22 June 1973.

6. STACRES noted with appreciation the continuing interest of FAO in ICNAF activities by the active participation of the FAO observer (Mr E. Cadima) in the work of STACRES and its Subcommittees.

7. STACRES noted that ICSEAF (International Commission for the Southeast Atlantic Fisheries) is now a member of the CWP (Coordinating Working Party on Atlantic Fisheries Statistics) and welcomed the Assistant Executive Secretary of ICSEAF (Dr B. Draganik) as an observer at its meetings.

VIII. PUBLICATIONS AND REPORTS

1. Review of Publications

The Executive Secretary presented a summary of the publications and reports issued during the fiscal year 1972/73 (Comm.Doc. 73/10, Section 6). He noted that at the request of STACFAD the 1973 Annual Meeting documents were issued in three series:

a) Commissioners Documents (Comm.Doc.) with green cover page include conservation proposals, panel membership, administrative report, status of conservation proposals, annual return of infringements.

b) Summary Documents (Summ.Doc.) with blue cover page include national reaearch reports, mid-term committee, subcommittee, working party, working group meeting reports, statistical tabulations of catches, reports on status of fisheries and research carried out, trawl material and mesh size report.

c) Research Documents (Res.Doc.) with yellow cover page include research papers, other statistical returns.

2. Symposium on the Early Life History Stages of Fish

Although the Commission at its 1972 Annual Meeting did not approve financial support for the Symposium, which was held at Oban, Scotland, 17-23 May 1973, STACRES was informed that the symposium steering committee hoped that ICNAF would reconsider its position and provide some financial support toward publication of the papers. It was generally agreed that, if STACFAD could provide for funds in the 1974/75 budget, ICNAF should support the publication of the papers in collaboration with ICES. However, it was noted that as much as $8,000.00 might be needed as ICNAF's contribution.

3. Twenty-five Year Anniversary Issue

STACRES noted that the year 1975 will be the twenty-fifth anniversary of the Commission and supported the view that the Commission should explore the possibility of having one or more persons, who have been associated with the Commission throughout most of its 25-year history, be invited to prepare papers on the history of fisheries science and management in the Northwest Atlantic, for publication prior to the 1975 Annual Meeting of the Commission.

4. Publication of Status of Fisheries Reports in Meeting Proceedings

STACRES considered the disposition of Reports on Status of Fisheries, which are reproduced as Annual Meeting Summary Documents. At present these reports are attached as appendices to the Reports of Scientific Advisers to Panels when the latter are published in Meeting Proceedings, and they are also edited and included in the Annual Proceedings. STACRES accordingly

recommends (21)

that the inclusion of Status of Fisheries Reports in the Meeting Proceedings be discontinued.

5. World Bibliography on Seals

STACRES was informed that Dr K. Ronald, Chairman of the Symposium on the Biology of the Seal, had prepared an extensive world bibliography on seals and inquired if ICNAF would be interested in publishing it. The subject and author indexes are estimated to be about 4,000 pages and to coat about $15,000.00 initially, with most or all of the cost recoverable by the sale of the publication. In view of the increasing demands on the Secretariat staff to prepare for additional special meetings of the Commission, as well as to prepare the several ICNAF publications issued annually, STACRES decided that the Secretariat should not be burdened with the printing of such a large publication as the seal bibliography.

6. STACRES noted that 55 of 123 Research Documents presented at this Annual Meeting had been selected by the Steering and Publications Subcommittee for publication (subject to approval by the authors and the Editor) in *Redbook* 1973, Part III, or in ICNAF Research Bulletin.

IX. FUTURE MEETINGS

1. Mid-term Meetings

a) STACRES together with the Assessments Subcommittee will meet at a time and place to be decided but not later than January 1974. In order to facilitate the computational procedures involved

in providing comprehensive assessments of herring and mackerel for consideration at the Mid-term Meeting of the Commission, STACRES

recommends (22)

that the Mid-term Meeting of STACRES be held at a location where suitable computing facilities can be available to utilize computer programs presently available.

b) The Special Working Group on ICNAF Data Base Improvement will meet just prior to the Mid-term Meeting of the Assessments Subcommittee at a location to be decided.

c) The ICES/ICNAF Joint Working Party on North Atlantic Salmon will meet at Copenhagen during 15-22 March 1974.

2. Regular Meetings

STACRES and its Subcommittees and Working Groups will meet for several days prior to the 1974 Annual Meeting of the Commission at Halifax, Nova Scotia, Canada.

X. OFFICERS FOR 1973/74

Chairman of STACRES: Dr A.W. May (Canada)
Chairman of Assessments Subcommittee: Mr D.J. Garrod (UK)
Chairman of Statistics and Sampling Subcommittee: Mr Sv.Aa. Horsted (Denmark)
Chairman of Environmental Subcommittee: Mr H.W. Hill (UK)
Chairman of Working Group on Coordinated Groundfish Surveys: Dr J. Messtorff (Fed.Rep. Germany)
Chairman of Special Working Group on ICNAF Data Base Improvement: Mr R.C. Hennemuth (USA)

Members of Steering and Publications Subcommittee:

USSR, Romania, Poland, Bulgaria	- Dr A.S. Bogdanov (USSR)
France, Portugal, Spain	- Mr J. Morice (France)
Iceland, Norway, Italy, Japan	- Mr Ø. Ulltang (Norway)
Fed.Rep. Germany, Denmark, UK	- Dr A. Schumacher (Fed.Rep. Germany)
Canada	- Dr F.D. McCracken (Canada)
USA	- Mr R.C. Hennemuth (USA)

XI. APPRECIATION

The Standing Committee on Research and Statistics expressed its appreciation for the excellent work of the outgoing Chairmen: Dr A.S. Bogdanov (STACRES), Mr V.M. Hodder (Statistics and Sampling), Dr N.J. Campbell (Environmental) and Dr M. Grosslein (Groundfish Surveys) and also to Mr D.J. Garrod who continues as Chairman of the Assessments Subcommittee.

APPENDIX I - REPORT OF ASSESSMENTS SUBCOMMITTEE

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APPENDIX I - REPORT OF ASSESSMENTS SUBCOMMITTEE

Chairman: D. J. Garrod

The Subcommittee and its Working Groups met at Copenhagen, Denmark on 22-29 May 1973 in conjunction with the 1973 Annual Meeting of STACRES. The main task at this Meeting was to assess the various fish stocks in the Convention Area (Subareas 1-5) and Statistical Area 6 and to recommend TAC's for 1974. The Mid-term Meeting of the Subcommittee was held at FAO, Rome, Italy on 8-13 January 1973 and the report of that meeting is given on pages 9-30 of this Redbook.

1. Review of the Latest Statistics of Nominal Catches and Fishery Trends

The total nominal catch of all species from the Convention Area of 3.15 million tons in 1972 has remained close to the 1971 total of 3.28 million tons, and the total nominal catch from Stat. Area 6 also remained steady at 1.06 million tons. The main changes in the total nominal catch ('000 tons) within the subareas were as follows:

	1971	1972	% change
Subarea 1	150	139	-7
Subarea 2	246	218	-11
Subarea 3	954	952	Nil
Subarea 4	1,064	911	-14
Subarea 5	866	936	+8
Stat. Area 6	1,059	1,056	Nil
	4,339	4,212	-3

The provisional data on nominal catches in Subareas 1-5 and in Stat. Area 6 with comparable data since 1959 are given in Table 1. These include data for all Member Countries plus the German Democratic Republic and other non-members in recent years.

a) Subarea 1

Total nominal catch declined by about 10,000 tons to 139,000 tons in 1972, the lowest catch so far recorded in ICNAF statistics. The decrease is almost entirely due to the decline in cod catch from 121,000 tons in 1971 to 111,000 tons in 1972.

German (FR) catch-per-day of cod fell to about half the level of 1970-71 catch rates. A decline in catch-per-effort of the same order was reported by the UK, whereas Norwegian catches which increased tenfold over those in 1971 seem to be connected with a great increase in effort, as well as an increase in catch-per-day. The general trend in effort is, therefore, difficult to judge.

The redfish catch remained at the low level of about 3,000 tons and the shrimp catch maintained the relatively high level of 9,000 tons reached in 1971.

b) Subarea 2

The main fishery is conducted offshore and almost entirely by large otter trawlers fishing principally for cod. There is, however, an inshore small-boat cod fishery, which declined further from 3,000 tons in 1971 to only 1,200 tons in 1972. From a peak catch of 449,000 tons in 1968, the total annual catch of cod has declined to 163,000 tons in 1971 and remained at the same low level (163,000 tons) in 1972, due mainly to increasingly severe ice conditions since 1970, which during the winter-spring fishery interfered with trawler operations and forced the vessels to leave the fishing grounds earlier than in former years.

The redfish catch, taken mostly as by-catch in recent years, increased from 7,000 tons in 1971 to 9,000 tons in 1972. The catch of other groundfish species increased in 1971 from the 1959-70 average of 5,000 tons to 58,000 tons in 1971, the increase consisting mainly of roundnose grenadier, but decreased again to only 5,000 tons in 1972. This decrease may also have been due to the severe ice conditions. The increase in the catch of other fish from 4,000 tons in 1971 to 22,000 tons in 1972 was the result of a newly developed fishery for capelin, which produced 18,000 tons in 1972 almost solely from Div. 2J.

Table 1. Nominal catches ('000 tons) by main species and species groups, 1959-1972.

Subarea	Species	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972[1]
1	Cod	234	243	345	451	406	350	359	366	430	382	215	116	121	111
	Redfish	33	44	54	61	47	30	19	17	13	10	5	5	3	3
	Flounders[2]	2	1	2	1	4	4	4	3	3	2	2	3	4	4
	O. Gro'fish	4	7	13	13	18	15	13	10	9	7	4	8	7	7
	Total Gro'fish	273	295	414	526	475	399	396	396	454	401	226	132	135	125
	O. Fish	+	+	+	1	+	10	3	3	5	1	2	6	6	5
	Shellfish	1	2	3	3	3	4	5	5	6	6	7	8	9	9
	All Species	274	297	417	530	478	413	404	404	465	408	235	146	150	139
	Total finfish relative to 1959	100	108	151	193	174	150	146	145	166	147	84	51	52	48
2	Cod	60	188	265	255	216	213	333	338	298	449	454	224	163	163
	Redfish	53	83	26	8	6	27	23	14	17	9	8	11	7	9
	Flounders[2]	+	2	1	+	+	3	8	5	8	11	19	13	14	19
	O. Gro'fish	1	6	4	2	1	2	12	9	4	12	4	4	58	5
	Total Gro'fish	114	279	296	265	223	245	376	366	327	481	485	252	242	196
	O. Fish	+	+	1	1	+	6	1	1	1	1	5	3	3	22
	All Species	114	280	297	266	223	251	377	366	328	482	490	255	246	218
	Total finfish relative to 1959	100	245	260	232	196	215	331	320	287	422	430	224	216	190
3	Cod	425	471	461	389	466	581	496	499	721	733	572	533	514	522
	Haddock	35	67	79	35	15	12	9	10	11	7	5	7	5	4
	Redfish	246	99	90	61	69	95	112	79	89	53	93	84	102	120
	Flounders[2]	28	38	32	29	35	56	82	112	158	158	149	167	165	157
	O. Gro'fish	19	17	11	8	7	7	17	11	23	41	18	28	35	33
	Total Gro'fish	753	692	673	522	592	751	716	711	1002	992	837	819	821	836
	Herring	4	6	4	5	6	3	8	23	78	145	145	135	118	52
	O. Pelagics	+	+	1	1	1	2	1	1	2	1	2	3	1	2
	O. Fish	6	7	5	5	6	14	6	7	12	5	13	13	11	60
	Total Finfish	763	705	683	533	605	770	731	742	1094	1143	997	970	951	950
	Shellfish	4	6	10	2	4	14	9	6	9	1	2	3	3	2
	All Species	767	711	693	535	609	784	740	748	1103	1144	999	973	954	952
	Total finfish relstive to 1959	100	92	90	70	79	101	96	97	143	150	131	127	125	125
4	Cod	214	218	212	219	218	229	225	215	194	247	206	262	222	209
	Haddock	53	46	47	44	51	60	85	66	49	46	42	28	31	18
	Redfish	42	50	42	43	58	53	68	106	88	104	112	119	142	130
	Flounders[2]	22	29	29	27	32	36	50	57	43	74	54	43	58	43
	Silver hake	2	+	+	9	123	81	50	10	2	3	46	169	129	114
	O. Gro'fish	45	48	45	55	73	58	57	47	34	38	34	32	49	46
	Total Gro'fish	378	391	375	397	555	517	535	501	410	512	494	653	631	560
	Herring	102	105	81	116	112	140	181	236	261	370	458	426	311	259
	O. Pelagics	8	8	6	8	13	14	13	14	13	23	20	22	23	21
	O. Fish	9	7	6	8	17	17	16	25	12	16	27	25	51	33
	Total Finfish	496	511	468	529	697	688	745	776	696	921	999	1126	1016	873

[1] Provisional statistics
[2] Includes halibut

Table 1. Continued

Subarea	Species	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972[1]
4	Shellfish	28	38	30	50	56	52	32	26	27	41	48	45	48	38
	All Species	524	549	498	579	753	740	777	802	723	962	1047	1171	1064	911
	Total finfish relative to 1959	100	103	94	107	141	139	150	156	140	186	201	227	205	176
5	Cod	16	14	18	26	30	29	42	57	42	49	46	38	35	31
	Haddock	41	46	52	59	60	70	155	127	57	44	25	13	12	7
	Redfish	16	12	14	14	10	8	8	9	11	7	12	17	20	19
	Flounders[2]	25	27	29	38	48	58	57	54	49	53	78	55	46	49
	Silver hake	50	47	43	86	147	220	323	162	101	81	88	49	97	107
	O. Gro'fish	90	42	44	23	69	56	110	138	82	73	109	44	66	95
	Total Gro'fish	238	188	200	246	364	441	695	547	342	307	358	216	276	308
	Herring	48	69	94	223	167	159	74	166	250	407	310	250	276	220
	Mackerel	2	1	1	1	2	2	4	7	16	51	67	106	116	201
	O. Pelagics	27	25	16	20	14	6	5	9	5	6	13	11	13	15
	O. Fish	8	9	11	32	11	28	24	50	26	37	73	34	62	86
	Total Finfish	323	291	322	522	558	636	802	779	639	808	821	617	743	830
	Shellfish	136	152	167	170	156	121	87	88	93	98	108	113	123	106
	All Species	459	443	489	692	714	757	889	867	732	906	929	730	866	936
	Total finfish relative to 1959	100	90	100	162	173	198	249	242	198	251	255	192	224	257
6	Flounders	-	-	-	-	-	-	-	9	12	8	9	9	13	14
	Silver hake	-	-	-	-	-	-	-	96	23	18	10	6	11	8
	O. Gro'fish	-	-	-	-	-	-	-	63	35	24	17	11	19	28
	Total Gro'fish	-	-	-	-	-	-	-	168	70	50	36	26	43	50
	Herring	-	-	-	-	-	-	-	6	5	29	53	40	42	16
	Mackerel	-	-	-	-	-	-	-	2	7	10	43	100	232	185
	O. Pelagics	-	-	-	-	-	-	-	140	128	107	108	233	244	325
	O. Fish	-	-	-	-	-	-	-	42	38	38	57	42	56	61
	Total Finfish	-	-	-	-	-	-	-	358	248	294	297	441	617	637
	Shellfish	-	-	-	-	-	-	-	436	398	371	387	460	442	419
	All Species	-	-	-	-	-	-	-	794	646	665	684	901	1059	1056
	Total finfish relative to 1966	-	-	-	-	-	-	-	100	69	82	83	124	173	178

[1] Provisional statistics
[2] Includes halibut

c) Subarea 3

Provisional statistics for 1972 indicate that the total groundfish catch was only slightly above the 1971 level (836,000 tons compared to 821,000 tons in 1971). The cod catch increased slightly to 522,000 tons from 514,000 tons in 1971. The haddock catch remained at a very low level, being only 4,000 tons in 1972. The redfish catch increased somewhat from 102,000 tons in 1971 to 120,000 tons in 1972, with the most pronounced increase in Div. 3M from 8,000 tons in 1971 to 40,000 tons in 1972. The total flounder catch declined slightly from 165,000 tons in 1971 to 157,000 tons. There were no significant changes in the catches of other groundfish.

The herring catch further decreased from 118,000 tons in 1971 to 52,000 tons in 1972. This decrease was caused partly by lack of significant recruitment to the stocks which are fished during winter-spring period in southwest Newfoundland. The total catch of "other fish" increased from 11,000 tons in 1971 to 60,000 tons in 1972, mainly due to s significant capelin catch of 52,000 tons.

d) Subarea 4

The total nominal catch of all species declined 15% to 911,000 tons in 1972 from 1,064,000 tons in 1971. Some decline occurred in all major species and species groups. The largest proportional decline occurred in the haddock catch (-42%), due in small part to quota regulations but principally to declining abundance. Cod, redfish, silver hake and "other groundfish" catches declined between 6% and 12%. The pollock catch increased from 12,000 tons to 20,000 tons, and there were indications of some increase in pollock abundance. Small increases occurred in cusk and white hake catches, which are in the "other groundfish" category, but the overall decline in this category resulted from a decrease in the catch of anglers from 14,000 tons to 3,000 tons and also from small declines in catches of red hake and wolffish.

The pattern of herring catches changed greatly in 1972: the Div. 4X catch increased by over 100% to 143,000 tons, at least in part due to the entry to the fishery of the large 1970 year-class, whereas the Div. 4T catch declined 60% to 54,000 tons; declines of 75% in the catch from Subdiv. 4Vs and 57% in Div. 4W occurred, while increases of 9% in Subdiv. 4Vn, 33% in Div. 4S and 15% in Div. 4R were recorded. Overall, the herring catch in Subarea 4 declined by 17%. The mackerel catch remained about the level of 20,000 tons.

In the "other fish" category, the largest decline was recorded for skates from 18,000 tons in 1971 to 5,000 tons in 1972. The dogfish catch increased from 4 tons to 2,500 tons. The overall decline was 35%.

The decline in the shellfish category of 21% was principally due to the decline in the squid catch from 7,300 tons in 1971 to 1,800 tons in 1972, but declines also occurred in scallop, lobster and shrimp catches.

e) Subarea 5

The total catch of all species increased from 866,000 tons in 1971 to 936,000 tons in 1972. While the catches of some species declined from 1971 to 1972, in some cases as a result of regulation, catches of some unregulated species increased considerably. Major increases in catches from 1971 to 1972 were for mackerel (116,000 to 201,000 tons), red hake (30,000 to 60,000 tons), yellowtail flounder (23,500 to 29,600 tons), argentine (7,300 to 32,700 tons), dogfish (200 to 12,800 tons), skates (2,900 to 8,700 tons) and squids (11,400 to 24,200 tons). Cod and haddock catches declined from 1971 to 1972, cod from 35,000 to 31,000 tons and haddock from 12,000 to 6,600 tons. Other species showing declines in catches from 1971 to 1972 were summer flounder (1,000 to 600 tons), winter flounder (12,400 to 10,500 tons), ocean pout (6,200 to 2,900 tons), pollock (14,300 to 13,000 tons), alewives (14,600 to 8,700 tons) and sharks (4,600 to 300 tons). The catch of redfish remained at sbout the same level (19,000 tons) in 1972 as in 1971, while the silver hake catch increased slightly from 97,000 to 107,000 tons.

Herring and mackerel comprised 51% of all finfish catches in Subarea 5 in 1972. The herring catch decreased to 220,500 tons in 1972, which was the lowest herring catch since 1966, although this figure was 40,500 tons in excess of the TAC for this stock due primarily to large unexpected catches by non-member countries. Quotas were exceeded for all species (i.e. haddock, yellowtail and herring) under regulation in 1972; the total yellowtail catch was nearly 25% in excess of the allowable catch. The catch of mackerel has been increasing since 1964, with the increase averaging 41% annually for the years 1968 to 1971 and up 73% from 116,000 tons in 1971 to 200,500 tons in 1972.

f) Statistical Area 6

The total catch of all species in Stat. Area 6 remained at about the same level in 1972 (1,056,000 tons) as in 1971 (1,059,000 tons). The mackerel catch increased steadily from zero in 1965 to a maximum of 232,000 tons in 1971 but then declined to 185,000 tons in 1972. The herring catch declined by 63% from 42,000 tons in 1971 to 15,700 tons in 1972. Catches of some other species also decreased markedly from 1971 to 1972: butterfish (6,000 to 2,100 tons), alewives (21,200 to 15,600 tons), sharks (3,200 to 100 tons) and silver hake (11,000 to 8,500 tons).

The catch of menhaden increased from 234,000 tons in 1971 to 320,100 tons in 1972, while the total groundfish catch increased from 43,000 to 50,300 tons, due mainly to increased catches of summer flounder (2,400 to 3,100 tons), yellowtail (7,800 to 8,900 tons) and red hake (10,300 to 15,800 tons). The squid catch also increased from 10,500 tons in 1971 to 16,800 tons in 1972, and the catch of dogfish increased sharply from 600 to 8,700 tons.

2. Cod Assessments

The commercial sampling and research vessel survey data on which the following assessments are based are not all equally satisfactory, and for many stocks the age structure of the catches by some countries is not known. The matter of inadequate sampling is discussed in Summ.Doc. 73/2, in the Report of the Statistics and Sampling Subcommittee, and in Section 8 of this report. Table 2 presents a summary of recommended TAC's for 1974 together with ancillary data. Details of the individual stock assessments follow.

Table 2. Cod assessments: recommended TAC's for 1974 with ancillary data.

Stock area	MSY	Nominal Catch ('000 tons)			TAC ('000 tons) Recommended (Allocated)[1]			F_{max}	F_{1974}
		1966-70	1971	1972	1972	1973	1974		
1A to 1F	300	304	121	111	-	102	80	0.56A-D 0.65E-F	Slightly below F_{max}
2G-H	30	62	13	13	-	-	20[2]	0.7	
2J-3K-L	550	657	421	453	-	650 (665.5)	650	0.4	0.4
3M	35	28	25	56	-	-	35[2]	0.5	0.5
3N-O	130	140	118	102	-	70 (103.5)	85	0.2	0.2
3Ps	60	66	60	46	-	70 (70.5)	70	0.3	0.3
3Pn-4R		74	74	45	-	-	-		
4T-Vn		60	67	77	-	-	-		
4Vs-W	60	62	53	62	-	60 (60.5)	60	0.45	0.5
4X		31	23	22	-	-	-		
5Y	10	7	8	7	-	10 (10)	10		
5Z	35	39	28	25	-	35 (35)	35		

[1] "Allocated" here refers to the total allowable catch agreed by the Commission as the TAC.
[2] Long-term yield-per-recruit x average recruitment.

a) Subarea 1 (Res.Doc. 73/38, 107, 108)

The nominal catch declined from 121,000 tons in 1971 to about 111,000 tons in 1972, the lowest catch so far recorded in the ICNAF statistics. German (FR) and French catch-per-day fell to about half the level of 1970-71 catch rates. Also UK data indicate an abrupt decline in catch-per-unit-effort from 1971 to 1972. The Norwegian catch, on the other hand, which is reported to have increased about tenfold over that of 1971, seem to be connected both with a great increase in effort and with an increase in catch-per-day (with no correction for possible difference in fishing power of vessels in 1971 and 1972). The general impression is, however, that stock size has declined further.

The 1972 catch is about 14% higher than predicted (for an F value in 1972 of 0.60) by the Sub-committee at the 1972 Annual Meeting (*Redbook* 1972, Part I, p. 20) and again at the Mid-term Meeting, January 1973 (This volume, p. 27-28). In these two reports it was stated that the greatest uncertainty in the assessments at that time was connected with mean weight for the various age-groups in the two separate parts of the stock (Div. 1A-D and Div. 1E-F). New information on weight by age was presented to the 1973 Annual Meeting (Res.Doc. 73/38 and 108), and these revised values have been used in a new assessment of Subarea 1 cod (Res.Doc. 73/107).

There is still much uncertainty as to the level of fishing mortality in the most recent years. Based on available age-composition data for 1971 catches, calculations have, therefore, been made for different levels of fishing mortality in 1971. Upon comparing the new predictions for 1972 catches with the catches actually obtained in 1972, the Subcommittee concluded that the most likely values of F for fully recruited age-groups were about 0.50 for Div. 1A-D and close to 0.65 for Div. 1E-F, which for both regions are close to the level of F_{max}.

Information on pre-recruit cod indicates that the 1968 year-class is the only important one that will recruit to the fishery in 1973 to 1976. Although the actual size of the year-class is difficult to judge at present, all assessments (i.e. assessments for various levels of mortalities) point to a further decline in stock size and catches in the next two years.

Noting that the 1968 year-class will start spawning in 1974 and will be rather vulnerable to trawl fishing, and considering the desirability of maintaining a spawning stock pending better information on stock recruitment relationship, the Subcommittee felt that advice to the Commission on TAC for 1974 should be conservative. On this basis, the Subcommittee recommends a TAC of 80,000 tons in Subarea 1 for 1974. Should the 1968 year-class or other new year-classes prove to be better than estimated at present, the TAC can be adjusted for 1975. A conservative figure of TAC for 1974 will, however, allow spawning in 1974-75 to be better than if a higher 1974 quota is set.

The assessments have, as indicated above, been carried out for two separate regions (Div. 1A-D and Div. 1E-F). The Subcommittee discussed whether advice on TAC should he given for these two regions separately. Although it was the general opinion that this should be done if the scientific background permitted, the Subcommittee did not consider a breakdown of the TAC feasible at this time. One of the reasons for this is that the recommended TAC for 1974 has been based to some extent on present knowledge of the 1972 catches. However, for more than 1/3 of the 1972 catches, no information on breakdown by division is yet available. Another reason for regarding Subarea 1 as a whole at present is the fact that the 1974 catches are likely to be based mainly on the 1968 year-class and this year-class seems to be rather evenly distributed in Subarea 1. The distribution of fishing in 1974 will to a great extent be determined by the behaviour of the 1968 year-class when it is schooling for spawning, and it is not possible to predict whether the heaviest con-centrations will be found in one region or the other.

b) Divisions 2G-H (Res.Doc. 73/106)

Cod catches in Div. 2GH, after decreasing from about 50,000 tons in 1954, remained at a very low level during 1955-64. There was a sharp increase to about 100,000 tons in 1966 and a subsequent decline to about 10,000 tons in 1971. The 1972 catch was 13,000 tons.

Fishing mortality on fully recruited age-groups was at a low level ($F<0.1$) during 1962-64, corresponding to the low catches in this period. F-values then generally increased to a peak of about 1.0 in 1969-70.

Total stock size of cod of ages 3 and older decreased from about 310-320 million fish in 1964-65 to about 110-130 million in 1969-70. However, the number of fish over age 13 decreased from about 10 million in 1962-64 to about 1 million in 1969, a decrease of about 90%. The number of fully recruited fish declined from about 93 million in 1965 to 22 million in 1969, a decline of about 77%.

Yield-per-recruit calculations indicate that F_{max} for this stock occurs at F = 0.7 but that on the flat-topped yield curve 93% of this maximum was available at F = 0.2.

The average stock size of age 5 cod was about 54 million fish in the 1962-66 period, so that fishing at F_{max} (0.7) in that period would have produced average maximum catches of about 39,000 tons. However, the stock size of age 5 cod was about 26 million fish in the 1967-70 period, so that the average maximum catch in the early 1970's is estimated at about 20,000 tons.

The stock relationship in the Subarea 2 and Div. 3K-L complex is at present not well understood. However, the differences in growth rate between those in Div. 2G-H and in Div. 2J indicate that there is not complete mixing of the cod in these divisions. If the total allowable catch for Div. 2G-H is, in fact, included with that for Div. 2J-3K-L, the actual catch in Div. 2G-H could exceed the total allowable catch desirable for Div. 2G-H separately in a given year by a considerable amount. In view of the prospects for poorer recruitment, the decreased abundance of older fish and the fact that the cod stock in Div. 2G-H is about 10% of the total cod stock in Div. 2J-3K-L, the inclusion of Div. 2G-H with the much larger Div. 2J-3K-L stock would be undesirable. Therefore, the recommended TAC in Div. 2G-H for 1974 is 20,000 tons and this should be allocated separately from that for Div. 2J-3K-L.

c) Divisions 2J-3K-L (Res.Doc. 73/13, 22, 60; Summ.Doc. 73/14, 20, 22, 27)

The remarkable decline of the total cod catch in these divisions from a peak of 784,000 tons in 1968 to 421,000 tons (54%) in 1971 did not continue into 1972. The preliminary statistics show a slight increase to 453,000 tons in 1972, although ice conditions especially in Div. 2J became even worse than in the preceeding 3 years, but considerably larger catches were taken in Div. 3K.

Div.	Cod catches ('000 tons) 1970	1971	1972
2J	199	150	149
3K	91	80	146
3L	196	191	158
Total	486	421	453

An indication of possibly higher abundance of cod in the area is given by a considerable increase in the catch-per-day-fished of the German (FR) fleet in Div. 3K, although the effort was also increased due to diversion from Div. 2J.

Stock sizes at first entry to the fishery (age 4) from virtual population analyses averaged about 650 million fish for the 1959-65 year-classes. Based on updated assessments including correlations between pre-recruit survey indices of abundance and stock sizes at age 4, the average stock size of the 1966-69 year-classes was estimated to be 820 million fish at entry to the fishery.

Estimates of fishing mortality (F) for fully recruited age-groups during 1968-71 of 0.55, 0.93, 0.52 and 0.66 respectively were still well beyond the level corresponding to maximum yield-per-recruit (F_{max} = 0.4). However, because the catch level in 1972 was below 500,000 tons, the better recruitment by the evidently stronger 1966-68 year-classes probably reduced the mortality rate for 1972 to a level nearer to F_{max}. Assuming that the TAC of 650,000 tons will not be taken in 1973 because of severe ice conditions, fishing at F_{max} in 1974 should produce 650,000 tons. Also, in view of the reduced abundance of older age-groups in recent years, the newly recruited and relatively good year-classes, especially that of 1968, should be conserved to support the fishery in the years after 1974 and to provide a good spawning stock. The TAC in 1974 should therefore not exceed 650,000 tons, the same as was recommended for 1973.

d) Division 3M (Res.Doc. 73/22, 105)

Catches from this stock were generally low during 1953-59, except in 1957 (20,000 tons). Catches increased to a peak of 55,000 tons in 1965 and subsequently declined to about 18,000 tons in 1970, and 25,000 tons in 1971. However, the catch in 1972 increased sharply to 56,000 tons.

The fishing mortality estimate (F) was about 0.03 in 1959, and presumably very low for several years previous to this, but increased to about 0.3 in 1960-62 and to a peak of 0.9 in 1967. There was a decrease in 1968 to about 0.6. F-values since 1968 are not known but catches in 1969-71 were lower than in 1965-68. The doubling of the catch in 1972 compared to 1971 is probably associated with an increase in fishing effort (and hence F), since the catch of redfish in this area

also increased in 1972. Maximum yield-per-recruit occurs at F = 0.5, so that F-values during 1965-68 were beyond F_{max}.

Stock size fluctuated between 90 million and 190 million fish during 1959-68. Recruitment, as evidenced by numbers of 4-year-olds in the stock, fluctuated between 2 and 75 million fish for the 1955-64 year-classes. USSR young fish surveys indicated fluctuations in pre-recruit survey indices of abundance from 1 to 41 fish-per-hour for the 1961-69 year-classes. Of the recent year-classes, that of 1968 is the strongest. The average recruitment to the stock during the 1959-68 period, as evidenced by the numbers of 4-year-olds in the stock, was about 35 million fish. A maximum yield-per-recruit at age 4 of 1.0 kg implies a long-term sustainable yield of about 35,000 tons. Therefore, the TAC recommended for 1974 is 35,000 tons.

e) Divisions 3N-O (Res.Doc. 73/3, 4, 22, 60, 89)

The cod catch in Div. 3N-O decreased from a maximum of 220,000 tons in 1967 (supported by strong 1963 and 1964 year-classes) to about 110,000-120,000 tons in 1969-71. The 1972 catch was approximately 102,000 tons.

Fishing mortality estimates (F) obtained from virtual population analyses indicated that F of fully recruited age-groups fluctuated between 0.3 and 0.6 during 1959-64 but increased to 0.7 and to 0.8 in 1965 and 1966 respectively, and to 0.9 in 1967 and 1968. F in 1969-71 was in the range of 0.5-0.6. Since the maximum yield-per-recruit for this stock is estimated to be at F = 0.2, F-values in 1959-64 were 1.5 to 3 times the level of F_{max}, but in 1965-66 F was about 3.5 times and in 1967 and 1968 about 4.5 times F_{max}. Although F in 1969-71 was lower than in the 1965-68 period, it was still 2.5 to 3 times F_{max}. Mortalities calculated from survey data for the same period indicated general agreement with the above F-values.

Stock size estimates indicate that the total stock decreased from 156 million fish in 1959 to 120-125 million in 1961-62 and then increased to 185 million during 1964-65 and to 300 million in 1967. There was a subsequent decline to 180 million fish in 1969. The fully recruited portion of the stock fluctuated around 20-30 million fish in 1959-66 and then decreased to 15 million fish in 1969. With a decrease in F below the high 1967-68 values, there was an increase in the fully recruited portion of the stock to about 23 million fish in 1970-71.

Recruitment estimates from surveys of year-classes expected to contribute to the fishery in 1974 indicated that the 1968 year-class is expected to be fairly strong, while the 1967, 1969 and 1970 year-classes are poorer ones. Since the 1972 catch did not increase over that of 1971, there is some uncertainty as to the magnitude of the 1968 year-class. If this year-class is as abundant as previously estimated, the catch in 1972 should have been substantially higher than that of 1971. Also, since the F-values for 1969-1971 were substantially beyond F_{max}, a reduction in fishing mortality in 1974 to a level near F_{max} is highly desirable. Therefore, the TAC recommended for 1974 is 85,000 tons as compared with 103,000 tons allocated in 1973 (the TAC recommended in 1973 was 70,000 tons).

f) Subdivision 3Ps (Res.Doc. 73/3, 4, 22, 60, 89)

Catches from the Subdiv. 3Ps cod stock increased from 60,000 tons in 1959 to 84,000 tons in 1961, fluctuated between 47,000 and 52,000 tons in the 1962-65 period and then increased to 61,000-74,000 tons in 1966-70. The 1971 catch was about 60,000 tons and the 1972 catch about 46,000 tons.

Fishing mortality estimates were generally in excess of F_{max} (0.3) during the 1960's and were about 0.4 to 0.5 in 1970-71, still above F_{max} for this stock. The 1973 TAC of 70,000 tons was recommended on the basis of an exceptionally good 1968 year-class. However, the 1972 catch was considerably lower than that of 1971, indicating that the year-class did not contribute to the 1972 catch to the extent anticipated previously. No sampling data were available to adequately assess the contribution of the 1968 year-class in 1972 and there is some uncertainty as to whether it is actually as strong as was previously estimated. At present, there is no evidence to indicate that the TAC of 70,000 tons recommended for 1973 should be changed and, thus, the TAC advised for 1974 is 70,000 tons. If the 1968 year-class does prove to be strong as was indicated from the survey data, then the potential yield can be attained in future years.

g) Division 4T and Subdivision 4Vn (Res.Doc. 73/7)

As indicated in the 1972 Assessments Subcommittee Report (*Redbook* 1972, Part I), two stocks are involved in this area: (i) the major stock, which inhabits Div. 4T in the summer, migrates eastward to Subdiv. 4Vn in December - January and moves back into Div. 4T in April - May; and (ii) small inshore stocks in Subdiv. 4Vn, which are independent of the larger migratory stock.

Landings from the major migrating stock declined from a high of 110,000 tons in 1956 to 41,000 tons

in 1967 but then increased to over 64,000 tons in 1970, declining in 1971 to about 56,400 tons and increasing in 1972 to 66,200 tons.

Abundance estimates indicate that stock size at present is about average, with year-classes of average strength expected to enter the fishery in 1974. The F-value estimated for 1971 indicates that at the current level of stock abundance, catches in 1972 and 1973 would be expected to decline to 50,000 tons. This F-value was slightly below the estimated F_{max} for this stock. Since the catch in 1972 increased to 66,200 tons, an increase in F to about the level of F_{max} is implied. Therefore, catches in 1974 should not be allowed to increase above the 1972 level.

h) Subdivision 4Vs and Division 4W (Res.Doc. 73/7)

Of the year-classes which were expected to contribute to the fishery in 1973, only the 1968 year-class appeared to be good, the 1966, 1967, 1969 and 1970 year-classes being poor onea. Therefore, the Assessments Subcommittee at the 1972 Annual Meeting concluded that F should not be allowed to increase above the current level which was close to F_{max}, and this implied a catch of 60,000 tons which was recommended as the TAC for 1973.

Survey results for 1972 confirm that the 1966, 1967, 1969 and 1970 year-classes are indeed below average but that the 1968 year-class is at leaat of average abundance. Thus, while the 1968 year-class, although strong, is not exceptional, stock abundance is likely to decline over the next few years. Total mortality estimates for fully recruited age-groups in 1971 ranged between 0.50 and 0.57, slightly lower than the 1960-69 average and also lower than that giving maximum yield-per-recruit ($Z = 0.65$).

The 1971 size compositiona indicate that Spanish catches are composed of cod which are significantly smaller than those caught by Canada. Since the analysis of the fishery for 1960-71 assumed that the size compositions of removals by Canada and Spain were the same due to lack of data from the Spanish fleet, this implies that yield-per-recruit and F_{max} values are in fact less than those estimated in earlier assessments. Thus, the TAC of 60,000 tons recommended for 1973 may in fact have been somewhat high, but the sampling data available does not allow adequate assessment of the situation. It does, however, seem prudent not to allow the catch to increase above the 1973 level, and the recommended TAC for 1974 is 60,000 tons.

i) Division 4X (Res.Doc. 73/7)

Previous data have indicated that the cod of the offshore Browns and LaHave Banks of Div. 4X belong to a separate stock from the inshore cod in Div. 4X. Preliminary results of tagging in 1969 and 1972 confirm this separation.

The catch from the offshore stock declined 50% to about 8,600 tons in 1970 and was about 9,000-10,000 tons in 1971. The 1972 catch from the offshore stock was probably at about the same level as 1971. Estimated population numbers from 1970-72 surveys indicate continued low stock abundance. Total mortality rate (Z) continued at the high level of the late 1960's, estimates being 1.5 in 1970-71 and 0.8 in 1971-72, well above the value of F_{max} of 0.55. Indications are that the year-classes after 1966 are poorer than those which supported the fishery in the mid-1960's. Thus, adult stock abundance is low, expected recruitment is poor and mortality rates are excessively high.

j) Division 5Y

The TAC in 1973 for the Gulf of Maine stock was set at 10,000 tons, which is somewhat higher than the average catch during 1952-71. The 1972 catch was about 7,000 tons. The Subcommittee had no new evidence on which to recommend changing the present TAC, and for 1974 the TAC of 10,000 tons is proposed.

k) Division 5Z

The 1973 TAC for the Georges Bank stock was set at 35,000 tons, which is considered to be the long-term MSY. The 1972 catch was about 24,000 tons. No new evidence was presented to suggest that the TAC should be changed from that of 1973, and thus the TAC recommended for 1974 is 35,000 tons.

New assessments should be carried out for both the Div. 5Y and Div. 5Z stocka, but at present both stocks seem to be exploited at a reasonable level, and the TAC's recommended should be able to prevent rapid expansion of effort in fisheries directed for cod.

3. Subareas 2 and 3 Assessments for Species other than Cod

A summary of recommended TAC's for 1974 together with ancillary data is given in Table 3. Details of the individual species/stock assessments follow.

Table 3. Subareas 2 and 3 assessments: recommended TAC's for 1974 with ancillary data (species other than cod).

Species	Stock area	MSY	Nominal Catch ('000 tons)			TAC ('000 tons) Recommended (Allocated)[1]			F_{max}	F_{1974}
			1966-70	1971	1972	1972	1973	1974		
Haddock	3L-N-O-P		8	5	4	-	-	-		
Redfish	3K		13	13	10	-	-	-		
	3L-N		20	34	28	-	-	20[2]		
	3M		4	8	40	-	-	-		
	3O		14	20	16	-	-	15[2]		
	3P		28	28	25	-	-	23[2]		
Amer. plaice	3L-N-O		75	68	59	-	60 (60.5)	60	$0.5(F_{0.1})$	0.50
Yellowtail	3L-N-O		13	37	39	-	50 (50)	40	$0.7(F_{0.1})$	0.75
Witch	2J		5[3]	2	1				No assessment	
	3K-L		12[3]	14	16					
	3N-O		6[3]	15	9					

1 "Allocated" here refers to the total allowable catch agreed by the Commission as the TAC.
2 General production study.
3 1970 catches only.

a) Haddock (Subarea 3) (Summ.Doc. 73/22)

A 1972 catch of 4,000 tons was at about the same low level as in the past several years. Young fish surveys in 1969, 1970 and 1971 indicated that the abundance of 1+, 2+ and 3+ year-old fish were at a low level. Surveys in 1972, although indicating some improvement in the abundance of 1+ haddock in Div. 3N-O, showed a marked reduction of 1+ fish in Div. 3P. Thus in 1973 and 1974 there will continue to be low recruitment to the adult stock, and abundance will remain at the present very low level.

In the southern part of Subarea 3 (Grand Bank, Green Bank and St. Pierre Bank) the average catches of 1+, 2+ and 3+ year-old fish per hour of trawling by USSR research vessels for the 1963-71 year-classes are as follows:

Year-class	1+		2+		3+	
	3N-O	3P	3N-O	3P	3N-O	3P
1963	-	-	-	-	2	17
1964	-	-	4	55	6	153
1965	1	13	1	41	1	4
1966	3	110	8	191	1	20
1967	1	183	1	16	1	2
1968	4	25	8	10	2	4
1969	4	35	4	38	1	5
1970	1	32	1	8	-	-
1971	9	2	-	-	-	-

It seems likely that almost all haddock caught on Grand Bank (Div. 3N-O) and to a large degree on St. Pierre Bank (Subdiv. 3Ps) are taken as incidental to fishing for other species, and this amounts to an intensive fisheries on the haddock stocks themselves. Fishing mortality is thus likely to be very high, and, because of poor recruitment, removals from this stock should be minimized.

b) Redfish (Division 3L-N, Division 30 and Division 3P) (Res.Doc. 73/40, 41, 88)

Redfish (*Sebastes mentella*) of Div. 30 and 3P exhibit different growth rates and hence are considered separately for assessment purposes. Redfish of the northern and eastern Grand Bank (Div. 3L-N) are considered to constitute a different stock from those of Div. 30 and 3P.

The mean annual catch of redfish in Div. 3L-N during 1955-71 was 20,400 tons, with annual catches fluctuating between 4,000 and 45,000 tons. The standardized catch-per-hour values fluctuated irregularly during 1955-71. The nominal catch in 1971 was approximately 34,000 tons, and preliminary statistics indicate that the 1972 catch was slightly lower at 28,000 tons.

Redfish catches in Div. 30 fluctuated between 2,000 and 20,000 tons during 1955-71. The 1972 catch of about 16,000 tons was less than the 1971 catch of 19,800 tons but above the 1955-71 mean annual catch of 11,000 tons. Standardized catch-per-hour values declined sharply from 1.3 tons in 1958 to about 0.4 in 1965, then increased to 1.0 in 1969 and subsequently declined to about 0.7 in 1971.

Redfish catches in Div. 3P increased gradually from less than 5,000 tons in 1955 to about 15,000 tons in 1964, with a substantial increase to a peak of 37,000 tons in 1970. The catch subsequently decreased to about 28,000 tons in 1971 and 25,000 tons in 1972.

The redfish catch in Div. 3M increased dramatically from 8,000 tons in 1971 to approximately 40,000 tons in 1972. The standardized catch-per-hour values were relatively high during 1955-58 (0.9 to 1.0 tons), decreased from 0.7 in 1959 to about 0.5 in 1962, increased sharply to 0.9 in 1965 and subsequently declined to 0.6 in 1971.

Because of the lack of adequate data on the size and age compositions of redfish catches, it has not been possible to conduct rigorous analyses of the fisheries in these areas. The Schaefer generalized production model was utilized to derive estimates of maximum sustainable yield from the commercial catch and effort data. The estimates of maximum sustainable yield of redfish are 20,000 tons for Div. 3L-N and 23,000 tons for Div. 3P. The maximum sustainable yield level for Div. 30 is less certain, but an upper limit of 19,000 tons was derived by means of a simplified application of the Schaefer model, this value being considered an over-estimate.

Catches in recent years have been above the long-term average and existing data are insufficient to determine how long these higher catch levels might be sustained. USSR research vessel survey data indicate that redfish abundance in these areas has been high in recent years and that the relatively large catches have resulted from good recruitment during this period. Although there is no definite evidence of over-exploitation, commercial catch/effort data indicate that the maximum sustainable yields are lower than recent catch levels and close to the long-term average catches.

Previous experience has indicated that redfish stocks are very slow in rebuilding after a period of intense exploitation. Since regulation of other species could result in a deployment of effort to these redfish stocks, it seems prudent to prevent any substantial increase in fishing pressure on redfish in these areas. Available data are insufficient to derive for 1974 total allowable catches which would correspond to particular fishing mortalities. The Subcommittee agreed that the TAC's for 1974 should be set at the maximum sustainable yield levels as indicated by present analyses - 20,000 tons for Div. 3L-N, 15,000 tons for Div. 30, and 23,000 tons for Div. 3P, until such time as adequate data are obtained to carry out more detailed assessments.

c) American Plaice (Divisions 3L-N-O) (Res.Doc. 73/34, 87, 89)

The fishery in Div. 3L, which has been mainly Canadian, reached a peak in 1969 at 50,000 tons. Catches have gradually declined to 40,000 tons in 1970, 38,000 tons in 1971 and to 33,000 tons in 1972. In Div. 3N the largest catch occurred in 1966 (35,000 tons) and recent catches were 15,000 tons in 1969, 20,000 tons in 1970 and 23,000 tons in 1971. The 1972 catch declined to near the 1969 level with approximately 17,000 tons being reported.

The increase in the fishery during the 1960's resulted in a corresponding increase in fishing mortality (F) which was maximal in 1970 at 0.65 for females and 0.77 for males. In 1971 F declined

to 0.6 and 0.7 for females and males respectively and was at the level of $F_{0.1}$* of 0.5 (females) and 0.6 (males) in 1972. Assuming that the 1973 TAC of 60,000 tons for Div. 3L-N-O will be taken, the stock sizes should remain unchanged. At this level of removal, fishing mortality values in 1973 should correspond to the level of $F_{0.1}$. Assuming recruitment in 1972 to 1974 to be at the average level of the previous few years, the TAC recommended for 1974, if fishing is at the $F_{0.1}$ level, is 60,000 tons (which includes an expected catch of 8,000 tons from Div. 30).

d) Yellowtail (Divisions 3L-N-O) (Res.Doc. 73/5, 89)

Yellowtail catches in Div. 3L-N increased from 3,000 tons in 1965 to 32,000 tons in 1971 and to 35,000 tons in 1972; in addition, approximately 5,000 tons were landed from Div. 30 in 1971 and 4,000 tons in 1972.

A new assessment utilizing the virtual population method has permitted the calculation of stock size for the years since the start of the fiahery. From this and from catch-per-unit-fishing intensity data, it is evident that, up to 1970, the total stock of yellowtail was increasing as the species extended its range over the shallow (<50 fm (90 m)) parts of the Grand Bank. However, the stock sizes in 1970 and 1971 seem to have remained at approximately the aame level and catch-per-unit-fishing intensity points to the same conclusion. It is therefore assumed that the stock has ceased to expand.

In estimating the probable levels of recruitment to the fishery at age 5, the average recruitment for 1969-70 was used. If the 1973 TAC of 50,000 tons (including 5,000 tons for Div. 30) is taken, the resulting fishing mortality rate is estimated to be about 0.9, which is considerably above the optimal level ($F_{0.1}$) of 0.7. Therefore, assuming that the 1973 TAC will be realized and using the 1969-70 average recruitment level, fishing at the level of $F_{0.1}$ (i.e. F = 0.70) indicates a TAC of 35,000 tons in 1974 for Div. 3L-N. Allowing a catch of 5,000 tons in Div. 30 indicates that the 1974 TAC for Div. 3L-N-O should not exceed 40,000 tons.

e) Witch (Divisions 2J-3K-L, Divisions 3N-O, Subdivision 3Ps) (Res.Doc. 73/49, 80)

For management purposes and with the present limited knowledge of stock separation, it is suggested that the groupings, indicated in the table of catches listed below with Div. 2J added to Div. 3K-L, probably represent the witch stocks of Subareas 2 and 3.

Year	Nominal Catches (tons)			
	Div. 2J	Div. 3K-L	Div. 3N-O	Subdiv. 3Ps
1962[1]	126	364	4,839	963
1963[1]	-	1,993	2,096	924
1964[1]	452	2,386	1,094	1,011
1965[1]	1,862	3,608	1,733	570
1966[1]	883	3,200	9,387	1,359
1967[1]	1,207	2,804	18,797	3,409
1968[1]	1,678	7,298	16,152	2,666
1969[1]	5,200	5,062	8,197	2,404
1970	5,388	12,134	6,039	2,702
1971	1,975	14,075	14,965	2,250
1972	1,443	15,687	9,176	2,680

[1] Catches in 1962-69 are estimates, since the actual quantities of witch included in the large "Flounders (NS)" catches reported for these years are not known.

At present no assessment of the stocks and no real knowledge of the size of the resource are available, but research vessel catches indicate that the numbers of witch in Div. 3L, 3N, 3O and Subdiv. 3Ps are small in comparison to the quantities of American plaice and yellowtail.

* $F_{0.1}$ = the value of fishing mortality at which the marginal yield per recruit is 10% of the catch-per-recruit per unit mortality in a very lightly exploited stock (*Redbook* 1972, Part I, p. 41). It represents a level of fishing mortality where the sustainable yield-per-recruit on the average reaches approximately 90% of the maximum sustainable yield for species with a 'flat-topped' yield-per-recruit curve.

The good catches reported from Div. 2J and 3K in recent years were composed mostly of large old fish constituting part of the virgin stock. It seems probable that witch fished by the Canadian inshore fleet belong to the same stock as that fished offshore.

With the limit on removals of many other atocks in the ICNAF Area, there ia a real possibility of diversion of effort to presently unregulated species. Since research vessel data do not indicate a large witch resource in these areas, it would be prudent to limit removals of witch to a level of catch in 1974 not substantially above recent catches.

f) General Biological Information

Several documents were presented which summarized studies in Subarea 3 on the biology and distribution of various species that are not considered elsewhere in the report. Since some of these contain data on species not before considered by the Assessments Subcommittee and some new biological data uaeful to further assessments of species already being considered, a reference to their contents is included here.

Res.Doc. 73/37 presents data on the food and feeding of American plaice in Subdiv. 3Ps, indicating their dependence on species living on or near the bottom. Geographical, seasonal and diurnal variations in feeding as well as variations with temperature and size of fish were indicated.

Res.Doc. 73/71 presents data on the sexual maturity and sex ratios of the squid (*Illex illecebrosus*) in Subarea 3, and Res.Doc. 73/72 defines the length-weight relationship of the species. Res.Doc. 73/79 discusses the distribution and biological characteristics of *Illex* on the Grand Bank, St. Pierre Bank and Nova Scotian Shelf from surveys in 1970-72. Res.Doc. 73/73 summarizes the nominal catch of squid in Canadian Atlantic waters in the 1920-68 period.

Res.Doc. 73/39 summarizes data on the maturity, feeding and length and age compositions of white hake in Subarea 3 in 1969, 1971 and 1972, suggesting one local population in the area. Hake feed heavily on various fish and spawn in the middle of the summer.

Res.Doc. 73/49 presents information on the breeding and development of witch in the Northwest Atlantic, indicating proposed spawning localities and the direction of egg and larval drift. Spawning occurs from March to September.

4. Subarea 4 Assessments for Species other than Cod and Herring

A summary of recommended TAC's for 1974 together with ancillary data is given in Table 4. Details of the individual species/stock assessments follow.

Table 4. Subarea 4 assessments: recommended TAC's for 1974 with ancillary data (species other than cod and herring).

Species	Stock area	MSY	Nominal Catch ('000 tons) 1966-70	1971	1972	TAC ('000 tons) Recommended (Allocated)[1] 1972	1973	1974	F_{max}	F_{1974}
Haddock	4V	25	3	3	2	0	0	0	0.5	
	4W		11	10	3	(4)	(4)			
	4X	(18)	32	18	13	0 (9)	0 (9)	0	0.5	
Redfish	4V-W-X		25	62	50	-	-	30[2]		
Silver hake	4V-W-X		26	129	114	-	-	50-100		
Pollock	4V-W		7	2	4	-	-	50[2]		
	4X		10	10	16	-	50 (50)			
	SA 5		9	14	13	-				
Amer. plaice	4V-W-X	32	13	14	11	-	-	13.6		
Yellowtail			7	2	2	-	-	5.4	32	
Witch			13	18	11	-	-	13.0		

[1] "Allocated" here refers to the total allowable catch agreed by the Commission as the TAC.
[2] Annual catch averaged over period of stability 1962-71 or adjusted therefrom.

a) Haddock (Divisions 4V-W) (Res.Doc. 73/7)

Nominal catches from this stock declined from 13,400 tons in 1971 to 4,700 tons in 1972. This was not entirely due to the quota limitation of 4,000 tons in Div. 4W in 1972 as the quota was not fully taken in that division.

Catch rates of Canadian commercial vessels declined again in 1972 to a new record low, and research vessel survey data also indicate a further decline in population abundance in 1972. Predictions of the strengths of the 1968-71 year-classes are that they are poor and no significsnt increase in abundance of the stock is expected to occur prior to 1976. Fishing mortality rates (F = 1.0) in 1969-72 have been consistently much higher than that giving maximum yield-per-recruit (F = 0.50).

Thia stock, which has been capable of sustaining catches of 25,000 tons in the past under conditions of normal recruitment, is severely depleted and the exploitation rate continues to be high. In 1972 a TAC of 4,000 tons in Div. 4W did not prove restrictive. The Subcommittee accordingly advises that there be no directed fishery for haddock in Div. 4V-W in 1974. By-catches alone are likely to amount to over 2,000 tons. It is also desirable that Div. 4V be included in the regulations to obtain full mansgement control of the stock throughout its range.

b) Haddock (Division 4X) (Res.Doc. 73/7)

The nominal catch in 1972 was 13,500 tons, which was considerably in excess of the TAC of 9,000 tons, although the directed fishery was closed in October. In 1973 the directed fishery for haddock was closed at the end of April, as landings and estimated by-catches for the remainder of 1973 are approximately equal to the 1973 TAC of 9,000 tons. Improved fishing success in the early part of 1973 resulted in part from the entry of the 1969 year-class to the fishery as 4-year-olds. Research vessel survey data indicate that the 1969 (and also the 1971) year-classes are stronger than those since 1963. However, these are still poor by pre-1963 standards when the stock was in a healthy condition.

Current levels of fishing mortality are probably close to that giving maximum yield-per-recruit. However, stock abundance is considerably below that giving maximum sustainable yield and current management objectives should be to rebuild the stock. Therefore, it is particularly important at this time, with the entry to the fishery of a slightly stronger year-class and with the prospect of another year-class of similar strength entering the fishery in 1975, that removals be minimized. This will maximize the chances of stock recovery.

At the 1972 Annual Meeting, the Assessments Subcommittee concluded that the proposed increase in trawl mesh size to 130 mm in Subarea 4 should result in increases in the yields from cod, haddock and flounders. This conclusion applies to Div. 4X as to the other divisions of Subarea 4.

c) Redfish (Divisions 4V-W-X) (Res.Doc. 73/100)

Redfish catches from the Scotian Shelf averaged close to 30,000 tons in the past decade, but increased to 62,400 tons in 1971 and was about 50,000 tons in 1972. Although commercial catch-per-unit-effort showed a slight increase in 1971, higher values were recorded in other years in the last decade, and thus 1971 and 1972 values do not suggest that any major increase in abundance took place. However, research vessel surveys also indicate that moderate increases in abundance took place over the 1970-72 period with the entry of a strong year-class (or several adjacent strong year-classes) to the fishery. This year-class was almost fully recruited to the commercial fishery in 1972 and was exploited heavily in both 1971 and 1972. There are no indications from research vessel surveys of further strong year-classes not yet recruited to the fishery, and thus there is no reason to believe that the present abundance is substantially above the long-term average. It is unlikely then that the high level of catch in 1971 and 1972 can be sustained.

A detailed aasessment of these stocks is not possible at this time. However, despite large variations in year-class strength, the slow growth and low mortality of redfish imply that little loss in yield will result from fishing consistently at a level corresponding to the long-term MSY. The Scotian Shelf stocks are known to have sustained a yield of about 30,000 tons in the last decade. The Subcommittee therefore advises that the appropriate level of TAC for 1974 should be 30,000 tona.

d) Silver hake (Divisions 4V-W-X)

The fishery for silver hake expanded rapidly from almost zero in 1960 to a catch of 123,000 tons in 1963 and subsequently declined to a very low level in 1967 and 1968. In recent years the fishing has redeveloped rapidly, and catches reached 169,000 tons in 1970, 129,000 tons in 1971 and 114,000 tons in 1972. No data are available from the earlier fishery to show to what extent the decline waa due to fishing or to natural causes. The present fishery has been conducted almost

exclusively by USSR, the midwater trawls used since 1971 taking very little by-catch of other species, except during the period when the fleet is searching over a wide area as the silver hake are concentrating and later diapersing.

Estimates of the yield-per-recruit (at M = 0.5) indicate that the level of fishing mortality at $F_{0.1}$ = 0.6 would give approximately 90% of the maximum sustainable yield-per-recruit. However, because of rapid development of the fishery and insufficient data, the current levels of fishing mortality, natural mortality, recruitment and the age of recruitment are not known accurately. The most reliable estimate indicates an F of 1.1 in 1970/71. This, in conjunction with an assumed high average recruitment, suggeats that a value of F = 1.4 would be required to account for the catch in 1972. The projected catches for 1974 are 50,000 tons at F = 0.6 and 100,000 tons at F = 1.4.

The Subcommittee also noted that, although the range of TAC for 1974 was estimated on the basis of partial recruitment values in 1970 and 1971, silver hake first recruit to this fishery as one-year-olds and that the indicated level of total mortality in 1972 (Z = 1.9) will result in a small number of age-groups in the exploited stock and so make the fishery heavily dependent on recruitment in eacb year. Silver hake mature at an early age (3 years).

e) Pollock or Saithe (*Pollachius virens*) (Divisions 4V-W-X, Subarea 5 and Statistical Area 6) (Res. Doc. 73/101)

At the January 1973 Special Commission Meeting a pre-emptive TAC of 50,000 tons was placed on pollock in Div. 4X and Subarea 5 for 1973. The pollock stock structure is not well known but only one major spawning location on Jeffrey's Ledge (Div. 5Y) has been located in the Northwest Atlantic. Thus, it would be prudent at this time to consider that the pollock of the Scotian Shelf and Subarea 5 belong to a single stock. Annual pollock catches in Subareas 4 and 5 and Stat. Area 6 declined from 35,000-41,000 tons in the 1960-65 period to 23,000-26,000 tons in 1967-71. The total catch increased in 1972 to 32,000 tons. Between 12% and 40% of these catches were taken outside the area covered by the 1973 regulation. Canadian commercial catch-per-unit-effort data suggest that the reduction in catches in 1966-71 resulted from a decline in stock abundance and that abundance increased again in 1972.

No detailed assessment is available for pollock, and it is unlikely that an accurate estimate of maximum sustainable yield will be possible unless biological sampling of the catches improves. However, it appears that some increase in removals over those in 1960's is possible without damage to the stock and there is no reason to suggest an adjustment in the 50,000 tons TAC at this time. However, this regulation should be extended to include Div. 4W and Div. 4V, taking account also of the fishery in Stat. Area 6, to ensure that the entire distribution range is under management.

f) Flatfish (Divisions 4V-W-X) (Res.Doc. 73/102)

Catches of flatfish (excluding halibut) from the Scotian Shelf increased from 10,000 tons in 1960 to 55,000 tona in 1968, and ranged from 20,000 to 37,000 tons in the 1969-71 period. A break-down of catchea by species for all of the countries exploiting the stocks is available only from 1970. In analysis, USSR catches of "unspecified flounder" in 1960-69 were allocated to species in proportion to the rstio of species catches reported for 1970 and 1971.

Greenland halibut. This is a cold-water species which is sparsely distributed on the Scotian Shelf. The maximum catch was 38 tons in 1969.

Winter flounder. This is a coastal species, sbundsnt in bays along the coast of Nova Scotia and particularly the Bay of Fundy. On the offshore grounds the only sizeable population is found in the shallows of Sable Island Bank. Catches have been small, the largest being 3,000 tons in 1971. The Canadian catch is almost entirely coastal in origin and is taken by small inshore boats fishing within Canadian territorial waters. The bulk of the USSR catch is probably taken from the deeper fringes of the Sable Island Bank stock, as the bulk of the population lies within the Canadian 12-mile fishing zone around that island.

Witch. This species is widely distributed in low abundance on the Scotian Shelf with localized areas of high abundance occurring in depths greater than 100 fm along the edge of the Laurentian Channel, in the "Gully" between Sable Island and Banquereau Banks, and in the deep holes north of Banquereau.

Catches fluctuated between 5,000 and 22,500 tons in 1960-71, Canadian catches being in the range of 5,000-9,000 tons and USSR catches fluctuating greatly from zero to 13,700 tons. Cansdian seine-net vessels accounted for 18% of total catches in recent years, the remainder being taken by otter trswls. Between 1965 and 1972 catch rates of witch by Canadian otter trawlers declined

in Subdiv. 4Vn but increased slightly in Div. 4W and 4X, resulting in no major trends in catch rates for the Scotian Shelf as a whole.

Canadian biological sampling of commercial catches is poor and USSR sampling non-existent. Thus, only a general impression of size and age composition of catches can be obtained. Canadian commercial landings are composed of fish 30-60 cm long and 5-15+ years old. Females are larger and older than males in the landings, full recruitment to the fishery occurring at age 8 for males and age 11 for females. Fishing with Danish seines takes smaller and younger fish than fishing by otter trawl.

Best estimates of mortality are Z = 0.55 for males and Z = 0.50 for females. Assuming natural mortality (M) to be 0.20 for males and 0.15 for females, males are being exploited at $F_{0.1}$ corresponding to a yield-per-recruit 93% of F_{max}, and females are being exploited close to F_{max}. Thus, although catches since 1965 were higher than those before 1965, catch-per-unit-effort has not declined. However, fishing mortality rates for both sexes are close to those giving maximum yield-per-recruit and catches significantly above the average for 1965-71, i.e. 13,000 tons, would not be sustainable.

American plaice. Plaice are widely distributed on the Scotian Shelf but major concentrations occur only in Div. 4V in depths less than 100 fm, particularly in the cold water area to the north of Banquereau. Catches increased from less than 3,000 tons in 1960-63 to over 10,000 tons in 1966-71 and may have been as high as 20,700 tons in 1968. Over 90% of the catches are by otter trawl, small quantities being taken by Danish seine, longlines and handlines.

Biological sampling of the Canadian commercial fishery allows description of the Canadian fishery in Div. 4V only, and this has been taken as representative of the entire fishery. Landings of males and females ranged in length from 30-55 cm and 30-70 cm respectively with modes at 38 cm and 48 cm. Occasional 5-year-olds and a few 6-year-olds occur in the landings of males, full recruitment occurs at age 9, and few fish older than 15 years are landed. No age-5 and 6 fish and only a few age-7 fish occur in the landings of females. Full recruitment occurs at age 11 and about 29% of females landed are older than age 15.

Catch rates of Canadian trawlers increased between 1965 and 1969 and then declined up to 1972. Research vessel surveys also indicate a decline in abundance in 1970-72 of similar magnitude.

Best estimates of mortality are Z = 0.65 for males and Z = 0.60 for females. Assuming M = 0.25 for males, the current value of F = 0.40 is close to $F_{0.1}$ and gives about 80% of the yield-per-recruit theoretically obtainable at very high values of F. Assuming M = 0.20 for females, the current value of F = 0.40 is higher than $F_{0.1}$ and yield-per-recruit is over 90% of that obtainable at very high values of F. These yield-per-recruit curves are flat-topped and these is no F_{max}.

Although landings increased in 1965, catch rates also increased through 1969, then dropped to about the 1965 level by 1972. However, the F's which are representative of the 1966-72 period were close to $F_{0.1}$ and little gain in yield would accrue from further increase. Thus, any substantial increase in catch above the 1966-72 average of 13,600 tons is unlikely to be sustainable.

Yellowtail. This species has a localized distribution on the tops of offshore banks in depths less than 50 fm. The densest concentrations are located on Banquereau, particularly on the Eastern Shoal, Sable Island and Middle banks. Catches increased from less than 1,000 tons in 1960 to over 5,000 tons in 1964 and to over 9,000 tons in 1968, declining to about 1,800 tons in 1971.

Canadian landings are composed of males 25-50 cm in length with a mode of 36 cm, and females 30-55 cm with a mode at 38 cm. A few 4-year-olds and a few fish over 10 years old occur in the landings, but most are 5-8 years old and there is little difference in age composition of males and females. Both sexes are fully recruited at age 6. Catch rates of yellowtail by Canadian otter trawlers on the Scotian Shelf declined by 80% from 72.9 kg/hr in 1965 to 14.8 kg/hr in 1972. This decline occurred in both the Banquereau and Sable Island - Middle Bank areas to the same degree.

The best estimate of fishing mortality for sexes and areas combined, with Z = 1.23 and assuming M = 0.30, is F = 0.93. This is considerably above $F_{0.1}$ of 0.50. The yield-per-recruit curve is flat-topped with no F_{max}. The $F_{0.1}$ level gives about 95% of the yield-per-recruit obtainable at very high levels of F.

In the 1965-69 period when catches averaged 6,250 tons after a period of lower landings, catch rates (and presumably abundance) fell from 72.9 kg/hr to 24.8 kg/hr, a decline of 66%. In 1970-72 catch rates have been more steady at the low level of about 15 kg/hr, implying that current lower levels of catches are not resulting in further stock decline. During the 1965-72 period, F has been above $F_{0.1}$ and yield-per-recruit has been close to maximum. This implies that the sustained yield of yellowtail from the Scotian Shelf is lower than 6,000 tons per annum.

General Conclusions on Flatfish. Individual species assessments indicate that the catches of witch should not greatly exceed 13,000 tons, American plaice not greater than 13,600 tons, and yellowtail should be less than 6,000 tons, to obtain rational exploitation of the flatfish resources of the Scotian Shelf. However, as the separation of catches by species prior to 1970 is largely hypothetical, the level of landings associated with the species mortality rates calculated is only approximate. An adequate species by species management regime requires a major increase in biological sampling coverage of all sections of the fishery and an accurate breakdown of flatfish catches by species.

Any errors in estimated yield levels resulting from the method of assessment used should balance each other when the species yields are combined. It is recommended, therefore, that the 1974 TAC for witch, yellowtail and American plaice combined should not exceed 32,000 tons in Div. 4V-W-X. (Combined catches have exceeded this level only twice (1968, 1971) in the 1960-71 period.)

5. Subarea 5 and Statistical Area 6 Assessments for Species other than Cod and Herring

A summary of recommended TAC's for 1974 together with ancillary data is given in Table 4. Details of the individual species/stock assessments follow together with comments on the mixed species fishery problem and the minimum mesh size in Subarea 5.

Table 5. Subarea 5 and Statistical Area 6: recommended TAC's for 1974 with ancillary data (species other than cod and herring).

Species	Stock area	MSY	Nominal Catch ('000 tons)			TAC ('000 tons) Recommended (Allocated)[1]			F_{max}	F_{1974}
			1966-70	1971	1972	1972	1973	1974		
Haddock	5Y-Z		53	12	7	0 (6)	0 (6)	0		
Redfish	5Y-Z		11	20	19	-	30 (30)	30[2]		
Silver hake	5Y	160	17	8[3]	6	-	10	10		
	5Ze		110	57[3]	77	-	80 (80)	80		
	5Zw + 6			25[3]	31	-	80 (80)	80		
Red hake	5Ze	40	42	6	39	-	-	50-70		
	5Zw			14	20	-	40 (40)			
	6		10	10	16					
Pollock			See Table 4							
Yellowtail	5(E69°)		35	24	30	16 (16)	16 (16)	16		
	5(W69°)					10 (10)	10 (10)	10		
Flo. except yellowtail	5 + 6		28	27	24	-	25 (25)	25[2]		
Mackerel	5 + 6		84	348	386	-	- (450)	245		

[1] "Allocated" here refers to the total allowable catch agreed by the Commission as the TAC.
[2] Annual catch averaged over period of stability.
[3] The total catch in Subarea 5 and Stat. Area 6 was 108,000 tons, of which 18,000 tons was unallocated by divisions in Subarea 5.

a) Haddock

The nominal catch from Subarea 5 in 1972 was 6,600 tons against a TAC of 6,000 tons. The fishery was closed on 12 October 1972. The USA autumn survey indicated the 1972 year-class was again very poor, similar to those observed over the past nine years. The recently observed increase in growth rate indicates that haddock are now recruiting at the age of 1½ years in contrast to age 2½ during earlier years, and this may reduce further the probability of increments to the spawning stock. The incidental catches (by-catches) of haddock are at present greater than the annual surplus yield. It is recommended, therefore, that the 1974 TAC for Div. 5Y-Z in 1974 be set at zero, and that any possible means to reduce the by-catch be taken if, in fact, this species is to have any chance of recovery.

b) Redfish

No assessment is available on the current status of the Subarea 5 stock. In 1972 the nominal catch was 19,000 tons, being the largest catch over the last decade but still well below the estimated MSY level of 30,000 tons. During the past five years survey abundance indices have shown no clear trends, but US commercial catch/day indices show a downward trend since 1969. There is no evidence to suggest that the 1974 TAC in Subarea 5 should be changed from that for 1973, i.e. 30,000 tons.

c) Silver hake (Summ.Doc. 73/22, 26)

An updated assessment for this species was not available. Information presented indicates that the abundance indices of the 1972 year-class on Georges Bank (Subdiv. 5Zs) and off southern New England (Subdiv. 5Zw and Stat. Area 6) were at about the same level as those of the 1971 year-class. However, the index for Div. 5Y increased significantly.

The 1972 nominal catch in Subarea 5 and Stat. Area 6 was 114,000 tons, an increase of 6,000 tons over that in 1971. Catches in 1972 by stocks were 6,000 tons in Div. 5Y, 77,000 tons in Subdiv. 5Ze and 31,000 tons in Subdiv. 5Zw and Stat. Area 6.

The Subcommittee has no reason to suggest that the TAC's for 1974 be changed from those set for 1973: 10,000 tons for Div. 5Y, 80,000 tons for Subdiv. 5Ze, and 80,000 tons for Subdiv. 5Zw and Stat. Area 6.

d) Red hake (Res.Doc. 73/27, 28; Summ.Doc. 73/22, 26)

The 1972 catch in Subarea 5 and Stat. Area 6 was 75,000 tons, an increase of 35,000 tons over that for 1971. The catch from Subdiv. 5Ze was reported as 39,000 tons and that from Subdiv. 5Zw and Stat. Area 6 was 36,000 tons. The US research vessel survey data indicated a decrease in population on Georges Bank (Subdiv. 5Ze) from 1971 to 1972, and an increase for the Subdiv. 5Zw - Stat. Area 6 stock.

A new assessment prepared by the USSR indicated that the TAC for the area west of 69°W could be 50,000 tons, if a 50% exploitation rate was assumed and if the 1972 year-class was equal in abundance to those of the previous years.

The following facts must be taken into account in advising the level of catch for 1974:

i) At the 1972 Annual Meeting the 1973 TAC of 40,000 tons was advised for the whole of Subarea 5 and Stat. Area 6. The Commission agreed to this TAC for Subdiv. 5Zw and Stat. Area 6, on the assumption that catches in Subdiv. 5Ze would be incidental and that there would be no increase in catch in 1972. In 1972, however, the total removals were 75,000 tons, of which 39,000 tons were reported from Subdiv. 5Ze. Because the two population components mix along the dividing line between Subdiv. 5Ze and 5Zw, the 69° longitude line is considered a better dividing line between the two stocks. It is probable that a large proportion of the Subdiv. 5Ze catch came from the western part of the subdivision.

ii) The new assessment applies to the population west of 69°W (not to Subdiv. 5Zw and Stat. Area 6) and does not include the effects of the 1972 catch. The recruitment in 1974 is unknown, but is assumed to be equal to the average of the last five years.

iii) The previous assumption of only incidental catches from the Georges Bank stock should be reviewed when a new assessment is made.

In order to avoid possible confusion concerning the identity of the stocks from which catches have originated, the TAC for 1974 should be set either as an overall TAC of 52,000 tons for Subdiv. 5Ze + 5Zw + Stat. Area 6, or divided as follows: 12,000 tons for Subdiv. 5Ze, and 40,000 tons for Subdiv. 5Zw + Stat. Area 6. A 1974 TAC of 50,000 tons for Subdiv. 5Zw and Stat. Area 6 was also

suggested. The alternatives arose in discussion about the size of the stock in Subdiv. 5Ze. Since this cannot be evaluated until a new assessment is completed, the Subcommittee agreed to an overall TAC for 1974 of between 50,000 and 70,000 tons for Subdiv. 5Ze + 5Zw + Stat. Area 6.

e) Pollock (See Section 4(e) above)

f) Yellowtail (Res.Doc. 73/104; Summ.Doc. 73/22, 26)

Subarea 5, east of 69°W longitude. The reported catch for the year was 18,302 tons, exceeding the quota of 16,000 tons significantly. The USA caught 15,316 tons (including discards), while other countries reported 2,988 tons after the end of the year. The US directed fishery was not closed because the bi-weekly reports indicated that the quota would probably not be exceeded.

The catch-per-tow from US autumn survey cruises indicated that the population density on Georges Bank has not changed significantly from 1971. The USSR survey data suggested a decrease in population density since 1970. However, the 1971 survey data were not directly comparable because of a change in gear.

The density index of age 1+ fish from both US and USSR surveys indicated a decreased recruitment for 1973 and 1974. The relationship of this index to subsequent population density is not yet determined, and it is not therefore a reliable predictor of potential catch. The Subcommittee agreed, therefore, that the 1974 TAC should remain at 16,000 tons.

Subarea 5, west of 69°W longitude. The reported catch for the year totalled 13,689 tons (including US discards of 1,941 tons and industrial fishery catch of 329 tons), a significant surplus over the quota of 10,000 tons. A total catch of 1,644 tons was reported for the Cape Cod stock, for which a catch of 2,000 tons was predicted. The US directed fishery was closed on 29 November 1972. The 1972 catch of 13,689 tons includes 2,761 tons reported by USSR at the end of the year.

The catch-per-tow of yellowtail in the US research vessel survey increased significantly from 1971 to 1972. The USSR survey implied a decrease and the US commercial catch-per-unit-effort did not change. The proportion of yellowtail in the total catch of all species in the US survey did not change from 1971 to 1972. It was concluded, therefore, that the increase indicated by the US autumn survey in 1972 probably was due to sampling error. The index of age 1+ fish in both the USSR and US surveys decreased from 1971 to 1972.

Using the prediction index of population size developed by Brown and Hennemuth (Res.Doc. 71/22), it is estimated that a catch from the southern New England stock (excluding the Cape Cod stock) of 7,000 tons in 1974 would maintain F at the MSY level, but would not provide for any increase in spawning stock size. However, with the uncertainty about the 1972 survey index and the 1974 recruitment estimate, the Subcommittee agreed that no change was warrented at this time, and advised that the 1974 TAC for the area west of 69°W be 10,000 tons (8,000 for the southern New England and 2,000 for the Cape Cod stocks).

Statistical Area 6. The 1972 nominal catch was 8,900 tons, an increase over the 1971 catch of 6,900 tons. The relationship of this stock to that in Subarea 5 is not precisely known, although some mixture is almost certain to occur because of the contiguous distribution along the dividing line. The increasing catch may, therefore, offset the Subarea 5 conservation program, and perhaps some limitations of catch in this area should be considered.

g) Flounders except Yellowtail

The 1972 nominal catch in Subarea 5 and Stat. Area 6 was about 24,000 tons, somewhat lesa than that in 1970 and 1971. Abundance indices of flounders (except yellowtail) from US groundfish surveys in 1969-71 in Div. 5Z and Stat. Area 6 indicated a moderate decline (about 30%) from the level observed in 1963-65 (Res.Doc. 73/8). Even greater declines in flounder abundance was observed for the southern parts of Stat. Area 6 in both US and USSR surveys since 1967. However, no assessments are available for these stocks as yet, and no change is recommended in the TAC level of 25,000 tons in 1974 for flounders (except yellowtail) in Subarea 5 and Stat. Area 6.

h) Mackerel (Res.Doc. 73/14, 23, 70, 82, 98)

The Subcommittee set up an *ad hoc* Mackerel Working Group to re-analyze all available data concerning the mackerel fishery in Subareas 4 and 5 and Stat. Area 6. The Report of the Working Group is at Annex 1.

There is a possibility that mackerel in the ICNAF Area are divided into two distinct stocks. More information is needed to resolve this question, but there is no reason to suppose that the broad conclusions expressed here would be affected.

The age structure of the catch in 1971 and 1972, the growth rate, the total mortality in 1971 and 1972 and recruitment up to and including the 1970 year-class were agreed to. The allocation of total mortality into the ratio of its component natural and fishing mortality (F/M), the recruitment since the 1970 year-class, and the age of recruitment to the fishery were not agreed to, so the Group investigated a range of values representing the interpretations put forward. Although differences of opinion exist on the exact level of exploitation in 1971 and 1972, all selected ratios of F/M indicate the long-term yield is close to (within ± 10%) the yield-per-recruit at $F_{0.1}$.

The catch in 1974 has been estimated assuming that (i) total mortality, and the ratio of F/M within that total, remain at the 1971/72 level; (ii) average weight in the catch has been taken at the highest observed value in the catch (1972); and (iii) the catch from the recruiting age-groups (age 1 in 1973, ages 1 and 2 in 1974) is equal to the largest catch in numbers for those age-groups as reported in Res.Doc. 73/98 (Table 4). The results are summarized in Table 6 of Annex 1.

Depending on the assumption taken, expected catches range between 200,000 and 250,000 tons in both 1973 and 1974. In view of this, the Subcommittee is particularly concerned that the TAC of 450,000 tons aet for 1973 is greatly in excess of the projected catches. The attainment of this TAC and its subsequent effect on the resource depend critically on the size of the 1971 and 1972 year-classes which cannot be assessed at the present time. If the 1971 and 1972 year-classes are only of moderate size, fishing mortality must increase considerably over the 1971 level for the 1973 TAC to be obtained. The projected catch for 1974 may then be too high. The implication to the future fishery and to the spawning stock will be particularly severe if the average age of recruitment is at one year of age.

The estimate of TAC currently advised for 1974 is 245,000 tons. Some scientists disagreed with this conclusion, and the Subcommittee has invited them to submit to the Mid-term Meeting other estimates of TAC supported by data which will permit critical evaluation by the Subcommittee of the parameters upon which the estimate is based. These scientists are also expected to participate in a re-assessment of mackerel in order to reach an agreed solution to the problem.

The Subcommittee recalled the recent history of some herring stocks in the ICNAF Area and emphasized that a conservative management strategy at this time could reduce the risks of a recurrence of a similar concern with regard to mackerel. The risks are highest if the average age of recruitment to the fishery is low (1 year). If the average age of recruitment is higher, then the potential harvest of the 1971 year-class, even if it is large, could be taken in 1975 following a TAC of 245,000 tons in 1974. Regulation to ensure that the average age of recuritment is higher (2 years), e.g. minimum mesh or size regulations, would mean that 245,000 tons is somewhat higher than the catch that would be achieved.

i) Squid (Res.Doc. 73/62, 71, 72, 73, 79)

Two types of squid are caught commercially in the ICNAF Area, *Loligo* and *Illex*. *Loligo* is the genus sought by fishermen and provides the basis for the fishery, which caught 41,000 tons in 1972, primarily by Japan, Poland, Spain and USSR (39,000 tons). *Loligo* is a short-lived species; very little is known of its biology, but, so far as can be judged at present, they only occur in the fishery for one year. The Japanese fishery takes place in the winter - early spring period, when the squid are moving northward through Stat. Area 6 and into Subarea 5 before dispersing to spawn.

Estimates of stock size have been based on the detailed information on the catch, area and fishing effort contained in logbooks of Japanese fishermen. These indicate that quantities in the region of 100,000 tons of *Loligo* have migrated into the area each year since 1968, when observations began. Bearing in mind the short life span, the only biological restraint on the potential catch is the need to preserve an adequate spawning stock, and, presuming this to be a proportion comparable to that currently judged necessary for fish stocks, it appears that catches of 50,000-80,000 tons per year could be taken. This preliminary evaluation, therefore, indicates that at current catch levels the squid fishery is approaching a level of full exploitation.

j) The Mixed Species Fishery Problem (Comm.Doc. 73/5; Res.Doc. 73/8, 9, 99)

The Subcommittee discussed changes in the biomass of total finfish resources as indicated by the US and USSR research vessel surveys in Subdiv. 5Zw and Stat. Area 6 during recent years (Annex 3A). These show a downward trend throughout the period for major species group components. Although the precise significance of changes between any two pairs of years for any one species is difficult to evaluate, it is clear that groundfish fishing operations could be expected to catch a mixture of species. A description of the nature of the species mixture problem in Subarea 5 and Stat. Area 6 is given in Res.Doc. 73/9. A further analysis of the by-catch of species caught incidentally in fisheries for other species, and its implication to the efficiency

of ICNAF regulations, was presented in Res.Doc. 73/99. The Subcommittee considers that the technique described offers one method of evaluating the problem but emphasizes

i) that the basic estimates of by-catch represented by the interpretation of monthly landings must overestimate the true incidental catch as defined in Comm.Doc. 73/5;

ii) that, although the true incidental catch may be overestimated, the data do reflect the subsidiary catch of other species associated with a directed fishery and that the identification and reduction of true incidental catch would involve more rigorous reporting and fleet management procedures; and

iii) that the preferential adjustment of species TAC's to reduce the by-catch problem depends on a judgement of the relative importance of different species fisheries which cannot be based solely on biological criteria.

k) Minimum Mesh Size in Subarea 5 (Comm.Doc. 73/18)

The US memorandum on conservation measures (Comm.Doc. 73/18) proposed supplemental gear regulations for the area west of 69°W longitude. These were:

i) that all trawl fisheries using gear capable of catching demersal epecies inside the 40-fm contour use codends with a minimum mesh size in the codend of 130 mm (manila); and

ii) That outside of the 40-fm contour a minimum codend mesh of 62 mm be used.

Most of the major species fisheries are conducted both inshore and offshore with some seasonal variations in fishing patterns: the flounder fisheries are more inshore and the squid fishery predominantly offshore. Differential size distributions of the fish considered do not provide for selective fishing, except possibly for the hakes which are generally larger (>22 cm in length) offshore in the winter - spring fisheries.

Information regarding mesh size in use and selectivity of the 62-mm mesh is given in Table 6. Although no information was available on mackerel selectivity, the 62-mm mesh probably would retain a large proportion of fish now caught. The herring meshing problem was seen to be a potential problem with the 62-mm mesh. Information on squid was not adequate to delineate the effect of a larger mesh.

Table 6. Information on mesh size in use by various countries for different species.

Fishery[1]	Country	Mesh used (mm)	Selectivity (62 mm)
Herring (minimum size limit 23 cm)	Poland	45-50	Retains about 10% of fish less than 23 cm
	FRG	45	
	USSR	40-44	Possible meshing and gilling problems
	Bulgaria	-	
	Japan	48-63[2]	
Mackerel	Poland	45-50	No information
	FRG	45	
	USSR	40-44	
	Bulgaria	?	
Red hake and Silver hake	USSR	40-44	50% selection length for silver hake is 27 cm and red hake is 30 cm (ICNAF *Res.Bull.* No. 3, 1966)
	USA	50-70	
Squid	Japan	48-63[2]	No information
	Spain	?	
	FRG	45	
Scup and Butterfish	Japan	48-63[2]	No information
	USA	50-70	

[1] Other species taken as by-catches or in mixed fisheries.
[2] Double net nylon liner in 90 mm codend.

The 130 mm mesh inside 40 fm would significantly effect the hake, herring and also probably the mackerel fisheries.

The trawl fisheries for hake are conducted to a large extent with bottom trawls. The Japanese fisheries also use bottom trawls. The herring and mackerel fisheries of Bulgaria, Poland and USSR are conducted with pelagic trawls which fish near but not on the bottom, the distance from the bottom being variable. The use of such trawls tends to minimize the by-catch of some groundfish species, but does not eliminate it. The Fed. Rep. Germany herring fishery use a mid-water trawl and the by-catch of groundfish species in this fishery was less than 3% by weight in 1972.

In summary, the effect of the 62-mm minimum mesh outside of 40 fm could not be fully evaluated, but its potential disadvantages (e.g. meshing) may not be such as to preclude its use as a partial solution to the by-catch problem. The 130-mm minimum mesh inside 40 fm would alleviate the by-catch problem but would cause a significant loss of catch of herring and the hakes. The gear at present in use in the fisheries mentioned above is generally capable of catching groundfish species.

6. Developing Fisheries

a) Capelin (Subareas 2 and 3) (Res.Doc. 73/26, 33, 90)

Capelin is distributed mainly off Labrador and north and east Newfoundland. Typically these fish spawn inshore but the existence of spawning concentrations on the southeast shoal of Grand Bank suggests at least partial separation of the capelin in this area from those further north. This developing fishery took 70,000 tons in 1972, the bulk of the catch being taken in Div. 2J and 3K in a fishery on maturing capelin, with the remainder being taken in a fishery for spawning capelin in Div. 3N-O during June and July.

No assessment can yet be made, but a review of the stocks of fish and marine mammals which feed on capelin indicate that their annual consumption could amount to at least 2.2 million tons, pointing to a stock well in excess of this figure. Present catches, therefore, represent an insignificant proportion of the total, but the quantity which might be harvested without detriment to their predators is not known. Evidently the catch could be increased considerably, perhaps to 750,000 tons, but being a short-lived fish both stock and potential catch are likely to fluctuate sharply. In order to control the development of the fishery to a rate consistent with assessment of its potential, the Subcommittee considers that the total catch in 1974 should not exceed 250,000 tons. Since a substantial proportion of capelin die after spawning, a limitation of fishing to the pre-spawning aggregations would permit a catch which ensures the adequate escapement of spawning fish and at the same time preserves the stock necessary as fodder for associated resources.

Countries concerned in the development of this fishery are requested to provide data that will permit analysis of its effect upon the resource.

b) Other Species

Other species for which significant fisheries may be, or have already been, developed include sand launce (Subareas 1-4), Greenland halibut (Subareas 1-3), roundnose grenadier (Subareas 1-3), midwater oceanic redfish (Subareas 2-3) and argentine (Subareas 4-5).

Argentine (Res.Doc. 24 and 25) are distributed along the edge of the continental shelf and make limited migrations inshore to spawn in pockets of deep water. Mixing north and south along the shelf edge is very limited. Total catches in 1972 were 6,000 tons in Subarea 4 and 33,000 tons in Subsrea 5. The size and age of argentine varies with depth of capture, and thus the estimation of mortality in the stock as a whole is difficult. At present the mortality appears to be low in Subarea 4, but in view of the slow growth rate and late maturity the overall productivity of the resource is expected to be rather low, as with redfish, with potential catches in Subsrea 4 of the order 50,000 tons. No data have been presented concerning the potential of argentine in Subarea 5, but it is unlikely to be very high.

The fishery for roundnosed grenadier yielded 80,000 tons in 1971 and 26,000 tons in 1972 but, as for sand launce, Greenland halibut and oceanic redfish, insufficient data have so far been presented to provide a basis for assessments to be made.

7. Herring

Information on herring preaented to the 1973 Annual Meeting is contained in Res.Doc. 73/2, 11, 12, 16, 17, 19, 29, 37, 51, 63, 68, 81, 84, 91, 92, 93, 94, 95, 97, 115. The Report of the Herring Working Group is at Annex 2, a summary of which follows.

a) Status of the Fisheries

The total nominal catch in the ICNAF Area and Stat. Area 6 for 1972 was 547,000 tons which represents a 25% reduction from the 1971 catch and 43% reduction from the peak 1969 catch.

Preliminary information on the 1973 fisheries indicates that, as anticipated in January 1973, the 1970 year-class is large for the Georges Bank stock (Div. 5Z and Stat. Area 6).

b) Size Limits

The Canadian proposal (Comm.Doc. 73/1) for alternative tolerance criteria for herring size limits was discussed in the light of information presented in Res.Doc. 73/91. It was agreed that the Canadian proposal would lead, if anything, to a lower exploitation of under-sized fish than under the criteria at present being used.

c) Timing of Setting TAC's

Proposals related to the timing of the establishment of TAC's for herring (Comm.Doc. 73/2) and to the expediting of coming into force of measures recommended by the Commission (Comm.Doc. 73/14) were discussed in relation to the availability of scientific data at different times of year. The potential catch during a calendar year depends upon the size of the adult stock and on recruitment of young herring to that fishery. Estimates of this recruitment could be best obtained from juvenile herring surveys during the first half of the year in conjunction with the results of earlier surveys. The scale of the fishery as a whole in the second half of the year exerts a critical influence on the potential catch for the following year.

The accuracy of a TAC set at the Annual Meeting for the following January to December calendar year would be limited because of the unknown influence on the total stock of the fishery to come in the second half of the year. A TAC for the calendar year January - December set at a mid-term meeting in January, as at present, takes account of the fishery in the previous year but it cannot incorporate all the recruitment information that has a bearing on the potential catch in the year in question. For the same reason, a TAC set at the mid-term meeting for a quota year starting in July of that year to June of the following year would be no more accurate.

It was agreed that the Assesments Subcommittee at the time of the Annual Meeting could have available the estimatea of recent recruitment and of the effect of the fishery in the previous year, and so could provide the best estimates for a TAC in a quota year beginning in July, following the Annual Meeting, to June of the following year. For such a scheme to be practicable recommended measures would have to be brought into force very quickly.

d) Management Proposals for the Banquereau Stock (Subdivisions 4Vs, 4Vn and 4W(a))

No satisfactory biological basis for the recommendation of a TAC for the Banquereau stock was available to the Group. It was agreed that a pre-emptive level of TAC of 45,000 tons for 1974 could be given as advice to the Commission (Annex 2).

e) Research Program

Statistics and Sampling. It was agreed that monthly herring catches, expressed in numbers by age-group in a standard format similar to that given in Summ.Doc. 73/10, is desirable for herring data and should be reported for small statistical areas than in current ICNAF formats. Improved catch, effort and sampling data is required for all areas.

Larval Surveys. The results of the 1972 herring larval surveys were collated (Res.Doc. 73/115) and discussed. Larval production in the Georges Bank area (Subdiv. 5Ze) was lower and that in the Nantucket Shoals area (Subdiv. 5Zw) higher than in 1971 but total production over the whole survey area (i.e. including Div. 5Y and 4X) was similar for 1971 and 1972. The essential discreteness of spawning areas, with larval drift between areas minimal, is now considered to be established by the series of surveys carried out in recent years. Continuation of surveys was recommended to establish a time series of data relevant to factors determining larval survival and year-class size.

Juvenile Surveys. The results of a preliminary survey for juvenile herring were promising. They confirmed the existence of a large 1970 year-class, indicated that the 1971 year-class is relatively small, and provided useful information on the distribution and abundance of other species including mackerel, cod, haddock, pollock and squid. Although the results cannot yet be interpreted in terms of absolute abundance of individual year-classes, and hence of recruitment prospects, continuation of such surveys on a more comprehensive baais is strongly recommended in order to establish a strong basis for estimates of future recruitment to the fisheries. Detailed plans for 1974 were

discussed, as was the extent to which surveys for pelagic species can be coordinated with those for groundfish. For 1974 it was agreed that bottom herring-trawls would be used, but that basic sampling strategy would be based on that for groundfish, and comparative experiments carried out to determine the extent to which more comprehensive coordination will be possible in later years.

8. Statistics and Sampling

Throughout the extensive analyses associated with the many TAC's that have been estimated at the present meeting, the Subcommittee has been more than ever aware of the inadequacy of the data upon which these recommendations are made. This can only be rectified by considerable increase in national sampling efforts, but the task will be assisted by improvements in the presentation of data in the ICNAF *Sampling Yearbook* and in the ICNAF *Statistical Bulletin*. Accordingly, the Assessments Subcommittee

recommends (2)

a) *that national sampling data of commercial and research vessel sampling by species, gear and division be published according to the format described in Table 1 of Summ.Doc. 73/10; and*

b) *that Tables in the Statistical Bulletin be arranged so that (i) monthly nominal catches of mackerel, capelin, red hake, pollock, American plaice, yellowtail and witch can be readily available; and (ii) nominal catches of squid be identifiable by species where possible.*

9. Groundfish Surveys

The Groundfish Survey Working Group (Annex 3) reviewed progress in establishing a comprehensive survey program for the ICNAF Area and improvements in gear comparability and sampling design that would further enhance the value of the results. Several scientists reported that although surveys had been conducted recently it had not been possible to analyse the results in time for this meeting. Necessarily, with the increased volume of data becoming available, timely analysis must rely on automatic data-processing to an increasing extent and the Subcommittee endorsed the view of the Working Group regarding the need to review the volume of sampling and fishery data in relation to the management measures in operation, to establish the level and techniques, particularly sampling design of all sampling associated with varying degrees of accuracy that might be required, and to investigate the need and costs of establishing an expanded central data-processing unit in the light of that study.

ANNEX 1 - REPORT OF AD HOC MACKEREL WORKING GROUP

Participants were: P. Kolarov (Bulgaria), D. Iles and L. Parsons (Canada), S. Munch-Petersen (Denmark), A. Schumacher (Fed.Rep. Germany), Ø. Ulltang (Norway), A.J. Paciorkowski (Poland), B. Brown and V. Anthony (USA), V.A. Rikhter (USSR) and E. Cadima (FAO) was Chairman. The Group met on 25-26 May 1973 to consider and discuss the data and information in the following documents: Res.Doc. 73/14, 23, 70, 82, 98; and working papers by Anderson (USA) and Noskov and Isakov (USSR).

1. Stock Identity, Inter-relationships and Migration

The discussions were based on the assumption that the Subarea 5 and Stat. Area 6 fisheries exploit a single stock, inhabiting these areas. Information on tag returns (Res.Doc. 73/82) indicates that mackerel from Subarea 3 migrate to the area of the Subarea 5 and Stat. Area 6 fishery. This brings into question the assumption that mackerel in the ICNAF Area are divided into two biologically distinct stocks, the northern and southern. If there is only one stock in the ICNAF Area, the assessment considered here is affected only slightly, because catches in Subareas 3 and 4 are currently relatively very small. If two stocks are involved, with the northern stock over-wintering in the southern area, the effect on the assessment will depend on the degree to which "mixing" varies from year to year, and no data is available on this matter. More information relating to stock identity is urgently needed to solve these questions, although there is no reason to suppose, at the present time, that the broad conclusions expressed here would be affected.

2. Data and Parameters Used for Assessment

As the basis for a joint assessment of mackerel in Subarea 5 and Stat. Area 6, the Working Group agreed to use data and the actual values of parameters which were judged reliable and to use appropriate ranges for those parameters for which the data were not precise enough to allow the choice of a single agreed standard.

a) Catch Statistics for 1972

The catch statistics for 1972 (Table 1) are derived from data presented in Summ.Doc. 73/17 of nominal catches by member and non-member countries as submitted on STATLANT 21A forms

Table 1. Mackerel catches (tons) from Subarea 5 and Stat. Area 6 in 1972.

	BUL	CAN	FRG	JAP	POL	ROM	SPA	USSR	USA	GDR	CUBA	TOTAL
Subarea 5	7,452	1	758	209	61,486	515	6	103,686	1,020	25,374	9	200,516
Stat. Area 6	16,104	-	14	895	80,513	2,003	-	30,371	976	54,567	-	185,443
Total	23,556	1	772	1,104	141,999	2,518	6	134,057	1,996	79,941	9	385,959

b) Catch-per-effort Data

Catch-per-effort data were available for B-18 and B-20 class Polish trawlers (Res.Doc. 73/98), as numbers-per-hour and tons-per-hour from USSR data (Res.Doc. 73/23), and from a collation prepared by USA of data for countries fishing the mackerel stocks (Res.Doc. 73/14). The USA also contributed research vessel sampling data. A summary of all catch-per-effort data considered by the Group is listed in Table 2.

c) Growth Data

No great discrepancies were found in the growth data presented by repreaentatives of several countries. The Group agreed on a method of weighting to describe mackerel growth in terms of the von Bertalanffy growth equation. The parameters that were agreed by the Group are: L_∞ = 45 cm (total length), K = 0.25, t_o = -1.9 years, and W_∞ = 735 gm.

d) Age Distribution of Catches

Examination of available 1971 data indicated that the between-country differences in age distribution of mackerel catches were small. Data for 1972 presented by Polish scientists were more

complete in coverage and included a proper weighting by season and area. These data together with Polish data for 1971 (Res.Doc. 73/98) were accepted as the basis for assessment and are given in Table 3. Data for earlier years were considered less representative and were not used.

Table 2. Catch-per-unit-effort data, 1968-73.

	Res.Doc. 73/98[1]											
	Polish B-18 trawlers						Polish B-20 trawlers					
	20-60% mackerel			>60% mackerel			20-60% mackerel			>60% mackerel		
Year	Days	C/day tons	Ratio to 1970	Days	C/day tons	Ratio to 1970	Days	C/day tons	Ratio to 1970	Days	C/day tons	Ratio to 1970
1968	69	25.6	0.78				69	11.4	1.18			
1969	18	27.5	0.84				444	12.3	1.27			
1970	529	32.7	1.00	471	34.9	1.00	645	9.7	1.00	411	6.8	1.00
1971	982	31.9	0.97	982	31.9	0.91	665	10.7	1.10	393	8.8	1.29
1972	760	32.1	0.98	760	32.1	0.92	1,057	9.8	1.00	1.057	9.8	1.44
1973[2]				108	39.1	1.22				275	12.5	1.83

	Res.Doc. 73/23				Res.Doc. 73/14					
	USSR large otter trawlers				w/o learning		w/learning		US bottom trawl spring survey data (No./haul)	Ratio to 1970
Year	No. of hours	Ratio to 1970	Catch /hr[3]	Ratio to 1970	Catch /hr	Ratio to 1970	Catch /hr	Ratio to 1970		
1968	239	0.01	0.63	0.14	0.46	0.52	1.80	1.71	0.73 (±0.24)[4]	
1969	5,099	0.28	1.18	0.27	0.62	0.70	1.32	1.26	0.03 (±0.02)	
1970	18,218	1.00	4.39	1.00	0.89	1.00	1.05	1.00	0.56 (±0.18)	1.00
1971	12,456	0.68	3.69	0.84	0.82	0.92	0.91	0.87	0.52 (±0.18)	0.92
1972									0.42 (±0.18)	0.75
1973									0.33[5]	0.59

1 Fishing season, November - May, with year designated for January - May.
2 Preliminary data for partial season, November 1972 - March 1973.
3 Calculated using weight at age from Res.Doc. 73/23, of age VI, and Anderson working paper for ages VII-XI.
4 95% confidence limits.
5 Preliminary calculation, no confidence limits available.

Table 3. Weighted age composition data (‰) for 1971 and 1972 used in the mackerel assessment.

	Age											
	0	1	2	3	4	5	6	7	8	9	10+	Total
1971	-	76	210	79	400	172	34	10	8	7	4	1,000
1972	9	34	62	232	181	339	91	27	7	11	7	1,000

e) Mortality Estimates

Natural Mortality (M). Catch curves for older age-groups for the 1968-1972 period gave estimates of total mortality (Z) for years previous to 1968. It was assumed that, because exploitation rates for years prior to 1968 were low, total mortality estimates from these curves would approach values for M. Data from Res.Doc. 73/23 gave ranges of Z (≈M) of 0.4 to 0.6; from data in Res.Doc. 73/98 values of Z (≈M) varied in the range of 0.2-1.2 both for within- and between-years. An estimate of M, by comparing estimated total effort and estimates of Z over the years 1970-72, is given in Res.Doc. 73/98 as 0.35. The same method was applied to data in Res.Doc. 73/14 (without a learning factor being used) and in Res.Doc. 73/23 for the years 1968-1971. It gave variable results, depending on the interpretation of 1969 data, and no indication of an actual value for M.

After discussion, it was concluded that the life-spans of mackerel stocks on both sides of the Atlantic were similar, indicating that values for M found for North Sea mackerel (M in the range of 0.15-0.25) might be applied. However, differences in values for the von Bertalanffy growth parameters were large, and it was agreed that further information was needed to be able to come

to a conclusion on these comparative grounds. It was agreed to use working values for M in the range of 0.2 to 0.4.

Total Mortality (Z). Variation in year-class strength was too high to determine Z (for individual years) from catch curves derived from data in Res.Doc. 73/98 and from other data (supplementary to Res.Doc. 73/98) made available to the Group. Catch-per-effort curves, averaged over the period 1968-1972 (from Res.Doc. 73/98), gave an estimate of Z = 0.59, but this value was considered likely to be biased by year-class effects also.

Jackson's method was used on data from Res.Doc. 73/23 to compare abundance indices for 1970 and 1971, beginning at age 4 and also at age 5. This was necessary becuase there was some difference of opinion as to the age at which full recruitment to the fishery takes place. Comparison of abundance for 4-year-old fish and older and 5-year-old fish and older gave an estimate of Z = 0.80; for 5-year-old and older and 6-year-old and older, the estimated value was Z = 0.89.

Discussion of data presented in Table 3A of Res.Doc. 73/98 led to agreement that the use of any age-group pairs from age 4 would give estimates unbiased by partial recruitment. Analysis of data in Res.Doc. 73/14 indicated a value of Z of about 0.8. Res.Doc. 73/23 (from yearly catch-curve data) gives estimates of Z of 0.26 (1968), 0.88 (1969), 0.51 (1970), and 0.72 (1971), with a mean value of Z = 0.59. It was agreed to use working values of Z = 0.7 and Z = 0.8.

3. Assessment

Fig. 1 shows the yield-per-recruit curves for different values of M in the range of 0.2-0.4 and over a range of values for F from 0.1 to 3.0. Table 4 compares the estimated sustained yields at both F_{max} and $F_{0.1}$ with yields corresponding to the F values assumed for 1971. The two extreme cases, representing extremes of opinion among the scientists taking part in the discussion but within the limits agreed to by all scientists for parameter values, are given in the first two lines of Table 4 for (A) where M = 0.2, Z = 0.8 and F = 0.6; and for (B) where M = 0.4, Z = 0.7 and F = 0.3.

For both (A) and (B), the F-values assumed to be equivalent to the fishing effort for 1971 give yields close to the yield at $F_{0.1}$. For (A) where F = 0.6, the yield is 105% of the yield at $F_{0.1}$, and for (B) where F = 0.3, the value is 89% of the yield at $F_{0.1}$. For (A) the assumed 1971 F-value of 0.6 is higher than that corresponding to $F_{0.1}$ which is 0.33, whereas for (B) the assumed 1971 F-value of 0.3 is lower than that corresponding to $F_{0.1}$ which is 0.42. The maximum yield-per-recruit for (A), i.e. with the low extreme value for M of 0.2, is 138, which is much higher than that for (B) of 80, for the high extreme value for M of 0.4. Estimates for other combinations of M and Z are also presented in Table 4.

Table 4. Comparison of sustained yields at F_{max} and $F_{0.1}$[1] with those at assumed F for 1971.

Mortality assumptions	Assumed F_{1971}	F_{max}	$F_{0.1}$	$\frac{F_{1971}}{F_{max}}$	$(Y/R)_{1971}$	$(Y/R)_{max}$	$(Y/R)_{0.1}$	$\frac{(Y/R)_{1971}}{(Y/R)_{max}}$	$\frac{(Y/R)_{1971}}{(Y/R)_{0.1}}$
(A) M = .2, Z = .8	0.6	0.68	0.33	88.2%	137.7	138	130.5	99.8%	105.5%
(B) M = .4, Z = .7	0.3	3.60+	0.42	8.3%	55.0	80	62.0	68.8%	88.7%
M = .3		1.60	0.44			102	92.0		
Z = .7	0.4			25.0%	89.0			87.3%	96.7%
Z = .8	0.5			31.3%	94.0			92.2%	102.2%
M = .35		2.70	0.48			90	78.0		
Z = .7	0.35			13.0%	71.0			78.9%	91.0%
Z = .8	0.45			16.7%	77.0			85.6%	98.7%

[1] See footnote on page 74 for definition.

The value chosen for M is critical, and it is not possible at this time to narrow the range in which it probably lies. However, the following comments on the results of the yield-per-recruit assessments can be made: (a) Under assumption (A), where M = 0.2 and F = 0.6, the 1971 effort would be assessed as being a little lower than F_{max}, that giving maximum yield, but that it produced 99.8% of the maximum

yield of 138 (see Fig. 1). (b) Under assumption (B), where M = 0.4 and F = 0.3, the 1971 effort would be assessed as being only 1/12th of F_{max}, producing 68.8% of maximum yield; a doubling of effort relative to 1971 would increase the yield to 87.5% of the maximum, i.e. from 55 to 70 (Fig. 1). (c) Under (A) the 1971 effort already exceeds $F_{0.1}$ (137.7 compared to 130.5). (d) Under (B) the 1971 effort is about 71% of $F_{0.1}$ and produces 89% of the yield at $F_{0.1}$.

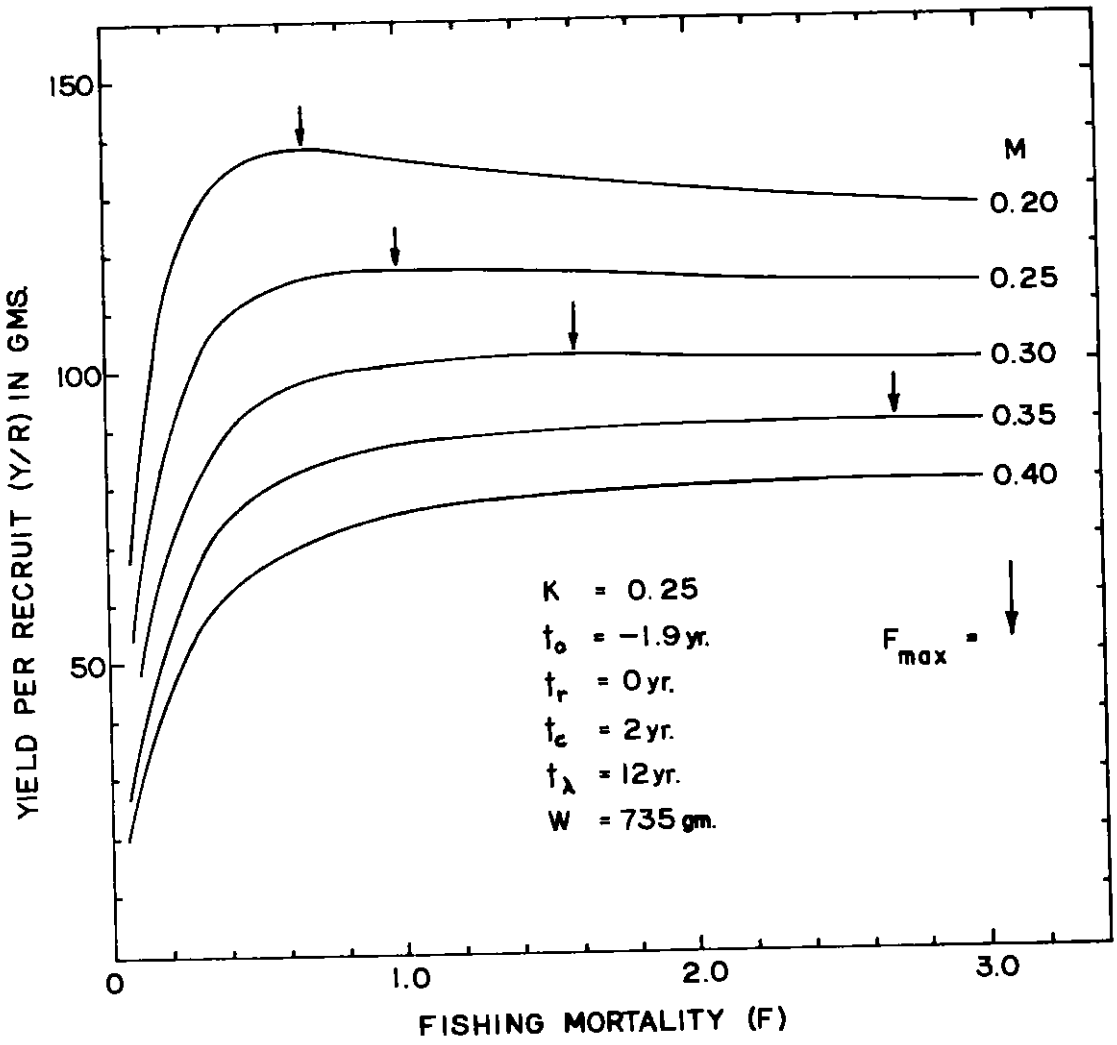

Fig. 1. Yield-per-recruit curves for mackerel in Subarea 5 and Stat. Area 6 (t_c = 2.0 yr).

4. Age at Capture and Size Limit Considerations

The growth parameters on which this assessment is based were derived from data collected in the early part of the year, i.e. before the growing season begins. Length at (say) age 2, therefore, refers to length (and weight) of fish that have undergone growth in the year in which they were spawned (first year mackerel is relatively large compared to many other species) and during the following year as 1+ fish, but which have not yet begun their third year of growth. The length at capture assumed in this assessment (t_c = 2.0) is, therefore, the length of these fish.

The rate of recruitment to the adult stock by age is not known with certainty. A large proportion of two-year-old fish are believed to spawn, but whether a significant proportion do not spawn until they are three years of age or older is not known. While there may be some exploitation of 0-group fish late in the year in which they were spawned and of 1-group fish in their second year of growth (Res. Doc. 73/98, Table 3A), there is significant exploitation of fish in their third year as 2-group fish which have not yet spawned for the first time.

Calculations of year-class biomass with age for M = 0.2 and M = 0.4 indicate that maximum year-class biomass is achieved, under natural conditions, at 4.5 years and 3.5 years respectively (Table 5). To protect juvenile fish and preserve reproductive potential, it may be necessary to impose minimum size limits, or other measures, which would effectively increase t_c to values greater than t_c = 2.0 years.

Table 5. Biomass at age (for natural mortality only).

Age	$\bar{W}$ (gm)	M = 0.2		M = 0.4	
		Number	Biomass	Number	Biomass
1	79	1,000	79,000	1,000	79,000
2	149	819	122,031	670	99,830
3	227	670	152,090	449	101,923
4	336	549	184,464	301	101,136
5	394	449	176,906	202	79,788
6	474	368	174,402	135	63,990
7	509	301	153,209	91	46,319

Maximum yields-per-recruit and biomass-per-recruit have therefore been estimated over a range of values of t_c from 1.0 to 5.0 years (other parameters remaining unchanged) with results shown in Fig. 2A and 2B. For assumption (A) with M = 0.2 and Z = 0.8, there is an increase in yield to a maximum at t_c = 3.0 years; for assumption (B) with M = 0.4 and Z = 0.7, both maximum yield and biomass decreased for all values from t_c = 1.0 year and older. Any size limit designed to protect spawning potential will thus reduce the yield, if the higher natural mortality rate applies.

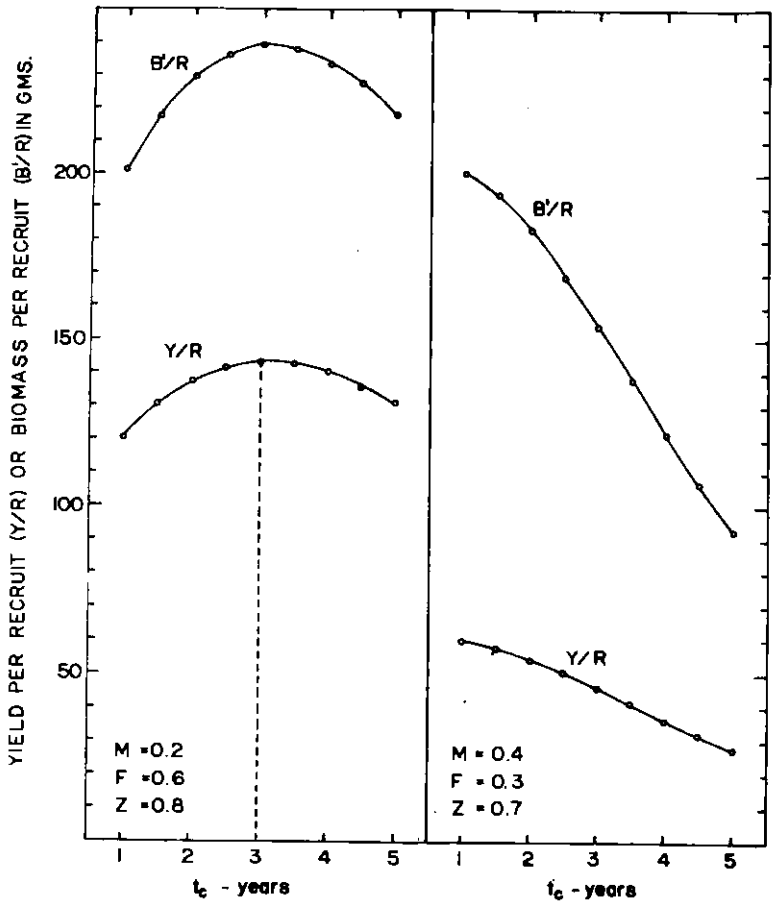

Fig. 2. Yield-per-recruit and biomass-per-recruit at t_c from 1 to 5 years for the two extreme cases of mortality assumptions.

5. Yield-per-recruit and t_c

The value of t_c = 2.0 years was estimated on the assumption that full recruitment to the fishery was at age 4.0 years and making allowance for partial recruitment before this age. Because of doubt concerning the exact age of full recruitment to the fishery and because there was the indication from 1973 length frequencies supplied by Bulgaria that younger fish may now form a more significant part of the 1973 catch, yield-per-recruit curves were also calculated for t_c = 1.0 year (Fig. 3). For all assumptions of M in the range 0.2-0.4, F_{max} values can be defined and these range from 0.4 to 1.2 (i.e. they are lower than values estimated for t_c = 2.0 years). Values of $F_{0.1}$ are also lower for t_c = 1.0 than for t_c = 2.0 years.

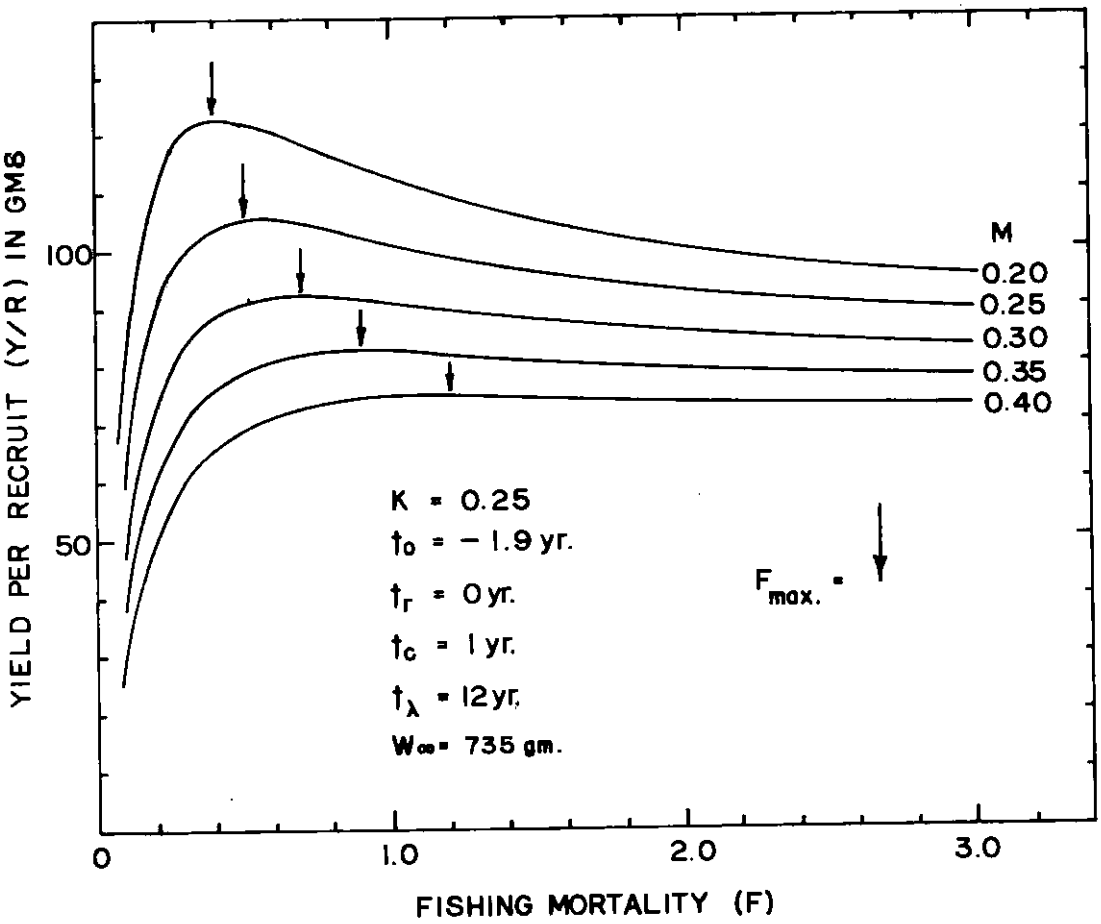

Fig. 3. Yield-per-recruit curves for mackerel in Subarea 5 and Stat. Area 6 (t_c = 1.0 yr).

6. Fishing Prospects for 1973 and 1974 in Relation to Stock Status

The agreed data on 1972 catches and age distributions were converted into estimates of population numbers using the two extreme cases (A) and (B) for mortality coefficients. This method allowed extrapolation of population size and catch in numbers for the years 1973 and 1974. Recruitment in 1973 and 1974 was taken into account by adding the highest observed historical catches of fish at age 1 for 1973 and of ages 1 and 2 for 1974, the data being taken from Table 4 in Res.Doc. 73/98. Calculations were made under two assumptions as to the degree of recruitment to the fishery at age and also using population size estimates (in numbers) taken from Table 5 of Res.Doc. 73/98, assuming M = 0.4 and F = 0.2 (Table 6). Population and catch numbers were converted to weight by using the highest recorded mean weight of fish in the catch (321 g) (Res.Doc. 73/98). The assumptions in these estimates both with regard to recruitment and to mean weight of fish are optimistic and more likely overestimate rather than underestimate the population and catch sizes.

Table 6. Stock size and catch in 1972 and projected stock size and catch for 1973 and 1974 (stock size refers to age 1 fish and older at the beginning of the year).

Mortality assumptions	Unit	1972 Stock size	1972 Observed catch	1973 Stock size	1973 Catch	1974 Stock size	1974 Catch	Recruitment assumptions
(B) M = 0.4	No.[1]	6142	1199	4782	793	4196	764	Partial recruitment considered by reducing F at age 1 to 35% and at age 2 to 50% of F at age 3+.
F = 0.3	Wt.[2]	1972	385	1535	255	1347	245	
(A) M = 0.2	No.	3179	1199	2344	745	2067	714	
F = 0.6	Wt.	1020	385	752	239	664	229	(t_c = 2.0 years)
(B) M = 0.4	No.	5551	1199	3140	678	3063	662	No partial recruitment
F = 0.3	Wt.	1782	385	1008	218	983	213	
(A) M = 0.2	No.	2903	1199	1642	678	1602	662	
F = 0.6	Wt.	932	385	527	218	514	213	(t_c = 1.0 years)
M = 0.4	No.	8202	-	4724	1020	3970	857	No partial recruitment. Stock size derived from Table 5 of Res. Doc. 73/98 assuming M = 0.4 and F = 0.2. (t_c = 1.0 years)
F = 0.3	Wt.	2633	-	1516	327	1274	275	

[1] Number of fish in millions.
[2] Weight of fish in '000 tons.

Under both of the recruitment assumptions (t_c = 2.0 years and t_c = 1.0 years) (Table 6), although the 1973 and 1974 stock size estimates for case (B) are approximately twice those for case (A), the projected catch levels for 1973 and 1974 are not very different (218-255 thousand tons in 1973 and 213-245 thousand tons in 1974). However, the catch levels based on data derived directly from Table 5 of Res.Doc. 73/98 (assuming M = 0.4 and F = 0.2) are somewhat higher.

The TAC agreed by the Commission for 1973 is 450,000 tons. On the assumptions used to estimate the projected catches in Table 6, this TAC would be achieved only if there is a substantial increase in effective fishing effort in 1973 and 1974 relative to that of 1971 (the base year used for these calculations), or if recruitment in 1973 and 1974 is significantly higher than that which has been assumed. If effective effort is indeed increased, there will be a consequent decrease in stock size below those estimates given in Table 6.

It must be pointed out that, in the period January to March 1973, catch-per-effort for the Polish fleet increased relative to that for 1972 (Res.Doc. 73/98), which could be interpreted as implying an increase in biomass between 1972 and 1973. Up to the end of April 1973 the Polish catch was 75,000 tons, compared with a catch of about 80,000 tons for the same period in 1972 (personal communication - Dr Popiel, Poland), whereas estimated total effort for Subarea 5 and Stat. Area 6 (on both herring and mackerel) decreased by about 20%. It was maintained that more of this total effort was directed towards herring, implying a real reduction in effort on mackerel during the early part of 1973.

Bulgarian data of age and length composition from two experimental hauls in January 1973 and two hauls in February 1973 showed high proportions (in numbers) of mackerel of the 1971 year-class (Table 7). While these data are not comprehensive enough to give precise estimates of year-class size, there is the possibility that the 1971 year-class is larger than had been assumed in Res.Doc. 73/98. The data do agree with information presented in Res.Doc. 73/14 which suggests that the 1971 year-class is the largest since the 1967 year-class.

Assessment of mackerel stocks and advise to the Commission on TAC is dependent critically on estimates of year-class sizes being available as early in the life-history as possible, as is the case for herring. This emphasizes the crucial importance of planning and carrying out juvenile surveys, using methods which give the best opportunity of estimating year-class size and which are designed for adequate statistical analysis. It has already been agreed (Report of Herring Working Group, Annex 2) that a single survey method is likely to give good information for both herring and mackerel. Adequate support for the planned survey in early 1974 is therefore essential, if improvements in the quality of advice are to be expected. It is also stressed that, because of the possible interaction between the mackerel fisheries in Subarea 4 and Subarea 5 - Stat. Area 6, adequate stock sampling in Subarea 4 should be initiated in 1973.

Table 7. Age composition and mean lengths of mackerel from experimental catches (two hauls in each month) by Bulgaria in 1973.

		Year-class									Total	No. of fish sampled
		1972	1971	1970	1969	1968	1967	1966	1965	1964		
Jan	Age compos. (‰)	156	538	35	114	43	103	10	-	1	1000	1532
	Mean length (cm)	20.9	25.7	31.1	32.0	33.2	33.9	36.5	-	39.5	-	
Feb	Age compos. (‰)	103	654	29	79	33	91	10	1	1	1001	1300
	Mean length (cm)	21.3	25.8	30.9	32.1	33.3	34.0	36.5	38.5	39.5	-	

ANNEX 2 - REPORT OF THE HERRING WORKING GROUP

Chairman: T. D. Iles

Rapporteur: G. H. Winters

The Herring Working Group met on 22-23 May 1973 with representatives present from Bulgaria, Canada, Denmark, Fed. Rep. Germany, Japan, Poland, USSR and USA. The discussions were directed towards specific points raised at the Special Commission Meeting, January 1973, and to the consolidation of research and survey plans for 1974. The following research documents on herring were reviewed: larval surveys (Res. Doc. 73/11, 12, 16, 19, 93, 96, 97, 115); assessment (Res.Doc. 73/17, 68, 91, 94, 95); stock discrimination (Res.Doc. 73/29, 37, 81); juvenile surveys (Res.Doc. 73/84); ageing (Res.Doc. 73/2), and biology (Res.Doc. 73/51, 63, 92).

1. Status of the Fisheries

Complete nominal catch data for 1972, updating the preliminary data presented in the January 1973 Report of the Herring Working Group (this volume, pages 31-49), indicate that the total catch of herring in the ICNAF Area (including Stat. Area 6) was 548,000 tons, a reduction of 26% from the 1971 level and 43% from the peak catch of 965,000 tons in 1969. Non-member catches (mainly GDR) increased from 22,000 tons in 1971 to above 50,000 tons in 1972, the latter including 40,000 tons from Div. 5Z and Stat. Area 6 and 9,000 tons from Div. 5Y.

Preliminary information on herring catches during the first half of 1973 was presented. The USSR reported a successful fishery in Div. 5Z from January - April 1973 with the 1970 year-class dominating in the catches. Canada reported reaching its quota of 4,000 tons in Div. 5Y by late spring. USA reported that 5,250 tons (about half of its quota) had been taken from the Georges Bank stock. Preliminary indications from the Polish fisheries in 1973 are of higher catch rates in Subarea 5 and Stat. Area 6 than in 1972. A high proportion of the 1973 catches consisted of 3-year-old fish, which tends to confirm that the 1970 year-class was a relatively large one.

2. Consideration of Proposals (Comm.Doc. 73/1, 2, 14)

a) Size Limits

The 9-inch (23 cm) size-limit proposal for herring included the application of an undersize tolerance level of 10% by weight to the season's catch of individual vessels. For practical reasons of enforcement, Canada proposed an alternative tolerance level of 25% by number to be applied on a per-trip basis (Comm.Doc. 73/1).

Data relevant to this proposal were presented in Res.Doc. 73/91. It was agreed that, on biological grounds and for the areas in which Canada has relatively large fisheries, a 25% tolerance by number is on the average very nearly equivalent to a 10% tolerance by weight. It was also agreed that, in an overnight fishery in which only a very few sets on individual schools can be made, the application of either tolerance level on a per-trip basis would result in fewer undersize fish being landed than on a seasonal basis. It was concluded that acceptance of the Canadian proposal would not increase the exploitation of undersize fish and would probably reduce it.

b) Timing of Setting Herring Quotas

Comm.Doc. 73/2 proposes that herring quotas be established at the Annual Meeting for the following year, in contrast to the current practice of having a Special Commission Meeting in January to establish TAC's for the current calendar year. Comm.Doc. 73/14 refers to a Canadian proposal that a Special Meeting on Herring early in 1974 will be necessary but that means should be sought to expedite the coming into force of measures recommended by that meeting. The Herring Working Group indicated in January 1973 (this volume, pages 44-45) that there would be considerable loss in the accuracy of assessments on which the advised catch levels are based, if advice on the TAC's for the next calendar year had to be formulated at the Annual Meeting.

The Working Group considered the possibility of making assessments at the Annual Meeting and advising the Commission on TAC's which would be appropriate for the 12-month period starting in July following the Annual Meeting and ending in June of the following year. Advice would be based on a complete assessment of the data for the previous calendar year together with data from spring surveys and commercial catches in the early part of the current calendar year. Such assessments would provide a good basis for advising on TAC's for July - December of the calendar year and a reasonable one for advice on TAC's for the following January - June period.

Under the current low herring stock conditions with management designed to achieve a phased stock recovery, accurate current assessments based on age composition of previous removals and estimates of the strength of recruiting year-classes are critical. Making recommendations at the Annual

Meeting in June for the period immediately following has these scientific advantages: (i) Adequate time to conduct assessment based on complete fishery data and research data for the previous calendar year, thus improving the precision of advice to the Commission; (ii) Two opportunities to measure the strength of the recruiting year-class through spring surveys, first as 2-year-olds and again as 3-year-olds, thus providing better estimates of the strength of the incoming year-classes.

c) Advice on Management Proposals for the Banquereau Stock

The Herring Working Group considered the status and identity of the presently-defined Banquereau herring stock (Subdiv. 4Vn, 4Vs and 4W(a)) in relation to a Canadian proposal (Comm.Doc. 73/14) that the Commission at its June 1973 Meeting establish a TAC for this stock. Prior to 1968, there was only a relatively small Canadian fishery in Subdiv. 4Vn and 4W(a) and none in 4Vs (Res.Doc. 73/94). In the winter of 1968 a large fishery developed in all 3 subdivisions and catches increased substantially in the 1968-69 fishing season to 108,000 tons, 71,000 tons of which were taken in Subdiv. 4Vs. Since then the seasonal catch has declined steadily, particularly in Subdiv. 4Vs to 25,000 tons in 1972-73 season. Age and lengtb composition data indicate that the fishery exploits mainly young herring (2-4 years old) in Chedabucto Bay (Subdiv. 4W(a)), adult herring of intermediate age in Subdiv. 4Vn and mainly very old herring on Banquereau Bank (Subdiv. 4Vs).

The identity and stock inter-relationships of the Banquereau stock complex were discussed, and it was concluded that the evidence available did not allow definitive stock description, particularly with regard to the relationship of Banquereau Bank herring to those inshore in Subdiv 4W(a) and also to the southern Gulf of St. Lawrence (Div. 4T) stock complex. The Working Group, therefore, emphasizes that, if the presently-defined Banquereau stock is to be managed on a rational basis, more research is required to elucidate various aspects of its distribution, abundance and migrations.

The advisability of recommending conservation measures for the Banquereau stock was discussed, and it was agreed that a pre-emptive TAC was needed in 1974 to prevent diversion of effort to this stock. In arriving at the level of TAC advised for 1974, consideration was given to the catches in Subdiv. 4Vn and 4W(a) for the period 1968-69 to 1972-73; the catches taken in Subdiv. 4Vs in 1968-69 and 1969-70 were not considered representative of the long-term sustained yield of this stock (which was a virgin resource at that time) and were consequently excluded from the estimation of TAC. The Herring Working Group agreed that a TAC of 45,000 tons should be applied to the presently-defined Banquereau stock for 1974.

3. Research Requirements

a) Statistics and Sampling

Information contained in Summ.Doc. 73/2 and 73/10 were discussed at some length. It was generally agreed that monthly herring catches, expressed in numbers by age-group in a standard format, would be desirable and that these should be reported by smaller statistical areas than the present ICNAF subdivisions. The Working Group re-emphasizes the need for improved catch and sampling statistics and urges that, in the future, member countries provide monthly effort data for herring.

b) Larval Surveys

A preliminary report of the 1972 ICNAF larval herring survey program was presented at the January 1973 Mid-term Meeting; a more complete report was available at this meeting (Res.Doc. 73/115).

The existence of four distinct spawning areas is again confirmed - Nantucket Shoals, Georges Bank, southwest Nova Scotia and Gulf of Maine - with larval drift between areas being minimal. Extensive larval drift from southwest Nova Scotia into the Bay of Fundy was observed, but the extent of larval exchange between the Bay of Fundy and the area south of Grand Manan Island near the Maine coast is still uncertain.

Abundance estimates indicate that overall larval production was similar in 1971 and 1972. However, larval abundance in the Georges Bank area was significantly less in 1972 than in 1971, while the reverse situation occurred on the Nantucket Shoals. The larval surveys off southwest Nova Scotia were restricted to offshore areas, with the result that larval abundance was underestimated and difficult to compare with the other areas.

It was agreed that the larval survey program has established the essential discreteness of the spawning areas. A continuance of these surveys was deemed important in order to acquire a time series of data on factors affecting survival during the early life history stage. The Herring Working Group, therefore, urges that the ICNAF Joint Larval Herring Survey in the Georges Bank - Gulf of Maine area be continued in 1973 and that the participants in the survey follow the recommendations on sampling, processing of samples, and reporting results, as outlined in the Appendix to Res.Doc. 73/115. The country schedule proposed for the 1973 ICNAF larval herring survey is

given in Table 1.

Table 1. Proposed schedule for 1973 ICNAF larval herring survey.

Country	Dates	Area of Survey
USA	7-15 Sept	Georges Bank
France	15-30 Sept	Standard Cruise Track
Poland	1-15 Oct	" " "
USSR	15-30 Oct	" " "
Fed.Rep. Germany	1-15 Nov	" " "
USA	1-15 Dec	" " "
Canada	Oct-March	Bay of Fundy Area

c) Juvenile Herring Surveys

At the January 1973 Mid-term Meeting it was proposed that initial attempts to set up surveys for juvenile herring be made for the period February - March 1973. Two countries found it possible to conduct such surveys in Subarea 5 and Stat. Area 6 during the early part of 1973. The Fed. Rep. Germany research vessel *Walther Herwig* (Res.Doc. 73/84) carried out 30-minute tows using a 180-foot bottom herring trawl with lined codend in areas from southwest Nova Scotia (Div. 4X) to Hudson Canyon (Stat. Area 6). The Polish vessel *Wieczno* occupied selected stations in Subdiv. 5Zw and Div. 6A (personal communication, Dr Popiel), making tows of variable duration and using a bottom herring trawl with 18-mm mesh codend. No systematic acoustic surveys for herring schools were conducted by either vessel.

Substantial catches of herring were made with the bulk consisting of the 1970 year-class. Very few individuals of the 1971 year-class were taken (as two-year-old fish). Since relatively large catches of two-year-old herring of the 1970 year-class were taken over the shelf area from Subarea 4 to Stat. Area 6 in 1972, it was concluded that the 1970 year-class is relatively large and that the 1971 year-class is probably quite small. However, there is as yet no quantitative basis for estimating absolute abundance from survey data.

d) Pelagic Fish Surveys in 1974

During the surveys mentioned above in (c) both the *Walther Herwig* and the *Wieczno* caught substantial quantities of other species. A discussion of these results together with those of US 1973 groundfish surveys, using a groundfish trawl with increased head-line height, indicated the possibility that, eventually, a single trawl could be found which could be used to provide satisfactory abundance indices for both pelagic and demersal fish species (adult and juvenile stages). However, it was concluded that the larger herring trawls should be used in surveys for pelagic species in 1974 and that sampling be concentrated in areas where the important pelagic species (mackerel and herring) are concentrated.

It was agreed that the sampling design for pelagic fish surveys should be based on the stratified random sampling design used for groundfish. It was conlcuded that modifications in the scheme, specifically for pelagic species, would give statistically unbiased estimates of relative abundance and stock composition and would allow great flexibility in allocating sampling effort according to both depth and geographic distribution appropriate to the pelagic species on which information is sought. The use of groundfish stratification schemes for Subareas 4 and 5 and Stat. Area 6 would also allow comparison of the potential of groundfish trawls for pelagic species.

It was decided that detailed plans for a juvenile survey of pelagic species (with special emphasis on herring and mackerel) be made for the early months of 1974. Table 2 gives a tentative list of vessels that will be involved, with information on approximate dates, number of hauls, gear and method of sampling. Three vessels will be concerned directly with surveys for pelagic fish using the bottom herring trawl: *Wieczno* (Poland), *Walther Herwig* (Fed.Rep. Germany) and *Cryos* (France). Arrangements will have to be made for comparative fishing experiments among these vessels to estsblish calibration coefficients. Vessels from the USA, USSR and Canada will be conducting fish surveys in Subareas 4 and 5 and Stat. Area 6 over the period but will be concentrating on groundfish or on surveys which are not specifically based on the sampling methods agreed to for pelagic

species. However, it should be possible to plan so that the results from these other vessels may be used for comparative and calibration purposes, including acoustic methods. Observers from different countries should be exchanged, if possible, in order that they may develop understanding of the techniques currently in use.

Table 2. Proposed pelagic and demersal trawl surveys in the ICNAF Area in the spring of 1974.

Country	Vessel	Area	Proposed sampling strata	Approximate period and/or number of vessel days	No. hauls	Type trawl	Nature of sampling
USSR	*Argus*	SA 6, Div.5Z, 4X, 4VW	all	1 Feb - 15 Apr	200 (≈ 50 per area)	Bottom and pelagic	Hydro-acoustic search for concentrations and trawling on same - sampling design unknown
Poland	*Wieczno*	SA 6, Subdiv.5Zw	1-12 61-76 (USA)	25 Feb - 31 Mar (35 days)	90	Bottom (herring)	Stratified random
Germany (FR)	*Walther Herwig*	Div.5Z	5-25 (USA)	5-25 Mar (20 days)	80	Bottom (herring)	Stratified random
USA	*Albatross IV*	SA 6, SA 5	1-40 61-76 (USA)	3 Mar - 30 Apr (50 days)	320	Bottom (groundfish)	Stratified random
Canada	*A.T. Cameron* *Brandal*	SA 4 (Div.VWX)		15 Feb - 15 Mar (30 days) (50 days vessel time for 2 vessels)	200	Bottom (groundfish)	Stratified random with bottom trawl on *Cameron*, and concurrent hydro-acoustic sampling
France	*Cryos*	SA 4 (Subdiv. 4Vs)		15 Mar - 15 Apr (30 days)	60	Bottom herring trawl and pelagic gear	Stratified random with herring trawl

N.B. Possible comparisons of herring *vs* groundfish trawls: Subarea 5, Stat. Area 6: *Albatross IV vs Wieczno vs Walther Herwig*
Subarea 4: *Cameron vs Cryos vs Argus*

The Working Group agreed that because of the uncertainty in estimates of pre-recruits for both herring and mackerel and the extent to which these estimates determine advice to the Commission on management measures for these species, the highest priority should be given to late-winter surveys for pelagic fish.

ANNEX 3 - REPORT OF THE GROUNDFISH SURVEY WORKING GROUP

1. Trawl Surveys in the ICNAF Area in 1972

Groundfish surveys conducted in 1972 were reviewed briefly in the Assessments Subcommittee, and it was noted that survey activity was generally similar to that for 1971. Standard surveys were carried out by Canada, USSR and USA in Subareas 4 and 5 and Stat. Area 6 in a manner similar to that described for 1971; and in Subarea 3 the 1972 survey activity by Canada and USSR was about the same as in 1971 but seasonal distribution was somewhat different. The total number of hauls decreased slightly from the 1971 level (1,910 hauls) to 1,815 in 1972, primarily due to the fact that in 1972 there were no Canadian surveys in Subarea 2 and USSR did not repeat its May-June surveys in Subarea 5 and Stat. Area 6 (Table 1). The general distribution of sampling among Subareas in 1972 remained very similar to that in 1971, with the bulk of trawling done in Subareas 3 to 5 and Stat. Area 6 and very sparse sampling in Subareas 1 and 2.

The Fed.Rep. Germany and UK (see Res.Doc. 73/111) conducted surveys in Subarea 1. The UK reported that it was possible to ssmple only the tops of the fishing banks on known trawlable locations. This is the same approach used by Denmark in Subarea 1, where standard selected stations have been established in a few locations where trawlable sites have been located. Rough grounds, ice conditions and large variability in fish distribution in relation to hydrographic changes al. combine to make it impractical to conduct stratified random surveys with fixed geographic and depth boundaries such as employed in Subareas 4 and 5 and Stat. Area 6. Nevertheless, it is useful to document fish distribution and hydrographic conditions, and it is possible to get estimates of relative age-length compositions of stocks.

Table 1. Inventory of bottom trawl aurveys conducted in the ICNAF Area in 1972. (The entries represent the number of hauls, division and country.)

Month	Subarea 1	2	3	4	5	6
Jan	-	-	-	40/R-S(CAN)	-	-
Feb	-	-	37/Ps(FRA)	-	-	
Mar	-	-	50/Ps(CAN)	-		85/(USA)[3]
Apr	-	-		70/X(USA)[3]	165/Y,Z(USA)[3]	-
May	-	-	53/Ps(FRA)	21/Vn,s(FRA)	-	-
Jun	-	-	90/L,N(CAN) 241/(USSR)[2,3]	-	-	-
Jul	-	-	-	125/VWX(CAN)[3]	-	-
Aug	-	-	-	120/VWX(USSR)[3]	-	-
Sep	-	-	-	65/T(CAN)	-	
Oct	-	-	50/L,N(CAN)	-	100/Z(USSR)[3] 157/Y,Z,(USA)[3]	50/(USSR)[3] 80/(USA)[3]
Nov	28/C-F(UK)	25/J,H(FRG)	19/K(FRG)	74/X(USA)[3] 45/R-S(CAN)	-	-
Dec	25/(FRG)[1]	-	-	-	-	-
Total hauls	53	25	540	560	422	215

[1] Divisions B-F.
[2] All divisions, April - July.
[3] Major survey representing time series of at least 3 years.

In November 1972, Fed.Rep. Germany conducted a further bottom trawl survey in Subarea 2, using the stratification scheme prepared by Dr Messtorff (Res.Doc. 72/125) except that stratum boundaries were changed to make them conform to statistical divisions. Dr Messtorff plans to circulate a description

of the revised plan early in 1973. In Subarea 2 rough grounds are not such a serious problem as in Subarea 1, and it was concluded that at least parts of Subarea 2 might be surveyed with a standard stratified random method. Mr Morice reported on survey activity by France in 1972, including age-length data for several species in Subareas 3 and 4.

Results of 1972 bottom trawl surveys in Subareas 3-5 and Stat. Area 6 were reported in many research documents and were utilized as integral parts of the discussions of the Assessments Subcommittee on the status of stocks of individual species. A comparison of the results of US and USSR surveys in Subdiv. 5Zw and Stat. Area 6 (Annex 3A) illustrates the information provided by the time series of survey data. Uncertainty about the accuracy of research vessel abundance indices continues to be a major problem, particularly in the case of pre-recruit indices. It was noted that there were advantages in the use of the logarithmic scale for analyzing abundance indices, since this method reduces the influence of occasional large catches which contribute serious skewness to the frequency distribution and result in extremely large variances. In any case, it was abundantly clear that it will be necessary to attach statistically valid confidence limits to the abundance indices ao that objective measures of their precision will be available to help the Assessments Subcommittee evaluate their accuracy. Again it should be noted that one of the important advantages of the stratified random design is that valid estimates of statistical precision (variance) can be obtained for point estimates derived from any single survey. Even more important, however, is the need for insuring that the sampling designs yield unbiased estimates from one year to the next; and the two most important elements here are the standardization of gear and towing parameters, and the selection of stations. Trawl comparison work is continuing in Subareas 4 and 5 and Stat. Area 6 by Canada, USSR and USA, and in Subareas 1 and 2 by UK and Fed.Rep. Germany. Comparison experimenta in Subareas 3 and 4 among French, USSR and Canadian vessels would be helpful. Furthermore, adoption of standard sampling strata in Subareas 2 and 3 and establishing consistent time series (standard surveys in the same season and area) could provide estimates of between-year variance components and contribute to more accurate measures of trends in abundance.

Another important need is for more comprehensive multispecies summaries of the major surveys, particularly in Subareas 3 and 4, where both Canada and USSR have valuable time series which can provide measures of change in total biomass at least for groundfish species. For example, USSR estimates of change in abundance of many species in Subarea 3 from 1971 to 1972 (Res.Doc. 73/40) should be compared with comparable data from Canadian surveys. Comparisons of USSR and Canadian pre-recruit indices for cod have shown reasonably good agreement (Res.Doc. 73/60), and it is to be expected that indices for older cod and other species should exhibit similar trends as well. Major surveys representing time series of at least 3 years are indicated by footnote 3 in Table 1.

2. Proposed Survey Activity for 1973

Proposed survey activity for 1973 is outlined in Table 2, and it is encouraging to note some increase in sampling of Subareas 1 and 2, although the level of effort can hardly be considered adequate in view of the difficulties associated with obtaining adequate information on stock structure and abundance from commercial sampling. While further survey activity would be desirable, it is perhaps more important at this stage to obtain more comprehensive documentation and analysis of the existing survey data, particularly with respect to precision of the pre-recruit indices and general consistency of the abundance trends among years and countries for the available time series. In addition it should be stressed that available age-length data from the surveys should also be analyzed to provide a more comprehensive picture of the accuracy of research vessel surveys.

It should be noted that the possibility appears rather good of using a single trawl for surveys of both pelagic and demersal species, providing adequate adjustments are made in the allocation of sampling effort according to distribution of the more aggregated (pelagic) species, and countries are urged to analyze their survey results with this in mind. The Herring Working Group (see Annex 2) has formulated a pelagic fish survey plan in Subareas 4 and 5 and Stat. Area 6, employing bottom trawls and the same basic stratified random sampling scheme used for groundfish surveys. Comparisons of standard bottom trawls and bottom herring trawls will be incorporated into the survey plan.

There was some discussion of the possible advantages and disadvantages of bottom trawls designed for groundfish and semi-pelagic fishes (herring and mackerel, primarily), as well as allocation of research vessel time to collection of data required for assessment of pelagic *vs* demersal species. It was noted that much less research vessel time has been spent on estimating abundance and recruitment for pelagic than for demersal species, although the pelagic species represent major components of the exploited biomass especially in the southern part of the ICNAF Area, and there is a critical need for reliable estimates of pre-recruits. The Working Group noted with satisfaction that several countries have committed research vessel time in the spring of 1974 to the further development of pelagic fish surveys, as outlined in the Herring Working Group Report (Annex 2). Furthermore, it was noted that considerable ship time has again been committed to the ICNAF Larval Herring Survey Program, which, it is hoped, will provide valuable insight into the larval stage of the recruitment process for sea herring, which hopefully may be generalized to other species as well.

Table 2. Proposed bottom trawl surveys in the ICNAF Area for 1973. (The entries represent the number of hauls, division and country.)

Month	Subarea 1	2	3	4	5	6
Jan	-	-	35/Pn(FRA)	35/R(FRA) 30/Vn(CAN) 42/R,S(CAN)	-	-
Feb	-	-	42/Pn,Ps(CAN)	-	-	-
Mar	-	-	60/Ps(CAN) 30/Ps(FRA)	30/Vs(FRA) 70/X(USA)	54/Z(FRG) 165/Y,Z(USA) 30/Z(POL)	11/(FRG) 85/(USA) 15/(POL)
Apr	20/(DEN)[1]	-	60/L,N(CAN)	60/R,S(CAN)	-	-
May	-	-	80/L,N,O(CAN)	-	-	-
Jun	-	-	240/(USSR)	-	-	-
Jul	-	-	-	125/V,W,X(CAN)	-	-
Aug	-	-	-	-	-	-
Sep	-	25/J(CAN)	25/K(CAN)	65/T(CAN)	70/Z(USSR)	80/(USA)
Oct	-	-	40/O,N,(FRA)	40/R,T(FRA) 20/W(USSR)	165/Y,Z(USA)	60/(USSR)
Nov	30/(UK)[1]	25/J,H(FRG)	-	70/X(USA) 45/R,S(CAN)	-	-
Dec	25/(FRG)[1]	-	-	-	-	-
Total[2] hauls	75	50	612	632	484	251

[1] Spread throughout divisions and months.
[2] Total number of hauls proposed is 2,104.

3. Need for Improved Data Base

A general discussion was held on the need for improvements in the data base required for assessments. For some of the largest stocks, existing data and/or analyses were entirely inadequate for making assessments with any reasonable degree of reliability. Attention was drawn to recommendations by the USA (Comm.Doc. 73/19) for improved collection, processing, and analysis of both commercial and research vessel data. The most critical needs are for establishing standardized and well-defined statistical sampling plans for collecting samples, and for adoption of appropriate (atatistically unbiased and efficient) analytical procedures with improved standards of documentation so that statistical reliability of estimates may be evaluated. It is often impossible to adequately evaluate either the sampling plan or the analysis underlying an estimate, because these critical elements are not documented in sufficient detail; and, even if they were, there would seldom be sufficient time to evaluate them adequately during an assessment meeting. Consequently, there is a real need for standardization of sampling and analytical techniques.

In addition, however, it was noted that the nature and volume of the existing data base, let alone a considerably expanded data base, are such that a substantial increase in data processing capability will also be required in order to implement better and more comprehensive analysis. The USA indicated there is a need for an expanded central data processing unit in ICNAF Headquarters, (in the form of high speed computers with substantial memory for storing large volumes of data) in view of the extremely limited capability of most ICNAF countries to carry out the comprehensive analyses required and to do them within the time span required for up-to-date assessments. For example, it is entirely impractical with a desk calculator to compute properly weighted length frequencies and associated measures of sampling variability for any significant set of commercial or research vessel samples. Another important type of analysis requiring a large computer is the analysis of structure and change in relative biomass as indicated by research vessel surveys, taking account of all species.

However, the need for an expanded ICNAF central data processing unit was questioned by some members of the Subcommittee. Particularly, concern was expressed about the desirability of having analysis done

remotely from the scientists who have the best knowledge of characteristics of the data. It was noted that centralized data processing would not preclude the necessity of careful auditing of the original input records by appropriate scientists prior to analysis, nor would it preclude the independent processing and analysis by any scientist or country wishing to do so. It would, on the other hand, facilitate data exchange and analytical capability particularly for countries without large computers, and it would promote mutual confidence in the entire data base.

The whole problem is a large and complicated one and many details have to be worked out. However, the Working Group was unanimous in that significant improvements in the data base are essential in order to improve the quality of assessments. Toward this end the Subcommittee urges that consideration be given to the establishment of a Special Working Group to:

a) investigate ways of improving the sampling and analysis of fishery data required for assessment with particular reference to suggestions made in Comm.Doc. 73/19,

b) conduct a detailed study of the advantages and posaible disadvantages, as well as costs, of an expanded central data processing unit in ICNAF Headquarters, and

c) promote the expansion and improved coordination of research vessel surveys to meet critical data requirements for assessments.

For further consideration of this problem, see Report of Statistics and Sampling Subcommittee, Section 13.

ANNEX 3A - NOTES ON DECLINE OF FINFISH BIOMASS IN SUBDIVISION 5Zw AND STATISTICAL AREA 6 BASED ON USA AND USSR TRAWL SURVEYS

by

M. D. Grosslein

On US bottom trawl surveys, south of Hudson Canyon (strata 61-76), mean catch-per-haul for all finfish species combined has declined by approximately 70%. The average catch-per-haul of total finfish for the three years 1970-1972, was only 73 pounds as compared with an average of 252 pounds for the years 1967-1969 (Table 1). Although sampling errors are fairly large, they are not so large as to mask a decline of this magnitude. When we exclude species which exhibit the greatest variability in distribution and catches (i.e. dogfish, sharks, searobins, skates, and rays) average catch-per-haul of the remaining finfish declined from 57 pounds for the first three years to 30 pounds in the last three years (Table 1 and Figure 1). Of particular concern is the drastic reduction in flounders as a group, whose average catch-per-haul in the last three years has been only 15% of that in the first three years, i.e. 2.6 versus 17.4 pounds.

USSR surveys in the same area (strata 61-76) indicate an even greater decline based on the four years (1967, 1968, 1970, 1972) when the standard 27.1 m trawl was used.[1] The average catch-per-haul of all finfish species for the first two years (1967, 1968) was 242 pounds - compared with only 46 pounds (average of 1970 and 1972), representing a decline of about 80% (Table 2). Excluding dogfish, other sharks, searobins, skates and rays, as before, the decline in other finfish is 60%; and, in the case of flounders, they seem to have virtually disappeared (Table 2 and Figure 2).

Some of the most important groundfish stocks (e.g. red and silver hake, yellowtail flounder) are more abundant east of Hudson Canyon, and the southern New England area should therefore be included for a comprehensive picture. USSR surveys in this ares (strata 1-12) also indicate major declines in principal stocks as well as total biomass of finfish. The average catch-per-haul for all finfish (exclusive of dogfish) for 1970 and 1972 combined was only 123 pounds as compared to 278 pounds for 1967 and 1968 combined, a decline of 60% (Table 3 and Figure 3). Similar comparisons between the first two years, and the latter two years for flounder, red hake, and silver hake, show declines of approximately 45, 65, and 80% respectively.

This is the same general picture of rapid decline in biomass with the recent increase of international fishing that was indicated by US surveys in southern New England and on Georges Bank (Res.Doc. 72/119 and 73/8). Thus, the additional US and USSR survey data presented here for the mid-Atlantic area (and USSR data for southern New England) confirm the implications of the earlier studies regarding overfishing in the mid-Atlantic area as well as southern New England.

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[1] In the 1969 and 1971 surveys, non-standard gear with considerably greater fishing power was used.

Table 1. Mean catch-per-haul (pounds) of principal fish and invertebrates for the Middle Atlantic area (strata 61-76) for *Albatross IV* autumn surveys in 1967-1972.

Species	1967	1968	1969	1970[1]	1971	1972
Silver hake	1.8	2.0	0.3	0.5	0.6	1.1
Red hake	0.3	1.8	1.0	0.4	0.8	0.5
Spotted hake	2.0	6.0	2.2	6.5	7.3	1.1
Summer flounder	4.4	3.3	1.7	0.1	0.9	0.3
Yellowtail flounder	7.4	12.2	8.0	0.1	0.7	0.2
Winter flounder	3.8	2.8	1.4	0.1	0.4	0.3
Other flounders	1.5	4.4	1.3	0.8	1.8	2.1
Butterfish	7.9	40.0	8.5	11.8	11.0	9.3
Scup	5.8	1.8	18.5	0.2	0.6	7.0
Round herring	0.3	0.3	0.6	5.6	11.3	0.0
Common searobin	286.8	30.4	11.9	15.0	6.9	3.6
Spiny dogfish	105.3	6.9	10.9	-	-	-
Smooth dogfish	18.0	8.6	3.4	-	6.2	4.5
Other sharks	4.3	3.2	5.0	4.1	3.5	14.5
Skates and rays	9.0	18.3	64.9	15.5	28.1	26.1
All other finfish	7.5	3.2	6.3	1.5	2.6	4.2
Total finfish	466.1	145.2	145.9	62.2	82.7	74.8
3-Yr means		$\bar{x}$ = 252			$\bar{x}$ = 73	
Finfish (exclusive of all sharks, searobins, skates and rays	42.7	77.8	49.8	27.6	38.0	26.1
3-Yr Means		$\bar{x}$ = 57			$\bar{x}$ = 30	
Flounder	17.1	22.7	12.4	1.1	3.8	2.9
3-Yr Means		$\bar{x}$ = 17.4			$\bar{x}$ = 2.6	
Lobster	2.0				1.4	0.4
Sea scallop	1.3				0.6	4.7
Squid (all)	23.9				6.0	28.5
Total invertebrates[2]	27.2	-	-	-	8.0	36.9

[1] 1970 survey in early September.
[2] Compilation of invertebrate catch not yet complete for 1968-1970.

Table 2. Mean catch-per-haul (pounds) of principal fish and invertebrates for the Middle Atlantic area (strata 61-76) for USSR autumn surveys, 1967-72.

Species	1967	1968	1969[1]	1970	1971[1]	1972
Silver hake	26.8	13.3	7.0	4.9	9.8	4.3
Red hake	8.5	2.2	10.5	0.2	5.0	0.5
Spotted hake	10.8	7.0	21.2	4.3	43.7	0.1
Summer flounder	2.5	0.9	5.6	0.0	0.3	-
Yellowtail flounder	7.8	10.3	14.6	0.0	0.8	0.0
Winter flounder	12.2	1.2	6.9	0.0	1.1	-
Other flounders	5.2	1.4	5.5	0.2	2.0	0.0
Butterfish	8.2	13.4	289.4	31.1	30.9	7.5
Scup	3.1	5.3	10.0	0.0	1.4	3.2
Round herring	5.3	0.2	5.2	5.3	38.4	1.1
Common searobin	62.6	71.9	156.0	1.3	22.6	0.5
Spiny dogfish	79.1	18.0	124.8	-	0.0	0.5
Smooth dogfish	18.1	23.2	22.6	-	10.0	1.0
Other sharks	8.6	11.5	84.5	-	5.4	8.9
Skates and rays	17.7	7.9	26.6	6.8	89.9	6.2
All other finfish	13.4	7.6	19.9	0.6	6.1	3.6
Total finfish	289.9	195.3	-	54.7	-	37.4
2-Yr Means	$\bar{x}$ = 242				$\bar{x}$ = 46	
Finfish (exclusive of all sharks, searobins, skates and rays)	103.8	62.8	-	46.6	-	20.3
2-Yr Means	$\bar{x}$ = 83.3				$\bar{x}$ = 33.4	
Flounder	27.7	13.8	-	0.2	-	0.0
2-Yr Means	$\bar{x}$ = 20.8				$\bar{x}$ = 0.1	
Lobster	1.3	0.9	3.0	0.0	1.8	0.1
Sea scallops	1.3	0.2	0.2	0.0	2.0	0.0
Squid	33.4	34.3	50.8	6.8	37.4	31.3
Total invertebrates	36.0	35.4	54.0	6.8	41.2	31.4

[1] USSR vessel used non-standard gear in 1969 (24.6 m trawl) and 1971 (modified 27.1 m trawl) which had considerably greater fishing power than the standard 27.1 m trawl used in 1967, 1968, 1970 and 1972. See Res.Doc. 72/112 for fishing power comparisons.

Table 3. Mean catch-per-haul (pounds) of major finfish species for the southern New England area (strata 1-12) for USSR autumn surveys, 1967-1972.

Species	1967	1968	1969[1]	1970	1971[1]	1972
Silver hake	85.4	99.8	104.3	22.2	86.1	17.9
Red hake	56.1	18.5	51.6	17.7	80.1	8.2
Flounder	39.7	41.3	53.1	29.6	64.4	14.2
Butterfish	16.2	55.7	86.2	22.0	58.6	34.0
Scup	5.8	3.2	13.7	2.2	6.1	4.3
Skates	31.8	7.3	13.1	23.8	68.7	8.3
Other finfish	63.5	33.5	106.0	25.5	87.0	17.1
Total (exclusive of dogfish and invertebrates)	298.5	259.3	428.0	143.0	451.0	104.0
2-Yr Means		$\bar{x}$ = 278			$\bar{x}$ = 123	
2-Yr Means for						
Silver hake		$\bar{x}$ = 92.6			$\bar{x}$ = 20.0	
Red hake		$\bar{x}$ = 37.3			$\bar{x}$ = 13.0	
Flounder		$\bar{x}$ = 40.5			$\bar{x}$ = 21.9	

[1] USSR vessel used non-standard gear in 1969 (24.6 m trawl) and 1971 (modified 27.1 m trawl) which had considerably greater fishing power than the standard 27.1 m trawl used in 1967, 1968, 1970 and 1972. See Res.Doc. 72/112 for fishing power comparisons.

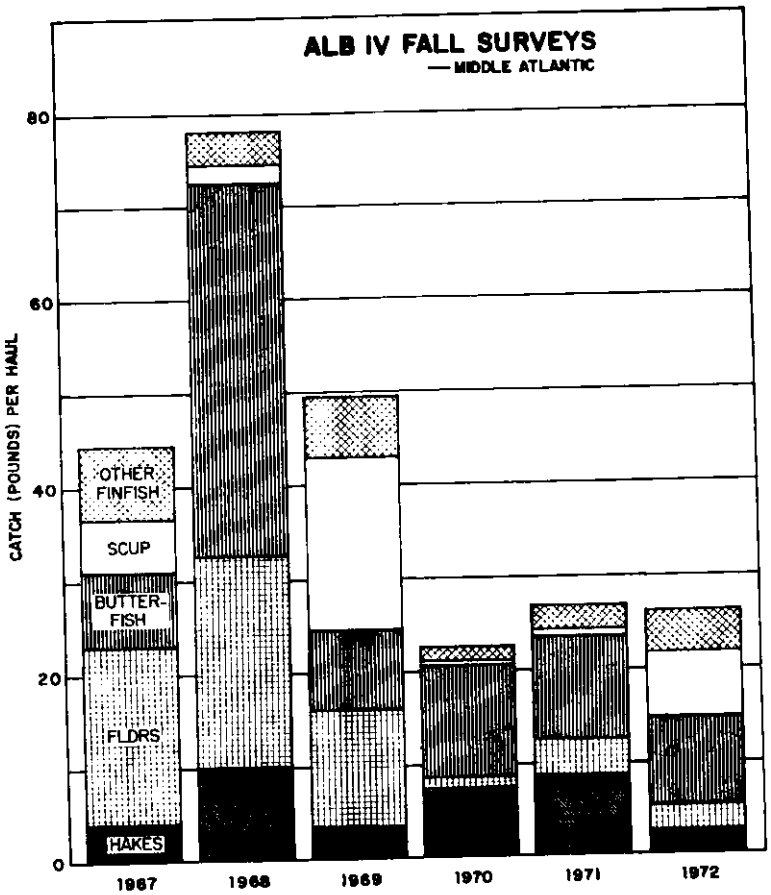

Fig. 1. Mean catch-per-haul of finfish species from *Albatross IV* autumn surveys in Middle Atlantic area, 1967-72.

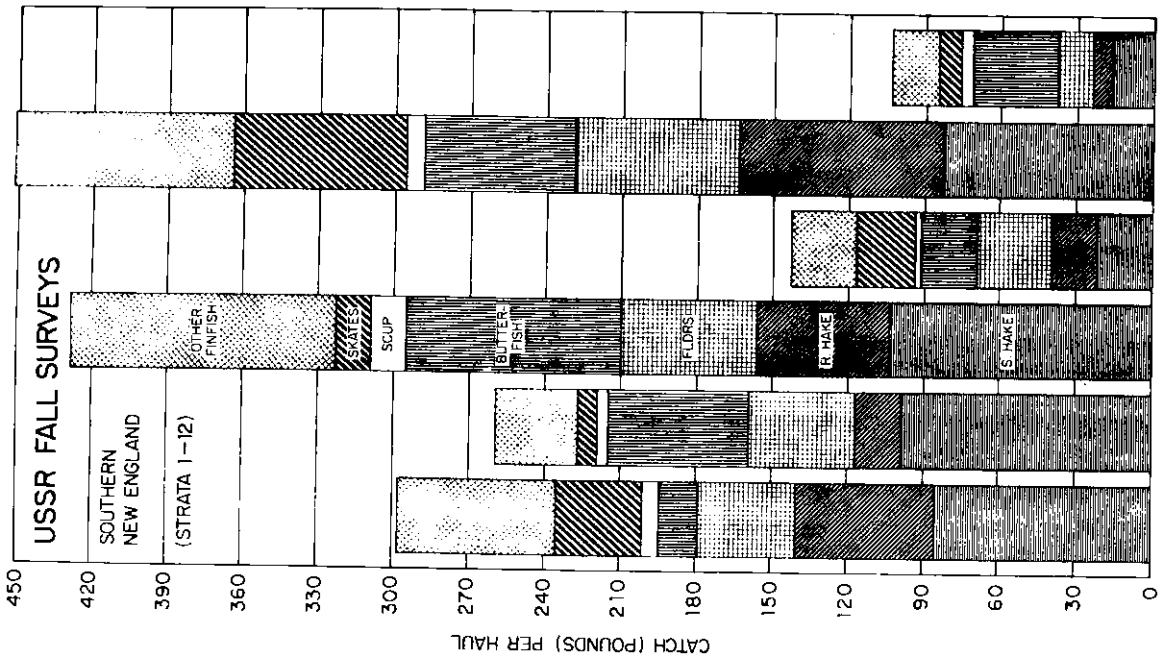

Fig. 3. Mean catch-per-haul of finfish species from USSR autumn surveys in Southern New England area, 1967-72.

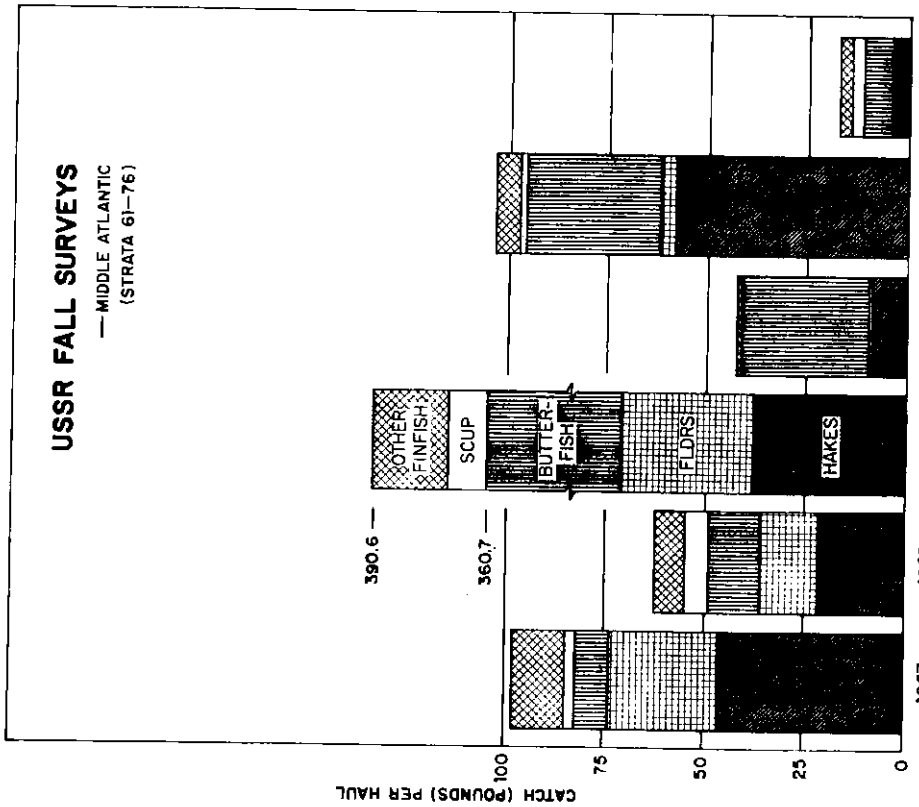

Fig. 2. Mean catch-per-haul of finfish species from USSR autumn surveys in Middle Atlantic area, 1967-72.

APPENDIX II - REPORT OF STATISTICS AND SAMPLING SUBCOMMITTEE

Chairman: V. M. Hodder

Rapporteurs: L. P. D. Gertenbach (Statistics)
T. K. Pitt (Sampling)
M. D. Grosslein (ICNAF Data Base)

The Statistics and Sampling Subcommittee met in three sessions on 30-31 May and 1 June 1973 to consider the matters referred to it by STACRES, including the US proposal (Comm.Doc. 73/19) for improving the ICNAF data base. The following documents were reviewed in relation to the various agenda items: Comm.Doc. 73/10 (Section 9), and Summ.Doc. 73/2, 5, 8, 9, 10, 11, 16, 17.

1. ICNAF Statistical Activities Report

a) The Assistant Executive Secretary presented a brief description of ICNAF's statistical activities during the fiscal year 1972/73 and referred the Subcommittee to a more detailed outline of these activities as described in Section 9 of Comm.Doc. 73/10.

b) ADP methods facilitated the compilation and publication of Volume 21 of the ICNAF *Statistical Bulletin* by December 1972 despite delays in submissions of Statlant 21A and 21B returns (deadline 15 April and 15 June, respectively). The Subcommittee noted with concern that these failures by national offices to meet agreed deadlines prevented the Bulletin from appearing as early as September or October.

c) The ICNAF *List of Vessels* for 1971 is now computerized. ADP methods can be used to reproduce each country's 1971 list for submission to national offices to provide revised data for the next issue. Reporting offices would merely delete the entries for vessels not fishing in the ICNAF Area in 1974 and add any new ones. This would greatly reduce the work in national offices, and the Subcommittee agreed that the Secretariat should follow this procedure if the 1974 Meeting approves the publication of a 1974 *List of Vessels*.

2. Discards and Industrial Fish

The Subcommittee reviewed Summ.Doc. 73/8 and the revised version of ICNAF Stat. Form 4, on which countries are requested to report information on (a) quantities of fish discarded at sea and (b) the quantities used for industrial purposes, broken down by principal species and subareas. It was noted that industrial fish is already covered as part of the nominal catches reported on Statlant 21A and 21B forms. Nevertheless the Subcommittee considered it useful to have detailed information by divisions and species for industrially-used fish. It was considered advisable not to confuse the request to national offices by including industrial fish on the same form used for collecting discard data. Accordingly, the Subcommittee

recommends (3)

i) that the CWP Secretary prepare in consultation with the ICNAF Secretariat a Statlant form similar to 21A for collecting, separately by species and division, the nominal catches of fish used for industrial (reduction) purposes; and

ii) that the Assistant Executive Secretary redesign ICNAF Stat. 4 form to collect information on discards by divisions and by all principal species (TAC species, including also capelin, argentines and squids).

The Subcommittee noted the absence of reports on discards by some countries which report in their Statlant 21A and 21B submissions nominal catches for only one or two species. Of particular significance are those countries which report very substantial cod catches from areas where other species are also known to abound. These countries should carefully review their fishing and fish-utilizing activities to ensure that their national statistical procedures do not fail to identify other species used for industrial or food purposes or discarded at sea, and arrange for the reporting of as complete information as possible on discards and industrial fish for their entire fishing fleets.

3. Timeliness and Adequacy of Reporting Statistical Data

The Subcommittee welcomed the details as outlined in Summ.Doc. 73/2, indicating delays in nationally submitted data. It was considered necessary to reaffirm the 1972 recommendation of the Subcommittee which reads

"that ICNAF cooperate with the other agencies to bring to the attention of the member countries the need to take all possible steps to avoid serious delays in submitting their statistical data to the Secretariat, as such delays adversely affect the distribution of future volumes of the Statistical Bulletin."

The Subcommittee noted that the Commission has introduced regulatory measures for selected species. These measures require all countries to introduce and maintain detailed current records on monthly, bi-weekly or even weekly catches. It should, therefore, be possible to obtain from all national offices, on an accumulative monthly basis, data permitting the calculation of annual totals within a few days after the end of each calendar year. The Subcommittee also took note of the NEAFC recommendation (see Summ.Doc. 73/28), and accordingly

recommends (4)

i) that the Commission be advised to take the necessary steps to ensure that all member countries fishing in the ICNAF Area establish and adequately maintain within their national administrations the resources necessary to provide the statistical data required by the Commission for effective implementation of its management programs;

ii) that the Commission be advised to request member countries to improve, if necessary, their procedures of collecting and compiling nominal catch data for reporting immediately after the end of each calendar year, and that in so doing the national offices should ensure the prompt reporting of monthly nominal catch data by divisions for all TAC species and others (e.g. capelin, argentines, squids) in time for use by the Assessments Subcommittee at its Mid-term Meeting.

4. Inadequacy in Statistics Reported by Countries

The Subcommittee, upon reviewing a statement by the Assistant Executive Secretary on inadequacies in national data submitted on Statlant 21A and 21B forms,

recommends (5)

that the Secretariat bring to the attention of national offices the urgent need to ensure the proper completion of Statlant forms:

i) the breakdown by divisions within the five subareas and Statistical Area 6;

ii) the breakdown by subdivisions of Div. 3P into 3Pn and 3Ps, Div. 4V into 4Vn and 4Vs, and Div. 5Z into 5Ze and 5Zw;

iii) further improvements of the species breakdown by as accurate as possible estimates of the large nominal catch quantities still listed as "Miscellaneous", "Others", "Mixed", etc.;

iv) the proper approved breakdown of the fishing gears;

v) the amended GRT classes for identifing "fishing class units" used in the 21B forms;

vi) species breakdown for the squids;

vii) the proper species designation for hakes caught in Subareas 3 and 4 (e.g. Summ.Doc. 73/17 shows red hake catches in certain divisions of Subarea 3 and silver hake catches in Subdiv. 3Ps).

5. Improvements in Statistical Bulletin Format

The Subcommittee considered Summ.Doc. 73/9 and 73/11. The CWP Secretary described briefly the suggestions made by the CWP *ad hoc* Working Group on the Contents of Regional Fishery Statistical Bulletins, 16 January 1973. The Assistant Executive Secretary indicated tha nature of the proposed tables presented in Summ.Doc. 73/9, and of the experimentally detailed tables in Summ.Doc. 73/3, using data available for the German Democratic Republic. It was recognized that the *Statistical Bulletin* might have to be greatly expanded in order to provide the details now required. A small Working Group (D.A. MacLean, V.C. Anthony, E. Cadima and B. Draganik) was appointed to review the current arrangement of the tables in the *Statistical Bulletin* and make proposals for the reorganization of the tabular data, including the addition of new tables if required.

After considering the report of the Working Group, the Subcommittee agreed that the annual *Statistical Bulletin* should be organized into two main parts and accordingly

recommends (6)

i) that the Secretariat on redesigning the tables in the Statistical Bulletin, arrange for the publication of one or two annual volumes depending on the ultimate size of each part: Part I will contain in Section 1 those tables summarizing the annual data over a series of consecutive years, and in Section 2 those tables restricted to the annual and monthly nominal catch data of the current calendar year; Part II will contain a table or tables providing detailed catch/effort data as reported on Statlant 21B forms;

ii) that Section 1 of Part I be modified as follows:

a) new Table A to be identical to existing Table A with the addition of Statistical Area 6, the separate identification of non-member countries, the deletion of halibut as a separate species, and the addition of American plaice, witch, yellowtail, Greenland Halibut, other flounders, pollock, red hake, mackerel, capelin, argentines and squids;

b) the additional species noted above to be inserted in other tables whereever applicable;

c) the table giving halibut data to be deleted;

d) existing Table H giving Statistical Area 6 data to be deleted and the appropriate data inserted in all relevant tables.

iii) that Section 2 of Part I be modified as follows:

a) the existing Table 3 to become Table 1;

b) a new Table 2, based on the tabular presentation shown in Summ.Doc. 73/9, to be incorporated;

c) existing Tables 1 and 1A to be combined in a new Table 3;

d) a new Table 4, following the format as shown in Annex A to this report, to be produced giving monthly catch details by division, species, country, etc.;

iv) that Part II contain the catch/effort data in a format similar to that in Annex B to this report, providing a better arrangement of the data currently in existing Tables 4 and 5, with the addition of extra columns to show the catches of species such as mackerel, American plaice, witch, yellowtail.

The Subcommittee, noting that it might be difficult to introduce the aforementioned amendments in the next volume of the *Statistical Bulletin*, accordingly

recommends (7)

i) that Volume 22 should as far as possible be produced with the changes recommended for the tables in Sections 1 and 2 of Part I, noting that new Table 4 may include only a limited number of the more important species;

ii) that the catch/effort data be prepared and published in Part II of Volume 22 in a format similar to existing Tables 4 and 5 of Volume 21;

iii) that the Secretariat prepare for submission to the Mid-term Assessments Meeting as a meeting document a Table or Tables showing the catch/effort data in the proposed format as given in Annex B, and that the comments received from users be reported to the 1974 Annual Meeting of the Subcommittee as the basis for a final decision on the most appropriate form for the tabular presentation of the catch/effort data;

iv) that the Secretariat insert in an appropriate place in the Statistical Bulletin a note advising users of the reorganization of the tables to facilitate cross references to the tables in earlier volumes.

The Subcommittee noted that the aforementioned reorganization of the tabular statistics in the *Statistical Bulletin* will meet the recommendations of the Assessments Subcommittee that monthly nominal catches of mackerel, capelin, red hake, pollock, American plaice, yellowtail and witch be readily obtainable from the statistical tables.

The Subcommittee, being aware of the urgent and growing need for the prompt end-of-year reporting of "selected advance nominal catch data" required for stock assessment at the Mid-term Meeting,

recommends (8)

that countries be clearly informed by the Secretariat that the submission of "selected advance nominal catch data" does in no way whatsoever preclude the prompt reporting of the data on Statlant 21A forms with the deadline of 15 April and on Statlant 21B forms before the 15 June deadline.

7. Reporting and/or Publication of Statistical Data by Management Areas

The Subcommittee took note of correspondence from US scientists that their investigation of species mixture in the area along the boundary between Subdivisions 5Ze and 5Zw have not yet been completed.

It was decided that, pending further investigation of the problem in connection with the yellowtail fishery and possibly some other species, the statistical data for yellowtail be reported by subdivisions (5Ze and 5Zw) on Statlant forms and also by management areas (E and W of 69°) in a separate report to the Secretariat.

8. Statistical Activities of Collaborating Agencies

a) The CWP Secretary reported that ICSEAF (International Commission for the Southeast Atlantic Fisheries) is now actively involved in the Statlant program together with ICNAF, ICES, ICCAT and FAO. The Eighth Session of the CWP is expected to be held sometime during the second half of 1974.

The CWP Secretary explained the need for simplifying the present Statlant forms by eliminating the coloured sheets with monocarbon inserts and by using only single sheets. This would reduce printing costs and permit reprinting annually, thereby making it possible to introduce recommended changes on a year-to-year basis. The Subcommittee concurred with the proposal and accordingly

recommends (9)

that the CWP Secretary replace the multi-sheet forms used hitherto with single sheets, leaving it to the national offices to use their own procedures for preparing the number of copies required for submission to the different agencies.

b) The Subcommittee received a verbal report from the Secretary General of ICES, supplementing the information in Summ.Doc. 73/16, and noted that ICES is making good progress in its plans to introduce ADP procedures.

c) The Subcommittee noted that a rearrangement of the tables in the FAO *Yearbook of Fisheries Statistics* (see Summ.Doc. 73/11, Section 3) would reflect a more regional-oriented table, facilitating the release of additional documents supplementing not only the Yearbbok volumes but also the statistical bulletins of all regional agencies.

d) The recently appointed Assistant Executive Secretary of ICSEAF reported briefly on the activities of this new Commission and indicated ICSEAF's intention to draw upon ICNAF's statistical experience when developing through Statlant forms its statistical programs.

9. Amendments to Statlant 21A and 21B Forms and Notes for their Completion

a) The CWP Secretary will continue as in the past to be responsible for dispatching on behalf of ICNAF Statlant 21A and 21B forms, together with a new form for obtaining data on the quantities of the nominal catches used for industrial purposes. The Subcommittee, noting the increased demands for improved statistical data,

recommends (10)

that the CWP Secretary amend the Statlant forms and notes to facilitate the reporting of

i) nominal catches of squids by species, viz Loligo spp., Illex spp., and Squids, n.e.s.;

ii) monthly nominal catch data for the species required for inclusion in the proposed Table 4 of Section 2 of Part I of the Statistical Bulletin.

b) The Subcommittee took note of the recommendation from the Special ICNAF Meeting of Experts on Effort Limitation, Woods Hole, 26-30 March 1973, that the CWP be requested to provide a more precise definition of "days on grounds" than that currently in use. After a discussion of the difficulties involved in trying to arrive at a more precise definition, the Subcommittee

recommends (11)

i) that the question of the more precise definition of the effort concept "days on grounds" be referred to the next session of the CWP.

ii) that prior to that session the CWP Secretary obtain from member countries comments and suggestions to assist the CWP in arriving at a more precise definition than that currently in use.

iii) that, pending a decision on the question, the effort concept "days on grounds" not be re-inserted on Statlant 21B forms at this time.

10. Sampling Yearbook and Adequacy of Sampling Data

a) *Sampling Yearbook* Volume 16 for 1971 was prepared as in the past, pending a decision on streamlining the presentation of sampling data. The volume was issued in November 1972 and advance copies distributed to members of the Assessments Subcommittee to aid in their preparation of assessment material for the Mid-term Meeting in January 1973.

b) The Subcommittee took note of the information on the inadequacy of sampling data, as presented in Summ.Doc. 73/2, and again emphasized the need for substantial improvement in the collection and reporting of sampling data, especially for those areas and stocks which are now or will be under regulation and for any other stocks requiring assessment. The Subcommittee accordingly

recommends (12)

that the Scientific Advisers to Panels bring to the attention of the various Panels the inadequacies of sampling data, as presented in Summ.Doc. 73/2, and the need for positive action on the part of the Panels to ensure that countries, which catch significant quantities of fish in the various subareas, provide sampling data in sufficient quantity and detail to enable the calculation of the length and age composition of the commercial catches by stock/area on a monthly basis.

It was suggested that the minimum sampling requirement might be included in the regulatory proposals.

11. Streamlining of Sampling Yearbook

a) In discussing the possibilities for streamlining the presentation of sampling data, the Subcommittee noted the recommendation of the Assessments Subcommittee that sampling data be published by species, gear and division, according to the format of Table 1 in Summ.Doc. 73/10. The problems that might arise in converting "per mille" length and age frequencies to length and age compositions of nominal catches were discussed at some length. It was noted that sampling data were variously reported under three categories: research, exploratory and commercial, without any clear indications of how repreaentative the samples were of the actual commercial catches and/or landings. This was especially true for research and exploratory sampling data.

Regarding commercial sampling and the application of these data to actual catches or nominal catches, three distinct situations are apparent. In the case of samples taken from the catches of factory trawlers, in which discarding probably does not occur, the samples should reflect the composition of the nominal catches as reported by those vessels. However, a problem arises in weighting sampling data to nominal catches in the case of vessels whose actual catches are sampled but no information is provided on the quantities discarded. In the case of port sampling of landings, the samples should reflect the composition of the nominal catches (landings in round weight equivalent) of those vessels, but for proper assessment additional information is required: (i) the quantity of discards, and (ii) the composition of the discards. After discussing the problems at some length, the Subcommittee

recommends (13)

that the sampling data for 1972 be presented in the Sampling Yearbook in a format similar to that shown in Annex C to this report, i.e. length and age composition of catches by month.

b) The Subcommittee noted the need for some improvement in the design of the forms used for reporting the national sampling data, and, in particular, the need for countries to provide more details on their sampling methods. The Subcommittee, therefore

recommends (14)

that the Secretariat bring to the attention of national offices the need for more detailed information on the sampling data and methods reported and the annual updating of the Notes to Sampling Data.

12. Large Quantities of Flounders (Species Not Known) Reported Prior to 1970

The Subcommittee noted the difficulties which assessment scientists have in determining the long-term trends of the various flounder species caught in the Northwest Atlantic prior to 1970. The Assistant Executive Secretary suggested that he could correspond with scientists of the countries, whose statistics would be affected, with a view to obtaining, if possible, estimates of the quantities of individual flounder species recorded in the Statistical Bulletins prior to 1970 as Flounders (NS). The Subcommittee agreed to this suggestion and requested the Secretariat to prepare a report on this matter for consideration at the 1974 Annual Meeting.

13. ICNAF Data Base

The Subcommittee reviewed the US proposal (Comm.Doc. 73/19) for improving the ICNAF data base. There was considerable discussion of the nature of deficiencies in the present data base and ways and means of improving it, and the Subcommittee took note of similar discussion which had taken place earlier in the Assessments Subcommittee and during review of the groundfish survey program.

There was general agreement on the need for a finer breakdown of catches by species, gear and vessel classes, and smaller units of area within statistical subdivisions; information on depth range and main species sought may also be necessary in some areas. Since there already is a requirement for log-books, a finer breakdown would not involve more records by the fishermen, but only a more detailed reporting of existing records. However, it was noted that the required precision is not the same in all subareas and for all species. The Subcommittee considered that the desired level of precision for all of Subareas 4 and 5 and Stat. Area 6 and part of Subarea 3 might require that catch and effort statistics be reported on a bi-weekly basis in unit areas not greater than 30-minute rectangles within each statistical division or subdivision. Further breakdown of vessel classes within some of the existing tonnage categories would probably be required, as well as more precise indications of the type of fishing (e.g. bottom *versus* midwater trawls). The problem needs careful study in relation to the increased volume of statistics and associated problems of data processing by the Secretariat. It was also noted that any further subdivision of statistical areas should take into account the existing schemes designed by CWP.

With respect to sampling, it was noted that with few exceptions current levels of sampling are simply not adequate to do more than provide a "first approximation" level of accuracy in stock assessments. A substantial increase in sampling effort and more timely reporting will be required in order to advance beyond this stage, and much greater attention should be given to the manner in which samples are collected, processed and analyzed. There was general agreement among participants as to the potential for serious bias in estimates of stock abundance and age-length composition arising from improperly weighted samples. For example, in order to evaluate the possible magnitude and source of error in estimated length composition of catches for a subdivision or stock, it will be necessary initially to analyze length frequency samples on an individual sample basis, identifying each sample according to the unit area, time period and vessel on which it was taken, and indicating the aggregate weight of catch to which the sample applies. Similarly, individual age samples (preferably stratified by length groups) should be associated with identifiable units of area and time. It was noted that, at present, there is seldom any basis for evaluating how representative the samples are of the catch or the stock, because sampling methods have not been adequately documented. The Subcommittee agreed that there is a critical need for complete and detailed documentation of sampling designs in use by all member countries.

Another important aspect of the problem is that proper processing and pooling of age-length samples presents a substantial computing task. The information is required very soon after the fishing season is completed. There seems to be a rather clear need for developing the necessary capability within the Secretariat for processing the sampling data.

Finally, the Subcommittee considered briefly the question of developing sampling plans appropriate for the fisheries involved. The problem was recognized to be a complicated one and the Subcommittee felt that it would require further study by sampling experts. On the other hand, the need for an improved data base is critical and, therefore, the Subcommittee

recommends (15)

i) that a Special Working Group be established to:

a) formulate a detailed general plan for the finer breakdown of catch and effort statistics in the ICNAF Area along the lines noted above,

b) conduct a detailed study of the sampling methods used by member countries for estimating age-length compositions of catches, and document the sources and magnitude of sampling errors in past estimates of stock structure for major fisheries through analysis of past sampling,

c) investigate the advantages as well as costs of an expanded central data processing unit in the Secretariat with respect to processing more refined data on catch and effort, as well as providing increased capability for analysis of commercial and research sampling data; and

ii) that a Chairman for the Working Group be appointed at this meeting to organize the Group so that it can begin work immediately and meet prior to the Mid-term Assessments Meeting for an in-depth review of progress, and that a representative from each Member Country participate in the meetings of the Working Group.

ANNEX A - PROPOSED FORMAT OF NEW TABLE 4 OF SECTION 1 OF PART I
IN ICNAF STATISTICAL BULLETIN

Species	Div.	Country	Nominal catch ('000 tons) by months												Total
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	NK	
Cod	1A	Den(F)														
		Den(G)														
		Ger(FR) →														
		Total														
	1B	Den(G)														
		Port →														
		Total														
	→	→														
	1NK															
	SA 1	Total														
	2G	→														

(Each principal species would be set out in this way.)

ANNEX B - PROPOSED FORMAT FOR CATCH/EFFORT DATA IN PART II OF STATISTICAL BULLETIN

Div.	Main Species	Country	Gear	Tonn. Class	Month	Effort: Days on ground	Effort: Days fished	Effort: Hours fished	Nominal catches (metric tons): Cod	Had	Red ⟶	SF	Total
1A	Cod	Den(F)	OT	6	Jan								
					Jun								
					Dec								
				Total									
				5	Jan								
					Dec								
				Total									
			LL	4	May								
					Nov								
				Total									
		USSR ↓	OT ↓	7 ↓	Jan ↓								
	Had												
	Red												

ANNEX C - PROPOSED GENERAL FORMAT FOR PRESENTING LENGTH AND AGE SAMPLING DATA IN SAMPLING YEARBOOK

Country:	Germany (FR)						Cod - 1F - 1971						
Gear:	Otter trawl						Commercial Landings Mesh size 130 mm						
Length or Age Group	Composition of Catch by Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
30						2							
33						2							
36						7							
39				1		12			2				
42		1		2		24		2	3				
45		1		6		43		2	3				
48		8		18		62		15	3		1		
51		17		36		92		31	16		1		
54		32		52		127		64	19		3		
57		59		72		179		94	36		3		
60		72		100		239		82	79		12		
63		111		118		304		98	91		7		
66		83		95		344		71	120		16		
69		86		56		277		54	80		39		
72		55		40		215		36	45		33		
75		40		20		153		17	32		23		
78		27		11		108		15	10		29		
81		14		4		72		6	11		29		
84		20		3		50		5			5		
87		8		1		33		3			5		
90		4		1		21		1			5		
93		3				10					2		
96		1				8							
99		2				5							
102		1				2							
No. caught (000)		645		636		2291		596	550		213		
Wt. caught (tons)	-	1824	226	1500	763	6503	4158	1406	1451	260	186	265	18542
No. measured		2270		971		8253		470	306			500	
Mean len. (cm)		67.8		63.7		66.9		63.7	66.2			71.7	
Mean wt. (kg)		(2.83)		(2.36)		(2.72)		(2.36)	(2.64)			(3.34)	
3 68		-		-		5		-	2		-		
4 67		-		2		10		-	8		-		
5 66		9		76		105		17	14		5		
6 65		21		57		62		13	11		1		
7 64		123		185		686		273	250		69		
8 63		367		297		1108		257	225		112		
9 62		74		15		241		18	37		22		
10 61		28		-		153		18	3		3		
11 60		15		4		12					1		
12 59		2				-							
13 58		1				7							
14 57		1				-							
15 56		3				2							
15+ ..		1				-							
No. caught (000)		645		636		2391		596	550		213		
No. aged		956			1609			304			190		

(1971 Sampling Yearbook, p. 40, 41, 44, 45, 48)

APPENDIX III - REPORT OF ENVIRONMENTAL SUBCOMMITTEE

Chairman: N. J. Campbell

Rapporteur: G. H. Winters

The Subcommittee met on the mornings of 31 May and 1 June 1973. The following Research Documents were reviewed: 73/16, 19, 21, 33, 35, 42, 43, 44, 50, 53, 83, 113, 116, 117.

1. Environmental Material in National Research Reports

a) West Greenland

While ice conditions were severe during the winter of 1971/72 as in the three previous yeara, the 1972/73 winter seemed to be normal with ice being reported only sparsely.

Very cold conditions were found in the Fylla Bank section (Div. 1D) in the upper 100 m during April, June and July as a result of strong winter cooling and inflow of cold polar water from the East Greenland Current. The 1972 year-class of cod will probably be small, as the temperatures over the shallower part of Fylla Bank in June were less than 1°C, whereas earlier experience indicated that temperatures greater than 1.8°C are required to produce large year-classes.

Surface temperatures in the Weat and South Greenland area are now similar to the level of the mean value for the years 1876-1915, and the climatic trend to cold conditions has been just as sudden as the rise in temperatures in the 1920's.

b) Labrador Shelf and Grand Banks

In 1972 temperature anomalies in the 0-500 m layer in the Labrador and Newfoundland areas were the lowest over the whole period of observations since 1936. In the southern Labrador section very cold water extended farther seaward than in any previous year since 1951 when the section was first occupied. The volume of water with temperatures below -1.5°C was about seven times as great as in the first year of observation (1951) in the area. On the seaward slope of Hamilton Inlet Bank the deep water is derived from the West Greenland Current, and temperatures at 400 m and deeper were, however, almost as high as the highest temperatures observed since 1951. On the southwest slope of Grand Bank and across Cabot Strait temperatures in the 0-200 m layer were the lowest since 1969, whereas in the near-bottom layer (100-500 m), and especially in the 200-500 m layer, temperatures were higher than in the previous tbree years.

Transport of Labrador Current water in the area of the Grand Bank and southern Labrador was close to normal in late 1971, whereas in the spring of 1972 large positive anomalies were recorded. The intensity of the Labrador Current in the Hamilton Inlet Bank area in October 1972 was higher than in any previous year, causing negative anomalies and a stronger drift of ice. Observations on the appearance of ice in the Labrador area indicate that since 1969 ice has appeared 10 days earlier each year. It was noted that a time lag of one year exists between the ice conditions in West Greenland and Labrador. On this basis, one would expect ice conditions (and consequently, fiahing operations) to improve considerably in the Labrador area in 1973-1974.

The Subcommittee noted with interest the unusually large and estensive hydrographic coverage of the Newfoundland - Grand Bank area in 1972. In recognition of the extremely anomalous environmental conditions which prevailed in the area in 1972, the Subcommittee

recommends (16)

that a series of papers on the hydrography of the Newfoundland - Grand Bank area in 1972 and its effect on fishery trends be presented at a Special Session of the Environmental Subcommittee at the 1974 Annual Meeting.

c) Scotian Shelf and Georges Bank

The anomalous conditions which prevailed during the winter of 1972 on the Nova Scotian Shelf were caused by an enormous outflow of cold water from Cabot Strait and its subsequent expansion over the entire eastern portion of the Shelf. Floating ice was observed in great quantities on the northern slopes of Canso, Misaine and Artimon Banks.

Temperature observations on Georges Bank and adjacent areas during the summer and autumn of 1972 showed the temperature of the 0-50 m surface layer to be substantially lower than in 1971. For intermediate and bottom layera, water temperatures were either the same aa or above those for 1971.

The Subcommittee noted with interest that better hydrographic data would accrue from the inter-

national herring larval survey program in the Georges Bank area, if advice were given as to the selection of the most useful hydrographic stations in the area. An analysis of the environmental data collected by the surveys to date would also be most useful.

2. Cooperative Systematic Studies on North Atlantic Oceanography

The Subcommittee reviewed the Report of the 5th Meeting of the Joint ICES/ICNAF/IOC Coordinating Group for the North Atlantic, which was held at Copenhagen, Denmark on 23 September 1972 and at which ICNAF was represented by the Environmental Subcommittee Chairman and the Assistant Executive Secretary. Also attending were representatives of major oceanographic projects in the North Atlantic. The main purpose of that meeting was to exchange information and plans for oceanographic programs being conducted or organized with a view to improving cooperation and coordination as well as avoiding any duplication of effort, and summary reports were received on the activities of CINECA (Cooperative Investigation of Northern part of Eastern Central Atlantic), CICAR (Cooperative Investigation of the Caribbean), MODE (Mid-Ocean Dynamics Experiment), IGOSS (Integrated Global Ocean Station System) and the ICES Overflow 1973 Expedition.

3. ICES Hydrographic Committee Report

The ICES Hydrographer reported on some of the activities of the Hydrographic Committee (ICES *Proc. Verb. Reunions* 1972, p. 51-75). These were summarized as follows:

a) Preparation of monthly means of salinity and temperature. Canada has agreed to consider the application of ICES type products in the ICNAF Area, attempting wherever possible to make these products compatible with the ICES formats.

b) Publication of cruise reports based on the ROSCOP forms (Report of Observations Samples Collected from Oceanographic Programs) which are published by ICES with copies being submitted to World Data Center A. The question was raised as to whether or not investigations in the ICNAF Area are being reported and, if not, how these could be coordinated by ICES and ICNAF.

c) The ICES Overflow 1973 Expedition will be carried out during August - September 1973 by Canada, Denmark, Fed. Rep. Germany, France, Iceland, Norway, UK, USA and USSR. It is anticipated that 13 research vessels will be participating in the research program to study the influence of atmospheric pressure fluctuations, advection, mixing processes, and internal tides on the exchange of water masses across the Greenland - Scotland ridge.

d) ICES has continued to publish oceanographic data collected on ships stationed on North Atlantic Weather Stations, including data from US Coast Guard weather ships. The Working Group on Marine Data Management has set out the criteria for the digitization of salinity-temperature-depth data (STD) in order to facilitate the exchange of these records.

f) A group of interested chemical oceanographers is currently attempting to design a reporting system for chemical observations which will include marine pollution data.

4. Standardization of Hydrographic Sections and Stations and of Base Periods for Temperature and Salinity Anomalies

The Subcommittee Chairman presented a chart showing a series of hydrographic sections occupied by a number of ICNAF countries. In nearly every case they reflect historical interest in continuing time series of observations. It was quite apparent that there was need for closer collaboration, if some degree of standardization is to be achieved not only for the location of the stations and sections but also in the methodology and parameters. The Subcommittee accordingly

recommends (17)

that, in order to facilitate the standardization of sections and stations and of base periods for temperature and salinity anomalies, two ad hoc working groups be set up as follows:

i) one to coordinate the investigations for the West Greenland area consisting of representatives from Denmark (F. Hermann), Fed. Rep. Germnay (W. Lenz) and USSR;

ii) the other to coordinate the investigations for the Canadian eastern shelf area consisting of representatives from Canada (C.R. Mann, C.M. Cross), Poland (S. Grimm), USA (M.D. Grosslein), UK (H.W. Hill) and USSR (V.V. Burmakin, V.A. Brantsev, I.K. Sigaev).

It is anticipated that most of the work can be undertaken by correspondence. However, the Subcommittee Chairman and the Executive Secretary will attempt to identify some of the pertinent problems and will organize working sessions, if and when required.

With respect to the standardization of stations, sections and methodology, the Subcommittee further

recommends (18)

that the Canadian Oceanographic Data Centre (CODC) be identified as the regional centre for the processing and exchange of data for the ICNAF Area, as well as an analysis centre for historical and climatological summaries of hydrographic data.

5. Plankton Sorting Centre at Gdynia

The Subcommittee was informed of the pending establishment of a joint US - Polish plankton sorting centre at Gdynia, Poland, which could assist in the sorting of plankton samples collected in the ICNAF Area. It was recommended that a report, for presentation at the 1974 Annual Meeting, be prepared, outlining the techniques and types of analyses that will be adopted by the Gdynia Institute for the sorting of plankton samples.

6. Presentation by Representative from UK Institute of Marine Environmental Research

In response to an invitation recommended at the 1972 Annual Meeting, Dr G.A. Robinson of the UK Institute of Marine Environmental Research presented a paper on the results of the Continuous Plankton Recorder surveys in the ICNAF Area for 1961-71 (Res.Doc. 73/78). Of particular significance in the results of the plankton surveys was the similarity in the trends of annual fluctuations in larval fish abundance in ICNAF Subareas 1-4 and the fluctuations in plankton abundance in the same subareas. It was also noted that plankton data may be useful in the interpretation of the effects of extremely anomalous hydrographic conditions in the ICNAF Area in 1972. It was suggested that ICNAF scientists examine the plankton information in Res.Doc. 73/78 and evaluate it in relation to trends in fisheries.

Recognizing the utility of plankton data in the prediction of year-class strength of fish and in interpreting the effects of anomalous hydrographic conditions, the Subcommittee

recommends (19)

i) that the UK Institute of Marine Environmental Research be requested to present annually, in time for the ICNAF Annual Meeting, a report on the results of the previous year's Continuous Plankton Recorder surveys (the presentation could be similar to that reported annually to ICES);

ii) that a representative of the UK Institute of Marine Environmental Research be invited to present a paper at a special session of the Subcommittee in 1974 on plankton studies in the ICNAF Area in 1972 with emphasis on long-term trends and anomalies.

7. Presentation by Ice Experts and Forecasters and the Need for Improving Ice Forecasting Methods

Presentations of papers on ice dynamics were given at special sessions of the Subcommittee on 1 June 1973 as follows:

"Polar ice variations off the Greenland west coast 1900-1972" by Hans H. Valeur (Res.Doc. 73/117).

"Notes on the time-space variations in the features and dynamics of the East Greenland pack ice" by W.I. Wittman (Res.Doc. 73/119).

"Variability of ice seasons on the eastern Canadian seaboard" by W.E. Markham.

"Outline of present situation of sea ice services in Japan" by M. Akagawa. (This paper was supplemented with a film of ice movements recorded by radar observation network set up at Mombetsu, Abashiri and Esashi on Hokkaido Island, Japan.)

"The Greenland Ice Sheet as a Climatic Mirror" by Professor W. Dansgaard of Copenhagen University, who described a new technique of extrating climatic information by core-drilling of glacial ice and analysis of its stabilized isotope content.

Following the presentation of papers a lively discussion and exchange of views took place between the scientists present and an *ad hoc* panel of ice experts. It was noted that short-term (24-48 hours) forecasting of ice movements was difficult to do with accuracy because of local influences and the inteaction of several factors. The question of the feasibility of providing an annual ice index, which would indicate the comparative severity of ice conditions insofar as they may restrict fishing, was discussed. The panel indicated that a knowledge of the types of information required would he necessary before the feasibility of such an index could be properly assessed. A small *ad hoc* Group (N.J. Campbell and W.E. Markham, Canada; P. Kanneworff, E. Smidt and H.H. Valeur, Denmark; A. Meyer, Fed. Rep. Germany;

J. Smed, ICES) met to discuss in some detail the actual requirements of the fishing industry for ice forecasting. It was noted that the matter is included in the terms of reference of the WMO Working Group on Ice, of which H.H. Valeur and W.E. Markham are members.

Because of his close association with the German fishing fleet, Dr A. Meyer made several important points. Modern trawlers can operate in a great variety of ice conditions but they are mostly concerned about ice edges, convergence of ice and pressure development. Also the ships of the international fleet often operate quite close together, because most of the winter fishing is done in areas where the bottom depth is 200-500 m. Various possibilities of improving ice forecasting services were considered, including a questionnaire on the adequacy of services provided, national examination of practices used in providing ice and weather forecasts, and the idea that ICNAF relay to those nations providing the services some suggestions for changes in forecasting techniques.

A matter of major concern was the lack of weather reporting capability on large trawlers. Thus, there is often no information going into the service centres from the areas where fleets of vessels are operating. The Subcommittee, therefore,

recommends (20)

that the Commission encourage the provision of at least one weather report per day to coastal marine radio stations from fishing vessels operating in waters off Greenland and Canada when ice is in the vicinity.

RECOMMENDATIONS AND LISTS OF DOCUMENTS

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D. LISTS OF RESEARCH AND SUMMARY DOCUMENTS - 1973

1. RESEARCH DOCUMENTS

Res.Doc. No.	Serial No.	Title	Author
73/1	2899	Aide-memoire on the control of fisheries	D.J. Garrod
73/2	2901	Report of Herring Ageing Workshop, St. Andrews, N.B., 11-13 December 1972	J.J. Hunt, L.S. Parsons, J.E. Watson, G.H. Winters
73/3	2903	Comparison of mortalities calculated from virtual population assessments and from research vessel survey data for cod stocks in ICNAF Divisions 3NO and 3Ps	A.T. Pinhorn
73/4	2904	Virtual population assessment of the cod stock in ICNAF Divisions 3NO	A.T. Pinhorn, R. Wells
73/5	2905	Status of yellowtail fishery in ICNAF Divisions 3L, 3N and 3O, with Addenda 1 and 2	T.K. Pitt
73/6	2908	Memorandum on the mixed fishery problem in Subarea 5 and Statistical Area 6	D.J. Garrod
73/7	2909	Notes on the status of cod and haddock stocks of the Scotian Shelf	R.G. Halliday
73/8	2910	An evaluation of the effect of fishing on the total finfish biomass in ICNAF Subarea 5 and Statistical Area 6, with Corrigenda	B.E. Brown, J.A. brennan, E.G. Heyerdahl, M.D. Grosslein, R.C. Hennemuth
73/9	2911	Mixture of species in Subareas 5 and 6	M.D. Grosslein
73/10	2912	Total Sustainable finfish yield from Subarea 5 and Statistical Area 6 based on yield per recruit and primary reduction considerations	D.W.K. Au
73/11	2913	Preliminary report of ICNAF larval herring (*Clupea harengus*) survey in the Gulf of Maine and on Georges Bank during December 1972	D.W.K. Au, T.L. Morris, J. Dohrmann
73/12	2914	Autumnal diatribution, abundance and dispersion of larval herring, *Clupea harengus harengus* Linnaeus, along the western coast of the Gulf of Maine in 1972	J.J. Graham, C.W. Davis, B.C. Bickford
73/13	2915	Status of groundfish stocks and fishery prospects in ICNAF Subareas 1, 2 and 3	K.G. Konstantinov
73/14	2916	Assessment of Atlantic mackerel in ICNAF Subarea 5 and Statistical Area 6	E.D. Anderson
73/15	3059	Economic and technological implications of application of effort limitations	K.A. Smith, H.A. Hutchings
73/16	2918	Preliminary results of Georges Bank - Gulf of Maine ICNAF larval herring cruise, *Wieczno*, 2-28 October 1972	Stefan Grimm
73/17	2919	Estimates of fishing mortality and stock size of herring - Georges Bank	Bohdan Draganik
73/18	3060	Factors affecting estimates of relative catch-abilities of fishing units in ICNAF Subarea 5 and Statistical Area 6	W.H. Lenarz, B.E. Brown

Res.Doc. No.	Serial No.	Title	Author
73/19	2921	Preliminary results of ICNAF larval herring cruise, *Anton Dohrn*, 30 October - 13 November 1972, in Georges Bank - Gulf of Maine areas	D. Schnack, G. Joakimsson, E. Kretzler
73/20	2940	Seals tagged in North Atlantic waters, 1967-1972, by Institute of Marine Research, Directorate of Fisheries, Bergen, Norway	Ellen Sophie Thobro
73/21	2943	Environmental conditions in the region of Georges Bank, Gulf of Maine, Nantucket Shoal, and the western part of the Nova Scotia Shelf, 2-28 October 1972	A. Furtak
73/22	2955	Distribution and abundance of young cod off Newfoundland in April - July 1972	A.Yu. Bulatova
73/23	2956	Growth and total mortality of mackerel from the New England area	V.I. Isakov
73/24	2957	Growth and total mortality of argentine in the Northwest Atlantic	L.J. Shevchuk
73/25	2958	On argentine stock locality in the Northwest Atlantic (ICNAF Div. 4V, 4W and 4X)	L.I. Shevchuk
73/26	2959	Soviet investigations on capelin in the Grand Newfoundland Bank area in 1972	S.M. Kovalyov, B.D. Kudrin
73/27	2960	An approximate estimate of the abundance indices for red hake of Age-group I in view of specifying the total abundance indices and possibility of forecasting the stock size two years ahead	V.A. Rikhter
73/28	2961	On modern tendencies in the dynamics of red hake (*Urophycis chuss* Walbaum) population in the Northwest Atlantic	V.A. Rikhter
73/29	2962	Biological characteristics of southwest Newfoundland herring, 1965-1971	L.S. Parsons, V.M. Hodder
73/30	2963	Document withdrawn	
73/31	2964	Document withdrawn	
73/32	2965	Feeding patterns of yellowtail flounder of two New England stocks	V.N. Efanov, V.I. Vinogradov
73/33	2967	Observations on capelin (*Mallotus villosus*) in Newfoundland waters	O. Dragesund, T. Monstad
73/34	2970	Food and feeding of the American plaice (*Hippoglossoides platessoides* F.) on St. Pierre Bank (ICNAF Subdiv. 3Ps) and on Cape Breton Shelf (ICNAF Subdiv. 4Vn)	J.P. Minet
73/35	2971	Winter distribution of cod (*Gadus morhua* L.) off the southwest coast of Newfoundland (ICNAF Div. 4R) in relation to water temperature	J.P. Minet, J.C. Poulard
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73/46 (also ICES/ICNAF Salmon Doc. 73/11)	2985	Catches of species other than salmon taken by drift nets at West Greenland during 1972	W.H. Lear
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73/55 (also ICES/ICNAF Salmon Doc. 73/15)	2998	Report on the salmon tagging cruise to West Greenland by FRS *Scotia*, 1 August - 13 September 1972	W.R. Munro
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73/58 (also ICES/ICNAF Salmon Doc. 73/19)	3006	Preliminary report on local recaptures from the International Salmon Tagging Experiment at West Greenland, 1972	J. Møller Jensen
73/59 (also ICES/ICNAF Salmon Doc. 73/18)	3007	Length composition in samples of commercial salmon catches taken by observers during the International Salmon Tagging Experiment at West Greenland, 1972	J. Møller Jensen
73/60	3005	Evaluation of research survey indices of abundance for cod stocks in ICNAF Subareas 2 and 3, with Appendix	A.T. Pinhorn, R. Wells
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73/62	3009	Stock assessment of common American squid in ICNAF Subarea 5 and Statistical Area 6	I. Ikeda, F. Nagasaki, H. Imanaga
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73/65 (also ICES/ICNAF Salmon Doc. 73/4)	3012	Review of Atlantic salmon stocks in major New Brunswick rivers in 1972	G.E. Turner, N.E. MacEachern, C.P. Ruggles
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73/68	3015	Analysis of the southern Gulf of St. Lawrence herring stock and implications concerning its future management	G.H. Winters, V.M. Hodder
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73/76 (also ICES/ICNAF Salmon Doc. 73/5)	3028	Genetic polymorphism in Northwest Miramichi salmon, in relation to season of river ascent and age at maturation and its implications for management of the stocks	Paul F. Elson
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73/85 (also ICES/ICNAF Salmon Doc. 73/3)	3039	The Greenland fishery for Atlantic salmon and Canadian catches	J.E. Paloheimo, P.F. Elson
73/86 (also ICES/ICNAF Salmon Doc. 73/22)	3040	French salmon tagging contribution, R/V *Cryos*, 20 August - 29 September 1972 (translated)	J.P. Minet
73/87	3041	Catch per unit effort relationship in Grand Bank American plaice (ICNAF Div. 3L and 3N)	T.K. Pitt
73/88	3042	An evaluation of the status of ICNAF Divisions 3P, 3O and 3LN redfish	L.S. Parsons, D.G. Parsons
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73/123	3098	Preliminary report on Canadian research on harp and hood seals, 1973	D.E. Sergeant

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73/1	2941	Proceedings of Special Commission Meeting, FAO, Rome, Italy, 8-26 January 1973	
73/2	2931	Status of reporting 1971 statistical and sampling data by Member Countries	Asst. Exec. Secretary
73/3	2939	Catch and effort statistics for GDR fisheries in the ICNAF Area in 1969 and 1970	Asst. Exec. Secretary
73/4	2906	Report of a Mid-term Meeting of Panel A, Charlottenlund, Denmark, 9 November 1972, with Appendix	
73/5	2954	Report of Special Meeting of Experts on Effort Limitation, Woods Hole, Mass., 26-30 March 1973	
73/6	2945	Report of the Fifth Meeting of the Joint ICES/ICNAF/IOC Coordinating Group for the North Atlantic, Charlottenlund, 23 September 1972	
73/7	2991	Report of the ICES/ICNAF Joint Working Party on North Atlantic Salmon, Copenhagen, 19-23 March 1973	
73/8	2953	Summary of information on discards and industrial fish (ICNAF Statistics Form 4) for the year 1971	Asst. Exec. Secretary
73/9	2969	Tabulation of 1971 nominal catch statistics by species groups	Asst. Exec. Secretary
73/10	3004	Sampling Yearbook presentation of data	Asst. Exec. Secretary

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73/11	2968	Report of the CWP *ad hoc* Working Group on the Contents of Regional Fisheries Statistical Bulletins, FAO, Rome, January 1973	Secretary, CWP
73/12	2966	Norwegian Research Report, 1972	Ø. Ulltang
73/13	2988	French Research Report, 1972, with Corrigenda	J. Morice, R.H. Letaconnoux
73/14	2989	Canadian Research Report, 1972	A.M. Fleming, J.S. Scott
73/15	2994	United Kingdom Research Report, 1972	D.J. Garrod, H.W. Hill, T. Williams, K.A. Pyefinch, G.A. Robinson
73/16	2995	Extracts from resolutions passed at the 1972 ICES Meeting relevant to the research and statistical activities of ICNAF	
73/17	3046	Nominal catches in the Convention Area (Subareas 1-5) and Stat. Area 6 in 1972 (Revised 7 July 1973)	Asst. Exec. Secretary
73/18	2996	Catch and effort statistics for Canadian sealing in the ICNAF Convention Area in 1972	Fisheries & Marine Service Environment Canada, Ottawa
73/19	3000	Danish Research Report, 1972	Sv.Aa. Horsted, H. Valeur
73/20	3001	German Research Report, 1972	A. Meyer, W. Lenz, J. Messtorff, K. Schubert
73/21	2997	Extracts from ICES Liaison Committee Report to NEAFC, 1973	
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73/25	3044	Summary of trawl material and mesh size sampling, 1972	Asst. Exec. Secretary
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73/28	3078	North-East Atlantic Fisheries Commission - Eleventh Meeting - conclusions and recommendations	
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73/30	3088	Status of fisheries and research carried out in Subarea 3 in 1972	H.A. Cole
73/31	3089	Japanese Research Report, 1972	Ikuo Ikeda
73/32	3090	Status of fisheries and research carried out in Subarea 2 in 1972	A.W. May
73/33	3091	Status of fisheries and research carried out in Subarea 1 and off East Greenland in 1972	Sv.Aa. Horsted

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73/34	3095	Status of fisheries and research carried out in Subarea 5 and Stat. Area 6 in 1972	M.D. Grosslein, V.C. Anthony, R.C. Hennemuth
73/35	3096	Status of fisheries and research carried out in Subarea 4 in 1972	F.D. McCracken
73/36	3099	Status of the harp and hood seal fisheries and research carried out in 1972	A.W. Mansfield
73/37	3100	Report of Second Meeting of Experts on Effort Limitation, Copenhagen, Denmark, 30–31 May, 5 June 1973	