

ERRATA

Page 17, Sec. 4, line 15 " ...draft protocol..."

Page 35, Para. (e), line 3 "...indication that an..."

Page 52, Para. (vi), heading "Future research..."

Page 56, line 4 "...MSY level of..."

Page 56, Table heading "Years to recovery..."

Page 62, Sec. 1, Para. 1, line 14 "...density dependent..."

Page 70, line 1 "...Helgoland..."

Page 80, Sec. 15, line 10 "...subarea designations the..."

Page 81, line 1 "...of fishing by the vessel..."

Page 89, Sec. 1(b), line 17 "...layer were higher..."

Page 91, line 1 "...Gulf of Maine Program..."

Page 96, Sec. 2, line 7 "...general consensus that..."

Page 98, Sec. (f), line 9 "...releases to measure..."

Page 103, line 1 "...attach importance..."

Page 105, Sec. 2(a), line 1 "...a larger proportion..."

Page 107, Sec. (e), line 19 "...were consistently less..."

Page 108, line 4 "...scale control the..."



**INTERNATIONAL COMMISSION**  
**FOR THE**  
**NORTHWEST ATLANTIC FISHERIES**



**REDBOOK 1975**

**STANDING COMMITTEE ON RESEARCH AND STATISTICS**

**PROCEEDINGS**  
**OF**

**SPECIAL MEETING JANUARY 1975**  
**ANNUAL MEETING MAY-JUNE 1975**

**Dartmouth • Canada**  
**August 1975**

PREFACE

*Redbook 1975* is issued in one volume and contains the Reports of the Standing Committee on Research and Statistics (STACRES) from Meetings held at Bergen, Norway, in January 1975 and at Aberdeen and Edinburgh, Scotland, in May-June 1975. Meetings of the Assessments and Biological Surveys Subcommittees of STACRES were held at Woods Hole, USA, in April 1975, and the reports of these meetings are appended to the STACRES Report of the May-June 1975 Meeting as Appendices I and II. Meetings of the Subcommittees on Statistics and Sampling and on Environmental Studies and the Working Group on Fishing Effort Studies, which were held in conjunction with the Annual Meeting of STACRES, are reported as Appendices III, V and IV respectively.

The STACRES Reports in Sections A and B of this volume correspond to Proceedings No. 1 of the January 1975 and June 1975 Meetings of the Commission. Part C contains the STACRES Agenda for the 1975 Annual Meeting, a list of recommendations from the 1975 Annual Meeting, lists of Summary and Research Documents presented to meetings held in 1975 up to and including the Annual Meeting, and a list of participants in the April 1975 and May-June 1975 meetings of STACRES and its Subcommittees and Working Groups.

8 August 1975

V.M. Hodder  
Assistant Executive Secretary

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(A more detail Contents List of the 1975 Annual Meeting STACRES Report is given on page 11 of this volume).



PART A  
STACRES REPORT  
JANUARY 1975



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

Sixth Special Commission Meeting - January 1975

Chairman: A.W. May

Rapporteurs: V.M. Hodder  
D.J. Garrod

STACRES met at Bergen, Norway, on 13-15 January 1975 at the request of the Commission to review the latest information available on the capelin resource and the fishery in Subareas 2 and 3, and to recommend TACs (total allowable catches) for 1975. A further meeting was held on 16 January to consider what advice might be given relative to a proposal for a closed area regulation with respect to the capelin fishery in Div. 3L. Representatives were present from Canada, Denmark, Federal Republic of Germany, German Democratic Republic, Iceland, Norway, Poland, Portugal, Union of Soviet Socialist Republics, United Kingdom and United States of America, and an observer from FAO.

1. Fishery Trends

Prior to 1972 the capelin fishery in Subareas 2 and 3 was carried out almost entirely by Canada and the catches were taken exclusively in coastal waters during the early summer spawning period. Catches declined from about 6,000 tons in the late 1950's to a level of 2,000-3,000 tons up to 1971. Offshore exploitation began in 1972 when 71,000 tons were reported (Table 1), more than 60% of which was taken in Subarea 2 and Div. 3K. In 1973 the total catch increased to 268,000 tons, shared almost equally between the northern part of the area (Subarea 2 and Div. 3K) and the southern part of the area (Div. 3LNOPs). Preliminary statistics for 1974 indicate a total catch of 269,000 tons (Table 2), 40% of which was taken in Subarea 2 and Div. 3K and nearly all of the remainder in Div. 3LNO. The catches in 1974 were restricted by TACs established for the two major stock complexes: Subarea 2 + Div. 3K and Div. 3LNOPs.

Although the total catches in 1973 and 1974 were about the same, there were significant changes in the pattern of fishing, especially in the southern area (Table 1); in 1973 nearly all of the catch from the southern area was taken on the southern part of the Grand Bank (Div. 3NO), but in 1974 a very substantial fishery developed on the northern part of the Grand Bank (Div. 3L), where 63,000 tons were taken compared with just 4,000 tons in 1973. Consequently, the catch on the southern half of the Grand Bank (Div. 3NO) declined from 127,000 tons in 1973 to about 90,000 tons in 1974.

The change in the fishery pattern was not only geographical but also seasonal in that the new fishery in Div. 3L took place mainly in April and May, in contrast to the fishery in Div. 3NO, which was mainly in June and July.

Table 1. Nominal catches of capelin (000 tons) in Subareas 2 and 3, 1970-74.

Area	1970	1971	1972	1973	1974
SA2	-	-	18	60	53
Div. 3K	+	+	28	76	58
Div. 3L	2	1	1	4	63
Div. 3NO	-	1	21	127	89
Subdiv. 3Ps	+	1	3	1	2
Total	2	3	71	268	269 <sup>1</sup>

<sup>1</sup> Total includes 3,500 tons by Portugal from Div. 3LNO.

2. Stock Composition of the Capelin Resource

Review of age composition data from the fisheries in 1974 (Res. Doc. 75/2, 75/3, 75/7) has confirmed that the catches are composed of mature capelin of 3, 4 and 5 years of age. In the northern area (Subarea 2 + Div. 3K), these become available to the offshore fishery during the autumn of the year before they migrate inshore to spawn on the coast of east Newfoundland and Labrador. Elsewhere in Subarea 3, the maturing age groups can be fished as they migrate southward to spawn during the same year, either inshore on the eastern Newfoundland coast, or offshore on the Southeast Shoal of the Grand Bank. While commercial catches contain some juvenile capelin, these are generally not concentrated within the same area and time as the mature capelin during the periods of migration in which the fishery takes place.

Table 2. Preliminary nominal catches of capelin (tons) in Subareas 2, 3 and 4 in 1974.

Div.	Country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	NK	Total
2J	Canada (inshore)	-	-	-	-	-	-	-	2	-	-	-	-	-	2
	Poland	-	-	-	-	-	-	-	2580	-	-	-	-	-	2580
	USSR	-	-	-	-	-	-	-	4141	22111	23038	1586	-	-	50876
	Total	-	-	-	-	-	-	-	6723	22111	23038	1586	-	-	53458
3K	Canada (inshore)	-	-	-	-	-	20	148	791	174	5	157	-	-	1295
	Canada (offshore)	-	-	-	-	-	-	-	-	196	7	-	-	-	203
	Poland	22	-	-	-	-	-	-	60	1050	2040	2040	-	-	3150
	USSR	22	-	-	-	-	144	21826	19099	19099	6022	6157	-	-	53270
Total	22	-	-	-	-	20	292	22677	19469	7084	8354	-	-	57918	
3L	Canada (inshore)	-	-	-	-	-	338	3267	965	329	-	-	-	-	4899
	Canada (offshore)	-	-	-	-	-	2786	1136	-	-	-	-	-	-	3922
	Norway	-	-	-	-	1853	648	-	-	-	-	-	-	-	2501
	Poland	-	-	-	-	660	1170	720	-	-	-	-	-	-	2550
USSR	-	-	954	19353	28101	1083	-	-	-	-	-	-	-	-	49491
Total	-	-	954	19353	30614	6025	5123	965	329	-	-	-	-	-	63363 <sup>1</sup>
3N	Canada (offshore)	-	-	-	-	-	2577	-	-	-	-	-	-	-	2577
	Norway	-	-	-	-	-	23634	17270	-	-	-	-	-	-	40904
	USSR	-	-	-	-	-	23124	-	-	-	-	-	-	-	23124
	Total	-	-	-	-	-	49335	17270	-	-	-	-	-	-	66605 <sup>1</sup>
30	Poland	-	-	840	350	-	-	-	-	-	-	-	-	-	1190
	Spain	...	...	...	...	...	...	...	...	...	...	...	...	6100	6100
	USSR	-	-	-	-	11030	3852	-	-	-	-	-	-	-	14882
	Total	...	...	840	350	11030	3852	...	...	...	...	...	...	6100	22172 <sup>1</sup>
3Ps	Canada (inshore)	-	-	-	-	7	684	927	1	391	9	9	-	-	2028
	Canada (offshore)	-	-	-	-	-	154	67	-	-	-	-	-	-	221
	Total	-	-	-	-	7	838	994	1	391	9	9	-	-	2249
	Canada (inshore)	-	-	-	-	-	9	+	1	-	-	-	-	-	10
Canada (offshore)	-	-	-	-	-	160	-	-	-	-	-	-	-	160	
Total	-	-	-	-	-	169	+	1	-	-	-	-	-	170	
4R	Canada	-	-	-	1	129	44	1	5	-	-	-	-	-	180
	2J+3K	22	-	-	-	-	20	292	29400	41580	30122	9940	-	-	111376
	3L	-	-	954	19353	30614	6025	5123	965	329	-	-	-	-	63363
	3NO	-	-	840	350	11030	53187	17270	-	-	-	-	-	6100	88777
3P	-	-	-	-	7	1007	994	2	391	9	9	-	-	2419	
4R	-	-	-	1	129	44	1	5	-	-	-	-	-	180	
GRAND TOTAL															266115 <sup>1</sup>

<sup>1</sup> In addition, Portugal reported 3,500 tons from Div. 3LNO.

The seasonal differences in distribution identify two major components of the capelin resource at this stage of their life history. The distinction is supported by differences in the growth rate between the two groups (Res. Doc. 75/2). Capelin in the northern area grow less rapidly and show local differences of growth which indicate that these capelin populations do not mix completely during a year. Part of the mature capelin in Div. 3L migrate to spawn inshore in that area and in so doing can be associated with the summer inshore migration of cod. A second part moves further south to spawn mainly offshore in Div. 3NO and some may also contribute to inshore spawning in Subdiv. 3Ps. Capelin in these various areas are distinguished by their growth rate and by the seasonal distribution of the fisheries to date, but acoustic surveys (Res. Doc. 75/3) show the distribution of capelin to be continuous at least at certain times, so that the possibility of exchange between the northern and southern components cannot be excluded.

The available data, therefore, support a broad subdivision of the total capelin population into a northern group, spawning in Subarea 2 and Div. 3K, and a southern group, spawning in Div. 3LNOP. It is likely that each of these groups is further subdivided into separate spawning stocks, but the available evidence is insufficient to allow a finer subdivision to be made for management purposes.

### 3. Estimates of Stock Size

In October and November 1974 the USSR conducted an acoustic survey of capelin off Labrador and east Newfoundland, these most likely being the capelin that would spawn in Subarea 2 and Div. 3K in 1975 (Res. Doc. 75/7). The acoustic survey, supported by photographic techniques to estimate the abundance of capelin within shoals, gave a minimum estimate of 1.3 million tons biomass for this component of the total resource.

An alternative estimate of the longer term potential was also presented (Res. Doc. 75/2), based on an analysis of the food requirements of the major predators of capelin, i.e., cod, harp seals and whales. Stomach analyses for cod (Res. Doc. 75/2 and 75/5) show that capelin form the major component of the diet during the early summer period. This and similar information on habits of seals and whales enabled estimation of consumption of capelin by the existing predator resources which was compared with the amount that might have been consumed by these predators before they themselves become exploited. The analysis indicated a quantity of 1.25 million tons of capelin which is now surplus to the food requirements of the existing stocks of cod, seals and whales and which might, therefore, be taken by the fishery without detriment to these other important components of the ecosystem. The importance of the interspecific interactions has to be emphasized, but at present it is not possible to do more than speculate as to what effect the increased catches of capelin might have in terms of the abundance and distribution patterns of predators.

Both the specific estimate of the capelin resource in the northern area in the autumn of 1974 (1.3 million tons), and the broader view of the possible yield (1.25 million tons potentially surplus to predator requirements) point to a total resource of mature capelin well in excess of 1 million tons at the present time. An alternative mathematical formulation of the problem (Res. Doc. 75/6) gave a similar value.

The new information confirms previous views on the general magnitude of the resource, but it is not yet known what proportion could be caught without detriment either to the capelin through an effect on future recruitment or to the other dependent predator species.

### 4. Review of Previous Advice on TACs

The rapid development of an offshore fishery on capelin was first noted at the 1973 Annual Meeting, when STACRES was requested to examine the implications of establishing TACs for the capelin resources in Subareas 2 and 3. In the absence of any real knowledge of the capelin potential in the area, but recognizing that the potential might be as high as 750,000 tons, the Assessments Subcommittee recommended a TAC of 250,000 tons for 1974 as the first step in the development of the fishery, pending the acquisition of new information on the stocks, particularly in relation to the vital role played by capelin in the trophic ecology of the area. It was also recommended that future increases in TAC should be related to the rate at which new information became available to allow the full potential of the resource to be assessed. It was also recognized that there was at least partial separation of the capelin in Div. 3NO from those further north in Subarea 2 and Div. 3K.

At the Special Commission Meeting in January 1974, further development of the capelin fishery was noted when preliminary data indicated that the 1973 catch would exceed 260,000 tons, a value greater than the TAC of 250,000 tons recommended for 1974. New information presented indicated that a minimal stock breakdown would be Subarea 2 + Div. 3K as the northern stock complex and Div. 3LNOPs as the southern one. Consequently, the Assessments Subcommittee suggested that, if a partition of the 1974 TAC was required, the catch in the southern area should not exceed 150,000 tons. The Commission, consequently, adopted TACs of 110,000 tons for the northern area and 148,000 tons for the southern area, leaving open the possibility for any country with no specific allocation to catch up to 10,000 tons, no more than half of which to be caught in the southern area.

At the 1974 Annual Meeting, additional information presented to the Assessments Subcommittee did not alter the previous opinion that the potential catch of capelin in Subareas 2 and 3 could be 750,000 tons, and it was concluded that an appropriate adjustment of the TAC could be a catch of 500,000 tons in 1975, with this catch maintained for 3 years, and coupled with (i) the restriction of the fishery to mature fish and (ii) an undertaking that countries utilizing the resource conduct surveys on both adults and juveniles in order to monitor the effects of the fishery. It was also indicated that an appropriate partition of the TAC would be 300,000 tons for the northern area and 200,000 tons for the southern area. The matter of setting TACs for 1975 was deferred by the Commission to the present meeting.

5. Advice on Future Management of Capelin

New information presented at this meeting supported earlier scientific opinion that the potential MSY of capelin in Subareas 2 and 3 was about 750,000 tons. This estimate has been derived from direct surveys of capelin stocks and theoretical considerations of potential surplus production of capelin because of declines in the stocks of some major predators. STACRES is not now in a position to specify the kinds of interactions or to predict the effects on these major predators if fishing were to be carried on at this level. It was noted that no direct effects have yet been described in similar situations in other areas (e.g. cod and capelin fisheries in the Barents Sea). Under these circumstances, STACRES confirms its earlier advice that the most appropriate adjustment in the overall TAC could be to a level of 500,000 tons, not to be exceeded for three years, during which time the resources of capelin and other species would be monitored to determine whether any interspecies effects were occurring, but subject to adjustment within this period if new information warranted a change in the TAC level. STACRES points out that the increase to 500,000 tons is put forward as a suggested maximum adjustment of the TAC at this point in time, given the uncertainties surrounding interactions between species, yet providing for a level of fishing which might permit possible interactions to be detected.

Although existing estimates of MSY and stock sizes are very approximate, it appears that the capelin resource in the northern area (Subarea 2 + Div. 3K) is larger than that in the southern area (Div. 3LNOPs) by a ratio of 3 to 2. Taking this into account, STACRES again suggests that an appropriate split of a 500,000 ton TAC would be 300,000 tons in Subarea 2 and Div. 3K combined and 200,000 tons in Div. 3LNOPs.

Consideration was given to the question of further subdivision of the TAC on the basis of existing knowledge of stock differentiation. It was concluded that further subdivision of the northern TAC was not practical at the moment due to insufficient knowledge of stock separation in this area. In the south, however, there is evidence to suggest that the fishery in Div. 3L may operate on several separate spawning components which spawn later inshore in Div. 3L, on the Southeast Shoal, and possibly in Subdiv. 3Ps. In 1974, Div. 3L supported a large fishery, while the catch in Subdiv. 3Ps was small. To preclude rapid development of a fishery on a possibly small stock in Subdiv. 3Ps, STACRES advises that an amount of 10,000 tons from the southern TAC be reserved as a maximum permissible catch from Subdiv. 3Ps, with the proviso that any part of this amount could be taken in Div. 3NO if not taken in the former area. For the southern area as a whole, it was concluded that it would be desirable for the fishery to be concentrated as much as possible on the concentrations of mature capelin in Div. 3NO to minimize potential adverse effects on capelin and other species. If this were practical, it would avoid the possibility of overfishing any one of the spawning components present in Div. 3L earlier in the season, and, for the inshore spawning stock, it would avoid the possibility of adversely affecting inshore migration and feeding success of the Div. 3L cod. If the principle of directing the southern fishery toward the spawning concentrations is accepted by the Commission, this objective could be achieved by further subdivision of the southern TAC. For example, it could be achieved by setting an upper limit for the Div. 3L fishery of 50,000 tons, with the proviso that any part of this amount not taken in Div. 3L could be taken in Div. 3NO.

To summarize, the management regime in the southern area would then consist of an overall maximum TAC of 200,000 tons, no more than 10,000 tons of which could be taken in Subdiv. 3Ps and no more than 50,000 tons of which could be taken in Div. 3L. If these maxima were not achieved in Subdiv. 3Ps and Div. 3L, the uncaught amounts could be added to the catches in Div. 3NO.

6. Advice on Closed Area Regulation in Div. 3L.

Noting the Canadian proposal for a closed area regulation with respect to the capelin fishery in Div. 3L (Comm. Doc. 75/1 revised), and taking into account the STACRES conclusion that it would be desirable to adopt measures which would tend to divert fishing from Div. 3L to the capelin concentrations in Div. 3NO, STACRES advises that the proposed closed area could be effective in giving additional protection to that component of the Div. 3L capelin migrating to spawn inshore. This would be given at a time when the capelin are most closely associated with cod migrating inshore which are highly dependent on capelin as food. It is noted that there is no specific biological rationale for specifying precisely the boundaries of such a closed area, although the area as proposed would appear to offer such protection during the May-June period. However, it is further noted that the area to the south and west of the coordinates 48°00'N, 51°45'W probably contain a mixture of inshore-migrating and offshore-migrating capelin.

7. Future Research

Improvement in advice to the Commission on management of capelin and on the effects of capelin fisheries on other species depends critically on direct estimations of capelin abundance and on research in species interactions. While both subject areas deserve priority, it was evident that survey results were more likely to be available in the shorter term. During 1975, Canadian and USSR vessels plan to carry out acoustic and fishing surveys in both the northern and southern areas, and a survey is also tentatively planned by Norway. Planning and coordination of these surveys, for most efficient use of vessel time and uniformity of techniques insofar as possible, will be considered at the Woods Hole meeting of the Biological Surveys Subcommittee in April 1975. It was noted that larval surveys could also contribute substantially to knowledge of abundance and stock separation.

Information on species interactions will require longer term research on biological systems and will have wider application as fisheries develop on species other than capelin at lower trophic levels, as well as application in mixed fisheries generally. The importance of beginning new studies and expanding existing research programs in this field cannot be overemphasized.

8. Appreciation

The Chairman expressed his appreciation for the excellent work of the participants during this Special Meeting of STACRES and thanked the Director of the Institute of Marine Research for the excellent meeting facilities provided.



PART B

STACRES REPORT

MAY-JUNE 1975



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

Annual Meeting - May-June 1975

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

Annual Meeting - May-June 1975

Chairman: A.W. May

Rapporteur: V.M. Hodder

Meetings of STACRES and its Subcommittees and Working Groups were held at the Marine Laboratory in Aberdeen, Scotland, during 2-7 June and at Edinburgh, Scotland, on 18 June 1975. Representatives were present at the Aberdeen Meetings from all Member Countries except Bulgaria, German Democratic Republic, Iceland, Italy and Romania, and observers were present from Cuba, the Food and Agriculture Organization of the United Nations (FAO) and the International Council for the Exploration of the Sea (ICES).

These meetings were preceded on 27-31 May by a meeting of the Environmental Working Group at Aberdeen, and by meetings of the Assessments and Biological Surveys Subcommittees at the Northeast Fisheries Center in Woods Hole, USA, during 10-18 April 1975. Since the 1974 Annual Meeting STACRES met during the Sixth Special Commission Meeting in Bergen, Norway, in January 1975 (this volume, page 5).

The reports of the various Subcommittees and Working Groups, as adopted by STACRES at this Annual Meeting, are given at Appendix I (Assessments), Appendix II (Biological Surveys), Appendix III (Statistics and Sampling), Appendix IV (Fishing Effort Studies), Appendix V (Environmental) and Appendix VI (Steering and Publications). Brief summaries of these reports, together with other matters considered by STACRES, are given below. The STACRES Agenda and Lists of Summary and Research Documents are given in Part C of this volume.

### I. ASSESSMENTS (APP. I)

#### 1. Fishery Trends

The total catch of all species in the Northwest Atlantic (Subareas 1 to 5 and Statistical Areas 0 and 6) in 1974 was about 4.0 million tons (Summ. Doc. 75/32), a 10% decline from 4.45 million tons in 1973. Major declines occurred in the fisheries for redfish (81,000 tons), silver hake (209,000 tons), red hake (32,000 tons), herring (53,000 tons), mackerel (81,000 tons), and menhaden (82,000 tons). Smaller declines occurred for many species, the most significant being cod (15,000 tons), witch (14,000 tons), yellowtail (16,000 tons) and squids (11,000 tons). Some of these declines were due to the effect of regulation. The declines were partially offset by increases in the catches of round-nose grenadier (19,000 tons), capelin (18,000 tons) and argentine (34,000 tons). Catches declined in Subarea 3 (63,000 tons), Subarea 4 (265,000 tons) and Subarea 5 (259,000 tons), and increased in Subarea 1 (6,000 tons), Subarea 2 (96,000 tons) and Statistical Area 6 (7,000 tons). Catches from Statistical Area 0 were very low (less than 4,000 tons) in 1973 and 1974.

#### 2. Stock Assessments

The Assessments Subcommittee reviewed all stocks for which TACs (total allowable catches) are in effect or proposed in order to recommend catch levels for 1976. As for 1975, the assessments are categorized as follows:

- (1) assessments using analytical models based on analysis of age structure of a stock over time;
- (2) assessments derived from general production models where stock size as a whole is known but age composition data are not available;
- (3) assessments based on general biological information;
- (4) assessments based on catch statistics alone.

Throughout its discussion the Subcommittee has had to assume that the statistics reported by Member Countries represent the total catches, even though it is known that for some stocks substantial quantities of discards occur. In particular, it is noted that discarding of small fish is believed to be more widespread throughout the ICNAF Area than is apparent from the data available. Discarding of small fish and of unwanted species of commercial size removes important quantities of the resource from the regulatory regime and obviously detracts from the precision of scientific advice when the amount of such discarding is not known.

The Subcommittee has made recommendations on a total of 60 TACs, including those for species groups in a few situations and for the second-tier TAC in Subarea 5 and Statistical Area 6. In approximately one-third of these, the recommendation is for a reduction from the TAC levels advised for 1975, assuming that the 1975 TACs are taken. This reflects the Subcommittee's conclusion that a cautious approach is in order, being aware that the time lag in providing information (e.g. 1976 TACs set on the basis of 1974 data reflecting changes in the fishery from 1973) may prevent a sufficiently rapid or adequate response to secure the management objective. Table 1 contains a summary of catches (1971-74) and TACs (1973-76) for all stocks proposed for regulation in 1976. Similar information organized by subarea is given in various tables in the Report of the Assessments Subcommittee (Appendix I).

The Subcommittee also examined the question of the size of the management area for several stocks for which TACs apply over a wide geographic area, and noted that for some stocks (as for capelin) it may be desirable on the basis of biological and practical considerations to augment the overall TAC by regulations to ensure some appropriate distribution of the fishery.

Table 1. Nominal catches (1971-74) and TACs (1973-76) of species for possible regulation at the 1975 Annual Meeting.

Species	Stock area	Nom. catches(000 tons)				TACs (000 tons) <sup>2</sup>				Assessment category	
		1971	1972	1973	1974 <sup>1</sup>	1973	1974	1975	1976		
Cod	1	121	111	63	48	- (102)	107.0 (80)	60.0 (55)	(<45)	1	
	2GH	13	14	+	4	-	20.0 (20)	20.0 (20)	(20)	1	
	2J+3KL	432	458	355	373	665.5 (650)	656.7 (650)	554.0 (550)	(300)	1	
	3M	34	58	23	24	-	40.0 (35)	40.0 (40)	(40)	1	
	3NO	126	103	80	73	103.5 (70)	101.1 (85)	87.7 (85)	(85)	1	
	3Ps	64	44	53	45	70.5 (70)	70.0 (70)	62.4 (60)	(60)	1	
	4T+4Vn <sup>3</sup>	57	68	50	42	-	63.0 (60)	50.0 (50)	(45)	1	
	4Vn <sup>4</sup>	11	9	7	6	-	10.0 (10)	10.0 (10)	(10)	1	
	4Vsw	54	62	54	44	60.5 (60)	60.0 (60)	60.0 (60)	(40)	1	
	4X(offshore)	9	7	7	6	-	- (8)	5.0 (5)	(4)	1	
	5Y	8	7	6	8	10.0 (10)	10.0 (10)	10.0 (10)	(8)	4	
	5Z	28	25	29	27	35.0 (35)	35.0 (35)	35.0 (35)	(35)	2	
Haddock	4VW	13	5	4	2	4.0 (0)	0.0 (0)	0.0 (0)	(0)	1	
	4X	18	13	13	13	9.0 (0)	0.0 (0)	15.0 (15)	(0)	1	
	5	12	7	6	5	6.0 (0)	0.0 (0)	6.0 <sup>5</sup> (0)	(0)	1	
Redfish	2+3K	19	20	39	30	-	30.0 (25)	30.0 (30)	(30)	2	
	3M	8	42	22	35	-	40.0 (..)	16.0 (16)	(16)	2	
	3LN	34	29	33	22	-	28.0 (20)	20.0 (20)	(20)	2	
	3O	20	16	9	13	-	16.0 (15)	16.0 (16)	(16)	2	
	3P	28	26	18	22	-	25.0 (23)	25.0 (25)	(20)	2	
	4VWX	62	50	40	33	-	40.0 (30)	30.0 (30)	(30)	4	
	5	20	19	17	10	30.0 (30)	30.0 (30)	25.0 (25)	(17)	2	
Silver hake	4VWX	129	114	299	96	-	100.0 (50-100)	120.0 (120)	(100)	1	
	5Y	8	7	9	5	10.0 (10)	10.0 (10)	15.0 (15)	(10)	3	
	5Ze	72	78	62	66	80.0 (80)	80.0 (80)	80.0 (80)	(50)	1	
	5Zw+6	28	35	65	58	80.0 (80)	80.0 (80)	80.0 (80)	(43)	1	
Red hake	5Ze <sup>6</sup>	9	39	25	10	-	20.0 (20)	20.0 (20)	(26)	1	
	5Zw+6 <sup>6</sup>	31	36	41	24	40.0 (40)	50.0 (50-70)	45.0 (45)	(16)	1	
Pollock	4VWX	12	20	30	25	50.0 (50) <sup>7</sup>	55.0 (50)	55.0 (55)	(55)	4	
	5	14	13	13	12						
American plaice	2+3K	5	9	5	5	-	10.5 (8)	8.0 (8)	(8)	1	
	3M	1	1	1	2	-	2.0 (2)	2.0 (2)	(2)	4	
	3LNO	68	59	53	46	60.5 (60)	60.0 (60)	60.0 (60)	(47)	1	
	3Ps	7	7	15	6	-	11.0 (10)	11.0 (11)	(8)	1	
Witch	2J+3KL	16	17	24	16	-	22.0 (17)	17.0 (17)	(17)	1	
	3NO	15	9	7	8	-	10.0 (10)	10.0 (10)	(10)	1	
	3Ps	2	2	3	2	-	3.0 (3)	3.0 (3)	(3)	4	
Yellowtail	3LNO	37	39	33	24	50.0 (50)	40.0 (40)	35.0 (35)	(<10)	1	
	5(E69 <sup>9</sup> )	31	39	31	16	16.0 (16)	16.0 (16)	16.0 (16)	(16)	2	
	5(W69 <sup>9</sup> )+6				10	10.0 (10) <sup>8</sup>	10.0 (10) <sup>8</sup>	4.0 <sup>9</sup> (0)	(0)	2	
A. plaice, witch and yellowtail	4VWX	34	23	28	25	-	32.0 (32)	32.0 (32)	(28)	4	
Flounders (except yellowtail)	5+6	28	24	22	22	25.0 (25)	25.0 (25)	25.0 (25)	(20)	3	
Greenland halibut	0+1	4	14	10	14	-	-	-	(20)	4	
	2+3KL	25	30	29	27	-	40.0 (30)	40.0 (40)	(30)	1	
Roundnose grenadier	0+1	8	8	5	12	-	-	10.0	(12)	4	
	2+3	75	24	18	28	-	32.0 (30)	32.0 (32)	(32)	1	
Herring	Option 1		4V (adults)				(Seasonal - Jul to Jun)				
			4WX(adults)								
Option 2			72	32	30	44	-	45.0	30.0 <sup>12</sup>	-	
			4VW(a)				(Seasonal - Jul to Jun)				
			4VW(a)								
			4XW(b)								
			5Y(adults)								
		5Z+6									

Table 1. (Continued)

Species	Stock area	Nom. catches(000 tons)				TACs (000 tons) <sup>2</sup>				Assessment category
		1971	1972	1973	1974 <sup>1</sup>	1973	1974	1975	1976	
Mackerel	3+4	24	22	38	44	-	55.0 <sup>15</sup>	70.0 (70)	} (310)	1
	5+6	349	387	381	294	450.0	304.0 (251-312)	285.0 (285)		
Argentine	4VWX	7	6	1	17	-	25.0 (25)	25.0 (25)	(25)	3
	5				20	-	25.0 (25) <sup>16</sup>	-	-	4
Capelin	2+3K	+	46	136	127	-	110.0 <sup>17</sup>	160.0 <sup>18</sup>	(300)	3
	3L	1	1	4		-		45.0	} (200)	3
	3NO	1	21	127	160	-	148.0 <sup>17</sup>	126.0		3
	3Ps	1	3	1		-		9.0	3	
Squid- <i>Illex</i>	3+4	9	2	10	+	-	-	25.0	(15)	3
"- <i>Illex</i>	5+6	[ 25	49	57	21	-	71.0 (50-80)	71.0 (71) <sup>20</sup>	} (30)	3
"- <i>Loligo</i>	5+6				34	-				
O. finfish <sup>21</sup>	5+6	156	168	155	111 <sup>22</sup>	-	125.0 (125)	150.0 (125)	(150)	4
Overall 2nd tier <sup>23</sup>	5+6	1136	1165	1154	935	-	923.9	850.0 (850)	(650+)	

<sup>1</sup> Provisional statistics compiled for the 1975 Annual Meeting.  
<sup>2</sup> TACs include quantities estimated to be taken outside the Convention Area; quantities in parentheses are TACs recommended by STACRES and the Assessments Subcommittee.  
<sup>3</sup> Div. 4T(Jan-Dec)+4Vn(Jan-Apr).  
<sup>4</sup> Div. 4Vn(May-Dec).  
<sup>5</sup> Solely for by-catch allocation (see Summ. Doc. 75/1).  
<sup>6</sup> TACs for 1973 to 1975 pertain to 5Z(E69<sup>o</sup>) and 5Z(W69<sup>o</sup>)+6 respectively; TACs recommended for 1976 pertain to 5Ze and 5Zw+6.  
<sup>7</sup> TAC for 1973 pertains to 4X+5 only.  
<sup>8</sup> TACs for 1973 and 1974 pertain to 5(W69<sup>o</sup>) only.  
<sup>9</sup> See Summ. Doc. 75/1 (Proc. 5th Spec. Comm. Mtg., Nov 1974).  
<sup>10</sup> TACs recommended pertain to the period July to June for 1975/76 and 1976/77 respectively.  
<sup>11</sup> TAC to be reduced by whatever catch is to be taken in Div. 4W(a) in the period 1 Jul-31 Dec 1975.  
<sup>12</sup> TAC pertains to Jan-Jun 1975 only.  
<sup>13</sup> An appropriate amount has to be deducted from this TAC to allow for the inshore fishery, if the TAC is to be set according to the principle used in previous years.  
<sup>14</sup> Reduction to 16,000 tons agreed at Spec. Comm. Mtg., Nov 1974 (Summ. Doc. 75/1).  
<sup>15</sup> TAC pertains to 4VWX.  
<sup>16</sup> TAC included with "Other finfish" after 1974.  
<sup>17</sup> Countries without specific allocations may each take up to 10,000 tons, no more than 5,000 of which may be taken from Div. 3LNOPS.  
<sup>18</sup> Countries without specific allocations may each take up to 10,000 tons.  
<sup>19</sup> Countries without specific allocations may not take more than 1,000 tons from Subdiv. 3Ps or more than 5,000 tons from Div. 3L; countries with specific allocations may add to their Div. 3NO allocations any part of their Subdiv. 3Ps and Div. 3L allocations not taken in the two last-mentioned areas.  
<sup>20</sup> Scientific recommendation was intended to pertain to Squid-*Loligo* only.  
<sup>21</sup> Excludes all TAC species and also menhaden, billfishes, tunas and large sharks (except dogfish).  
<sup>22</sup> Excludes argentine (23,000 tons) as a separate TAC was set in 1974 only.  
<sup>23</sup> All finfish species (except menhaden, billfishes, tunas and large sharks) and squids.

3. The Overall Level of Fishing in Subareas 2, 3 and 4

The Assessments Subcommittee examined the effects on 1976 catches of various percentage reductions in fishing effort (fishing mortality) in Subareas 2 to 4 as requested in Comm. Doc. 75/18. Considering the groundfish stocks in these areas as a whole, it is probable that the level of exploitation in the early 1960's was approaching the level associated with the MSY (maximum sustainable yield), and that it passed beyond the MSY level in the 1968-70 period. Taking into account increases in fishing efficiency, it is estimated that from 1961-73 fishing effort has doubled and stock abundance declined by one-half. These general relationships suggest that a significant reduction in fishing effort will not reduce the total catch in the long term, although the immediate loss in catch will be roughly proportional to the reduction in effort. The possible implications of effort reduction for individual stocks are considered in more detail in Section VIII of the Assessments Subcommittee Report (Appendix I).

4. Further Discussion of Assessments at Annual Meeting

Additional material was presented pertaining to silver hake in Divisions 4VWX and mackerel in Subareas 3 to 5 and Statistical Area 6. In both cases, it was agreed that the new data did not warrant adjustment to the recommended TACs agreed by the Assessment Subcommittee in April 1975, but for mackerel the need to implement a minimum size regulation at 25 cm was re-emphasized.

In further discussion of the TAC for herring in Division 5Z and Statistical Area 6, it was agreed to note that the range of assumptions used in preparing the assessment did allow for an upper limit of 100,000 tons for the TAC, depending on the level of recruitment of the 1973 year-class.

## II. BIOLOGICAL SURVEYS (APP. II)

### 1. Review of Survey Results

Results of recent surveys on groundfish, larval and juvenile herring, capelin, and hydroacoustics were reviewed. It was concluded that survey results could provide firm data for stock assessment purposes only when a time series of survey catches could be satisfactorily correlated with independent estimates of biomass. Nevertheless, preliminary results which indicated sharp changes in catches could not be ignored and should be considered as background information in stock assessments. Several examples of such changes were available from surveys conducted in 1974.

### 2. Survey Activities and Plans

Most of the surveys conducted in 1974 were groundfish surveys and these remained at about the same level as in 1973. It was noted that an increase in surveys would be desirable in the northern part of Subarea 3, in Subarea 2 and in Statistical Area 0. Schedules were developed for the joint larval herring surveys in the autumn of 1975 and for the juvenile herring surveys early in 1976. It was noted that Dr. M.D. Grosslein (USA) agreed to act as task force leader to coordinate the larval and juvenile herring programs in the Georges Bank-Gulf of Maine area.

A stratification scheme for Statistical Area 0 was approved, and it was recommended that the scheme should be extended into the adjacent waters of Divisions 1C and 1D.

### 3. Manual on Coordinated Surveys

An outline of the contents of a proposed manual on ICNAF coordinated surveys was developed and agreed, and preliminary drafting of the various sections of the manual assigned to scientists from several national laboratories.

### 4. Hydroacoustic Surveys

Descriptions of equipment and techniques for hydroacoustic surveys being developed in Canada were reviewed. It was noted that hydroacoustic techniques had recently been applied in capelin surveys. It was also noted that the body of data collected on recent joint hydroacoustic cruises by research vessels from German Democratic Republic, Poland, USSR and USA form a comprehensive and detailed history of a prototype acoustic survey.

## III. STATISTICS AND SAMPLING (APP. III)

### 1. Statistical Activities and Publications

As in the past, it was noted that the late reporting of statistical data is a severe hindrance to the timely preparation of statistical and assessment material for the Commission, and Member Countries are once again urged to provide for the timely submission of statistical reports.

The Eighth Session of the CWP (Coordinating Working Party on Atlantic Fishery Statistics) was held in September 1974, and a number of proposals of relevance to ICNAF statistical procedures were reviewed and adopted.

The ICNAF Statistical Bulletin for 1973 was issued in January 1975; it could have been prepared and issued some months earlier if all countries had met the 30 June deadline for the submission of statistical reports.

Since many countries are not yet reporting squid catches by species, and since the Assessments Subcommittee has recommended separate TACs for *Illex* and *Loligo*, STACRES accordingly

recommends (1)

*that all member countries take steps immediately to collect and report their catches of squids by Illex and Loligo and also to provide a breakdown of their squid catches for preceding years.*

### 2. Advance Monthly Statistics

STACRES noted that the Commission now requires Member Countries to report their monthly catches of species under TAC regulation within 30 days following the month in which the catches were made. These data could be utilized for stock assessments early in the following year if the catch figures were appropriately revised, and STACRES accordingly

recommends (2)

- i) *that the Secretariat at the end of the year compile the data obtained from the monthly submissions for as many months as are available for each country and forward the appropriate tabulations to both scientists and national statistical offices for updating with the request that the revised data be broken down by ICNAF divisions and/or subdivisions and also, where possible, by major gear categories; and*
- ii) *that the revised data be airmailed to reach the Secretariat, with copies of relevant information to designated scientists, at least two months prior to the start of the Assessments Subcommittee Meeting.*

3. Statistics on Discards

Less than one-half of the Member Countries had supplied discard information for 1973. Noting the many difficulties in obtaining discard data for inclusion in the Statistical Bulletin, as recommended at the 1974 Annual Meeting, STACRES

recommends (3)

- i) *that the Secretariat not include the statistics on discards in the Statistical Bulletin but issue the data in a Summary Document; and*
- ii) *that the Secretariat contact Member Countries with a view to improving the collection and reporting of statistics on discards by species, in particular by TAC species.*

4. Consideration of Proposal for an International Observer Program.

Discussions of the proposal, referred to STACRES by STACTIC (Summ. Doc. 75/9, page 25), took place within both the Assessments Subcommittee and the Statistics and Sampling Subcommittee, and these are summarized here. Such a program, if implemented, could be of great value for the scientific work of the Commission, as observers could obtain additional information on catch and effort and, in particular, information on species composition of catches and discards which are often lacking. If properly trained, the observers might also be able to carry out biological sampling from the catches. Several representatives pointed out that in some cases sampling might conflict with the work of fishermen and therefore might better be done as a special program independent of the observer program being discussed by the Commission. It was noted, however, that, if information collected by observers were ever used for enforcement purposes, the likely result would be a change in fishing pattern for those vessels carrying observers, making the information collected by them much less useful. On the other hand, the present information on by-catch and discards is so limited that any means of improvement should be considered.

Following discussion within STACTIC, STACRES was informed that the proposed international observer program, when implemented, would probably be scientifically oriented, and that a draft protocol was being prepared by STACTIC for consideration by STACRES. It was agreed that a joint STACTIC-STACRES Working Group could be set up to consider the draft protocol when it becomes available.

STACRES further considers that a scientifically-oriented observer program would be most useful if observers could take biological samples of the catches as well as collecting information on species composition, discards, etc. This does not imply any lessening of the obligations of Member Countries to provide such data themselves. STACRES also considers that provision must be made to ensure that data collected under the observer program cannot be used directly for enforcement purposes.

5. Incomplete Reporting of By-catch

For some stocks the precision of assessments is far from satisfactory due to lack of information on by-catch and discards; in particular, this applies to silver hake and the flounder stocks in the ICNAF Area. Better information on by-catch could be obtained through the proposed international observer program (see Subsection 4 above).

6. Adequacy of Sampling

Although minimum levels of sampling for length, age and associated data had been recommended by STACRES and adopted by the Commission some years ago and the matter is brought to the attention of Member Countries annually, sampling continues to be very inadequate for many stocks under TAC regulation. This seriously affects the precision of advice on TACs, and STACRES again requests the Commission to stress the importance of these data and to urge Member Countries to comply with the Commission's requirements for an adequate level of sampling.

#### IV. FISHING EFFORT STUDIES (APP. IV)

##### 1. Division 5Z Pilot Study Data Base

Catch and effort statistics for the Division 5Z Pilot Study were submitted by four countries and a partial report by a fifth country. The Working Group discussed various analyses that could be performed using these data in order to clarify the effects of various factors of catchability.

##### 2. Fishing Efficiency

Studies of fishing efficiency related to fitting of production curves gave estimates of increases in efficiency between 2% and 11% per year over the long term in Subareas 2, 3 and 4. It was noted that changes in fishing technology, particularly changes involving operational procedures as opposed to changes in fishing gear, were not generally documented. Such changes could significantly affect reported catch per unit effort and fishing mortality generated per unit effort.

##### 3. Simulation of Effects of Fishing Effort Regulation

A simulation study was presented based on the previously proposed overall reduction of fishing effort of 25% from 1971 for 1973 in Subarea 5. The simulation gave results that might have been expected if such a regulation had been in effect in 1973. Because of increased fishing efficiency, the simulation implied that, instead of a 25% reduction, a 15% increase in fishing effort would probably have occurred. In order to have achieved the desired 25% reduction in 1973, a greater reduction from the 1971 level might have been necessary. Factors that could have influenced these changes include possible changes in fishing power of the standard vessel class and shifts to different species with different changes in abundance during the period.

##### 4. Future Fishing Effort Studies

Because of the possibility that fishing effort will in future be directly controlled by some method, it was agreed that the *ad hoc* Working Group should be maintained to monitor continuing technical studies. It was also agreed that all countries should submit qualitative descriptions (and, if possible, quantitative data) of changes in gear and operating factors of various vessel types over the period 1971-75. Detailed studies of the Division 5Z Pilot Study material were encouraged.

#### V. ENVIRONMENTAL (APP. V)

##### 1. Environmental Data Base

It was noted that the Canadian Marine Environmental Data Service (MEDS) is now able to accept various kinds of oceanographic data and several reports are currently being prepared based on data already submitted. Noting that MEDS will eventually be expected to provide data summaries annually, STACRES emphasized the importance of the timely submission of data and accordingly

recommends (4)

*that a national representative in each country be designated and made responsible for the submission of oceanographic data to MEDS.*

##### 2. Weather and Ice Reporting by Fishing Vessels

Noting that the submission of weather and ice reports by fishing vessels to coastal radio stations was currently at a very low level, STACRES

recommends (5)

*that the Secretariat contact national meteorological offices, suggesting that they negotiate with national fishing industries to select a representative sample of fishing vessels operating in the area that should be equipped to provide the minimum amount of information as defined by the Environmental Subcommittee (see Appendix V)*

##### 3. Environmental Conditions in the ICNAF Area

Following discussion of the environmental conditions in the area in 1974, details of which are contained in the Report of the Environmental Subcommittee (Appendix V), STACRES

recommends (6)

*that all Member Countries submit their oceanographic data to MEDS within six months of its collection so that an annual summary of environmental conditions can be provided.*

4. Environmental Working Group

The Environmental Working Group was established at the 1974 Annual Meeting and has met twice since then. Its basic terms of reference are to suggest a proposal aimed at determining the factors involved in the production of good and poor year-classes in some of the main fisheries of the ICNAF Area. The Working Group selected the herring of the Georges Bank-Gulf of Maine area and the cod and redfish stocks of Flemish Cap as stocks for detailed investigation in accordance with the terms of reference. A number of research proposals were put forward in order to fill data gaps and to test hypotheses, and STACRES accordingly

recommends (7)

- i) *that monitoring of larval production should continue at least for the next two years in the Georges Bank-Gulf of Maine area;*
- ii) *that the spring bottom trawl surveys should be continued to provide estimates of age 2 herring;*
- iii) *that efforts be intensified toward a comprehensive analysis of the available data base on larval and juvenile herring;*
- iv) *that a concerted effort be made to understand the circulation and diffusive processes in the Georges Bank-Nantucket Shoals area;*
- v) *that a special sampling study to follow an isolated patch of herring larvae on Georges Bank be attempted in 1975 and/or 1976.*
- vi) *that attempts be made to identify relationships between the various currents around Flemish Cap and other relevant environmental factors with the year-class strengths of cod and redfish;*
- vii) *that a joint study of existing data for Flemish Cap be carried out by one scientist from each of USSR and North America;*
- viii) *that the standard sections agreed by the Environmental Subcommittee be accepted as ICNAF standard oceanographic sections.*

VI. GEAR AND SELECTIVITY

1. Trawl Materials and Mesh Size Sampling

STACRES reviewed the information submitted by 11 Member Countries (Summ. Doc. 75/23) and noted that no reports were available for Bulgaria, France, Norway and Romania.

2. Recent Selectivity Experiments

Dr. Bohl (FRG) reported that Federal Republic of Germany has initiated comparative selection experiments between bottom and midwater trawls. The fisheries research vessel *Anton Dohrn* carried out 19 successful hauls with a polyamide midwater trawl in April-May 1975 in the Barents Sea. The catches consisted of 21,300 cod and 15,300 haddock, and the selection factors were 3.65 and 3.06 respectively. About 20 nautical miles from the position of the midwater trawl experiment, 13 hauls were made with a polyamide bottom trawl. The numbers of cod and haddock caught were 15,300 and 5,100 respectively, and the selection factors were 3.62 for cod and 3.49 for haddock. There was therefore no difference between the selectivity of the two gears in the case of cod but a considerable difference for haddock. However, the haddock selection factor for the bottom trawl is considered to be not very reliable.

Eight hauls, carried out with bottom trawl about 30 nautical miles to the east of Bear Island resulted in a selection factor of 3.36 for cod, 17,400 specimens of which were caught. It was noted that covered-haul experiments may be carried out on stern trawlers provided that the cover consists of very strong material and is strengthened by a number of ropes running lengthwise with the codend.

Dr. Bohl indicated that he would prepare a paper containing the details of these experiments for the 1976 Annual Meeting.

3. Mesh Measuring

STACRES noted the results of experiments on measuring with different gauges (Res. Doc. 75/88,89) which indicated that the ICES gauge gave the most consistent results, followed by the ICNAF gauge and then by the wedge-type gauge.

## VII. AGEING TECHNIQUES AND VALIDATION STUDIES

### 1. Ageing Workshop

STACRES noted the concern of the Assessments Subcommittee regarding differences in age determination of cod between Canada and Spain for the stocks in Divisions 2J+3KL and 3NO, and also between USA and USSR for silver hake stocks in Subarea 5 and Statistical Area 6. Problems with ageing grenadiers and redfish were also noted. After considerable discussion it was agreed that a proposed workshop should be restricted to consideration of cod stocks in all areas with emphasis on those in Subareas 2 and 3, and silver hake stocks in Subareas 4, 5 and Statistical Area 6. It was emphasized that countries fishing those stocks should participate in the workshop and that participants should include the persons who actually do the age reading.

Although the St. John's (Newfoundland) Laboratory had previously offered to host the Workshop if the number of participants would not be too many for its facilities (see Appendix I), the Chairman indicated that an invitation to host the workshop had recently been received from the Director of the Institute for Fishery Investigations, Vigo, Spain. STACRES accordingly

#### recommends (8)

- i) *that an ageing workshop of at least one week's duration be held at Vigo, Spain, in late October 1975; and*
- ii) *that the workshop consider the ageing of cod stocks in the ICNAF Area with emphasis on those in Subareas 2 and 3, and silver hake stocks in Subareas 4, 5 and Statistical Area 6.*

### 2. Inventory of Age Validation Studies

STACRES noted that, while two research documents on this matter (Res. Doc. 74/110, 111) were presented at the 1974 Annual Meeting and it was emphasized that such studies should be vigorously pursued, no research documents on validation studies are available for review at the present meeting. The need to have a validation study for every stock for which age compositions are utilized in assessments was emphasized, and STACRES accordingly

#### recommends (9)

*that validation studies be continued with emphasis on those species and stocks for which none are available at the present time.*

## VIII. COLLABORATION WITH OTHER ORGANIZATIONS

1. The publication status of the Report of the Joint ICES/ICNAF Salmon Tagging Experiment was reported by Mr. B.B. Parrish (UK), who indicated that the fully-edited papers should be ready to go to the printers late in 1975. The Report will appear as a special volume of the ICES *Rapports et Procès Verbaux* and publication costs will be covered by funds remaining from contributions to the Special Fund for the Tagging Experiment.

Mr. Parrish observed that the 1974 salmon catch at West Greenland totalled 1,960 tons, consisting of 505 tons, 111 tons and 145 tons in the Danish, Faroese and Norwegian drift net fisheries respectively, and 1,199 tons in the fishery by Greenlanders. Mr. Horsted (Denmark) commented that the catch rates in 1974 were very high compared with previous years and the fishery by Greenlanders had to be closed at the end of August. Research vessel observations indicated that salmon were also present late in the season.

2. STACRES was informed that the Editor of the papers which were presented to the ICES/FAO/ICNAF Symposium on Acoustic Methods in Fisheries Research at Bergen, Norway, in June 1973, was having some difficulty in recovering the edited papers from authors who were sent copies for their approval. ICNAF has contributed financial support toward the cost of publishing these papers which will appear in a volume of ICES *Rapports et Procès Verbaux*.
3. STACRES noted the Report of the Eighth Session of the CWP (Summ. Doc. 75/21) which was held at Paris, France, in September 1974. ICNAF was represented by Mr. V.M. Hodder (Assistant Executive Secretary), Mr. Sv. Aa. Horsted (Chairman of Statistics and Sampling Subcommittee) and Mr. R. Hall (USA), with Dr. E.G. Hyerdahl (USA) as observer.
4. STACRES took note of some resolutions adopted at the 1974 Meeting of ICES relevant to the research and statistical activities of ICNAF (Summ. Doc. 75/14), particularly those pertaining to seals, shellfish assessments including squids, and gear research.

5. STACRES noted with appreciation the continuing interest of FAO in ICNAF activities by the active participation of FAO Observers (Mr. L.P.D. Gertenbach and Mr. L. Boerema) in the work of STACRES and its Subcommittees.

#### IX. STEERING AND PUBLICATIONS (APP. VI)

##### 1. Organization and Operation of STACRES

In view of the greatly increased workload of the Assessments Subcommittee, it was agreed that the Chairmen of Scientific Advisers should take the lead, under the direction of the Chairman of the Assessments Subcommittee, in organizing the updating of TACs and reporting the details to Panels, but the reporting to the Commission would continue as at present, i.e. through the Assessments Subcommittee and STACRES.

##### 2. Review of Publications

STACRES agreed to a set of publication guidelines for the Research Bulletin, as set out in the Report of the Steering and Publications Subcommittee (Appendix VI). It was also agreed to establish an annual publication to be known as "Selected Papers from the Annual Meeting" to serve as a publication medium for selected research documents. The 1975 Research Documents were reviewed and selections made for possible publication in the Research Bulletin and the Selected Papers series.

The status of Working Papers was reviewed and STACRES agreed that, while these are intended only for use at the particular meetings for which they were prepared, they should be numbered consecutively for each calendar year, a file maintained at the Secretariat and individual copies issued on request only.

##### 3. Index of ICNAF Publications

STACRES welcomed the recent issue of Special Publication No. 11, which contains subject and author indexes and lists of titles of ICNAF publications from 1950 to 1974 covering research papers and reports in Annual Proceedings, Research Bulletin, Special Publications and Redbooks, and commended the Assistant Executive Secretary for the great amount of work involved in compiling the indexes in such detail. It was noted that an index covering the research and summary document series was in preparation.

#### X. FUTURE MEETINGS

1. STACRES noted the possible need for one or more mid-term meetings to further consider matters deferred to Special Commission Meetings, but considered that those could only be arranged after the Commission's decision to hold such meetings is made known.
2. Noting the advantages of the arrangement agreed at the 1974 Annual Meeting to hold meetings of the Assessments and Biological Surveys Subcommittees in April 1975, STACRES agreed to continue this practice and scheduled meetings of these Subcommittees for the period 30 March-9 April 1976 at ICNAF Headquarters in Dartmouth, Canada. It is expected that the computer terminal proposed for installation in the Secretariat will be fully operational at that time.
3. STACRES agreed to meet during the week preceding the 1975 Annual Meeting of the Commission to consider all other matters not directly related to assessments.

#### XI. OFFICERS FOR 1975/76

1. Chairmen of STACRES and its Subcommittees were elected (or re-elected) as follows:

STACRES	- Dr. A.W. May, Canada (re-elected)
Assessments Subcommittee	- Mr. A.T. Pinhorn, Canada (elected)
Statistics and Sampling Subcommittee	- Mr. Sv. Aa. Horsted, Denmark (re-elected)
Environmental Subcommittee	- Mr. H.W. Hill, UK (re-elected)
Biological Surveys Subcommittee	- Dr. J. Messtorff, FRG (re-elected)

2. Members of the Steering and Publications Subcommittee were confirmed as follows:

Canada	- Mr. A.T. Pinhorn
Denmark, Fed.Rep. Germany, UK	- Mr. Sv. Aa. Horsted (Denmark)
France, Portugal, Spain	- Mr. R.H. Letacounoux (France)
Iceland, Italy, Japan, Norway	- Mr. Ø. Ulltang (Norway)

Bulgaria, German Dem.Rep., Poland, Romania, USSR  
USA  
*Ex officio* Chairman

- Dr. A.S. Bogdanov (USSR)  
- Mr. R.C. Hennemuth  
- Chairman of STACRES

3. STACRES agreed that the *ad hoc* Working Group on Fishing Effort Studies should be continued for another year, and Mr. R.C. Hennemuth agreed to continue as Convener.

## XII. APPRECIATION

1. STACRES expressed its thanks to Mr. D.J. Garrod, who so ably chaired more than the usual number of meetings of the Assessment Subcommittee during the past three years, during which TACs for nearly all of the stocks currently under management in the ICNAF Area were introduced to the management regime of the Commission.
2. The Chairman of STACRES expressed his appreciation for the excellent work of participants during the January 1975 Meeting at Bergen, Norway, during the April 1975 Meetings at Woods Hole, USA, and during this Annual Meeting of STACRES at Aberdeen and Edinburgh, Scotland. On behalf of STACRES he thanked the Directors of the various Institutes for the excellent facilities and assistance provided for the meetings.

## APPENDIX I - REPORT OF ASSESSMENTS SUBCOMMITTEE

Chairman: D.J. Garrod

The Subcommittee met at Woods Hole, USA, during 8-18 April 1975 to review the state of marine resources in the ICNAF Area, to recommend TAC levels for 1976, and to advise on the scientific aspects of certain proposals which the Commission will consider at its Annual Meeting in Edinburgh, Scotland, in June 1975. Representatives attended from all Member Countries except Bulgaria, Iceland, Italy, Portugal and Romania. The review of TAC levels was carried out in small Working Groups of the Subcommittee as follows: groundfish stocks in SA<sup>1</sup> 0, 1, 2 and 3 (A.T. Pinhorn, Canada); groundfish stocks in SA 4, 5 and 6 (E.G. Heyerdahl, USA); mackerel stocks throughout the ICNAF Area (Ø. Ulltang, Norway); and herring stocks in SA 4, 5 and 6 (V.C. Anthony, USA). The various sections of this report are set out to correspond as far as possible to the manner in which they will be considered by the Panels and their Scientific Advisers.

The Subcommittee also met on 3 June 1975 during the STACRES Meeting at Aberdeen, Scotland, to review trends in the fisheries in 1974 and to discuss some points arising from the assessments carried out at the April 1975 Meeting.

### I. INTRODUCTORY REMARKS

In preparing its advice, the Subcommittee kept in mind the desirability of maintaining TACs that have already been agreed for 1975, except where there is clear evidence that adjustment is necessary for conservation reasons. In some instances, where earlier advice was based on average catch levels, and where the Commission reached agreement at slightly different levels but in conformity with the advice, the Subcommittee has adjusted its advice to the agreed level, except where there is new evidence that this is contrary to the biological objective of management.

Throughout its discussions, the Subcommittee has had to assume that the statistics reported by Member Countries represent the total catches. However, it should be noted that in at least one area (SA 3) substantial quantities of flatfish of a commercially valuable size to some countries may be caught and discarded by other countries in which these fish have no value (Res.Doc. 75/28). This would lead to an under-estimate of stock size and of the potential of the resource, and it may cause unexplained fluctuations in the fishery. In the silver hake fishery in SA 5 (Res. Doc. 75/62), substantial quantities of young fish are discarded at sea, causing the subsequent supply of recruits to commercial landings to fall short of expectations. Discarding of fish of less than commercial size will influence the efficiency of the regulatory regime, and this is believed by the Subcommittee to be more widespread throughout the ICNAF Area than is apparent from the data available. Both circumstances remove important quantities of the resource from the regulatory regime and have an influence on subsequent advice in a way which cannot easily be measured, except to say that it detracts from precision. It is thus absolutely essential that the catches of species be fully reported, and the Subcommittee had this in mind when it considered the potential benefits of the Observer Program proposed by STACTIC at its Special Meeting in Leningrad, USSR, in March 1975 (Summ.Doc. 75/9) and referred to STACRES for comment (see Section IX below).

Consideration of the TACs led to the general problem concerning the management area of individual stocks in relation to the collection of the statistics. A Canadian proposal (Comm.Doc. 75/9) requested that consideration be given to establishing TACs for smaller management areas in respect of certain stocks believed to be composed of several small units. A similar problem has arisen in respect of other stocks (e.g. mackerel) not subject to a specific proposal of this kind, and, in view of the generality of the issue, the Subcommittee has adopted a consistent approach to the point raised. The Subcommittee recognizes that several of the present management units may contain groups of fish which could probably be regarded as separate 'stocks' when they reach the exploited age-groups. Although there is a measure of overlap, the Subcommittee, having in mind the importance of the stock-recruitment relationship and the uncertainties concerning the distribution of very young fish within these areas, considers that, unless the subdivision into separate TACs could be shown to offer the prospect of an increase in yield by more efficient management, such a group of 'stocks' should be assessed as a single biological unit with a single TAC. At the same time it is apparent that some areas are sufficiently large that the stocks do not become fully mixed each year, with the result that fishing could concentrate in a part of the stock area, causing local depletion and an imbalance in the stocks and the fisheries. It may therefore be desirable to augment the single TAC with regulations to ensure an appropriate distribution of the fishery on the basis of biological and practical considerations, as have been applied to the regulation of capelin fisheries in 1975. Stocks to which this principle might usefully be applied are identified in the appropriate sections below in conjunction with the review of species' TACs.

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<sup>1</sup> The abbreviation "SA" is used throughout the text in referring to both "Subarea" and "Statistical Area".

II. GENERAL FISHERY TRENDS

Statistics of nominal catches of all species taken in the Northwest Atlantic were not available at the time of the Subcommittee Meeting in April 1975, as the request for advance statistics for assessment purposes was confined to species stocks under present or prospective catch quota regulation. However, provisional nominal catches for 1974, as compiled from STATLANT 21A submissions, were available at the Annual Meeting in June, and these are summarized by subarea in Table 1, together with comparable figures for 1973. It should be noted that catch figures used in the "Species Review" sections throughout this Report, based on preliminary advance statistics provided prior to the April 1975 Meeting, may differ slightly from the data listed in Table 1 and also from the figures mentioned in the "Fishery Trends" sections, these having been prepared at the Annual Meeting for insertion in the Report.

The total nominal catch of all finfish and invertebrates declined from 4.45 million tons in 1973 to 4.0 million tons in 1974. Reduced catches of silver hake in SA 4 and of herring and mackerel in SA 5 account for about 70% of this deficit and follow the implementation of TAC regulations. The remainder was caused largely by a decline in redfish catches in SA 4, but flounder catches also showed a reduction which, although small in relation to the overall total, nevertheless reflects a decline in productivity of these resources. Except for increases in the catches of argentine, roundnose grenadier and capelin, the nominal catches of other species remained close to but generally slightly below 1973 levels and these have in many cases been influenced by Commission regulations in 1974. The most significant changes in the catches of individual species by subarea are outlined at the beginning of each of the sections dealing with the species/stock assessments.

Table 1. Nominal catches (000 tons) in 1973 and 1974<sup>1</sup>. (The symbol + indicates less than 500 tons).

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
Cod	-	-	63	48	58	125	464	409	188	176	35	34	+	1	808	793
Haddock	-	-	+	+	+	+	2	2	18	16	6	5	+	+	26	23
Redfish	+	+	3	3	11	6	110	116	170	96	17	10	+	+	313	232
Silver hake	-	-	-	-	-	-	-	+	299	96	120	118	16	12	435	226
Red hake	-	-	-	-	-	-	-	+	2	3	50	21	17	12	68	36
Pollock	-	-	+	+	+	+	+	1	30	25	13	12	+	+	44	39
Flounders	2	1	9	16	18	21	155	120	48	48	41	37	11	10	284	253
Roundnose grenadier	1	3	4	10	7	6	11	23	-	-	-	-	-	-	22	41
Other groundfish	-	-	7	10	2	4	12	12	33	40	31	20	11	11	96	98
Herring	-	-	+	+	+	+	17	18	233	228	220	172	14	13	485	432
Mackerel	-	-	-	-	+	-	3	2	36	43	315	152	66	142	420	339
Other pelagics	-	-	-	+	-	-	-	-	1	2	42	49	316	220	359	270
Argentine	-	-	-	-	-	-	+	1	1	17	3	20	-	-	4	38
Capelin	-	-	3	3	60	85	209	202	+	+	+	-	-	-	273	291
Other finfish	-	-	3	2	2	7	8	23	34	47	48	23	40	41	135	143
Squids	-	-	-	-	+	+	1	+	9	+	36	28	21	23	67	56 <sup>2</sup>
Other invertebrates	-	-	13	18	-	+	4	4	37	36	85	102	475	510	613	671
All species	3	4	105	111	159	255	996	933	1139	874	1063	804	988	995	4452	3980 <sup>2</sup>

<sup>1</sup> Nominal catches for 1974 are based on STATLANT 21A reports compiled for the 1975 Annual Meeting.

<sup>2</sup> These totals include 4260 tons of squids reported by Italy from SA 5+6.

III. SUMMARY OF RECENT CATCHES AND TACs

Tables containing summaries of recent catches and TACs for the various stocks regulated in 1975 and for which regulation is proposed for 1976 are given in the following 4 sections which deal with the stock assessments. In almost all cases the TACs recommended for 1976 are based on the assumption that TACs agreed by the Commission for 1975 are taken, as the Subcommittee cannot prejudice countries' intentions in this respect. The implications of this assumption is pointed out in the species' reviews where failure to reach the 1975 TACs might influence the advice for 1976.

A complete listing of recent catches and TACs by species and stock areas is presented in Table 1 of the

STACRES Report (this volume, page 14). The provisional nominal catches for 1974 listed in that table are based on statistics compiled for the Annual Meeting and those may differ slightly from the 1974 nominal catches listed in the tables of this Report, the latter having been compiled from preliminary statistics submitted prior to the Meeting of the Subcommittee in April 1975.

IV. STATISTICAL AREA 0 AND SUBAREA 1

1. Fishery Trends<sup>1</sup>

The total nominal catch of all species from SA 0 in 1974 was about 3,500 tons or slightly more than in 1973. However, whereas in 1973 about two-thirds of the catch consisted of Greenland halibut, most of the 1974 catch (2,700 tons) consisted of roundnose grenadier.

In SA 1 the total nominal catch of all species increased slightly from 105,000 tons in 1973 to 111,000 tons in 1974. While there has not been very significant changes in the total catch over the last three years, great fluctuations have occurred for individual species. Catches of cod showed a continued decline from 111,000 tons in 1972 to 63,000 tons in 1973 and to only 48,000 tons in 1974. However, this reduction was offset by increased catches of some other groundfish species (Greenland halibut, roundnose grenadier, wolffish and Greenland cod) and also of shrimps, with nominal catches of the latter having risen from 13,000 tons in 1973 to more than 18,000 tons in 1974 as a result of increased fishing activity.

2. Species Review

Table 2 contains a summary of recent catches and TACs as well as those recommended for 1976 for the stocks under consideration for management in SA 1.

Table 2. Subarea 1: summary of nominal catches (1971-74) and TACs (1973-76) by species and stock area.

Species	Stock area	Nominal catches(000 tons)				TACs(000 tons) <sup>2</sup>			
		1971	1972	1973	1974 <sup>1</sup>	1973	1974	1975	1976
Cod	1	121	111	63	46	- (102)	107 (80)	60 (55)	(<45)
G. halibut	0+1	4	14	10	14	-	-	-	(20)
R. grenadier	0+1	8	8	5	12	-	-	10	(12)

<sup>1</sup> Advance preliminary statistics.

<sup>2</sup> Actual TACs include quantities estimated to be taken outside the Convention Area; quantities in parentheses are TACs recommended by Assessments Subcommittee.

a) Cod in Subarea 1 (Res.Doc. 75/31)

Since 1968, when the nominal catch of cod in SA 1 was close to 400,000 tons, catches have declined drastically to 63,000 tons in 1973, and provisional statistics for 1974 show a further decline to 46,000 tons or only 10% of what was considered to be the MSY level in the 1950's and 1960's. The catch obtained in 1974 is only 58% of the recommended TAC of 80,000 tons for 1974 and only 43% of the TAC of 107,000 tons agreed to by the Commission.

The decline in catches is due primarily to the present low stock size, which makes cod fishing in the subarea less attractive than formerly. Most countries seem to have reduced their activity further in 1974, and, although there are not yet many data available on catch per effort in 1974, the decline in catch and fishing activity is believed to have caused a reduction in fishing mortality.

More than 50% (by number as well as by weight) of the catch in 1974 is based upon the 1968 year-class. At present, all year-classes after 1968 seem to be poor. The 1968 year-class now has its main distribution in Div. 1C-E, i.e., overlapping the boundary between the two stock components of 1A-D and 1E-F. The analyses have therefore been carried out for the SA 1 stock as a whole. This 1968 year-class is now recruiting to the spawning stock, resulting in some temporary increase in the spawning biomass compared to the very low level in 1973. However, from the present poor recruitment prospects, the spawning stock will gradually decrease to a lower level, but the rate of the decrease and the level is, to a great extent, dependent on the actual exploitation.

<sup>1</sup> Catches used in this subsection are based on statistics compiled for the Annual Meeting, and these may differ slightly from figures given under "Species Review", which was prepared in April 1975.

The analyses indicate that the catch in 1976 corresponding to  $F_{0.1}$  would be about 60,000 tons. A catch of 45,000 tons in 1976 would maintain the spawning stock size at its 1974-75 level into 1977-78 and improve the possibility of stronger year-classes. However, this depends very much on environmental conditions as well as spawning stock size, and the Subcommittee cannot be certain that even complete closure of the fishery would ensure increased recruitment. The Subcommittee therefore recommends that the 1976 TAC be not more than 45,000 tons in order to maintain the present spawning stock level, and notes that reduction below this catch would further improve the chances of recovery of the stock.

Part of the 1968 year-class is expected gradually to emigrate to waters off East Greenland and to contribute to the spawning there. Spawning off East Greenland does, to some extent, supply recruits to the SA 1 stock. The Subcommittee, therefore, again points out that the matter of managing the SA 1 cod fisheries, so as to take stock/recruitment relationship into account, also involves regulation of the fisheries off East Greenland (in the NEAFC Area).

b) Greenland Halibut in Subarea 1 and Statistical Area 0

In its advice to the Commission in 1974, the Subcommittee expressed the view that, although there might be a single stock of Greenland halibut in the waters from Greenland to Baffin Island and southward to Labrador and northern Newfoundland, it would be better to partition this stock for management purposes. It was suggested that one of the management areas could be SA 0 and 1 combined. No new evidence has been presented to suggest a revision of previous advice regarding TAC or management area.

Provisional statistics for 1974 indicate a total catch of 14,000 tons from SA 0 and 1, an increase of 4,000 tons over that of 1973. The Subcommittee considers 20,000 tons to be an appropriate level of catch for the area, if the Commission should wish to implement a precautionary quota for 1976.

The Subcommittee noted that, although some sampling data were reported for the area, they were of limited value for assessment purposes, as they were not all reported for males and females separately as required (*Redbook* 1974, page 128).

c) Roundnose Grenadier in Subarea 1 and Statistical Area 0

Some new data collected in 1974 were reported by German Democratic Republic and USSR (Summ. Doc. 75/29, 30). However, information on the distribution of this species does not at present give reason to change the view that SA 0 and 1 be combined for practical management purposes. Age-reading methods are at present being developed, and with improved sampling (reporting of males and females separately) it is possible that a preliminary assessment can be provided within a few years.

Pending further information, the Subcommittee can only reiterate its advice of last year that a precautionary quota for SA 0 and 1 combined be set at a level close to the level of catches in recent years. Since the catch averaged about 7,000 tons annually in 1971-73 and increased to 12,000 tons in 1974, a precautionary TAC of 12,000 tons is recommended for 1976.

d) Capelin in Subarea 1 (Res.Doc. 75/53)

New information on the distribution and abundance of capelin at West Greenland indicated that the SA 1 stocks are considerably smaller than the Barents Sea stock, perhaps of the order of only 5-10% as large.

## V. SUBAREAS 2 AND 3

### 1. Fishery Trends<sup>1</sup>

The provisional nominal catch of all species in SA 2 increased from 159,000 tons in 1973 to 255,000 tons in 1974, due possibly to less severe ice conditions than in 1973. The cod catch more than doubled (58,000 to 125,000 tons) with most of the total being reported from Div. 2J and none from Div. 2G. While the redfish catch declined by nearly one-half (11,000 to 6,000 tons), the total catch of flounders, consisting largely of Greenland halibut, increased slightly (18,000 to 21,000 tons). Catches of other groundfish, principally roundnose grenadier, also increased slightly (9,000 to 10,000 tons). There was a substantial increase in the capelin catch (60,000 to 85,000 tons), which accounted for most of the increase in the "other fish" catch between 1973 and 1974.

<sup>1</sup> Catches used in this subsection are based on statistics compiled for the Annual Meeting, and these may differ slightly from figures given under "Species Review" which was prepared in April 1975.

In SA 3 the total nominal catch of all species declined from 996,000 tons in 1973 to 933,000 tons in 1974, comparable figures for the total groundfish catch being 754,000 and 683,000 tons respectively. The cod catch declined from 464,000 tons in 1973 to 409,000 tons in 1974, with most of the decrease occurring in Div. 3KL (297,000 to 252,000 tons). The redfish catch increased slightly (110,000 to 116,000 tons), with the most marked changes in Div. 3M (22,000 to 35,000 tons) and in Div. 3LN (33,000 to 22,000 tons). The yellowtail catch in Div. 3LNO declined sharply from 1973 to 1974 (33,000 to 24,000 tons), as did also the American plaice catches in Div. 3LNO (53,000 to 46,000 tons) and in Subdiv. 3Ps (15,000 to 6,000 tons), and the overall catch of flounders in 1974 was 120,000 tons compared with 155,000 tons in 1973. Of the remaining species the fishery for capelin is the most significant, and its catch remained at about the 1973 level (202,000 tons in 1974). However, while nearly all of the capelin taken south of Div. 3K in 1973 were reported from the Grand Bank (Div. 3NO), in 1974 a substantial fishery developed in Div. 3L where 60,000 tons were taken in 1974 compared with 4,000 tons in 1973. The herring catch changed only slightly between 1973 and 1974 (17,000 to 18,000 tons).

2. Species Review

Table 3 contains a summary of recent catches and TACs as well as the TACs recommended for 1976 for stocks under consideration for management in SA 2 and 3.

Table 3. Subareas 2 and 3: summary of nominal catches (1971-74) and TACs (1973-76) by species and stock area.

Species	Stock area	Nominal catches (000 tons)				TACs (000 tons) <sup>2</sup>			
		1971	1972	1973	1974 <sup>4</sup>	1973	1974	1975	1976
Cod	2GH	13	14	+	6	-	20.0 (20)	20.0 (20)	(20)
	2J+3KL	432	458	355	362	665.5 (650)	656.7 (650)	554.0 (550)	(300)
	3M	34	58	23	23	-	40.0 (35)	40.0 (40)	(40)
	3NO	126	103	80	71	103.5 (70)	101.1 (85)	87.7 (85)	(85)
	3Ps	64	44	53	50	70.5 (70)	70.0 (70)	62.4 (60)	(60)
Redfish	2+3K	19	20	39	30	-	30.0 (25)	30.0 (30)	(30)
	3M	8	42	22	32	-	40.0 (..)	16.0 (16)	(16)
	3LN	34	29	33	21	-	28.0 (20)	20.0 (20)	(20)
	3O	20	16	9	12	-	16.0 (15)	16.0 (16)	(16)
	3P	28	26	18	22	-	25.0 (23)	25.0 (25)	(20)
A. plaice	2+3K	5	9	5	5	-	10.5 (8)	8.0 (8)	(8)
	3M	1	1	1	2	-	2.0 (2)	2.0 (2)	(2)
	3LNO	68	59	53	45	60.5 (60)	60.0 (60)	60.0 (60)	(47)
	3Ps	7	7	15	7	-	11.0 (10)	11.0 (11)	(8)
Witch	2J+3KL	16	17	24	15	-	22.0 (17)	17.0 (17)	(17)
	3NO	15	9	7	8	-	10.0 (10)	10.0 (10)	(10)
	3Ps	2	2	3	2	-	3.0 (3)	3.0 (3)	(3)
Yellowtail	3LNO	37	39	33	24	50.0 (50)	40.0 (40)	35.0 (35)	(<10)
G. halibut	2+3KL	25	30	29	27	-	40.0 (30)	40.0 (40)	(30)
R. grenadier	2+3	75	24	18	33	-	32.0 (30)	32.0 (32)	(32)
Capelin	2+3K	+	46	136	111	-	110.0 <sup>3</sup>	160.0 <sup>4</sup>	(300)
	3L	1	1	4	156	-	148.0 <sup>3</sup>	45.0	126.0 <sup>5</sup>
	3NO	1	21	127		9.0			
	3Ps	1	3	1					
Mackerel	3+4	24	22	38	44	-	55.0 <sup>6</sup>	70.0 (70)	(310)
	5+6	349	387	381	304	450.0	304.0 (251-312)	285.0 (285)	
Squid	3+4	9	2	10	+	-	-	25.0	(15)

<sup>1</sup> Advance preliminary statistics.

<sup>2</sup> Actual TACs in some cases include quantities estimated to be taken outside the Convention Area; quantities in parentheses are TACs recommended by the Assessments Subcommittee.

<sup>3</sup> Countries without specific allocations may take up to 10,000 tons from the stocks, no more than 5,000 tons of which may be taken from Div. 3LNOPs.

<sup>4</sup> Countries without specific allocations may each take up to 10,000 tons.

<sup>5</sup> Countries without specific allocations may not take more than 1,000 tons from Subdiv. 3Ps or more than 5,000 tons from Div. 3L; countries with specific allocations may add to their Div. 3NO allocations any part of their Subdiv. 3Ps and Div. 3L allocations not taken in the two last-mentioned areas.

<sup>6</sup> TAC pertains to Div. 4VWX.

a) Cod in Divisions 2G and 2H

The TAC of 20,000 tons recommended for 1975 was less than the MSY level (30,000 tons) to allow for rebuilding of this stock which had experienced high levels of fishing in the period 1965-69. In addition, the recruitment of the 1964-66 year-classes was poor. Owing to severe ice conditions, catches since 1971 have been quite low and the preliminary estimate for 1974 was about 6,000 tons. Sampling data for 1972-74 are quite scanty and no new assessment could be done. The Subcommittee therefore recommends that the TAC for 1976 should remain at 20,000 tons.

b) Cod in Divisions 2J, 3K and 3L

i) Consideration of 1976 TAC. The catch in 1973 was 355,000 tons and preliminary statistics for 1974 indicate a catch of about 362,000 tons. Severe ice conditions since 1970 have hampered the fishery and have tended to divert fishing effort increasingly to the southern part of the area. In 1973, about 84% of the catch was taken in Div. 3KL and only 16% in Div. 2J.

Results of research vessel surveys by Fed.Rep. Germany, Canada and USSR show a severe reduction in the catch per unit effort of cod in this area since 1971, which may be due to either decreased abundance or a change in availability. The change in abundance could have been caused by an increase in natural mortality as a result of the unfavourable environmental conditions in recent years. The catch per day fished by the fleets of a number of countries also show a decline since 1969 and confirm the recent reduction in apparent stock size. The young fish surveys carried out by USSR indicate that no strong year-classes have appeared since that of 1968.

The change in fishing conditions and reduced stock size appear to have been associated with a change in catchability. Taking this in conjunction with the level of fishing effort indicates that the fishing mortality has remained close to the level of recent years. An analysis of the catch data was completed using a fishing mortality of 0.30 in 1974. It appears that the size of the 1968 year-class was over-estimated in the previous assessment, and this year-class has already been exploited fairly heavily since its entry into the fishery. Since recruitment of new year-classes has been poor since that of 1968, the fishery in 1976 will depend largely on fish of 8 years and older, and the 1971, 1970 and 1969 year-classes as 5-7 year old fish will contribute considerably less than average to the catch because of their low abundance. Therefore, a sharp reduction in TAC is indicated.

The expected catch in 1976 at  $F_{max}$  (0.35) would depend on the catch in 1975, as follows:

<u>Catch in 1975</u>	<u>Expected 1976 catch at <math>F_{max}</math></u>
300,000 tons	360,000 tons
400,000 tons	330,000 tons
500,000 tons	305,000 tons
550,000 tons	290,000 tons

If, in fact, the fishery fails to take the TAC of 554,000 tons in 1975 with recent levels of fishing activity, then this will reinforce the view that estimates of population size and fishing mortality in 1974 have been too optimistic. However, the Subcommittee considers that it should assume that the 1975 TAC of 554,000 tons will be caught (implying an increase in fishing mortality from the 1974 level) and, therefore, recommends a TAC of 300,000 tons in 1976.

ii) Advice relating to quota boundary areas for Div. 2J+3KL stock (Comm.Doc. 75/9). The Subcommittee considered the possible subdivision of the cod management area of Div. 2J+3KL into smaller units. A summary of the present knowledge on biological characters and migrations within the large stock complex was presented, indicating that results of research on meristics, parasites, etc., taken over many years, have shown a cline from north to south in this area, with significant differences in these characters occurring between the northern and southern entrances of the range. Extensive tagging data have indicated that most of the recaptures from cod tagged in a particular locality are, in fact, from the vicinity of that locality but some recaptures do occur throughout the entire range. Also, growth rates are considerably different between the northern and southern part of the area. It was concluded that free mixing does not take place throughout the area, and if the portion of the stock complex in one division were reduced because of heavy fishing in that division, recovery by migration from other divisions could not be expected for a number of years. The possibility of heavy fishing on a portion of the stock complex is more likely in this area than in others because of the heavy ice cover in some years, resulting in diversion of fishing effort to southern divisions. Catches indicate that this has taken place in recent years.

The Subcommittee concluded that for the present the TAC should be applied to Div. 2J+3KL cod as a whole, but that, if the Commission wished to prevent the possible local effects indicated above in one or other of the divisions, it should subdivide the TAC to limit the amount of catch in each division.

c) Cod in Division 3M

The catch in 1974 was 23,000 tons, compared with 1972 and 1973 catches of 58,000 and 23,000 tons respectively. The TAC in 1975 was 40,000 tons and no new data were available to suggest a change. Therefore, the TAC recommended for 1976 is 40,000 tons.

d) Cod in Divisions 3N and 3O

The catch in this area has declined from a high of about 225,000 tons in 1967 to about 80,000 tons in 1973. The provisional catch in 1974 is 71,000 tons. A significant difference in age compositions between 1973 and 1974 was apparently caused by differences in age-reading techniques between the countries submitting samples. In view of this uncertainty, no new assessment was done, and it is recommended that the TAC for 1976 remain at 85,000 tons as indicated by the assessment in 1974.

e) Cod in Subdivision 3Ps (Res. Doc. 75/63)

The provisional catch in 1974 was 50,000 tons compared with a catch in 1973 of 53,000 tons. First recaptures of cod tagged in early 1975 by France tend to confirm migrations of cod between the eastern Gulf of St. Lawrence and the area off Newfoundland, extending at least as far east as Burgeo Bank. In addition, a specimen tagged on Burgeo Bank was recaptured on Sable Island Bank. The relationship between these stocks will be reviewed when further results of this experiment are available for comparison with the results of earlier work on which previous advice to the Commission was based.

The assessment of the previous year was updated using an  $F$  of 0.3, since the catch in 1974 was at about the same level as in 1973. Using recruitment estimates based on research vessel surveys, results show that fishing at  $F_{max}$  (0.3) in 1976 would yield a catch of about 60,000 tons and this is the recommended TAC for 1976.

f) Redfish in Subarea 2 and Division 3K

General production analyses indicate that this stock can sustain catches of 40,000-45,000 tons per year under equilibrium conditions but the stock has been in a depressed condition in recent years. Catches in 1966 to 1972 were well below the equilibrium curve. The 1973 catch at 39,000 tons was the largest since 1965 and was taken in about 2,300 standard days fished. Effort in 1973 increased substantially in response to the improved catch per unit effort which, at 16.8 tons per day fished, was greater than that obtained in 1971 and 1972 but only slightly better than the 13.2 to 15.0 tons per day obtained during 1967-70.

Total allowable catches for 1974 and 1975 were limited to 30,000 tons to permit the stock to rebuild. There is a possibility of improved recruitment prospects over the next several years. Since redfish is a slow-growing, long-lived species, it is recommended that the TAC for 1976 be maintained at the 1975 level of 30,000 tons to take advantage of improved recruitment prospects and permit rebuilding of the stock.

g) Redfish in Division 3M

Maximum sustainable yield estimates of 13,000-17,000 tons were derived previously from a general production study of this stock. A yield-per-recruit analysis indicated an  $F_{0.1}$  level of 0.2 to 0.3 and suggested that the average level of mortality during 1963-1973, when catches averaged approximately 13,000 tons annually, may have been at or beyond  $F_{0.1}$  for the average recruitment levels during this period. Commercial catch-per-unit-effort values indicate an increase in recruitment during 1968 to 1971.

The 1972 catch of 42,000 tons was almost five times the average catch of 8,500 tons annually during 1963-71, and estimated fishing effort in 1972 was more than triple the 1963-71 average annual fishing effort. The catch declined in 1973 to 22,000 tons, about half of the 1972 catch, but increased again to about 32,000 tons in 1974. Catch per day fished by vessels of the standard tonnage category 151-500 tons declined from 4.4 tons in 1971 to 4.0 tons in 1972 and 3.4 tons in 1973. The estimated level of fishing mortality during 1972-73 of 0.8 to 1.0 was considerably beyond the  $F_{0.1}$  level of 0.2 to 0.3.

Catches of the magnitude of those taken during 1972-74 cannot be sustained without risking stock depletion. The Subcommittee recommends that the TAC for 1976 be maintained at the 1975 level of 16,000 tons, the level of the estimated maximum sustainable yield and approximately the level of the long-term average catch.

h) Redfish in Divisions 3L and 3N

The 1973 redfish catch from this area was 33,000 tons, approximately the same as the 1971-72

average of 32,000 tons, but considerably in excess of the estimated MSY level of 20,000 tons. Provisional catch statistics indicate that the 1974 catch was substantially lower at about 21,000 tons.

Virtually no commercial length or age data have been available for this stock since 1967 despite the increased catches of recent years, and it has not been possible to determine whether the recent increase in catches has been supported by improved recruitment. The Subcommittee therefore recommends that the TAC be limited to the estimated MSY level of 20,000 tons as in 1975, until such time as adequate data become available to permit a reassessment of this stock.

1) Redfish in Division 30

Catches from this stock declined from approximately 20,000 tons in 1971 to 16,000 tons in 1972 and 9,000 tons in 1973; provisional catch statistics indicate an increase to about 12,000 tons in 1974, less than the total allowable catch of 16,000 tons. Catch per standard hour fished fluctuated from 1.00 tons in 1969 to 0.79 tons in 1970, 0.71 tons in 1971, 0.83 tons in 1972 and 1.1 tons in 1973, with a decrease in estimated fishing effort from about 19,500 standard hours fished in 1972 to about 7,900 standard hours fished in 1973. The decline in catch appears to have resulted from decreased fishing effort rather than decreased abundance.

Virtually no commercial length or age data have been available for this stock since 1968. In view of this, the Subcommittee recommends that the 1976 TAC from this stock be limited to 16,000 tons, the level of estimated MSY, until such time as adequate data become available to permit a reassessment of this stock.

j) Redfish in Division 3P (Res.Doc. 75/45)

Nominal catches of redfish from this stock have been at a relatively high level in recent years, averaging approximately 31,000 tons during 1969-72. The catch declined from 27,500 tons in 1971 and 26,000 tons in 1972 to 18,000 tons in 1973; provisional catch statistics indicate an increase to 22,000 tons in 1974. Assessments of this stock based on a general production study and a yield-per-recruit model previously indicated a maximum sustainable yield of about 23,000 tons at the recruitment levels experienced during 1965-71. Catch per hour fished by Canadian vessels of 151-500 tons has exhibited a steady decline from a high of more than 0.9 tons per hour in 1965 to less than 0.5 tons per hour in 1974; there was a slight levelling off in 1972 but a continued decline in 1973 and 1974. The 1974 catch per hour fished was the lowest experienced since 1962. The slight increase in catch from 1973 to 1974 was apparently attained by an increase in fishing effort to about the 1969 and 1971 levels, considerably above the 1973 level (approximately 45,000 hours compared with about 30,000 hours). This 50% increase in effort yielded only a 20% increase in catch. At the level of catch per unit effort experienced during 1974 (0.49 tons per hour), the 1974 TAC of 25,000 tons could only be attained with fishing effort 30% in excess of that required to attain MSY under equilibrium conditions. If the 1974 catch rates are maintained in 1975, it would appear that the 1975 TAC of 25,000 tons can be taken only by fishing considerably beyond  $F_{max}$ .

Standardized commercial catch per unit effort values point to a high level of redfish abundance in Div. 3P during the mid-to-late 1960's with above-average recruitment during this period. Therefore, the estimated maximum sustainable yield of 23,000 tons derived from 1965-71 data probably represents an over-estimate of the long-term MSY for this stock. Only about half as many redfish were caught in 1973 and 1974 research surveys in this area as during a comparable 1965 survey at the onset of the recent period of increased exploitation.

The 1965 and 1966 year-classes, upon which the fishery will become more dependent during 1976-77, appear to be substantially less abundant than those which supported the fishery during 1965-74. Accordingly, it is recommended that the TAC for this stock be reduced from 25,000 tons in 1975 to 20,000 tons for 1976. If recruitment is substantially diminished, as expected during the next several years, then a further reduction in total allowable catch can be anticipated.

k) American Plaice in Subarea 2 and Division 3K

Nominal catches from this stock ranged between 5,000 and 9,000 tons since 1971. Preliminary statistics indicate that 5,000 tons were taken in 1974. A TAC of 8,000 tons for 1975 was recommended at the 1974 Annual Meeting and, since no new information is available, the Subcommittee recommends that the 1976 TAC remain at 8,000 tons.

l) American Plaice in Division 3M

Nominal catches from this stock have remained at the relatively low level of 1,000 tons, increasing slightly to about 1,600 tons in 1974. The Subcommittee recommends that the TAC remain at the 1975 level of 2,000 tons for 1976.

m) American Plaice in Divisions 3L, 3N and 30 (Comm.Doc. 75/9; Res.Doc. 75/28, 52)

i) Consideration of 1976 TAC. Nominal catches from this stock have continued to decline from 94,000 tons in 1967 to 53,000 tons in 1973 and to about 45,000 tons in 1974. A TAC of 60,000 tons was established for 1973 and this has remained in effect for 1974 and 1975.

The value of F calculated from 1973-74 research vessel surveys was about at the level of  $F_{0.1}$ , but the average value of F for 1973 from the virtual population analysis was somewhat above this level. The updated assessment indicates an apparent reduction in stock abundance. This is supported by a decline in catch per unit effort from research vessel surveys. Also commercial catch per hour fished declined by about 20% in 1974 from the 1973 level. Based on these data, the Subcommittee therefore recommends that the TAC be reduced to 47,000 tons in 1976 in order to reduce the fishing mortality to the  $F_{0.1}$  level.

ii) Advice relating to quota boundary areas for Div. 3LNO stock (Comm.Doc. 75/9). The Subcommittee considered the material presented in Res.Doc. 75/52 which indicated that, while vertebral and other meristic characters did not show any significant difference between American plaice in Div. 3L, 3N and 30, tagging results indicated that plaice on the Grand Bank moved very little, most being recaptured near the area of tagging. Also, size-at-age differences exist between the plaice in Div. 3L, 3N and 30 and more especially between the northern part of the Grand Bank area and the southern part. It was considered that the Grand Bank stock could possibly receive recruitment from larval drift from the north as well as from local spawning, although the evidence to support this is lacking.

Discussion centered on the biological and practical implications of subdividing quota areas. With free mixing of fish within a stock area, concentration of fishing effort in one or other of the portions of that area will not be expected to produce local effects on the fish in that portion. With lack of free movement of fish within a stock area, random distribution of fishing effort within the area will also not be expected to produce local effects on the fish in any given portion of the stock area. However, with lack of free mixing of fish within a stock area, concentration of fishing effort in one or other portion of the area for an extended period will be expected to produce local effects. Thus, the concentration of fishing effort in one part of the area would be expected to permit the stock component in another part of the area to recover. It was felt that this might tend to randomize fishing effort over the area, because of the tendency for fleets to fish where the catch per unit effort is highest. Effort figures presented showed wide fluctuations in the proportion of effort in one or other of the Div. 3L, 3N and 30, but with no observable trend.

The biological advantage of managing on a finer breakdown of the area depends on the relative biological productivity of the fish in these finer units as well as on the tendency of the fleet to concentrate or randomize its fishing effort. If productivity varies between areas, then management on a yield-per-recruit basis might only be achievable if each area is managed separately. On the other hand, practical difficulties result when the species being considered is fished in conjunction with other species as is the case in Div. 3LNO.

The Subcommittee considered that the information available at the present time did not allow a finer breakdown of Div. 3LNO for American plaice and advises that the quota boundary area remain as Div. 3LNO combined. The Subcommittee also considered that data, collected on a finer area breakdown than the ICNAF division, would aid in future in such considerations of stock boundaries and proposed that the reporting of catch and effort and eventually sampling data by 30-minute squares be examined by the Statistics and Sampling Subcommittee at the 1975 Annual Meeting.

n) American Plaice in Subdivision 3Ps (Res.Doc. 75/22)

Except for 1973, when 15,000 tons were removed, landings of 7,000 tons annually have been recorded for the period 1971-74. A TAC of 10,000 tons for 1974 based on catch statistics was recommended by the Subcommittee and established at 11,000 tons by the Commission at the January 1974 Special Commission Meeting, and this TAC was also recommended for 1975. A new assessment is now available indicating that the rate of removals in recent years generated a value of fishing mortality slightly beyond  $F_{0.1}$ . Therefore, in order to hold the fishery at  $F_{0.1}$ , a reduction of the TAC to 8,000 tons for 1976 was recommended.

o) Witch in Divisions 2J, 3K and 3L

Nominal catches from this stock declined from 24,000 tons in 1973 to about 15,000 tons in 1974. A TAC of 17,000 tons based on recent catch statistics was recommended for 1974 but this was set at 22,000 tons by the Commission. On the basis of a new assessment, a TAC of 17,000 tons was established for 1975. No new information was available to update the assessment, and the Subcommittee recommends that the TAC of 17,000 tons be maintained for 1976.

p) Witch in Divisions 3N and 3O (Res.Doc. 75/23, 25)

Recent nominal catches have ranged from 15,000 tons in 1971 to 7,000 tons in 1973 and 8,000 tons in 1974. A TAC of 10,000 tons was established for 1974 and 1975, based on recent catch statistics. A yield-per-recruit assessment of this stock indicates that fishing at  $F_{0.1}$  in 1976 would allow a TAC of 10,000 tons.

q) Witch in Subdivision 3Ps

Nominal catches from this stock have remained at the 2,000-3,000 ton level since 1971. A TAC of 3,000 tons, based on catch statistics, was established for 1974 and 1975. Since no new information is available for this stock, the Subcommittee recommends that the TAC be maintained at 3,000 tons for 1976.

r) Yellowtail in Divisions 3L, 3N and 3O (Res.Doc. 75/28)

The yellowtail fishery in Div. 3LNO increased dramatically from very low levels of catch in 1964-65 to a peak of 39,000 tons in 1972. The 1973 catch was 33,000 tons and the 1974 provisional catch was 24,000 tons. A TAC of 50,000 tons was recommended and allocated for 1973 to control the expansion of the fishery. This was reduced to 40,000 tons in 1974, based on an assessment of the stock, and to 35,000 tons in 1975, based on an updating of the assessment.

The stock was increasing in abundance and expanding its range of distribution during the late 1960's. Indications from the 1973 data were that the expansion had probably ceased during the early 1970's. Predictions for the 1975 TAC were based on optimistic levels of recruitment and it was advised that, if these were not realized, the potential of this fishery could be considerably reduced (Redbook 1974, p. 87).

Total mortality values for 1973-74 calculated from both Canadian survey data and Canadian commercial catch per unit effort data were in the region of 1.5 to 1.6. In addition, catch per unit effort in the Canadian commercial fishery decreased by about 30% between 1973 and 1974. Indices of abundance for yellowtail from Canadian surveys declined by over 95% in Div. 3L between 1971 and 1974 and by almost 40% in Div. 3N between 1972 and 1974. USSR young fish surveys indicated declines of 60% in Div. 3L, almost 30% in Div. 3N and 80% in Div. 3O between 1971 and 1974.

The relative contribution of environmental factors and fishing intensity to these declines was discussed. Bottom temperatures during the spring season of 1972-74 were unusually low in this area, and this may have had some effect on the behaviour of the fish in relation to the survey trawl or may have contributed to a high natural mortality.

If these events observed in the stock were caused mainly by availability due to environment, the catch rate could conceivably improve again in 1975-76. But if, as seems likely, they result from decreased abundance, then it would be prudent to restrict catches to as low a level as practicable to provide for adequate spawning stock for future recruitment. Preliminary information on possible discard rate for countries whose reported statistics contain almost solely cod indicate that there could be very large unreported removals from the stock, and management advice based on such incomplete statistics may have caused the sudden unexplained changes that have been observed in this fishery.

The uncertainty as to the relative effects of the environment and the fishery on this stock, and the further uncertainty as to the 1975 catch, indicate that the stock has been changing too rapidly to be properly assessed by current techniques. For example, the stock assessment carried out at this meeting indicates that previous estimates of recruitment were excessively optimistic and the projected stock in the current year indicates that it is impossible to catch the 1975 TAC of 35,000 tons, unless a major portion of the decreased catch rate has been due to decreased availability. If the 1975 catch is assumed to be approximately equal to the 1974 catch of 23,000 tons, the result will be a very high fishing mortality far above  $F_{0.1}$ , as previously predicted, and a drastically reduced stock size in 1976. If, as the Subcommittee expects, the stock cannot support the 1975 TAC and the actual catch in 1975 is as low as 10,000-12,000 tons, then it should be possible to remove 10,000 tons in 1976 at  $F_{0.1}$ .

The Assessments Subcommittee may well wish to review this stock at the end of 1975 when further data become available from the 1975 fishery and 1975 surveys.

s) Greenland Halibut in Subarea 2 and Divisions 3K and 3L (Res.Doc. 75/24)

Nominal catches from this stock have averaged about 28,000 tons since 1971 and approximately 27,000 tons were reported for 1974. A TAC of 30,000 tons was recommended by the Subcommittee for 1974, but this was increased to 40,000 tons by the Commission to account for possible non-reported incidental catches. At the 1974 Annual Meeting, the Subcommittee recommended

a TAC of 40,000 tons for 1975, pending clarification of the incidental catch-reporting problem.

A yield-per-recruit assessment is now available and this indicates that, if the stock is exploited at the  $F_{0.1}$  level, not more than 30,000 tons should be removed in 1976. No new information was available on by-catches of this species, and the Subcommittee therefore recommends that the TAC for 1976 be reduced to 30,000 tons.

t) Roundnose Grenadier in Subareas 2 and 3 (Res.Doc. 75/26)

Provisional catch statistics indicate that the 1974 TAC of 32,000 tons was taken. This represents an increase in catch from the levels of 24,000 and 18,000 tons during 1972 and 1973 respectively. The Subcommittee reviewed information presented on the distribution and relative abundance of grenadiers in the Northwest Atlantic in relation to area, depth and temperature, but it was unable to update the preliminary estimates of sustainable yield for this species in SA 2 and 3 because of lack of data on age composition of recent catches. Difficulty of ageing this species was noted and countries fishing the species indicated that further data would be forthcoming next year. The Subcommittee also identified a need for further clarification of the stock relationships of roundnose grenadier in SA 0, 1, 2 and 3.

The 1974 and 1975 TACs for SA 2+3 are based on preliminary estimates of sustainable yield for that part of the stock presently exploited. There was no indication that the fishery is at present conducted at greater depths than before. The Subcommittee recommends that the TAC for 1976 should be maintained at 32,000 tons, the same level as in 1974 and 1975.

u) Capelin in Subareas 2 and 3 (Res.Doc. 75/2, 3, 4, 5, 6, 7, 8; considered at Spec. Mtg. Jan 1975)

The Subcommittee reviewed the advice given to the Commission at its Sixth Special Meeting held in Bergen, Norway, 13-18 January 1975 (ICNAF Summ.Doc. 75/5). No new data were presented at this meeting that would warrant modifying the advice given by STACRES in Bergen, i.e. a maximum TAC of 500,000 tons, not to be exceeded for three years and split into 300,000 tons for SA 2 and Div. 3K and 200,000 tons for Div. 3LNOPs, no more than 10,000 tons of which should be taken in Subdiv. 3Ps and no more than 50,000 tons in Div. 3L. It was also considered desirable to institute a closed area in Div. 3L to provide additional protection to that component of Div. 3L capelin migrating inshore to spawn in coastal waters.

v) Mackerel in Subarea 3 and 4

The status of the mackerel fisheries in SA 3 and 4 is considered in conjunction with the overall assessment of the stocks in SA 3 to 6 (see under Mackerel in Section VII(o)).

w) Squid-*Illex* in Subareas 2 to 4

The assessment of *Illex* in SA 2 to 4 is considered together with the stock component in SA 5 and 6 (see under Squid-*Illex* in Section VII).

## VI. SUBAREA 4

### 1. Fishery Trends<sup>1</sup>

Provisional statistics indicate that the total nominal catch of all species declined from 1,139,000 tons in 1973 to 874,000 tons in 1974. Silver hake showed the most substantial decline (299,000 to 96,000 tons), the 1974 catch being limited by TAC regulation. Redfish catches also declined substantially (170,000 to 96,000 tons), with a major part of the decline occurring in the Gulf of St. Lawrence (130,000 to 63,000 tons). Significant decreases (more than 5,000 tons) also occurred in the catches of cod (188,000 to 176,000 tons), witch (16,000 to 11,000 tons), and squid (9,000 to 400 tons). These decreases were partially offset by increases in the catches of American plaice (20,000 to 28,000 tons), searobins (zero to 9,000 tons), mackerel (36,000 to 43,000 tons), alewife (9,000 to 18,000 tons), and argentines (1,000 to 17,000 tons).

### 2. Species Review

Table 4 contains a summary of recent catches and TACs, as well as the TACs recommended for 1976, for stocks under consideration for management in SA 4. Also included is pollock which overlaps SA 4 and 5.

<sup>1</sup> Catches used in this subsection are based on statistics compiled for the Annual Meeting, and these may differ slightly from figures given under "Species Review" which was prepared in April 1975.

Table 4. Subarea 4: summary of nominal catches (1971-74) and TACs (1973-76) by species and stock area.

Species	Stock area	Nominal catches(000 tons)				TACs(000 tons) <sup>2</sup>			
		1971	1972	1973	1974 <sup>1</sup>	1973	1974	1975	1976
Cod	4TVn <sup>3</sup>	57	68	50	42	-	63 (60)	50 (50)	(45)
	4Vn <sup>4</sup>	11	9	7	6	-	10 (10)	10 (10)	(10)
	4VsW	54	62	54	43	60 (60)	60 (60)	60 (60)	(40)
	4X(offshore)	9	7	7	6	-	- (8)	5 (5)	(4)
Haddock	4VW	13	5	4	2	4 (0)	0 (0)	0 (0)	(0)
	4X	18	13	13	13	9 (0)	0 (0)	15 (15)	(0)
Redfish	4VWX	62	50	40	32	-	40 (30)	30 (30)	(30)
Silver hake	4VWX	129	114	299	96	-	100 (50-100)	120 (120)	(100)
Pollock	4VWX	12	20	30	25	50 (50) <sup>5</sup>	55 (55)	55 (55)	(55)
	5	14	13	13	13	-	-	-	-
Flounders <sup>6</sup>	4VWX	34	23	28	25	-	32 (32)	32 (32)	(28)
Herring (1)	4V					(Seasonal - Jul to Jun)		(15) <sup>7</sup>	(11) <sup>7</sup>
	4WX(adults)					-	-	-	(115) <sup>8</sup>
or (2)	4VW(a)	72	32	30	44	-	45 (45)	30 <sup>9</sup>	-
	4VW(a)					(Seasonal - Jul to Jun)		45 (45) <sup>7</sup>	(36) <sup>7</sup>
	4XW(b)(adults)	70	75	91	89	90	90 (90)	90 (90)	(81) <sup>10</sup>
Mackerel	3+4	24	22	38	44	-	55 <sup>11</sup>	70 (70)	} (310)
	5+6	349	387	381	304	450	304 (251-312)	285 (285)	
Argentine	4VWX	7	6	1	18	-	25 (25)	25 (25)	(25)
Squid- <i>Illex</i>	3+4	9	2	10	+	-	-	25	(15)

<sup>1</sup> Advance preliminary statistics.

<sup>2</sup> Quantities in parentheses are TACs recommended by Assessments Subcommittee.

<sup>3</sup> Div. 4T(Jan-Dec)+4Vn(Jan-Apr).

<sup>4</sup> Div. 4Vn(May-Dec).

<sup>5</sup> TAC pertains to 4X+5.

<sup>6</sup> American plaice, witch and yellowtail.

<sup>7</sup> TACs for the season July to June in 1975/76 and 1976/77 respectively.

<sup>8</sup> TAC to be reduced by the quantity estimated to be taken inshore in 4W(a) during 1 Jul-31 Dec 1975.

<sup>9</sup> TAC pertains to 1 Jan-30 Jun 1975 only.

<sup>10</sup> TAC to be reduced by the quantity of adults estimated to be taken inshore, if the TAC to be set according to the principle used in previous years.

<sup>11</sup> TAC pertains to 4VWX.

a) Cod in Subdivision 4Vn(Jan-Apr) and Division 4T

Nominal catches in 1974 from the southern Gulf of St. Lawrence migrating stock were estimated to be 42,000 tons, substantially below the TAC of 63,000 tons and almost the lowest recorded catch since the early 1950s (41,000 tons in 1967). Cohort analysis and Canadian research vessel surveys indicate that F in 1971-74 ranged between 0.40 and 0.60. The 1968 year-class, which was the best since that of 1965, has supported the fishery in 1972-74. The 1969 year-class appears to be the poorest on record and the 1970 year-class seems to be of average size. The 1971 year-class is predicted to be good but not as strong as that of 1968.

Year-to-year fluctuations in growth rate prevent the accurate determination of a definite level of  $F_{max}$ , but it fluctuates between 0.4 and 0.5. The 1975 TAC of 50,000 tons will generate a fishing mortality of 0.6, and the maintenance of catches at this level in 1976 would again generate an F of about 0.6. The Subcommittee therefore recommends that the 1976 TAC be reduced to 45,000 tons in order to bring the fishing mortality within the range of  $F_{max}$ .

b) Cod in Subdivision 4Vn(May-Dec)

The 1973 catch from this stock was 7,000 tons and preliminary statistics for 1974 indicate a catch of 6,000 tons which is well below the TAC of 10,000 tons. Total catches since 1962 have averaged 8,800 tons and have exceeded 10,000 tons in only three years: 1964, 1965 and 1971. While a new assessment was not available for this fishery, the question of stock boundaries in relation to the Div. 4VsW stock was considered. The two stocks mix somewhat during the summer

months when the Div. 4VsW stock migrates northward, but the main component of the Subdiv. 4Vn fishery is based on inshore stocks. As such, it was considered more appropriate to maintain the current stock boundaries. The Subcommittee recommends that the 1976 TAC be maintained at 10,000 tons.

c) Cod in Subdivision 4Vs and Division 4W

Preliminary 1974 statistics indicate a nominal catch of 43,000 tons, substantially below the TAC of 60,000 tons. The 1973 nominal catch of 54,000 tons was likewise less than the TAC of 60,500 tons. Increased levels of biological sampling of catches in the most recent years indicate that catches are composed of younger cod than was previously thought, with fish of ages 2 to 5 comprising the bulk of the catch with some age 1 fish being taken as well.

Both cohort analysis and Canadian research vessel surveys indicate that fishing mortality averaged 0.60 in 1970-74. The 1975 TAC of 60,000 tons will generate an F of 0.70 and a reduction in TAC to 40,000 tons in 1976 is required to reduce F to the level of  $F_{max} = 0.45$ . The Subcommittee therefore recommends a TAC of 40,000 tons for 1976.

d) Cod in Division 4X (offshore)

The total nominal catch from Div. 4X declined slightly to 21,300 tons in 1974 from 22,200 tons in 1973. The nominal catch from the offshore stock, for which the 1975 TAC is 5,000 tons, declined to 5,800 tons in 1974 from 7,200 tons in 1973. Research vessel survey results indicate that fishing mortality remained about twice the level giving maximum yield per recruit in 1973-74, and there are no indications of improved recruitment in the immediate future. The 1975 TAC is expected to bring about a reduction in fishing mortality, and a further reduction to  $F_{max} = 0.35$  should be achieved by a catch of 4,000 tons in 1976. The Subcommittee therefore recommends that the TAC for 1976 should be reduced to 4,000 tons. It should be noted, however, that this will not allow a substantial rebuilding of the stock in 1976 toward the level giving the MSY.

e) Haddock in Divisions 4V and 4W

Haddock catches declined from 4,200 tons in 1973, when the catch quota of 4,000 tons pertained to Div. 4W only, to about 2,000 tons in 1974 under a zero catch quota. Research vessel surveys gave no indication that an improvement in stock size has occurred and recruitment is expected to be poor in 1976. The Subcommittee again recommends a zero TAC for the directed haddock fishery in order that removals from the stock be minimized to increase the possibility of recovery (MSY = 25,000 tons). Experience from the 1974 fishery suggests that unavoidable by-catches are in the order of 2,000 tons at the present low stock level.

f) Haddock in Division 4X

(i) Consideration of 1976 TAC. A nominal catch of 13,000 tons in 1974, similar to that for 1973, was taken under a zero TAC for a directed fishery in 1974. Catches depended heavily on the 1963, 1969 and 1971 year-classes.

Research vessel surveys indicate that fishing mortality is probably about  $F = 0.35$ . Sufficient data are now available to establish that the strength of the 1969 year-class at age 2 was about 20 million fish. Thus, the strength of more recent year-classes are estimated from research vessel surveys with decreasing reliability as follows: 2.5 million in 1970, 40.0 million in 1971, 20.0 million in 1972, and 15.0 million in 1973. It is estimated that the 1975 TAC of 15,000 tons will generate a fishing mortality of 0.40. A catch of 15,000 tons in 1976 would also generate a mortality of  $F = 0.40$ , whereas fishing at  $F_{max} = 0.50$  would generate a catch of 18,500 tons. However, spawning stock size was the lowest on record in 1974. While spawning stock size will increase in 1975 and 1976 with maturation of the 1971 and 1972 year-classes, it will decrease again in 1977 due to the weaker 1973 year-class although not to a level as low as that in 1974. It is desirable to increase spawning stock size to 60,000 - 70,000 tons, the level which would prevail under stable stock conditions and under optimal exploitation. The level in 1975-77 will be between 40,000 and 50,000 tons.

The situation regarding this stock is essentially the same as in 1973 and 1974; removals should be minimized to rebuild spawning stock, and the Subcommittee therefore recommends a zero quota in directed fisheries for 1976, while realizing that incidental catches are likely to be about 15,000 tons. The entry in Table 4 has therefore been changed to zero for 1976 compared with the recommendation of 15,000 tons for 1975, although the advice is essentially the same as that given last year for 1975.

(ii) Consideration of closed area and season (Res.Doc. 75/57). Haddock concentrate along the slopes of Browns and LaHave banks in overwintering and spawning concentrations. Particularly in March and April, these concentrations extend from 50 fm (90 m) to deeper than 100 fm (180 m)

on the southern edge of the banks between 64° and 67° longitude. Silver hake and argentine concentrations occur in deeper water from 80 fm (150 m). Thus, the distributions of these species overlap to some extent, particularly in March and April. The extent of overlap of fishable concentrations of these species is unknown but could be insignificant. Haddock concentrate on Browns and LaHave banks in February and May also, but normally in shallower water than in the intervening months.

The haddock closed area/season regulations have resulted in a reduction in fishing mortality during the months of closure, and the regulations in force for 1975 encompass almost all of the area in which haddock concentrate. This inevitably interferes with fisheries for argentine, silver hake, cod and, to some extent, pollock. Minimization of haddock mortality is important to its management. Should present closed area/season regulations prove an unacceptable interference with other fisheries, the Commission should consider alternative methods of regulating haddock mortality

g) Redfish in Divisions 4V, 4W and 4X.

The nominal catch of redfish from the Scotian Shelf declined to 32,500 tons in 1974 (TAC was 40,000 tons) from 40,000 tons in 1973, 50,000 tons in 1972 and 62,000 tons in 1971. Catch rates of Canadian and US otter trawlers declined in 1974. Canadian and US research vessel surveys indicate that redfish abundance increased about 1970 and remained high through 1973. However, both surveys show a 55% decline in catch per tow between 1973 and 1974.

Stock status cannot yet be analyzed in detail. However, it is apparent that abundance has declined to, or below, the level of the 1965-69 period when landings averaged about 23,000 tons annually. Canadian surveys in 1974 indicate a moderate abundance of pre-recruits (16-17 cm) which will begin to contribute to the Canadian and US fisheries in 1976. However, since the length at entry to the USSR fishery is lower (approximately 17-18 cm), these fish may be heavily exploited in 1975. Uncertainties about present abundance and potential recruitment levels do not allow a revision of the TAC at this time. In recommending that the TAC for 1976 be set at the 1975 level of 30,000 tons, the Subcommittee notes that a reduction may be required in 1977. It was further noted that the harvesting of redfish less than 20 cm in size almost certainly results in yields less than that giving the maximum yield per recruit.

h) Silver hake in Divisions 4V, 4W and 4X

The 1973 nominal catch was 299,000 tons. Preliminary data for 1974 indicate a catch of 96,000 tons against the TAC of 100,000 tons. The 1975 TAC is set at 120,000 tons. While discussions of the available data failed to produce agreement concerning age compositions and mortality rates, it was agreed that the 1973 year-class, which contributes to the fishery in the years 1974 to 1976, was poorer than those of 1971 and 1972, and the success of the fishery in 1976 therefore will be heavily dependent on the strength of the 1974 year-class, but there was insufficient information to allow agreement on the strength of this year-class. On the assumption that it will be of moderate strength, the Subcommittee recommends a TAC of 100,000 tons for 1976, subject to revision at the 1975 Annual Meeting if new information concerning the stock assessment for 1976 becomes available.

New information concerning age determination of silver hake and the relationship between year-class strength and sea temperature was presented to the Annual Meeting in June (Res. Doc. 75/104), and these data confirm the previous estimates of the present composition of the stock in Div. 4VWX. However, there remain differences of opinion on the levels of natural and fishing mortality and the age at first capture that will achieve the MSY for this resource. For example, the TAC of 100,000 tons recommended for 1976 is based on a natural mortality of  $M = 0.4$ , but higher values would justify increased exploitation of the youngest age-groups and an increased TAC. The Subcommittee discussed USSR scientists' data that  $M = 0.7$  which would permit a TAC of 125,000 tons in 1976, but, since this means that 50% of the stock would die 'naturally' each year, the Subcommittee concluded that tangible evidence for it must be presented (e.g. heavy predation by another marine organism) before such an extreme estimate could be accepted, and endorsed its previous recommendation that the TAC for 1976 be 100,000 tons.

i) Flounders in Divisions 4V, 4W and 4X

The total catch of flatfish (American plaice, witch and yellowtail combined) in 1973 was 27,900 tons compared with a preliminary catch of 25,000 tons in 1974, considerably less than the TAC level of 32,000 tons. The commercial catch per unit effort of American plaice and witch has remained stable in the period 1965-74, but yellowtail has shown a dramatic decline (Table 5).

An assessment was presented for American plaice but none was available for witch or yellowtail. The plaice assessment indicated that  $F_{0.1}$  was 0.48 for males and females combined. Furthermore, it was suggested that this stock is being over-exploited in Div. 4W but under-exploited in Div.

4V due to a disproportionate distribution of fishing effort. The level of catch associated with  $F_{0.1}$  for American plaice is about 11,700 tons, only slightly less than the 13,600 tons previously estimated. However, the observed reduction in abundance of yellowtail and the need to redistribute fishing effort within the American plaice fishery justifies a recommendation that the overall TAC for flatfish be reduced. The Subcommittee therefore recommends that the 1976 TAC be set at 28,000 tons, noting that work should continue with the aim to provide separate assessments for these species.

Table 5. Div. 4VWX flatfish: catch rates of Canadian side otter trawlers of 151-500 gross tons (kg/hr. fished).

YEAR	4Vn	4Vs	4W	4X	4VWX	Plaice	Witch	Yellowtail
1965	196	487	86	6	151	43	35	73
1966	154	535	32	6	140	68	22	50
1967	226	436	62	8	134	58	29	47
1968	173	478	61	10	142	62	31	50
1969	152	454	50	11	130	74	32	25
1970	135	393	31	8	108	73	21	14
1971	136	339	61	9	107	61	31	15
1972	112	321	71	7	105	55	35	15
1973	315	119	80	5	77	37	35	4
1974	160	251	45	5	82	40	36	5

j) Pollock in Divisions 4V, 4W and 4X and in Subarea 5

Nominal catches averaged approximately 35,000 tons annually during 1955-66 but declined to a low of 19,500 tons in 1970; since then catches increased to 43,100 tons in 1973. Preliminary statistics for 1974 indicate that about 38,000 tons were taken from this stock, of which 13,500 tons were reported from SA 5. Thus the nominal catch is again well below the 1974 TAC of 55,000 which was set in 1974 on the basis of commercial catch and bottom trawl survey data. Commercial catch rates have increased in recent years from 49 kg/hr fished to 259 kg/hr in 1974 for Canadian otter trawlers (151-500 GRT) in Div. 4VWX and from 41 to 55 kg/hr for US trawlers in Div. 4VWX and SA 5 over the same period. However, survey indices of abundance (Res. Doc. 75/65) fluctuated considerably during the period and indicate at best only a slight increase in biomass. It seems therefore that shifts in directed effort associated with recent declines in the SA 4 and 5 haddock stocks were primarily responsible for the increases in nominal catches and catch rates observed in recent years.

At present, there is no evidence to suggest that the Div. 4VWX and SA 5 stock is declining under current catch levels, and recruitment seems to have ranged from average to strong in recent years. The Subcommittee therefore recommends that the TAC be maintained at 55,000 tons in 1976.

k) Argentine in Divisions 4V, 4W and 4X and in Subarea 5

Although USSR scientists indicated that studies on the delineation of this stock are in progress, no new information was available to suggest a change in past advice. Catches in 1974 were 18,000 tons in Div. 4VWX and 23,000 tons in SA 5, both markedly up from catches of 1,400 and 2,500 tons for the two areas in 1973. In the absence of new information, the Subcommittee recommends that the 1976 TAC be maintained at 25,000 tons for Div. 4VWX. A catch of 25,000 tons is also recommended for SA 5, but this amount is included in the recommended TAC for the "other finfish" category (see Section VII). The total catch from Div. 4VWX and SA 5 should not exceed 50,000 tons.

l) Herring in Subarea 4 (see also Summ. Doc. 75/19)

(i) Banquereau stock (Divisions 4V and 4W(a) (Res. Doc. 75/39). The total catch in 1974 from Div. 4W(a) was 44,000 tons, an increase of 43% from that in 1973. The 1970 year-class again sustained the Canadian fisheries in both Subdiv. 4Vn and Div. 4W(a), comprising over 50% of the catch in numbers in both areas. The 1972 year-class made a strong appearance in Div. 4W(a), comprising 24% of the catch in numbers. The catch per unit effort data indicate radically different trends in the two areas (Table 6). In Subdiv. 4Vn the CPUE decreased by 39% in the past three years, while for the same period in Div. 4W(a) it has increased by 97%.

Tagging studies (Res. Doc. 75/38) have suggested that the Div. 4W(a) fishery should be combined with Div. 4XW(b) for management purposes and is assessed with Div. 4XW(b) in this report. No larval concentrations were found in recent larval surveys in Div. 4VW and this adds support to the hypothesis that the Div. 4W(a) fishery is not on a separate stock. A decision to combine Div. 4W(a) with Div. 4XW(b) for management purposes would leave the Div. 4V fishery to be managed separately. No analytical assessment is available for this fishery. However, in view

of the continuous decline in CPUE for this area during 1971-75, a decrease in the catch level should be considered. The average catch for the last three seasons has been about 16,000 tons, and a reduction to about 11,000 tons would seem appropriate for 1976.

Table 6. Catch per unit effort (metric tons) for the Canadian herring fishery in Subdiv. 4Vn and Div. 4W(a) for the 1971/72 to 1974/75 seasons. (Units of effort are given in parentheses.)

Area	1971/72	1972/73	1973/74	1974/75
4Vn	115.2 (56)	93.8 (149)	78.6 (193)	70.4 (183)
4W(a)	74.5 (270)	73.6 (97)	132.0 (194)	146.5 (129)

(ii) Southwest Nova Scotia stock (Divisions 4W(b) and 4X). This assessment is based on catches from Div. 4XW(b) as in previous years, in the event that the Commission will wish to continue regulating catches in 1976 as in the past. An additional assessment is given in Subsection (iii) which combines the catches from Div. 4XW(b) and Div. 4W(a).

The total catch of herring in Div. 4XW(b) was about 142,700 tons in 1974, an increase of 6% over that of 1973. Approximately 89,200 tons were taken against the 1974 TAC of 90,000 tons. The remaining 53,500 tons were taken in the traditional juvenile and fixed gear fisheries. The assessment was made using the catches of all fisheries off southwest Nova Scotia, which include all non-Canadian catches in Div. 4XW(b), Canadian catches in the Nova Scotia purse seine, weir, trap and gillnet fisheries, but excludes gillnet catches along eastern Nova Scotia which are assumed to be from local spawning stocks.

The assessment to recommend a TAC for 1976 was made with the following assumptions:

- (1) The 1975 TAC of 90,000 (plus 15,000 tons estimated for the fishery in Nova Scotia inshore waters which has so far been excluded from the TAC) will be taken.
- (2) The size of the 1970 year-class is twice the size of the 1966 year-class at age 1, as was assumed in 1974.
- (3) The 1971 year-class is of similar size to the 1969 year-class, which was one of the poorest on record.
- (4) The size of the 1972 year-class is one-half the size of the 1966 year-class at age 1. (Catches of the 1972 year-class at age 2 in the Canadian fisheries support the assumption that it is of reasonable size).
- (5) The size of the 1973 and 1974 year-classes are  $400 \times 10^6$ . This is the conventional size of year-classes entering this fishery as agreed in 1974 (*Redbook* 1974, page 109).

Based on the assumptions as to the sizes of year-classes, the catch for 1976 and stock size for 1977 were calculated using values of F from maximum yield per recruit considerations (*Redbook* 1974, page 109). The assessment indicates a decline in stock size of 25% from the beginning of 1975 to 1977, and a reduction in catch in 1976 of about 25,000 tons (from 106,000 to 81,000 tons). Since the inshore catches (estimated at 15,000 tons for 1975 and not under TAC regulation) were included in the assessment, these estimated catches have to be removed from the predicted catch before the TAC is determined. With the reduction in stock size predicted for 1976, the inshore catches should also decrease (probably 11,000 tons in 1976); the total predicted catch in 1976 is 81,000 tons, from which the appropriate amount has to be deducted for the inshore fishery, if the TAC is to be set according to the principle used in previous years. Only by raising the fishing mortalities on all age-groups substantially above optimum levels in 1976 can the TAC remain at 90,000 tons. It must be stressed, however, that, if the 1972 year-class is not as strong as assumed, the stock size could be severely reduced even with the recommended reduction in the 1976 TAC. If the 1973 and 1974 year-classes are less abundant than assumed ( $400 \times 10^6$ ) and optimum F levels are maintained on all age-groups, an even greater reduction in catch will be required for 1977.

(iii) Southwest Nova Scotia and Chedabucto Bay combined (Divisions 4W and 4X): a new assessment. Tagging experiments in 1974 indicated a strong connection between the Div. 4W(a) and Div. 4XW(b) stock components. It was decided, therefore, that an assessment should be made based on the two fisheries combined. The total catch in 1974 from Div. 4WX was 170,000 tons, and the 1970 year-class comprised about 67% of the catch.

Catches used in the assessment include Canadian catches off southwest Nova Scotia (Div. 4X(a)), the non-Canadian catches in Div. 4XW(b), as in the preceding Div. 4XW(b) assessment, the Can-

adian catches in Div. 4W(a) since 1969 when the fishery began, and USSR catches in 1974 from Div. 4VW(a). Catches in earlier years from Subdiv. 4Vs were not included as they were assumed to be from the same stock as catches from Subdiv. 4Vn.

The new assessment was made using the following assumptions:

- (1) The rate of fishing is the same in both areas, and thus the population size was calculated using the same starting Fs as in the Div. 4XW(b) assessment.
- (2) The size of the 1970 year-class is twice the size of the 1966 year-class at age 1.
- (3) The sizes of the 1973 and 1974 year-classes are  $750 \times 10^6$  fish. This is the conventional year-class assumption for Div. 4XW(b) taking into account the addition of Div. 4W(a).

The resulting prediction indicates a reduction in catch from 1975 to 1976 of about 4,000 tons in Div. 4W(a) and a reduction of 16,000 tons in Div. 4XW(b) to achieve  $F_{max}$ . A reduction in biomass of 47% between 1974 and 1976 is indicated. The total reduction in catch for the combined areas is thus very similar to the prediction resulting from the assessment for Div. 4XW(b) alone.

At the 1974 Annual Meeting, the 1975 TAC for Div. 4VW(a) was partitioned to allow the regulation to be based on a fishing season commencing on 1 July 1975. As a consequence, a January to June 1975 TAC was set at 30,000 tons for Div. 4VW(a). The 1975 TAC for Div. 4XW(b) was set at 90,000 tons. Thus the TAC for the combined area of Div. 4XW(b) and 4W(a) will allow a 1975 catch of 120,000 tons (plus an estimated inshore catch of 15,000 tons in Div. 4XW(b), for a total catch of 135,000 tons). The analysis indicates that a total catch for 1976 from the combined area of 115,000 tons can be taken, a reduction of 20,000 tons from that of 1975. An appropriate amount of catch in the inshore fishery would need to be deducted, if the Commission wishes to set the TAC on the same basis as in previous years (an inshore catch of 11,000 tons is estimated for 1976).

(iv) Management strategy in Divisions 4V, 4W and 4X. At the 1974 Annual Meeting, the TAC for the Div. 4VW(a) fishery was set on a fishing season basis, i.e. 1 July to 30 June. The TAC for the 1975/76 season was set at 45,000 tons. The 1975 TAC for the 4XW(b) fishery was set at 90,000 tons for the calendar year, excluding 15,000 tons estimated to be taken in the inshore fisheries.

Recent tagging studies have indicated the need for adjustments in the management areas and the following procedure is recommended:

Option 1. Recognizing that the Commission has already agreed on a TAC for the stock in Div. 4VW(a) for the season 1 July 1975 to 30 June 1976, the Subcommittee considers that the management area should be adjusted to give TACs as follows:

Div. 4V	1 July 1975 to 30 June 1976	15,000 tons
	1 July 1976 to 30 June 1977	11,000 tons
Div. 4WX	1 Jan 1976 to 31 Dec 1976	115,000 tons

The 115,000 tons for Div. 4WX should be reduced by whatever catch is to be taken in Div. 4W(a) in the period 1 July 1975 to 31 Dec. 1975.

Option 2. If the Div. 4VW(a) fishery continues to be managed as a unit (as in previous years), the recommended TAC for that area for 1976/77 season is 36,000 tons (on the basis of 11,000 tons for Div. 4V and 25,000 tons for Div. 4W(a)). This reduction in Div. 4W(a) is justified on the basis that the combined assessment predicted catches in Div. 4W(a) of 25,000 tons. If no reduction is made for this area, an even larger reduction will be required in 1977. If the fishery in Div. 4XW(b) continues to be managed as a unit (as in previous years), the predicted catch in 1976 is 81,000 tons, which include an estimated 11,000 tons to be taken in the inshore fisheries.

m) Mackerel in Subareas 3 and 4

The status of the mackerel fisheries in SA 3 and 4 is considered in conjunction with the overall assessment of the stocks in SA 3 to 6 (see under Mackerel in Section VII(o)).

n) Squid-Illex in Subareas 2 to 4

The assessment of *Illex* in SA 2 to 4 is considered together with the stock component in SA 5 and 6 (see under Squid-*Illex* in Section VII(q)).

VII. SUBAREA 5 AND STATISTICAL AREA 6

1. Fishery Trends<sup>1</sup>

The total nominal catch of all species decreased from 2,051,000 tons in 1973 to 1,799,000 tons in 1974 and the total finfish catch declined from 1,434,000 tons to 1,136,000 tons in 1974. The 1974 catch of finfish and squids (except menhaden, tunas, billfishes and large sharks) was 935,000 tons compared with 1,154,000 tons in 1973. Decreases from 1973 to 1974 occurred in the groundfish catch (369,000 to 304,000 tons), pelagic fish catch (975,000 to 748,000 tons), and "other fish" catch (91,000 to 84,000 tons), but the catch of invertebrates increased (617,000 to 663,000 tons).

Species which showed significant decreases in catch from 1973 to 1974 were mackerel (381,000 to 294,000 tons), herring (235,000 to 185,000 tons), redfish (17,000 to 11,000 tons), red hake (67,000 to 34,000 tons), yellowtail flounder (31,000 to 25,000 tons), angler (7,000 to 1,000 tons), sculpins (9,000 to 3,000 tons), butterfish (19,000 to 13,000 tons), and menhaden (331,000 to 248,000 tons). The silver hake catch declined slightly (136,000 to 130,000 tons), and the squid catches levelled off at 56,000 tons (57,000 tons in 1973). Few species showed increases in catch, notably argentine (2,500 to 20,000), dogfish (14,000 to 18,000 tons), and sea scallops (55,000 to 74,000 tons).

The total catch of all species declined in SA 5 from 1,063,000 tons in 1973 to 804,000 tons in 1974 but increased slightly in SA 6 from 988,000 to 995,000 tons.

2. Species Review

Table 7 contains a summary of recent catches and TACs, as well as the TACs recommended for 1976, for stocks under consideration for management in SA 5 and 6.

a) Cod in Division 5Y (Res.Doc. 75/46)

The TAC for the Gulf of Maine stock has been set at 10,000 tons since 1973, based on historical catch information only. While an assessment for this stock has yet to be completed, several points presented to the Subcommittee suggest that the current TAC is too high. A tabulation of catches in Div. 5Y since 1932 shows that the catch exceeded 10,000 tons only three times (1934, 1944 and 1945) and averaged only 6,130 tons over the entire period (1932-74). In addition, there is an unknown but considerable sport fish harvest of cod from this area. Estimates of abundance (mean weight/tow) from US autumn bottom trawl surveys indicate that a declining trend has been consistent since 1968 (Res. Doc. 75/65). Mortality estimates for Gulf of Maine fish indicate that the current fishery is generating F values of about 0.5, (assuming  $M = 0.2$ ). When compared to yield-per-recruit curves for the whole of SA 5, the current estimates of F appear to exceed that for  $F_{max}$  at 0.3. The Subcommittee therefore recommends that the 1976 TAC should be reduced to 8,000 tons.

b) Cod in Division 5Z (Res.Doc. 75/46)

The TAC for the Georges Bank stock since 1973 has been set at 35,000 tons, which was considered to be the MSY (Res.Doc. 72/117). No new assessment has been completed for this stock. Total nominal catches over the past 10 years (1965-1974) have averaged 34,300 tons but they have been below 30,000 tons since 1970. Estimates of abundance calculated from autumn R/V *Albatross IV* surveys indicate a relatively stable population since 1963. Length frequency samples for both bottom trawl survey and commercial fishery samples indicate a strong 1971 year-class which appeared to be fully recruited to the US fishery by the last quarter of 1974. Year-classes following 1971 are also present although not as abundant. Estimates of mortality rates for Georges Bank fish suggest that the current fishery is generating F values around 0.35 (assuming  $M = 0.2$ ), which exceed the estimate of  $F_{max}$  at 0.3 ( $M = 0.2$ ) calculated for the whole of SA 5. Moreover, a refit of the generalized production model with updated catch-effort data since 1973 indicates a lower MSY value of around 32,500 tons. However, the data presented were not felt to be sufficient to warrant a change in the current TAC, although it was noted that continued harvest at the TAC level may in fact be too high. A TAC of 35,000 tons is therefore recommended for 1976.

c) Haddock in Subarea 5 (Res.Doc. 75/48)

The TAC was set at zero in 1974, allowing for by-catch only. The 1975 TAC was set by the Commission at 6,000 tons (an estimate of by-catch) to allow each nation to formulate its own regulations to meet internal quota allocations and thus hold the catch at the lowest possible level. Provisional catch data indicates the 1974 incidental catch to be approximately 4,800 tons.

<sup>1</sup> Catches used in this subsection are based on statistics compiled for the Annual Meeting, and these may differ slightly from figures given under "Species Review" which was prepared in April 1975.

Table 7. Subarea 5 and Statistical Area 6: summary of nominal catches (1971-74) and TACs (1973-76) by species and stock area.

Species	Stock area	Nominal catches (000 tons)				TACs (000 tons) <sup>2</sup>			
		1971	1972	1973	1974 <sup>1</sup>	1973	1974	1975	1976
Cod	5Y	8	7	6	7	10 (10)	10 (10)	10 (10)	(8)
	5Z	28	25	29	28	35 (35)	35 (35)	35 (35)	(35)
Haddock	5	12	7	6	5	6 (0)	0 (0)	6 <sup>3</sup> (0)	(0)
Redfish	5	20	19	17	11	30 (30)	30 (30)	25 (25)	(17)
Silver hake	5Y	8	7	9	5	10 (10)	10 (10)	15 (15)	(10)
	5Ze	72	78	62	63	80 (80)	80 (80)	80 (80)	(50)
	5Zw+6	28	35	65	60	80 (80)	80 (80)	80 (80)	(43)
Red hake	5Ze <sup>4</sup>	9	39	25	14	-	20 (20)	20 (20)	(26)
	5Zw+6 <sup>4</sup>	31	36	41	34	40 (40)	50 (50-70)	45 (45)	(16)
Pollock	4VWX	12	20	30	25	50 (50) <sup>5</sup>	55 (50)	55 (55)	(55)
	5	14	13	13	13				
Yellowtail	5(E69°)	31	39	31	16	16 (16)	16 (16)	16 (16)	(16)
	5(W69°)+6				10	10 (10) <sup>6</sup>	10 (10) <sup>6</sup>	4 <sup>7</sup> (0)	(0)
Flounders except Yellowtail	5+6	28	24	22	21	25 (25)	25 (25)	25 (25)	(20)
Herring	5Y(adults)	39	43	16	18	25	25 (25)	16 (25) <sup>8</sup>	(9)
	5Z+6	267	174	202	149	150	150 (150)	150 (150)	(60)
Mackerel	3+4	24	22	38	44	-	55 <sup>9</sup>	70 (70)	(310)
	5+6	349	387	381	304	450	304 (251-312)	285 (285)	
Argentine	5				23	-	25 <sup>10</sup> (25)	-	-
Squid <i>Illex</i> " <i>Loligo</i>	5+6	25	49	57	21	-	71 (50-80)	71 (71) <sup>11</sup>	(30)
	5+6				34				
O. finfish <sup>12</sup>	5+6	156	168	155	144 <sup>13</sup>	-	125 (125)	150 (125)	(150)
Overall 2nd tier <sup>14</sup>	5+6	1136	1165	1154	998	-	923.9	850 (850)	(650+)

<sup>1</sup> Advance preliminary statistics for April 1975 assessments.

<sup>2</sup> Quantities in parentheses are TACs recommended by the Assessments Subcommittee.

<sup>3</sup> Solely for by-catch allocation (see Summ.Doc. 75/1).

<sup>4</sup> TACs for 1973 to 1975 pertain to Div. 5Z(E69°) and Div. 5Z(W69°)+ SA 6 respectively; TACs recommended for 1976 pertain to Subdiv. 5Ze and Subdiv. 5Zw+SA 6 respectively.

<sup>5</sup> TAC for 1973 pertains to Div. 4X and SA 5 only.

<sup>6</sup> TACs for 1973 and 1974 pertain to SA 5(W69°) only.

<sup>7</sup> See Summ.Doc. 75/1 (Proc. Fifth Spec. Comm. Mtg., November 1974).

<sup>8</sup> Reduction to 16,000 tons agreed at Fifth Spec. Comm. Mtg., November 1974 (Summ.Doc. 75/1).

<sup>9</sup> TAC pertained to Div. 4VWX.

<sup>10</sup> TAC included with "Other finfish" after 1974.

<sup>11</sup> Scientific recommendation was intended to pertain to *Loligo* only.

<sup>12</sup> Excludes all TAC species and also menhaden, billfishes, tunas and large sharks (except dogfish).

<sup>13</sup> Excludes 23,000 tons of argentine, as a separate TAC was set for 1974.

<sup>14</sup> All finfish species (except menhaden, billfishes, tunas and large sharks) and squids.

*Albatross IV* autumn bottom trawl survey data and US commercial indices of abundance (adjusted to eliminate effects of closed areas and seasons) both indicate declining trends to a very depressed state since the late 1960's. Recruitment has remained poor; the 1972 year-class has shown some strength in recent autumn surveys, although it appears to be only one-half the average size of the 1935-1960 year-classes. Young-of-year indices again indicate very poor year-classes for 1973 and 1974. Analyses of commercial data indicate additional disturbing trends. Growth rates of younger fish have increased sharply since 1970, implying a considerable reduction in age at recruitment. Also, the strong 1962 and 1963 year-classes are now disappearing from the fishery. These year-classes contributed approximately 75% of the total landings (by weight) for this stock during the 1967-1970 period, but by 1973 and 1974 yield from these year-classes approximated only 24% of the total. Taken together, these factors have serious implications relative to stock and recruitment and further indicate that every effort should continue to limit fishing mortality on this stock.

Stock abundance and recruitment estimates for Georges Bank haddock for the period 1968-76 are given in Table 8. It appears that the stock declined to an overall low in 1972 and has since gradually increased. However, most of the observed upswing is associated with recruitment of the 1972 year-class. Current data indicate a levelling off of the trend, due to poor recruitment in 1973 and 1974.

The Subcommittee recommends that removals in 1976 should be kept to the lowest possible level, with the understanding that unavoidable catches approaching 6,000 tons can be expected to occur under a zero TAC regulation. Even this level of by-catch is considered to be a serious hindrance to the recovery of the stock.

Table 8. Stock abundance and recruitment estimates for Georges Bank (Subdiv. 52e) haddock, 1968-76.

	1935-60	Yearly estimates (millions of fish)								
		1968 <sup>1</sup>	1969	1970	1971	1972	1973	1974	1975	1976
Population (age 2+)	145	70	36	24	23	12	20	42	48	48
<u>Removals:</u>										
total	63	35	16	9	9	4	6	10	11	12
fishing	41	25	11	5 <sup>2</sup>	5 <sup>2</sup>	2 <sup>2</sup>	3 <sup>2</sup>	3 <sup>2</sup>	3 <sup>2</sup>	3 <sup>2</sup>
natural	22	10	5	4	4	2	3	7	8	8
Recruits (age 2)	54	15	1	4	8	-	12	28	16	11

<sup>1</sup> Population size estimated with  $F = 0.5$  and  $M = 0.2$  during 1968.

<sup>2</sup> Under regulation; numbers computed on basis of mean weight in US commercial landings.

d) Redfish in Subarea 5 (Res.Doc. 75/59)

The TACs of 30,000 and 25,000 tons, recommended by the Subcommittee for 1974 and 1975 respectively, were derived from an analysis of catch and effort trends. A new preliminary assessment for the stock was presented.

During the developing years of the fishery (1935-1951) the SA 5 catch reached a maximum of 59,783 tons in 1941 but rapidly declined from this high level to 16,791 tons in 1953. The catch continued to decline until 1968 when only 6,777 tons were taken. During this period of declining catch, the stock appeared to be rebuilding as indicated by a rise in the US commercial and survey abundance indices in the mid-1960's, but a shift in fleet composition also occurred. Following 1968, landings from SA 5 rose to 20,035 tons in 1971 and 19,905 tons in 1972. A provisional catch of 10,600 tons is indicated for 1974.

Recent research cruise catch-per-tow indices and length frequency data indicate a lower abundance of larger redfish and increased abundance of smaller pre-recruit redfish between 1971 and 1974. This trend is also evident in US commercial catch per unit effort and length frequency sampling data.

Equilibrium yield curves were fitted using total catch statistics and the US commercial catch-per-unit-effort index from 1942 to 1973. These values varied between 20,000 and 28,000 tons, depending on the model and the averaging period used in the analyses. Because of the large number of years in which a single year-class may be subject to exploitation in the fishery, averaging periods of 6, 8 and 12 years were used in the analyses. The model which gave the best fit of observed data was the Gompertz with an 8-year average effort using the catch and effort data from 1942 to 1973. The estimated MSY from this analysis was 20,000 tons. When the data during the earlier period of expansion (1942-1951) were excluded from the analysis, the resulting MSY values were considerably lowered, varying between 16,000 (Gompertz) and 18,000 (logistic) tons. These estimates fall well below the catches observed during the developing years of the fishery but this can be attributed to the initial harvest of an accumulated stock at that time, a condition well known for such slow-growing and long-lived species as redfish. Considering the declining trend in abundance, the MSY values derived from the equilibrium yield model, and the long period needed for recovery of redfish stocks, the Subcommittee recommends that the 1976 TAC be set at 17,000 tons.

e) Silver Hake in Subarea 5 and Statistical Area 6 (Res. Doc. 75/13, 62).

i) Stock identification. The question arose at the 1974 Annual Meeting concerning stock differentiation and the definition of management areas for silver hake in SA 5 and 6 (Res. Doc. 74/100). It was agreed that the stocks be delineated as Div. 5Y, Subdiv. 5Ze, and Subdiv. 5Zw plus SA 6 until such time that there is sufficient evidence to suggest otherwise, and it was recommended that research be conducted to resolve this issue. However, no new evidence relating to stock identification was presented to this meeting.

ii) Age determination. A new method of age determination developed by US scientists using thin sections of otoliths (Res.Doc. 75/13) resulted in age-length tables differing markedly from those presented by the USSR. Difficulties involved in accurate age determination from silver hake otoliths undoubtedly result in the disagreement between the US and USSR data. Since accurate ageing is essential for valid stock assessments and the estimation of TACs, it is recommended that US and USSR scientists resolve the ageing differences as soon as possible.

iii) Division 5Y stock. The nominal catch declined from 8,900 tons in 1973 to 5,200 tons in 1974. These catches were substantially below the 1955-66 annual average of 28,500 tons for this area. Both the US commercial catch/effort index and the US survey abundance index declined in 1974. Estimates were available for the first time of the amount of discarding of ages 0 and 1 fish in the US silver hake and shrimp otter trawl fisheries, which employ nets with codend meshes of 45-50 mm. These estimates indicated that discards were as high as 12,500 tons in 1972, about twice the level of the landed catches. The 1974 discards were estimated at about 7,200 tons. High discarding seems to coincide with the appearance of strong year-classes. The inclusion of discard estimates result in actual catches which greatly exceed the reported nominal catches in recent years.

US survey data indicated a strong 1971 year-class, above-average 1972 and 1973 year-classes, and a strong 1974 year-class. Based on expected strong recruitment from these year-classes but not including the discard of small fish, the TAC was increased from 10,000 tons in 1974 to 15,000 tons in 1975 in anticipation of the imminent recovery of the stock to former levels. Analyses indicated that the earlier stock decline had resulted from catches exceeding recruitment during the 1960's. The present assessment indicates that failure of the stock to recover, in spite of the production of recent strong year-classes, can be attributed to excessive levels of fishing mortality exerted on the incoming year-classes at ages 0 and 1 fish. The stock, therefore, does not contain sufficient numbers of fish older than age 2 at the present time to support increased catches. The Subcommittee therefore recommends that the 1976 TAC be reduced to 10,000 tons. Previous mesh selection experiments for silver hake (ICNAF Res. Bull. No. 3, p. 86) indicated that a minimum mesh size of 64 mm would largely avoid the catching of ages 0 and 1 fish.

iv) Subdivision 5Ze stock. The nominal catch increased from 62,200 tons in 1973 to an estimated 64,700 tons in 1974. Estimates of the amount of discards of ages 0 and 1 fish in the US fishery were 3,400 tons in 1971 (approximately equal to US landings) but decreased to 300 tons in 1974. The US commercial catch/effort index dropped 50% from 1973 to 1974, whereas the US autumn survey abundance index decreased 38% from 1973 to 1974 to its lowest point since 1967. The survey indicated a strong 1974 year-class, although a close correlation has not existed in the past between survey predictions and actual year-class strength. Nevertheless, it was assumed that the 1974 year-class was equal to the mean of the strong 1971-1973 year-classes.

Virtual population analysis indicated that  $F$  ranged from 0.93 to 0.95 in 1973-1974. A similar level of fishing mortality would be required in 1975 to take the full TAC of 80,000 tons. Anticipating that the USA will take only a portion of its allocation, the total catch in 1975 was assumed to be 75,000 tons with  $F$  at 0.86. Earlier mesh selection studies by Jensen and Hennemuth (ICNAF Res. Bull. No. 3, p. 86) indicate that the 40 mm mesh used in the USSR fishery for silver hake results in a mean selection age of 1.25 years for which  $F_{max} = 0.45$ .

Alternative consequences for stock size in 1977 were calculated, assuming a 1975 catch varying between 50,000 and 80,000 tons: (1) if  $F$  in 1976 is maintained at the expected 1975 level, then a catch of 80,000 tons could be achieved but the stock size would decrease; (2) if the stock size is to be maintained, then the 1976 catch should be 65,000 tons; and (3) if, however, the objective is to reduce fishing mortality to  $F_{max}$ , then the 1976 catch should be 50,000 tons which would result in an increase in stock size. The latter approach, although resulting in an immediate drop in catch, would achieve a marked gain in yield within several years while holding fishing mortality at the level of  $F_{max}$ .

The best advice would, therefore, appear to be to recommmend a 1976 TAC of 50,000 tons. However, the USSR scientists felt that evidence was insufficient to justify reducing the TAC below the current level of 80,000 tons, since a critical 1974 year-class actually could be much more abundant than assumed in the estimates. Additional information concerning the strength of this year-class will be available in the autumn of 1975.

v) Subdivision 5Zw and Statistical Area 6 stock. The nominal catch decreased from 65,100 tons in 1973 to 61,400 tons in 1974. The TACs for 1973 to 1975 were set at 80,000 tons. The US commercial catch/effort index has declined since 1972 with the 1974 value being the lowest on record (1964-74). The US autumn survey abundance index dropped 73% from 1971 to 1974, the last value being the lowest observed during the period of the surveys. Survey data suggest that the 1973 year-class is not strong but that the 1974 year-class is stronger than average.

Fishing mortality (F) in 1974 was estimated to be 0.68. Since the USA is not expected to take its full share of the 1975 TAC, the virtual population analysis was carried out using a 1975 catch of 70,000 tons and this would require an F of 0.85. A 1976 catch of 43,000 tons would occur at  $F_{max} = 0.45$  and this would maintain stock size in 1977 as in 1976. The Subcommittee therefore recommends that the 1976 TAC be set at 43,000 tons.

f) Red Hake in Subarea 5 and Statistical Area 6

The recommended TACs for 1973 to 1975 were based on management areas separated by the 69°W longitude line as being the boundary between the Georges Bank and southern New England-Middle Atlantic stocks. The advice for 1976, however, assumes that the two stocks are divided by the 70°W longitude line (which is the boundary between Subdiv. 5Ze and 5Zw), as was agreed at the 1974 Annual Meeting.

i) Subdivision 5Ze stock. The catch from the Georges Bank area (east of 69°W) decreased from 21,500 tons in 1973 to about 14,400 tons in 1974. The 1974 and 1975 TACs were set at 20,000 tons for Div. 5Z (E69°). US autumn survey data showed a 50% decline in relative stock abundance from 1973 to 1974; however, the 1974 level was equivalent to the 1964-1974 mean abundance. The survey does suggest that the 1973 and 1974 year-classes may be strong. Assuming strong recruitment from these year-classes to the 1975 and 1976 fisheries, a USSR assessment indicated that optimum fishing mortality ( $F = 0.7$ ) would produce a 1976 catch of 26,000 tons. This procedure (Res.Doc. 74/64) utilized virtual population analysis to determine present year-class size and survey results to predict future year-class sizes, assuming  $M = 0.6$  and  $F = 0.2$  at age 2 and  $M = 0.4$  and  $F = 0.7$  at ages 3 and older. The method, however, does not consider the effect of the 1975 catch on the stock. Since there was no other advice available, the Subcommittee recommends a 1976 TAC of 26,000 tons for Subdiv. 5Ze.

ii) Subdivision 5Zw and Statistical Area 6 stock. The catch from the area west of 69°W decreased from about 44,700 tons in 1973 to about 34,500 tons in 1974. These catches are slightly different from those given in Table 7 owing to the boundary adjustment between the two stocks. The 1973, 1974 and 1975 TACs were set at 40,000, 50,000 and 45,000 tons respectively for the management area Div. 5Z(W69°)+SA 6. US survey data indicate a very large decrease (90%) in relative stock abundance from 1972 to 1974, the value for 1974 being the lowest recorded during the period of the US surveys. Survey catches of age 0 fish in this area have not been useful in predicting the subsequent strength of year-classes recruiting to the fishery. Therefore, no reliable estimate of recruitment was available.

A USSR assessment (following the same procedure as was used for predicting the TAC in Subdiv. 5Ze) indicated a 1976 catch of 16,000 tons. The low level of stock abundance in 1974, as shown by the survey data, suggests that, if the 1975 TAC of 45,000 tons is taken, the stock size at the beginning of 1976 will be quite low. Since the USSR prediction procedure did not take into account the 1975 catch, the estimate of 16,000 tons for 1976 may in fact be optimistic. However, USSR scientists suggested that a catch of 20,000 tons should be considered to take into account an anticipated catch of older age-groups (greater than age 6) not included in the prediction analysis. The Subcommittee finally decided to recommend a 1976 TAC of 16,000 tons for the management area Subdiv. 5Zw + SA 6, with the provision that a review of this value be considered at the 1975 Annual Meeting should new data or analysis become available.

g) Pollock in Subarea 5

A review of the pollock stock in Div. 4VWX and SA 5 is given under "Pollock" in the preceding Section VI.

h) Yellowtail in Subarea 5 East of 69°W Longitude

Stock abundance, estimated from catch-per-tow data of *Albatross IV* autumn cruises and from catch per unit effort of US commercial fisheries, seemed to have stabilized under TAC regulation during 1971 to 1973. In 1974, however, both sets of abundance indices showed a decline in stock size (Res.Doc. 75/65) with the latter one indicating a decrease of 15%. The Subcommittee considered that this was not sufficient evidence to recommend a reduction in the TAC, as a new assessment of the stock was not available, and recommends that the 1976 TAC be maintained at 16,000 tons, noting that the by-catch of yellowtail, particularly immatures, should be held to the lowest possible level.

i) Yellowtail in Subarea 5 West of 69°W Longitude and in Subarea 6.

Three groups of yellowtail are located in the management area west of 69°W longitude. The Cape Cod stock and the southern New England stock have been under a collective TAC regulation since 1971, and the group found in SA 6 was also included in the TAC established for 1975.

(i) Cape Cod stock. The catch increased from 1,700 tons in 1973 to 2,200 tons in 1974 (30% increase), while there was no increase in the US commercial catch per unit effort. Historic levels of catch taken in conjunction with the indication of a stable stock suggest that removals in 1976 should remain at 2,000 tons.

(ii) Southern New England stock. Although TAC regulations have greatly decreased removals since 1970, the US commercial catch per unit effort continued to decrease during the period. Catch per tow indices from US autumn cruises by *Albatross IV* for the southern New England cruise strata indicate a drastic decrease (90% since 1969) in abundance of pre-recruit (age 1) fish, with the catch per tow in 1974 being the lowest value observed during the entire series of years for which data are available. Assuming that the 1975 pre-recruit index is equal to that for 1974, the index of stock size will have decreased by about 80% from 1970 to 1975 (Table 9). Surplus production in 1976 is estimated to be at best only 1,000 tons.

Table 9. Catch per tow (age 1+) of pre-recruits and associated stock abundance indices for southern New England and SA 6 yellowtail from *Albatross IV* autumn surveys.

YEAR	Southern New England		Statistical Area 6	
	No. per tow (age 1+)	Abundance index	No. per tow (age 1+)	Abundance index
1963	16.3		11.1	
1964	18.6		5.3	
1965	11.5		19.2	
1966	35.5		14.2	
1967	20.0	102.5	12.5	64.4
1968	10.0	119.2	11.6	67.3
1969	12.8	92.6	0.6	59.0
1970	7.3	71.9	1.9	36.8
1971	6.3	53.6	11.0	11.7
1972	4.3	40.0	0.6	22.4
1973	1.9	30.8	0.69	21.6
1974	1.1	20.1	0.04	7.5
1975		11.9		2.8
1976		9.0		0.8

(iii) Statistical Area 6 stock. Stock abundance indices (Table 9) show a 90% decrease in stock size from 1970 to 1975. If the 1974 year-class is assumed to be the same size as that of 1973, the stock size in 1976 is estimated to remain extremely low, about 70% less than the 1975 level, and the surplus production is estimated to be zero in 1976.

(iv) Combined yellowtail stocks in Subarea 5 (west of 69°W) and Statistical Area 6. In the absence of information delineating the relationships between the yellowtail stock components in this area, a single management regime should be maintained. Recognizing the depressed condition of the stocks in this area, the Subcommittee recommends that removals in 1976 should be held to the lowest possible level with the knowledge that unavoidable catches may approach 4,000 tons under a zero TAC regulation.

j) Flounders except Yellowtail in Subarea 5 and Statistical Area 6 (Res.Doc. 75/69, 70).

Preliminary statistics for 1974 indicate a nominal catch of 21,000 tons of 'other flounders' in SA 5 and 6. Catches of these species have declined almost continuously since 1969, when 30,443 tons were taken. Bottom trawl survey data also indicate a steady decline in biomass over the same period. When taken together, the survey indices for the group show a decline of about 36% since 1963, while indices for individual species show declines up to 90%. Also, examination of length frequency data for sand flounder, winter flounder, summer flounder, with and American plaice taken in autumn bottom trawl surveys since 1963 reveals consistent declines in modal length.

A new assessment was presented for summer flounder in SA 5 and 6, which suggest that a sustainable catch level of 20,000-22,000 tons might be possible for this component of the flounder group. However, this species is a very popular one in the US sport fishery, and,

estimates of these catches are combined with the reported commercial catch, the total harvest of 27,000 tons is considerably above the estimate of sustainable yield.

The TAC for this group of species was originally established in 1973 at 25,000 tons, based on historical catches, research survey trends and general biology. Considering the declining trends observed in the survey estimates (Res.Doc. 75/65) and in commercial landings, and the implications of additional fishing mortality contributed by the US sport fishery on these species, The Subcommittee recommends a TAC of 20,000 tons for 1976, stressing that every effort should be made to reduce by-catch of these species in other directed fisheries in the area.

k) Argentine in Subarea 5.

For a review of Argentine in Div. 4VWX and SA 5, see under Argentine in the preceding Section VI.

l) Herring in Division 5Y (Gulf of Maine Stock) (see also Summ.Doc. 75/19)

The catch of adult herring in the Div. 5Y fishery increased in 1974 to about 17,800 tons from 16,900 tons in 1973, with the 1970 year-class contributing 60% (10,600 tons) to the total catch. The catch in the juvenile fishery increased from 16,400 tons in 1973 to 19,100 tons in 1974, with 50% of the total being age 3 and older herring.

In predicting the catch for 1976, the following assumptions were made:

- (1) The 1975 catch of 15,000 tons (TAC 16,000 tons less 1,000 tons not to be taken by Federal Republic of Germany and German Democratic Republic; see Proc. 5th. Spec. Mtg., Nov. 1974, Summ. Doc. 75/1) will be taken.
- (2) The size of the 1970 year-class is twice the size of the 1966 year-class at age 3.
- (3) The size of the 1971 year-class is equal to the size of the poorest observed in the fishery (1969 year-class at age 3 of 60 million fish).
- (4) Based on *Albatross IV* surveys in Div. 5Y and catches of this year-class in 1973 and 1974, the 1972 year-class is equal to the size of the 1969 year-class at age 3 (64 million fish).
- (5) The 1973 year-class is probably small but the available data are conflicting and consequently this year-class is equated to the size of the 1969 year-class at age 3 (64 million fish) and alternately to the conventional year-class size of 150 million fish (*Redbook* 1974, page 110).

Projected stock sizes in 1977 are given in Table 10 and illustrated in Fig. 1. Constraints provided by the Commission (Proc. 24th. Ann. Mtg., June 1974, page 240) state that the 1976 catch in Div. 5Y must be such as to maintain the adult (age 4 and older) stock size at a minimum of 60,000 tons and that the 1976 TAC must not exceed the 1975 TAC unless the adult stock size has reached a level that will provide the maximum sustainable yield by the end of 1976. Assessment results indicate that the adult stock size will not reach the level required to provide the maximum sustainable yield in 1976, and the 1976 TAC cannot therefore exceed that set for 1975. To maintain an adult stock size of 60,000 tons in 1976, a catch of 9,000-21,000 tons could be taken in 1976 (Table 10), depending on the size of the 1973 year-class. Maintaining the adult stock at 60,000 tons in 1977, however, allows a further decline in stock size from the 63,000 tons in 1976.

Table 10. Resultant stock size (age 4 and older) in 1977 as a function of 1976 catch (age 3 and older) for the Div. 5Y adult herring fishery, assuming that the 1970 year-class at age 3 is twice the size of the 1966 year-class, the 1972 year-class is equal to the 1971 and 1969 year-classes at age 3 (63.5 million fish), for two options on the size of the 1973 year-class at age 3 and for a range of fishing mortality in 1976.

Stock size at start of 1975 (10 <sup>6</sup> )	Total catch in 1975 (000 tons)	Stock size at start of 1976 (10 <sup>6</sup> )	Recruitment of 1973 y.c. (10 <sup>6</sup> fish)	F in 1976 (100%)	Predicted 1976 catch (000 tons)	Stock size at start of 1977 (000 tons)		
350	76	15	276.3	63.6	63.5	0.2	8.9	59.8
						0.4	16.5	52.0
						0.6	23.1	45.3
						0.8	28.7	39.7
						150.0	0.2	9.3
			0.4	17.4	63.9			
			0.5	21.0	60.0			
			0.6	24.3	56.8			
			0.8	30.3	50.8			

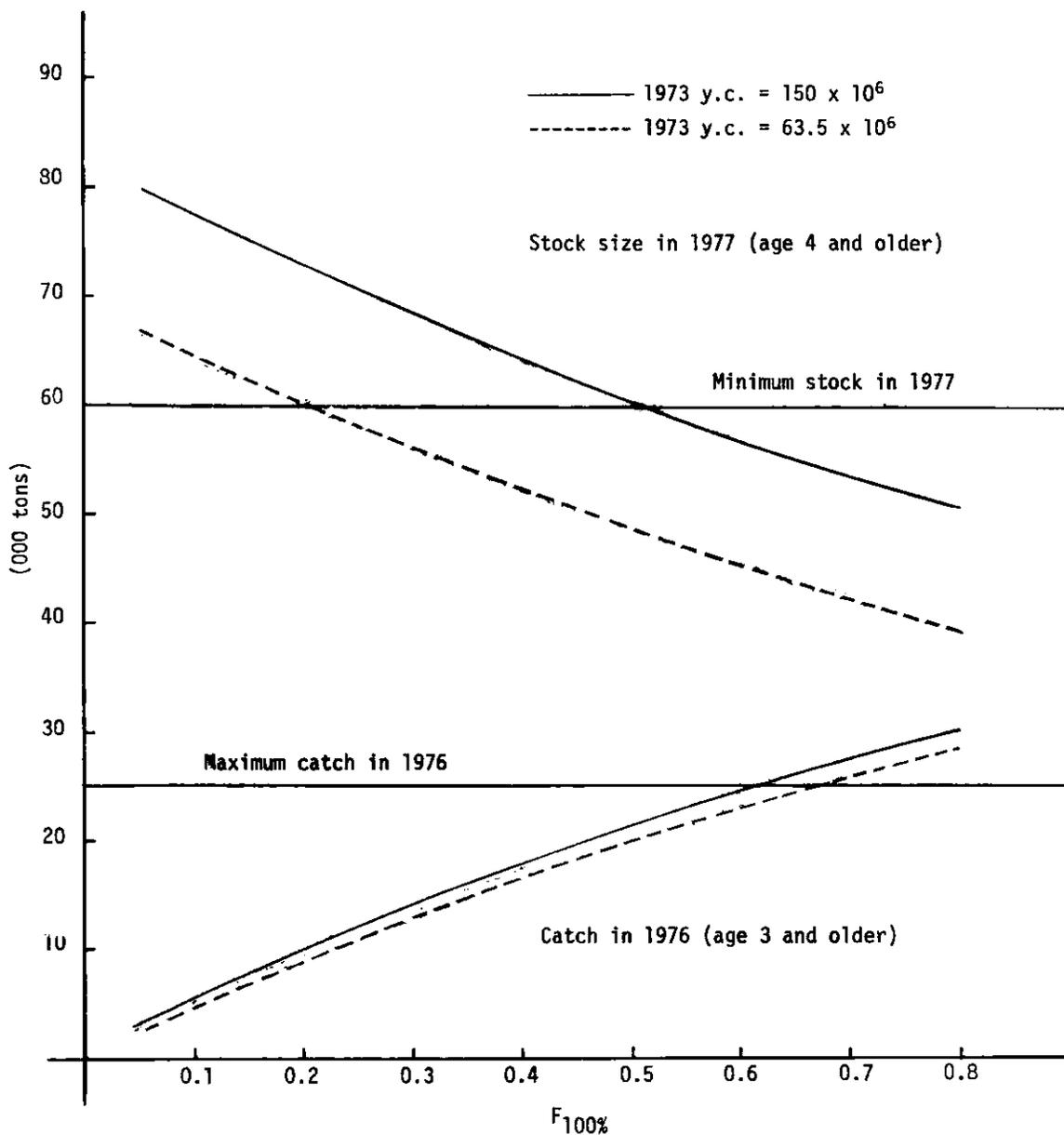


Fig. 1. Predicted herring catches in 1976 and resulting stock size in 1977 for the Div. 5Y adult fishery at two levels of recruitment.

It can be noted from Table 10 that a TAC of 21,000 tons in 1976 would just maintain the minimum stock size of 60,000 tons with no allowance for over-estimation of the size of the 1973 year-class. However, a TAC of 9,000 tons in 1976 would maintain the stock size at 60,000 tons in 1977, if the 1973 year-class recruits at the lower level, and this would allow some rebuilding of the stock if that year-class recruits at the higher level.

In view of the present state of the stock, the Subcommittee therefore recommends that the 1976 TAC should be set as close as possible to the 9,000 ton level. Only by setting the TAC at the lower level can any increase in stock size be anticipated by 1977.

m) Herring in Division 5Z and Statistical Area 6 (Georges Bank Stock) (see also Summ. Doc. 75/19)

The preliminary statistics for 1974 indicate a nominal catch of 149,000 tons (TAC = 150,000 tons), the lowest since 1966. Nominal catches in 1972 and 1973 were 174,000 and 202,000 tons respectively, when the TAC of 150,000 tons was also in effect. The 1970 year-class accounted for 82% of the 1974 catch in both numbers and weight. The US bottom trawl surveys indicate a rapid decline in stock abundance, but such is not the case for catch per unit effort data of two countries with major fisheries for herring.

The predicted catch for 1976 and stock sizes in 1976 and 1977 are based on the following assumptions:

- (1) The 1975 TAC of 150,000 tons will be fully taken.
- (2) The size of the 1970 year-class at age 3 is twice the size of the 1966 year-class as estimated in the previous assessment (*Redbook* 1974, page 44).
- (3) The sizes of the 1971 and 1972 year-classes at age 3 are equal to the poorest year-class observed in the fishery, i.e. 1969 (*Redbook* 1974, page 44).
- (4) The size of the 1973 year-class is equal to 800 million fish at age 3 or approximately one-half of the 1966 year-class and 25% below the 1964-69 average. The size of this year-class was chosen at a conventional level, as the information on its abundance is very limited. Since this level of recruitment (800 million fish) may be somewhat optimistic, an alternative assessment was done based on the assumption that the 1973 year-class at age 3 is equal to the size of the two preceding year-classes (i.e. 550 million fish), in order to demonstrate the effect on the 1977 stock size of over-estimating the size of the 1973 year-class.

The results of the assessments are given in Table 11 and illustrated in Fig. 2. The two constraints provided by the Commission (Proc. 4th. Spec. Mtg., Jan 1974, App. II) specify that an adult stock of at least 225,000 tons be maintained to the beginning of 1977 and that the 1976 TAC can only be increased if the adult stock size at the end of 1975 will reach the level of 500,000 tons which will provide the maximum sustainable yield. This level of stock size cannot be reached by the end of 1975 and the TAC for 1976 cannot therefore be advised to exceed 150,000 tons. Under the two assumptions as to recruitment of the 1973 year-class, a catch of 150,000 tons in 1976 would leave an adult stock size of 137,000 tons or 176,000 tons at the beginning of 1977 (Table 11). These levels of stock size are well below the minimum level of 225,000 tons agreed by the Commission. In order to prevent a decline in stock size below this minimum level by the end of 1976, the TAC should not exceed 100,000 tons if the higher level of recruitment of the 1973 year-class is assumed. For the lower level of recruitment of the 1973 year-class, the TAC for 1976 should be about 60,000 tons.

Table 11. Resultant stock size (age 4 and older) in 1977 as a function of 1976 catch (age 3 and older) for the Georges Bank (Div. 5Z and SA 6) herring stock, for two assumed levels of the 1973 year-class at age 3 and for a range of fishing mortality in 1976.

Stock size at start of 1975 (10 <sup>6</sup> ) (000 t)	Total catch in 1975 (000 tons)	Stock size at start of 1976 (10 <sup>6</sup> ) (000 t)	Recruitment of 1973 y.c. (10 <sup>6</sup> fish)	F in 1976 (100%)	Predicted 1976 catch (000 tons)	Stock size at start of 1977 (000 tons)		
1337	298	150	948	217	550	0.20	34	254
					0.38	60	225	
					0.60	87	200	
					0.70	96	188	
					1.00	125	161	
					1.26	142	142	
					1.35	150	137	
				800	0.20	35	293	
					0.38	61	265	
					0.60	89	236	
					0.70	100	225	
					1.00	129	196	
					1.26	150	176	
					1.35	156	170	

A TAC of 100,000 tons in 1976 implies a fishing mortality of 0.7 on fully recruited year-classes in that year. This level of F is equal to that of 1974 but below the level to be expected for 1975 if the 1975 TAC is fully taken (F = 0.8). A TAC of 60,000 tons in 1976, based on the assumption as to the lower level of recruitment of the 1973 year-class, implies a fishing mortality of 0.38, which is slightly higher than the level of F<sub>0.1</sub> from yield-per-recruit considerations. A TAC of 100,000 tons would merely maintain the size of the resulting stock at the current low level without any safeguard for over-estimation of the 1973 year-class. A TAC of 60,000 tons would also maintain the stock at the low level of 225,000 tons if recruitment of the 1973 year-class is at the lower of the two assumed levels, but it would reduce the probability that the stock size at the end of 1976 will be further decreased due to over-estimation of the 1973 year-class size. If the size of the 1973 year-class is larger than anticipated, then the stock size in 1977 will increase to about 250,000-300,000 tons, which would still be well below the estimated MSY level of 500,000 tons.

In view of the present state of the stock, the Subcommittee recommends that the 1976 TAC be set as close as possible to 60,000 tons. Only by imposing such a TAC level for 1976 can any increase in stock size be anticipated in accord with the management objective of the Commission to increase the stock size. If evidence should become available indicating a high level of abundance for the 1973 year-class, a TAC of 100,000 tons would maintain the stock size at 225,000 tons in accordance with the Commission's constraint as to the minimum stock size.

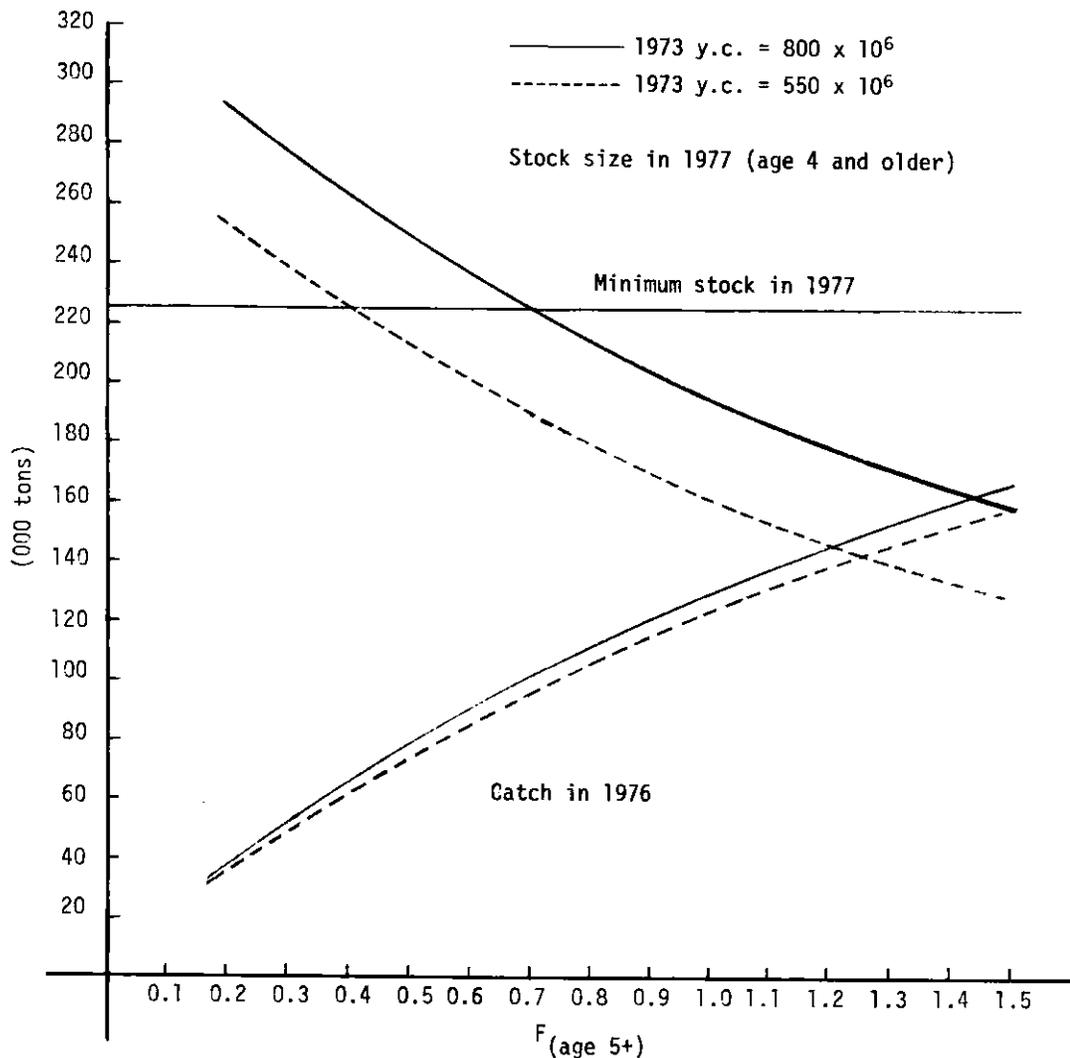


Fig. 2. Predicted stock size in Div. 5Z and SA 6 for 1977 in relation to catch in 1976 for two assumed levels of recruitment.

n) Preliminary Consideration of Effect of Juvenile Fisheries on Herring Yields

Although the stock relationship between herring exploited in juvenile fisheries and those in adult fisheries is not clear, the Subcommittee was concerned about the potential of excessive mortality being placed on the herring resources from both the juvenile and adult fisheries. This has not yet been fully evaluated for all of the Canadian fisheries, but the very preliminary assessment given below illustrates the importance of the juvenile fisheries to the overall conservation of the herring resources.

Herring catches in both of the juvenile fisheries in the Gulf of Maine (along the Maine coast and the New Brunswick side of the Bay of Fundy) were combined with the catches from the Div. 5Y adult fisheries and from the Div. 5Z and SA 6 fisheries over the period of 1956 to 1973. Fishing mortality rates were then calculated from cohort analysis. The average fishing

mortalities for the entire period (1956-73) were estimated as 0.09, 0.72 and 0.41 for age-groups 1 to 3 respectively, and for the period 1961 to 1973 they were 0.09, 0.47 and 0.28 for the same age-groups.

The fishing mortality on age 2 herring declined substantially during the 1960s from that indicated for the late 1950s but still accounted for an average annual catch of 45,000 tons during the 1960s. If caught at age 5, these fish would have produced an average annual catch of 176,000 tons. This is equivalent to 94% of the catches (by weight) that were taken from the Georges Bank stock over the 1961-73 period (i.e. almost a doubling of the catch).

More important than increasing the catch over that period, however, is the long-term effect of the juvenile fisheries on the size of the stock. Starting with the stock in 1961, three sets of fishing mortalities were applied for each year up to 1972. One set describes the present average situation, the second set utilizes an  $F$  of 0.25 for ages 2 and 3 fish, and the third set implies no fishing mortality on juveniles. The predicted catch and stock trends are illustrated in Fig. 3 for the first and third cases. From the Set 1 analysis, the stock declines to 216,000 tons by 1972 and gives a catch of 113,000 tons for that year. With  $F$  reduced on age 2 and 3 herring (Set 2), the stock size is estimated at 506,000 tons for 1972 with a catch of

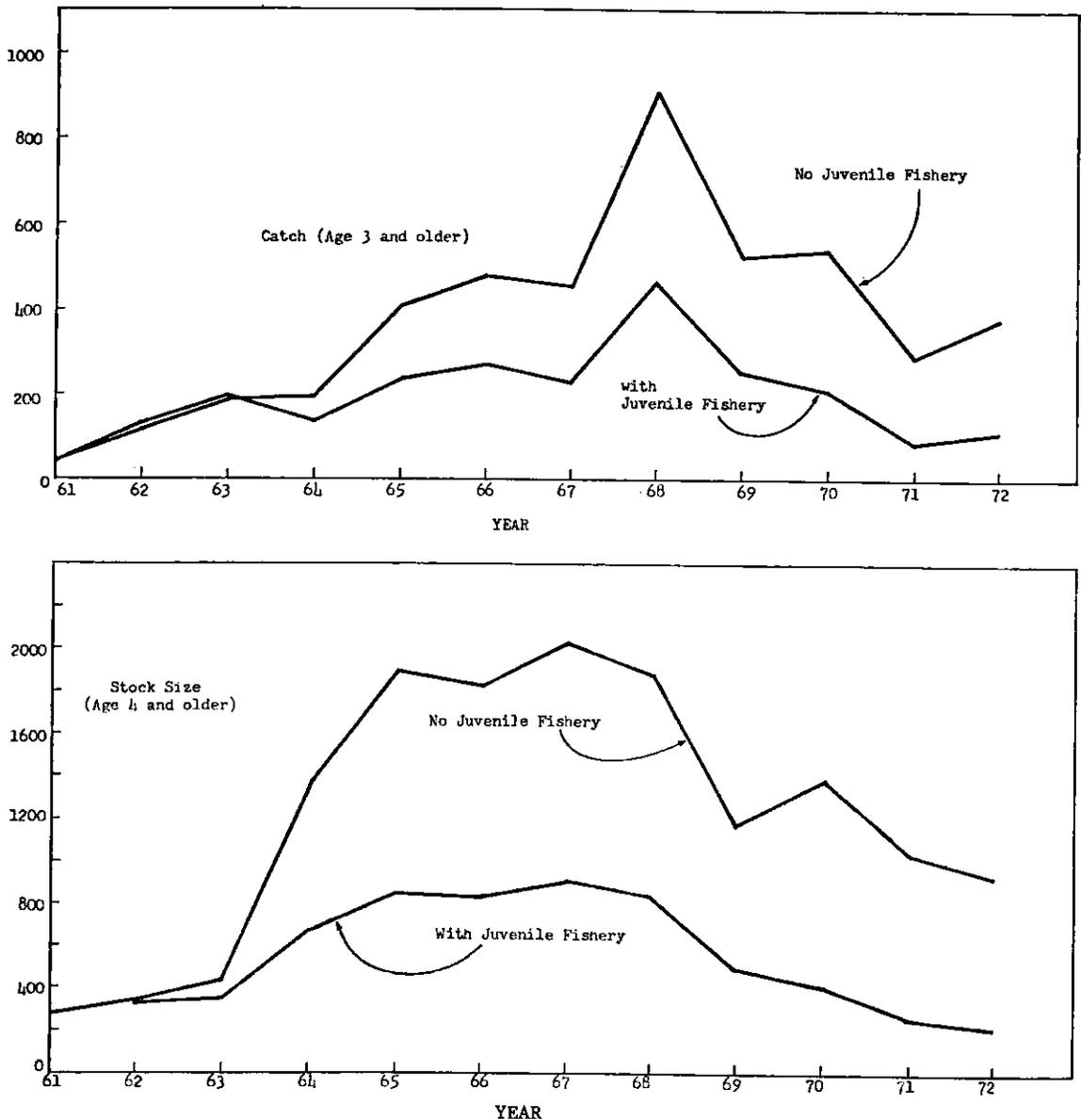


Fig. 3. Catch and stock size predications for herring in Div. 4X(b), and SA 5 and 6 with and without a juvenile fishery.

223,000 tons in that year. With no juvenile fishing mortality (Set 3), a stock size of 938,000 tons is indicated for 1972 giving a catch of 372,000 tons in that year. Over the period from 1961 to 1972, the average annual catch would have been:

- Set 1: 199,000 tons for the current situation.
- Set 2: 289,000 tons for  $F = 0.25$  on ages 2 and 3 fish.
- Set 3: 375,000 tons for no juvenile fishery.

o) Mackerel in Subareas 3, 4 and 5 and Statistical Area 6 (Res.Doc. 75/14, 15, 32, 33, 40)

i) Catches in 1974. Nominal catches in SA 3 and 4 increased from 38,000 tons in 1973 to 44,000 tons in 1974, whereas in SA 5 and 6 they declined from 381,000 tons in 1973 to 304,000 tons in 1974. The TACs for 1974 were 55,000 tons for Div. 4VWX and 304,000 tons for SA 5+6. TACs for 1975 were set at 70,000 tons for SA 3 and 4 and 285,000 tons for SA 5 and 6.

ii) Stock identity. Additional tagging data relating to the recaptures of tagged mackerel in SA 5 and 6 from releases in SA 3 and 4 confirmed the migration of at least a portion of the northern contingent of mackerel to over-wintering areas off the New England coast. However, the nature and magnitude of the tagging results do not allow estimates of the relative contribution of the northern and southern mackerel components to the fisheries in SA 3 to 6. Extensive tagging studies coupled with biological investigations, such as that initiated by Polish scientists on bi-modality of the first-year otolith annuli, will be necessary before first estimates of relative recruitment of the two components become available. It was generally agreed, however, that a combined assessment was the more appropriate stock evaluation approach.

iii) Abundance indices for 1974 and 1975. Results of research vessel surveys in 1974 and early 1975 were too variable to permit definitive evaluation of the abundance trends since 1973. However, surveys in both years indicate that the 1973 year-class and to a limited extent the 1974 year-class are dominant in the age compositions; whether this is due to strong recruitment or to a sharp decline in the abundance of older age-groups is not clear. Commercial length frequencies for the first quarter of 1975 (Res.Doc. 75/40) indicate that the major portion of the catches is now being derived from ages 1 and 2 fish. Catch per unit effort of the US mackerel fleet declined significantly in 1974 (70%). The catch/effort data for the German Dem.Rep. fleet decreased by 25% in 1974, while the overall catch/effort data for the Polish fleet remained at the 1973 level.

iv) Evaluation of 1974 assessment parameters. The following parameters were agreed for use in the assessment of overall stock size and projected catch in SA 3 to 6:

- (1) It was agreed that, where possible, the actual age composition data should be used in converting catches to numbers by age-group. This was also done for SA 3 and 4 catches instead of prorating SA 5 and 6 catches by number as had been done in the preliminary assessments (Res. Doc. 75/14, 40).
- (2) Both the Polish preliminary assessment (Res. Doc. 75/40) and the US assessment (Res. Doc. 75/14) indicated that the fishing mortality rate for fully recruited ages was in the range of 0.6-0.7. A regression of  $F$  (for age 4+) on fishing effort for the period 1968-72, with the assumption that there was a 25% decline in catch per unit effort in 1974, indicated a value of  $F$  (for age 4+) at 0.6 in 1974. This value was agreed as a reasonable one for 1974 and was used in the assessment.
- (3) For age-groups 2 and 3 a regression of partial recruitment rate on age 4+ stock size was used to estimate partial recruitment rates for 1974-76 as follows:

Age-group	Partial recruitment (%)		
	1974	1975	1976
0		0	0
1		18	18
2	42	50	57
3	82	90	96
4	100	100	100

- (4) The 1973 and 1974 year-classes are both predicted to be strong from stock-recruit curves in relation to environmental parameters. It was agreed that the 1973 year-class was relatively strong, perhaps of the order of 50% of the 1967 year-class at age 1.

The 1974 and 1975 year-classes were assumed to be equal to the average strength of the 1967-72 year-classes. If these 1974 and 1975 year-classes are underestimated, no loss in yield will result, because they will reach their maximum potential in 1977 and 1978 respectively.

- (5) There was insufficient evidence to justify a change in the natural mortality coefficient from the value agreed for the previous mackerel assessments ( $M = 0.3$ ).
- v) Results of assessment. The analysis of the available data, using the parameters as agreed to in the preceding section, result in the catch, fishing mortality and stock size estimates given in Table 12, and the following points are indicated:
- (1) The 1975 TAC of 355,000 tons, if taken, will generate an F of 0.7.
  - (2) An F of about 0.6 in 1976 will provide a catch of 310,000 tons in SA 3 to 6. This fishing mortality will allow 99% of the maximum yield per recruit to be achieved and will also maintain the stock biomass (age 2 and older) in 1977 at the level which provided maximum recruitment in the past 10 years, adjusting for environmental variations.
  - (3) The stock, as predicted for 1976 (Table 12), will be comprised mainly of very young fish (age 2 or younger), and thus there is the possibility of substantially increased fishing mortality on those age-groups, resulting in the loss in yield-per-recruit.

On the basis of the foregoing analysis, the Subcommittee strongly recommends that the 1976 TAC be set at 310,000 tons for the stock over its entire range in SA 3 to 6, accompanied by a size limit of 25 cm total length. Such a minimum size limit would effectively exclude the capture of 1-year-old mackerel. The recommended TAC for SA 3 to 6 as a whole should be partitioned to ensure a practicable distribution of the fishery.

vi) Furure research requirements.

- (1) Tagging projects in SA 5 and 6 are essential for further clarification of the migrating patterns of mackerel and for estimates of the relative contributions of the two major components in the SA 3 to 6 fisheries. Such tagging studies will require substantial inputs of research effort and time, if difficulties associated with weather conditions and mackerel distribution during the winter period are to be overcome.
- (2) Divergent opinions as to the level of natural mortality indicates the need for further investigation of M.
- (3) The variability in time, space and density of mackerel schools requires that resource inventory surveys be well planned and stratified to reflect spatial heterogeneity in size and density of the schools. A first approach to such an expanded survey program might be a detailed examination of past surveys to elucidate the distribution pattern of mackerel in SA 5 and 6 during the winter period.

vii) Further comments on mackerel assessment at Annual Meeting (Res. Doc. 75/103). The recommended TACs are based on expected catches of particular numbers of fish of each age-group under specified conditions of exploitation. For example, the TAC for 1975 includes an expected catch of certain numbers of 1- and 2-year-old fish. A provisional interpretation of catches taken in the first quarter of 1975 suggests that catches of 1-year-old mackerel from the 1974 year-class, when taken over the whole year, will eventually prove to be higher than expected. This will have been caused either by the 1974 year-class being more abundant than expected or by a disproportionate concentration of fishing on young mackerel in the absence of suitable concentrations of older fish. Scarcity of the older age-groups in research vessel survey catches indicate that this may be the case, but it is not technically possible to distinguish between the two effects. If the 1974 year-class is more abundant than previously assumed, then the recommended TAC for 1976 will be conservative, but, if the exploitation of 1-year-old mackerel in 1975 has increased, then the stock in 1976 will be reduced below the level used as a basis for the 1976 TAC of 310,000 tons and the TAC for 1977 will have to be further reduced if the presently agreed values of F and stock size are to be maintained. This emphasizes the need to implement a minimum size regulation for mackerel, as a higher yield-per-recruit could be achieved by delaying first capture until the mackerel are at least 2 years old. This would protect both the stock and future TACs from the adverse effect of an excessive proportion of a TAC being taken from the youngest age-groups, simply because they form the most commercially attractive fishing concentrations.

Table 12. Results of mackerel assessment for Subarea 3 to Statistical Area 6.

	Year-class	Catch, fishing mortality and stock size by year								
		1968	1969	1970	1971	1972	1973	1974	1975	1976
Catch (10 <sup>6</sup> )	1959	0.1	0.9							
	1960	8.3	13.3	12.9	4.6	3.8	0.3			
	1961	1.3	3.1	19.3	5.1	0.2	0.1	0.1		
	1962	9.2	6.3	21.7	9.8	9.4	1.4	0.4	0.2	
	1963	14.3	6.8	14.1	11.1	13.5	4.9	0.8	0.4	
	1964	15.3	7.8	15.2	14.1	8.6	7.4	2.0	0.9	
	1965	57.4	26.1	43.6	48.6	37.2	15.3	8.2	3.7	
	1966	99.0	99.9	190.2	234.7	114.2	41.6	26.0	11.8	
	1967	94.5	189.9	408.9	566.2	432.7	217.1	116.1	52.8	
	1968	2.2	139.5	34.7	110.7	226.5	182.9	116.0	52.7	
	1969		3.2	143.0	288.7	287.7	261.3	117.3	53.3	
	1970			3.2	101.2	76.3	237.1	103.3	47.0	
	1971				1.1	41.8	356.3	267.7	158.7	
	1972					11.0	95.3	258.1	317.6	
	1973						0.3	101.9	680.5	
1974							5.1	256.5		
Total (10 <sup>6</sup> )		301.6	496.8	906.8	1395.9	1262.9	1421.3	1123.0	1636.1	
Weight (000 t)		80.8	131.8	230.6	373.0	409.7	419.3	336.2	355.1	
Fishing mortality (F)	1959	0.037	0.600							
	1960	0.116	0.308	0.632	0.554	1.636	0.600			
	1961	0.024	0.082	1.213	1.785	0.317	0.290	0.600		
	1962	0.078	0.078	0.468	0.452	1.293	0.772	0.600	0.700	
	1963	0.099	0.069	0.222	0.306	0.864	1.106	0.600	0.700	
	1964	0.091	0.068	0.204	0.332	0.392	0.802	0.600	0.700	
	1965	0.102	0.069	0.174	0.335	0.526	0.486	0.600	0.700	
	1966	0.049	0.071	0.210	0.490	0.536	0.430	0.600	0.700	
	1967	0.015	0.042	0.131	0.302	0.451	0.487	0.600	0.700	
	1968	0.001	0.053	0.019	0.084	0.277	0.425	0.600	0.700	
	1969		0.001	0.058	0.177	0.301	0.557	0.600	0.700	
	1970			0.002	0.089	0.100	0.570	0.600	0.700	
	1971				<0.001	0.024	0.325	0.490	0.700	
	1972					0.005	0.059	0.250	0.630	
	1973						<0.001	(0.036)	0.350	
1974								0.126		
Weighted $\bar{F}$ (age 4+)		0.087	0.087	0.238	0.346	0.408	0.494	0.600	0.700	
Stock size (10 <sup>6</sup> fish)	1959	3.2	2.3							
	1960	87.3	57.6	31.4	12.3	5.3	0.8			
	1961	62.6	45.3	30.9	6.8	0.8	0.5	0.3	0.1	
	1962	141.5	97.0	66.5	30.8	14.5	3.0	1.0	0.4	
	1963	175.8	118.0	81.6	48.4	26.4	8.3	2.0	0.8	
	1964	202.5	136.9	94.8	57.2	30.4	15.2	5.1	2.1	
	1965	680.6	455.1	314.8	196.0	103.9	45.5	20.7	8.4	
	1966	2373.1	1673.4	1154.3	692.9	314.5	136.4	65.7	26.7	
	1967	7398.1	5397.8	3837.0	2493.2	1365.1	644.4	293.5	119.3	
	1968	4175.8	3097.1	2175.1	1582.2	1077.4	605.3	293.2	119.2	
	1969		3942.1	2934.6	2051.6	1273.4	698.5	296.5	120.5	
	1970			1863.0	1370.0	929.1	623.1	261.1	106.2	
	1971				2709.6	2039.9	1475.8	790.2	358.6	
	1972					2609.8	1921.9	1342.2	774.4	
	1973							(3700.0)	(2644.1)	
1974								(2500.0)		
1975								(1632.8)		
Total (10 <sup>6</sup> ) <sup>1</sup>		11124	111081	10721	8542	7180	6179	7071	6781	
Wt (000 t) <sup>1,2</sup>		1330.6	1715.8	1969.2	1871.8	1590.9	1293.0	1153.3	1084.6	
									971.0	

<sup>1</sup> Total number and weight are for age 1+ fish.

<sup>2</sup> Determined using previously-accepted mean weight at age data and adjusted by the procedure described in Redbook 1974, p. 34.

p) Other Finfish (including Argentine) in Subarea 5 and Statistical Area 6 (Res.Doc. 75/65, 70, 74).

The "other finfish" group consists of an aggregation of finfish species for which individual assessments are lacking or are at best available only in preliminary form. A TAC of 125,000 tons was established for this group (argentine excluded) for 1974, based on historical catch data and information from bottom trawl surveys. The 1975 TAC for the group (including argentine) was set at 150,000 tons. Preliminary data for 1974 indicate a total nominal catch of 167,000 tons (including 23,000 tons of argentine). This total is somewhat above the 1964-73 average of 159,000 tons.

Commercial catches of "other finfish" have remained relatively stable in recent years. However, bottom trawl survey data indicate that stocks are declining and that a reduction in TAC may be necessary in the immediate future, although the information available is not judged sufficient to warrant a reduction at the present time. The Subcommittee therefore recommends that the 1976 TAC for "other finfish" (including argentine) remain at 150,000 tons, noting that a reduction may soon be necessary if the declining trend in fishable biomass continues.

q) Squid-Illex in Subareas 2 to 5 and Statistical Area 6 (Res.Doc. 75/27, 58, 60, 61, 64)

Considerable discussion of available research data indicated that, while stock relationships have not been fully elucidated, there appears to be a single stock complex, ranging from SA 2 to 6. There is a northward migrant component which occurs in SA 2 and 4 on a seasonal basis only, probably over-wintering in SA 5 and 6. The species occurs in SA 5 and 6 throughout the year, suggesting that a component of the stock remains resident there.

Preliminary estimates of stock size were made from the results of USSR R/V *Angus* trawl surveys in June 1972, using a systematic coverage of the area from the Scotian Shelf to Southern New England (100,000 tons minimum stock size) and from Polish commercial data (90,000 tons). Analyses of yield-per-recruit and stock/recruitment considerations indicated that removals could be about 50% of the stock biomass. However, there is considerable uncertainty in the estimates of nominal catches in recent years and the subsequent estimation of stock size and also in the parameters used in the analyses. These estimates must be improved if the Subcommittee is to make more meaningful recommendations for the management of the fishery.

In the absence of reliable estimates of stock size and uncertainty as to the catch statistics of recent years, the Subcommittee considered that pre-emptive quotas should be instituted to regulate the orderly development of the fishery, and that TACs should be set for SA 2-4 and SA 5-6 separately so that fishing effort cannot be directed entirely to one or the other component of the stock complex. Recent removals are estimated to have been in the range of 20,000-22,000 tons in SA 5 and 6 and about 10,000 tons in SA 2 to 4. The Subcommittee therefore recommends that pre-emptive 1976 TACs be set at 15,000 tons for SA 2-4 and 30,000 tons for SA 5-6.

r) Squid-Loligo in Subarea 5 and Statistical Area 6 (Res.Doc. 75/44, 60, 61, 64).

The information available for assessment of squid-*Loligo* include: (1) a series of minimum biomass estimates from Japanese commercial data for the fishing seasons 1968/69 to 1973/74 which indicate a stable population in the area; (2) US research survey indices which also indicate no discernible change in abundance in the same period; (3) a virtual population analysis which indicated a stock size of about 88,000 tons at the start (October) of the 1972/73 fishing season; (4) US research survey catch data which indicate a minimum biomass estimate (70,000 tons) in reasonable agreement to the estimate from the virtual population analysis; and (5) yield-per-recruit and stock-recruitment considerations which indicate that removals of 50% of the stock biomass would seem reasonable.

Although there is an urgent need for more accurate estimates of removals of this species and for considerable refinement in the determination of the parameters used in the virtual population analysis and in the yield-per-recruit/stock-recruitment model, these preliminary studies suggest a TAC of 44,000 tons for 1976. This figure compares with an estimated 1974 nominal catch of 34,000 tons. The catch was also close to 30,000 tons in 1973, but lower at about 20,000 tons in 1971 and 1972. Since there appears to be no significant change in stock abundance in recent years, the Subcommittee recommends a 1976 TAC of 44,000 tons, which, if realized in 1976, would represent a 30% increase above the 1974 nominal catch.

s) Second Tier Overall TAC in Subarea 5 and Statistical Area 6 (Res.Doc. 75/18, 65, 68, 70).

At its Special Meeting in Ottawa, Canada, in October 1973, the Commission agreed that the total catch of finfish (except menhaden, billfishes, tunas and large sharks) plus squids should be regulated to an amount that will allow the biomass of stocks in SA 5 and 6 to recover to a level which will produce the maximum sustainable yield.

The Subcommittee reviewed the time series of trends in stock biomass indicated by commercial fishery statistics and by US autumn groundfish surveys, the latter being the surveys which provide the best data series. The catch per unit effort statistics of offshore trawler fleets show no marked decline in recent years, but these are not adjusted for improvements in fishing technique, variation in species sought, or learning in the development of new fisheries which took place during the 1960's. Research vessel surveys provide a series of more comparable results, and these show a progressive decline in total stock abundance. This would be expected in any fishery as the level of exploitation increases, but it is crucial to decide whether or not this has progressed beyond the level of biomass capable of sustaining the MSY. In the context of the Commission agreement, it is also important to decide whether or not the decline in stock abundance has been arrested by regulations implemented by ICNAF in the more recent years.

Previous analyses of this fishery (*Redbook* 1973, Part I) and more recent reviews indicate that the level of exploitation, and hence the decline in stock biomass, did exceed the level associated with the MSY in the early 1970's. Although there will always be some uncertainty concerning the precision of estimates from research surveys for the most recent years, the indications are that biomass continued to decline in 1974 as might be expected since the broad regime of TACs was not implemented until that year. Data are not yet available for the most recent years, and there is no way to judge whether the regulatory regime has yet had an impact on the state of the stocks. In considering the 2nd tier TAC for 1976, the Subcommittee had to assume that the decline in stock abundance continued into 1975. This assumption is justified on the basis of reductions in some of the individual TACs recommended for 1976.

The sum of the recommended TACs for 1976 is about 825,000 tons, 76% of the sum of the TACs in 1974. These reductions in part reflect improved analytical assessments but may reflect a 19% reduction in biomass from 1974 to 1975. Generalized production model interpretations of this mixed fishery indicate an MSY in the region of 1,000,000 tons, but, since this is an overall assessment of all species, the sum of individual species TACs at MSY stock levels would be rather higher. With this in mind, the Subcommittee concluded that, during the period when exploitation exceeded the MSY level, the stock biomass was reduced by at least 20 to 25% below the stock level that would support a catch of 1,000,000 tons at a level of fishing corresponding to the overall MSY. Reduction of fishing activity to the  $F_{MSY}$  on individual stocks is now estimated to yield a summed TAC of 825,000 tons. It follows, therefore, that, if the Commission wishes to follow a policy which will allow the stock to recover to the level associated with the overall MSY and give the corresponding catch, the fishing mortality must be reduced below the level estimated to give 825,000 tons.

The appropriate degree of reduction in fishing mortality below the MSY level is related to the period over which recovery is expected to take place. Other (environmental) things being equal, the larger the reduction below the summed TAC level, the more rapid the recovery will be, although there is likely to be a biological lag of at least 3 years.

The Subcommittee reconsidered evidence of biological interactions between species that could expedite or delay recovery, but it is not yet able to offer any firm advice on this point.

The Subcommittee then reviewed the effect of by-catch in mixed fisheries on the degree of compatibility between individual species quotas. Analyses have shown some significant trends in by-catch ratios of individual national species fisheries, but overall there are no significant trends with time in the by-catch matrix of all countries during the 1970-73 period. Data for any one year would provide an equally satisfactory estimate of by-catch ratios in a future year for fisheries conducted in the same manner as in those years. It is pointed out, however, that regulations recently implemented in SA 5 and 6 should reduce the by-catch ratios for 1974 and subsequent years. Indeed, this is one objective of the fishery regulations.

Application of linear programming techniques to optimize catches within the TAC allocations and by-catch characteristics of each national fishery indicates an overall TAC at about 66% of the summed TACs. If applied to the sum of the TACs recommended for 1976 (825,000), a 2nd tier TAC of about 550,000 tons is implied, but, having in mind the influence of recent regulations, the difficulty of identifying true incidental catches in the reported statistics, and efforts by countries to minimize by-catch, the Subcommittee considered 650,000 tons to be a realistic minimum level for the 2nd tier TAC in 1976, to correct for the by-catch problem.

The Subcommittee noted that the by-catch problem cannot be attributed equally to all species and that STACREM has considered methods of allocation which could recognize the degree of by-catch in different fisheries. Since no absolutely pure directed fishery exists, the Subcommittee concluded that it would be impossible to estimate the degrees of benefit that would be achieved by excluding one or another species from the 2nd tier TAC.

Having considered the points raised, and having in mind that as yet it is not possible to see whether or not the stock biomass as a whole has become stabilized, the Subcommittee concluded

(i) that the 2nd tier TAC should be reduced below 850,000 tons, and (ii) that the reduction need not exceed 200,000 tons (i.e. a 2nd tier TAC of 650,000 tons) to ensure a reduction in fishing mortality and a start towards recovery of the stock biomass.

The Subcommittee then took an estimate of the biomass of the stock at the long-term MSY lever of 4,000,000 tons, and, judging this to have been depleted by 1,000,000 tons (25%) by over-exploitation in 1970-72 (i.e. about 300,000 tons per year for 3-4 years), estimated the period of recovery to the MSY level, assuming (i) that the 2nd tier TAC is maintained, and (ii) that there would be a 3-year lag in biological response. The recovery times are estimated as follows:

2nd tier TAC (000 tons)	Year to recovery including 1976
800	13
750	11
700	9
650	7

The smaller the reduction, the longer will be the time required to recover the deficiency of 1,000,000 tons and the lower will be the probability of achieving a significant improvement. The situation is a direct consequence of over-exploitation in 1969-72.

At the June 1975 Annual Meeting, the Subcommittee took note of a method for judging the likely success of different possible levels of 2nd. tier TAC in achieving the Commission's objective of enabling the total stock biomass to recover (Res. Doc. 75/117). The accuracy of the estimates involved in this overall assessment do not admit a high level of precision in statistical interpretation, but the results of the study confirm that the larger the reduction in the overall TAC the greater the probability of success of the regulation.

#### VIII. THE OVERALL LEVEL OF FISHING IN SUBAREAS 2, 3 AND 4

A Canadian proposal (Comm.Doc. 75/8) requested STACRES to estimate the long-term effect of specified reductions in fishing mortality on the catch and stock size of groundfish resources in Subareas 2, 3 and 4. The Commission is asked to consider reductions in fishing mortality in the range of 20 to 50% below the 1973 level of fishing, while maintaining the Canadian fishery at its 1975 level (of catch), and it is further proposed that the reduction be implemented by control of the amount of fishing by each vessel category and division.

Res.Doc. 75/43 and 75/55 reviewed trends in the various fisheries over the last decade, documenting the statistical evidence from the commercial fisheries of variations in the abundance of the stocks as the level of catch and fishing has changed. As always, the true relationships are obscure, owing to inadequacies in statistical reporting, particularly in the earlier years, by the choice of effort unit used to estimate the changes and by undetected trends in efficiency of the effort unit. The scale of the changes also varied between areas and there have been fluctuations during the period. For example, in terms of catch, the fisheries as a whole were more productive in the late 1960s, owing to relatively good recruitment, and the fishery in Div. 4VWX (excluding silver hake) peaked slightly earlier (1965-66) and maintained a more consistent trend than the fisheries in SA 2 and 3. The decrease in catch and stock abundance at a maintained level of fishing since the productive period (1968-70) may accentuate the changes, but, from a broad view of the fisheries in the three subareas, the catch in 1973 was rather similar (in quantity) to that of the early 1960s. Production models of the total groundfish resource, in fact, indicate that the sum of the species TACs was close to the overall MSY level. However, bearing in mind the changes in efficiency, it is estimated that fishing effort has doubled and the stock abundance declined by one-half in the period 1961-73 (Fig. 4).

Again, taking a broad view, if the level of exploitation was approaching the level associated with the MSY in the early 1960, it certainly passed beyond that level later in the decade. These general relationships suggest that a significant reduction in fishing effort will not reduce the total catch in the long term, but a specific reduction in one year would inevitably cause an immediate loss. The status of particular stocks and the effect upon them of different degrees of reduction (as specified in Comm.Doc. 75/8) are summarized as far as possible in Tables 13 and 14. For some minor stocks, it is impossible to state categorically that they have been fished beyond the MSY level, and for these there is no definitive evidence that a reduction is necessary for conservation reasons. On the other hand, if after an interim period the same catch can be taken with reduced fishing, catch rates will improve and the increase that this implies must be biologically beneficial and reduce the risk to the stock. The Subcommittee is not competent to judge the economic impact of such a change.

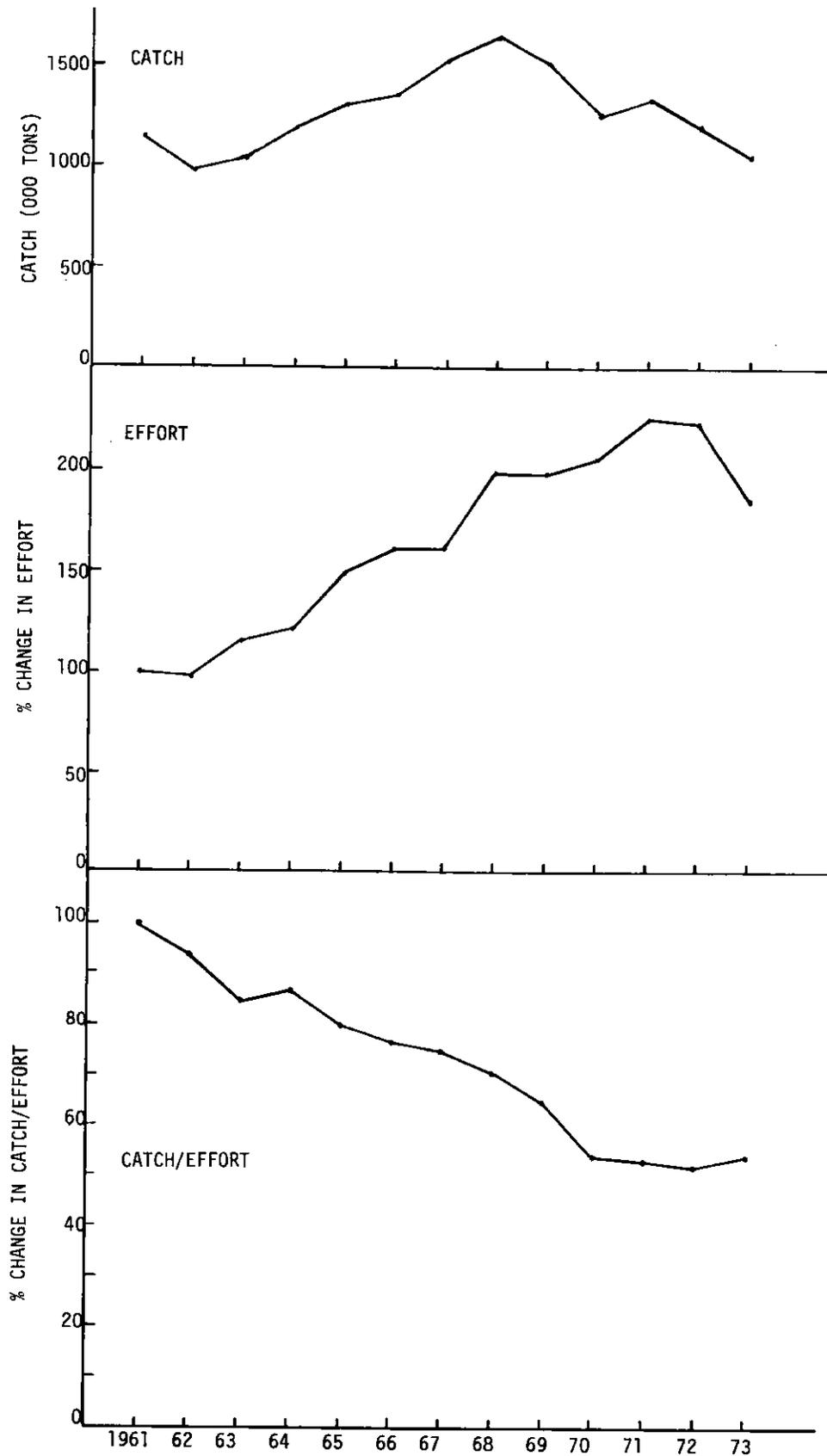


Fig. 4. Changes in catch, effort and catch/effort in SA 2 and 3 and Div. 4V, 4W and 4X, 1961-73.

Table 13. Required reduction in fishing mortality from 1976 TAC level to achieve specified reductions below 1973 level of fishing mortality.

Species	Stock area	Reference levels				% reduction from F76 to achieve			
		FMSY	F0.1	F76	F73	F73-20%	F73-30%	F73-40%	F73-50%
Cod	2J+3KL	0.35	0.20	0.35	0.27	38	46	54	61
	3Ps	0.30	0.15	0.30	0.30	20	30	40	50
	4T+4Vn <sup>1</sup>	0.30	0.20	0.50	0.45	28	36	46	54
	4VsW	0.45	0.30	0.45	0.65	0	0	13	27
	4X(offshore)	0.35	0.25	0.45	0.80	0	0	0	11
American plaice	3LNO	-	0.5 ♂ 0.45♀	0.5 ♂ 0.45♀	0.5 ♂ 0.45♀	20	30	40	50

<sup>1</sup> Div. 4T(Jan-Dec)+Subdiv. 4Vn(Jan-Apr).

Table 14A. Longer term changes in catch and stock size resulting from specified reductions in fishing mortality compared with the catch and stock size at the level of F used as the basis for TAC recommendations (years to equilibrium in parentheses).

Species	Stock area	TAC 1976	Catch at MSY			
		(000 tons)	(000 tons)			
Cod	2J+3KL	300.0	550.0			
	3Ps	60.0	60.0			
	4T+4Vn <sup>1</sup>	45.0	50.0			
	4VsW	40.0	60.0			
	4X(offshore)	4.0	15.0			
American plaice	3LNO	47.0	60.0			
Total		496.0	795.0 <sup>2</sup>			

Species	Stock area	% change in catch (Yr)			
		F73-20%	F73-30%	F73-40%	F73-50%
Cod	2J+3KL	-5(8)	-9(8)	-14(9)	-19(9)
	3Ps	-5(6)	-8(7)	-13(8)	-20(8)
	4T+4Vn <sup>1</sup>	-3(6)	-2(8)	0(9)	0(10)
	4VsW	-2(8)	0(8)	0(9)	0(10)
	4X(offshore)	-7(5)	-5(6)	-2(7)	-1(8)
American plaice	3LNO	-6(6)	-11(6)	-16(7)	-22(7)

Species	Stock area	Stock relative to MSY (=100)			
		F73-20%	F73-30%	F73-40%	F73-50%
Cod	2J+3KL	136(8)	150(8)	166(9)	178(9)
	3Ps	115(6)	124(7)	133(8)	145(8)
	4T+4Vn <sup>1</sup>	78(6)	85(8)	94(9)	106(10)
	4VsW	85(8)	91(8)	100(9)	111(10)
	4X(offshore)	70(5)	77(6)	84(7)	96(8)
American plaice	3LNO	109(6)	115(6)	120(7)	126(7)

<sup>1</sup> Div. 4T(Jan-Dec) + Subdiv. 4Vn(Jan-Apr).

<sup>2</sup> This is approximately equivalent to 60% of the MSY of the total stocks considered in Tables 14A and 14B.

Table 14B 1973 stock status and expected changes in catch and stock (for species lacking analytical assessments) with specified reductions in fishing mortality.

Stock status 1973	Species	Stock	TAC 1976 (000 tons)	Changes in stock and catch at	
				F73-20% to F73-30%	F73-40% to F73-50%
Exploited at slightly less than MSY level	A. plaice	2+3K	0.8	Significant decrease in catch and greatly increased stock size	Under-exploitation of stock
	Witch	2J+3KL	17.0		
		3NO	10.0		
	Pollock	4VWX	(55.0) <sup>1</sup>		
	Argentine	4VWX	25.0		
Exploited around MSY level	Cod	3M	40.0	Some decrease in catch compared with MSY level with increase in stock size	Decrease in catch and significant increase in stock size
		4Vn <sup>2</sup>	10.0		
	A. plaice	3Ps	8.0		
	G. halibut	2+3KL	30.0		
	Redfish	30	16.0		
	R. grenadier	2+3	32.0		
	Flatfishes	4VWX	28.0		
Exploited beyond MSY level	Cod	2GH	20.0	Improvement in stock and catch possibility to MSY level	Improvement in stock and catch probably to MSY level
		3NO	85.0		
	Redfish	2+3K	30.0		
		3LN	20.0		
		3P	20.0		
		4VWX	30.0		
	Haddock	4X	(15.0) <sup>2</sup>		
Overexploited	Yellowtail	3LNO	(10.0) <sup>3</sup>	Increase in stock and catch	Greater increase in stock and catch towards MSY level
	Redfish	3M	16.0		
	Haddock	4VW	0.0		

<sup>1</sup> TAC for Div. 4VWX+SA 5.

<sup>2</sup> Recommended TAC; estimated catch is 15.0 tons.

<sup>3</sup> Recommended maximum TAC.

The widespread reduction in TACs recommended for 1976 in this Report support the need for a cautious approach, and the Subcommittee is aware that the lag in providing information (e.g. 1976 TACs set on the basis of 1974 data reflecting changes in the fishery from 1973) may prevent a sufficiently rapid (adequate) response to secure the management objective.

Table 15 considers the reduction in fishing mortality; it assumes that the Canadian catch in 1976 may remain at the 1975 level and gives the proportionate reduction in fishing by countries other than Canada which would then be necessary to achieve the specified levels. Table 16 provides a basis for interpreting this percentage in terms of the reduction in TAC allocations for 1976. This has necessarily assumed the 1976 TACs would be allocated on the 1975 pattern, but nevertheless, provides a baseline. Assuming that this 1975 pattern applied in 1976, but maintaining the catch by Canada, national allocation for particular degrees of reduction can be obtained by applying the percentage reduction for "Other Countries" in Table 15 to the allocations in Table 16.

Table 17 summarizes the statistics of fishing effort in the reference year 1973. These are given as days fished by country and vessel category, the "days fished" being the unit most widely reported and, following earlier discussions in STACREM, the unit that might be most effective in implementing control of fishing effort.

Table 15. 1976 catches (000 tons) corresponding to reductions in fishing mortality from 1976 level (TACs) to achieve fishing mortality equal to 1973-20%, -30%, -40%, and -50%, but maintaining Canadian share as in 1975. (Illustration only.)

Species	Stock area	F <sub>76</sub>				F <sub>73</sub> -20%				F <sub>73</sub> -30%				
		Catches		% reductions		Catches		% reductions		Catches		% reductions		
		Total	Canadian	Others	Total	Canadian	Others	Total	Canadian	Others	Total	Canadian	Others	
Cod	2J+3KL	300.0	88.0	212.0	186.0	88.0	98.0	38	54	162.0	88.0	74.0	46	65
	3Ps	60.0	35.9	24.1	48.0	35.9	12.1	20	50	42.0	35.9	6.1	30	75
	4T+4Vn <sup>1</sup>	45.0	37.7	7.3	32.4	37.7	0.0	28	100	28.8	37.7	0.0	36	100
	4VsW	40.0	24.3	15.7	40.0	24.3	15.7	0	0	40.0	24.3	15.7	0	0
	4X(offshore)	4.0	3.2	0.8	4.0	3.2	0.8	0	0	4.0	3.2	0.8	0	0
A. plaice	3LNO	47.0	47.0	0.0	37.6	47.0	0.0	20	-	32.9	47.0	0.0	30	-

Species	Stock area	F <sub>73</sub> -40%				F <sub>73</sub> -50%					
		Catches		% reductions		Catches		% reductions			
		Total	Canadian	Others	Total	Canadian	Others	Total	Canadian	Others	
Cod	2J+3KL	138.0	88.0	50.0	54	76	117.0	88.0	29.0	61	86
	3Ps	36.0	35.9	0.1	40	100	30.0	35.9	0.0	50	100
	4T+4Vn <sup>1</sup>	24.3	37.7	0.0	46	100	20.7	37.7	0.0	54	100
	4VsW	34.8	24.3	10.5	13	33	29.2	24.3	4.9	27	69
	4X(offshore)	4.0	3.2	0.8	0	0	3.6	3.2	0.4	11	50
A. plaice	3LNO	28.2	47.0	0.0	40	-	23.5	47.0	0.0	50	-

<sup>1</sup> 4T(Jan-Dec)+4Vn(Jan-Apr).

NOTE: For some stocks and changes in fishing mortality the specified reductions cannot be achieved without some adjustment from the Canadian allocation in 1975.

Table 16. National allocations (000 tons) of 1976 TACs distributed according to the 1975 allocation but maintaining the Canadian share. (Illustration only.)

SPECIES	STOCK AREA	OTHER COUNTRIES														1976 TAC				
		CAN	BUL	DEN	FRA	FRG	GDR	ICE	ITA	JAP	NOR	POL	POR	ROM	SPA		USSR	UK	USA	OTHERS
Cod	2GH	1.0	-	-	0.5	4.0	1.0	-	-	-	0.9	4.5	3.2	0.4	0.5	2.6	0.8	-	6.0	20.0
	2J+3KL	88.0	-	4.0	18.1	18.0	11.3	-	-	-	5.8	16.9	47.9	-	36.3	40.8	6.3	-	6.5	300.0
	3M	3.0	-	7.2	7.0	0.5	-	-	-	-	1.4	0.8	10.4	-	2.2	5.2	2.2	-	0.1	40.0
	3NO	12.7	-	0.8	0.8	-	-	-	-	-	2.0	-	5.3	-	38.2	21.0	1.3	-	2.9	85.0
	3Ps	35.9	-	-	4.4	-	-	-	-	-	1.4	-	-	-	14.1	1.6	-	-	4.0	60.0
	4T+4Vn <sup>1</sup>	37.7	-	0.8	3.9	-	-	-	-	-	-	-	0.4	-	2.0	-	-	-	0.2	45.0
	4Vn <sup>2</sup>	7.8	-	-	0.4	-	-	-	-	-	-	-	0.4	-	0.9	-	-	-	0.5	10.0
	4Vsw	24.25	-	0.5	0.6	-	-	-	-	-	-	-	0.2	-	12.6	1.3	-	-	0.55	40.0
4X(offshore)	3.2	-	-	-	-	-	-	-	-	-	-	-	-	0.49	0.9	-	0.13	0.09	4.0	
Haddock	4VW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
	4X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(15.0) <sup>3</sup>
Redfish	2+3K	3.5	-	-	-	-	2.5	-	-	-	-	4.0	2.5	-	-	12.0	-	0.75	4.75	30.0
	3M	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	12.6	-	-	2.4	16.0
	3LN	1.3	-	-	-	-	1.0	-	-	-	-	-	1.0	-	-	13.8	-	-	2.9	20.0
	3O	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	14.3	-	-	1.2	16.0
	3P	12.5	-	-	-	-	-	-	-	-	-	-	-	-	-	5.3	-	-	1.0	20.0
	4VWX	14.8	-	-	0.74	-	-	-	-	-	-	0.97	-	-	-	4.9	-	7.43	1.1	30.0
Silver hake	4VWX	4.0	-	-	-	-	-	-	-	-	-	-	-	-	89.0	-	-	7.0	100.0	
Pollock	4VWX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(55.0) <sup>4</sup>
A. plaice	2+3K	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	4.2	-	-	0.3	8.0
	3M	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	-	0.5	2.0
	3LNO	47.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47.0
Witch	3Ps	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.0
	2J+3KL	6.6	-	-	-	-	0.4	-	-	-	-	4.6	-	-	-	4.9	-	-	0.5	17.0
	3NO	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	4.9	-	-	0.1	10.0
Yellowtail	3LNO	10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.0
	4VWX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(10.0) <sup>5</sup>
Flounders <sup>6</sup>	4VWX	20.0	-	-	0.2	-	-	-	-	-	-	-	-	-	-	7.0	-	0.3	0.5	28.0
R. grenadier	2+3	-	-	-	-	-	4.0	-	-	-	-	-	-	-	-	24.0	-	-	4.0	32.0
G. halibut	2+3KL	14.0	-	-	-	-	1.8	-	-	-	5.2	-	-	-	-	5.5	-	-	3.5	30.0
Argentine	4VWX	-	-	-	-	-	-	-	-	6.0	-	-	-	-	-	16.5	-	-	2.5	25.0

<sup>1</sup> Div. 4T(Jan-Dec)+4Vn(Jan-Apr).

<sup>2</sup> Subdiv. 4Vn(May-Dec).

<sup>3</sup> Recommended TAC; expected catch is 15.0.

<sup>4</sup> TAC pertains to 4VWX+5.

<sup>5</sup> Maximum; other alternatives are suggested.

<sup>6</sup> American plaice, witch and yellowtail.

Table 17. Subareas 2 and 3 and Divisions 4V, 4W and 4X combined: number of days fished<sup>1</sup> by country and vessel tonnage class in 1973.

Country	Vessel tonnage categories						Total
	0-49.9	50-149.9	150-499.9	500-999.9	1000-1999.9	2000+	
Bulgaria	-	-	-	-	-	3	3
Canada	?	5,114	8,235	9,600	-	-	22,949+
Denmark <sup>2</sup>	-	-	17	64	-	-	81
France	?	-	425	-	977	-	1,402+
FR Germany	-	-	-	-	256	1,166	1,422
German DR	-	-	-	4	805	306	1,115
Iceland	-	-	-	-	-	-	-
Italy	-	-	-	-	-	-	-
Japan	-	-	-	-	25	250	275
Norway <sup>2</sup>	-	-	571	133	73	-	777
Poland	-	-	-	-	72	2,567	2,639
Portugal	-	-	-	682	4,791	1,722	7,195
Romania	-	-	-	-	-	198	198
Spain	-	-	7,436	2,741	810	-	10,987
USSR	-	-	-	269	-	22,341	22,610
UK	-	-	-	24	1,012	-	1,036
USA	-	-	632	-	-	-	632
Total	?	5,114	17,316	13,517	8,821	28,553	73,321+

<sup>1</sup> Effort pertains to catches in which groundfish were caught.

<sup>2</sup> No effort available for 775 tons of groundfish caught by Norway in SA 2, and 4,514 tons by Denmark in Div. 4VWX.

#### IX. OTHER MATTERS

##### 1. Stock and Recruitment (Res.Doc. 75/10, 32, 33)

The uncertainty surrounding the relationship between spawning stock size and subsequent recruitment is one of the major constraints on management advice at the present time, owing to its implication for estimates of MSY catch levels when these are measured in terms of "yield-per-recruit". The Subcommittee discussed a new model of these relationships based on a multivariate synthesis of environmental and biological interactions in the egg, larval and juvenile stages of cod, mackerel, and herring in the Gulf of St. Lawrence. The model provided a satisfactory description of the data on which it was based, indicating a marked density dependent relationship between the biomass of the spawning stock and the number of eggs produced in all three species modulated by environmental effects as measured by temperature. The relationship between the number of eggs and subsequent numbers of larvae showed little density dependence for cod and herring, however, density dependence through competition and predation was extremely important in determining the final numbers of mackerel larvae. The model also implies an interaction between the total biomass of mackerel and herring and the abundance of herring larvae in producing herring year-class strengths. The hypothesis was that this density dependence was predominant at juvenile stage when pelagic biomass was low. At higher pelagic biomasses, predation of adult mackerel on herring larvae was considered an additional component.

The Subcommittee agreed the model is a numerically satisfactory description of the existing information but considered that uncertainties in the data base should be resolved and the time series extended before decisive conclusions can be drawn. Because of the enormous importance of the relationships involved, the Subcommittee expressed the hope that further work would be undertaken to develop the model as soon as possible. This significance is illustrated by one implication of the results presented, that the margin in fishery mortality between a maintained MSY and rapid collapse of a fishery may be very narrow indeed, especially in view of the sensitivity of the system to environmental parameters. As a consequence, it calls for a re-evaluation of larval surveys as an estimator of recruitment, it emphasizes the need for improved experimental design and data analyses, and it reinforces the general need for caution in regard to the permitted level of exploitation. The simulation also suggests potential benefit in management based on stock constraints (e.g. herring in SA 5) rather than mortality constraints, particularly because this might provide control of species interactions at the biological level.

It is clearly necessary for all countries to explore these possibilities with the utmost vigor.

2. Estimation of Parameters

a) New Techniques (Res.Doc. 75/35, 42, 51)

The Subcommittee reviewed briefly descriptions of 3 new developments in technique to improve the speed and precision in estimating parameters used in current assessment models.

b) Level of Sampling in Various Stocks (Summ.Doc. 75/11)

The Subcommittee considered the status of sampling the various stocks and noted the summary of sampling efficiency for the major fisheries in the ICNAF Area in 1973. For many stocks, the level of sampling for country-gear-quarter categories was below the minimum level recommended by STACRES, and for some stocks no sampling data were reported. It was emphasized that the accuracy of the advice provided to the Commission is very heavily dependent on the adequacy of the data base upon which the assessments are based. The Subcommittee urges scientists of the various countries to make every effort to improve the sampling efficiency in future years.

c) Reporting of Length and Age Data by Sex for Certain Species

The Subcommittee noted that some samples for the various flatfish species and for roundnose grenadier were not being reported by sex. It was emphasized that the use of unsexed length measurements and age samples for such species makes their assessment much less precise. Growth rates, mortality rates, age at maturity, etc., are so different for males and females that to combine them for assessment purposes is as meaningless as combining such data for different species. The Subcommittee, therefore, urges scientists in the various countries to provide, if at all possible, length and age data by sex for these species.

d) Recommendation for Ageing Workshop on Subareas 2 and 3 Cod.

Differences in age determination of cod between Canada and Spain in Div. 3NO, as shown by otolith exchanges in 1974, prevented a detailed updating, incorporating 1974 data, being completed for this stock. Also, anomalies in actual landed weight and calculated weight and difference in average lengths at age between countries, which could have been caused by age reading differences, were noted for cod in Div. 2J+3KL. The Subcommittee concluded that these differences were serious enough to warrant a cod ageing workshop in 1975.

The structure and duration of the workshop was discussed and it was decided that at least one week would be required to consider the age reading of cod in Div. 2J+3KL and 3NO in order to resolve the differences that exist. It was felt that limiting the workshop to these two stocks would provide a level of participation that would be small enough to achieve the objective. The Subcommittee therefore recommends (i) that an ageing workshop on Div. 2J+3KL and Div. 3NO cod be conducted in 1975, (ii) that countries fishing those stocks provide otolith samples and participate in the workshop, and (iii) that the participants should include the persons who actually do the age reading.

Although the workshop will focus on cod in Div. 2J+3KL and Div. 3NO, this does not preclude consideration of other cod stocks in SA 2 and 3 where age reading difficulties are suspected. The St. John's (Nfld) Laboratory offered to host the Workshop if the number of participants is not too large for its facilities.

3. Resolution Relating to the Enforcement of the Commission's Fishery Regulations: Implementation of an International Observer Program (Spec.Mtg. of STACTIC, Leningrad, USSR)

The use of an international observer program for the collection of additional scientific information could be of immense value if, and only if, the presence of international observers does not alter the pattern of fishing of the vessels concerned. Such changes, however, are almost inevitable if the data are ever used for enforcement purposes.

The information collected could help to ensure (i) that the assessments incorporate the total catches of each species, (ii) that all of the catches are sampled, (iii) improved estimation of the abundance of young fish, and (iv) better appraisal of the "mixed fishery" problem.

The Subcommittee also considers that the scheme, if given a scientific role, would have to be carried out by officers with the appropriate training to collect adequate sampling data. It was felt that the Subcommittee on Statistics and Sampling should consider this matter and specify the data requirements.



APPENDIX II - REPORT OF BIOLOGICAL SURVEYS SUBCOMMITTEE

Chairman: J. Messtorff

Rapporteurs: J.G. Pope  
J.A. Posgay

The Subcommittee met on three occasions during 8-18 April 1975 at Woods Hole, USA, in conjunction with the spring meeting of the Assessments Subcommittee, to consider a number of items on the STACRES Agenda. The main considerations involved a review of survey activity in the ICNAF Area in 1974 and survey plans for 1975, reporting and processing procedures for survey data, plans for a manual on coordinated groundfish surveys, and a review of hydroacoustic survey techniques.

The Subcommittee also met on two occasions during the 1975 Annual Meeting of STACRES at Aberdeen, Scotland to further consider some matters not finalized at the April Meeting. In particular, these relate to scheduling of the autumn 1975 and spring 1976 herring surveys, assignment of priorities regarding survey work, and plans for drafting the proposed manual on ICNAF Groundfish Surveys. These revisions have been incorporated into this Report.

1. Review of Survey Results Relevant to Assessments

The results of recent surveys relevant to stock assessment were reviewed as follows:

- Groundfish (Res.Doc. 75/15, 18, 26, 45, 48, 62, 63, 65)
- Larval and juvenile herring (Res.Doc. 75/47, 49, 50, 66, 67, 71)
- Capelin (Res.Doc. 75/3, 53)
- Hydroacoustic (Res.Doc. 75/16, 34, 41)

It was noted that survey results relevant to assessments would be considered in detail within the various stock assessment working groups. The general observation was made that survey results could only be considered as firm evidence when a time series of survey catches of a species could be satisfactorily correlated with independent estimates of the biomass. Nevertheless, preliminary results, such as the sharp declines in catches observed for cod in Div. 2J from groundfish surveys conducted by Fed. Rep. Germany and for several species in Subarea 3 from Canadian groundfish surveys, were too important to ignore and should be considered as background information in assessment of these stocks. With regard to the correlation of time series of catches, Mr Cohen (USA) reported that the use of logarithmic transformation of catch data helped to smooth the variability often inherent in such data.

Mr Parsons (Canada) reported that an analysis of day and night catches of redfish from Canadian surveys indicated that a strong diurnal variation in availability occurred. This could cause bias in the results of surveys not designed with this source of variation in mind. It was considered that this point, and others concerning the validity and variance of groundfish surveys, should be incorporated in the manual on survey techniques that is being prepared.

2. Review of Survey Activities in the ICNAF Area in 1974

An inventory of surveys conducted by Member Countries in the various subareas [including Statistical Areas 0 (Baffin Island) and 6] during 1974 and to April 1975 are listed in Table 1. The type of survey is indicated by abbreviations (explained at the bottom of Table 1), followed by the number of hauls, ICNAF divisions and country.

Most of the surveys listed were groundfish surveys. Those conducted by Denmark in Subarea 1 also include shrimp. The survey activity in 1974 remained at about the same level as in 1973. It was noted, however, that an increase of routine groundfish surveys using the existing stratified random schemes would be desirable, especially in the northern part of Subarea 3, in Subarea 2 and in the Baffin Island area.

3. Survey Plans and Coordination for 1975

Surveys already completed in early 1975 are listed at the bottom of Table 1. Planned survey activities of Member Countries are summarized in Table 2.

The provisional schedule for the joint larval herring surveys to be conducted in the autumn of 1975 was set up at the Annual Meeting as follows, subject to confirmation by correspondence with Dr M.D. Grosslein (USA):

R/V <i>Belogorsk</i> (USSR)	- 15 September to 5 October
R/V <i>Wleczno</i> (Poland)	- 15 October to 5 November
R/V <i>Anton Dohrn</i> (Fed.Rep. Germany)	- 26 October to 12 November
R/V <i>Albatross IV</i> (USA)	- December



Table 2. Biological surveys planned in the ICNAF Area in 1975.

Country	Type of survey	Area	Dates
Canada	Groundfish	2J	26 Nov-16 Dec
	"	3LNO	7-22 May
	"	3Ps	28 May-11 Jun
	"	4RST	8-22 Dec
	"	4VWX	15-22 Feb
	"	"	29 Jun-3 Aug
	Capelin	3LNO	20 Jun-2 Jul
	Larval herring	4X	Sep-Nov
-----			
Canada (1976)	Groundfish	4RST	19 Jan-3 Feb
	"	3Ps	29 Mar-14 Apr
	Capelin	3L	9-23 May
-----			
Denmark	Groundfish	1B	Jul
	"	1CD	Jan-Dec
	Shrimp	1AB	May-Oct
	"	1CD	Jan-Dec
	"	1F	Jun
	Plankton	1BC	Jul
	"	1D	Quarterly
-----			
Fed. Rep. Germany	Groundfish	1+East G'land	23 Jul-20 Aug
	"	2J+3K	16 Nov-20 Dec
	Larval herring	5YZ	16 Oct-15 Nov
-----			
France	Groundfish (cod)	3P+4RV	17 Jan-24 Feb
	Herring	3Pn+4TV	19-30 Apr
	Squid	30Ps+4W+5Z+6	3-19 May
	Shellfish	3Ps	27 Oct-10 Nov
	Squid	5Z+6	20 Nov-20 Dec
-----			
German Dem. Rep.	Herring & mackerel	5YZ	Aug-Sep
-----			
Norway	Capelin	3LNO	Jun-Jul
-----			
Poland	Larval herring	4X+5YZ	27 Sep-10 Oct
-----			
USSR	Groundfish (standard stations)	3KP	May-Jul
	" + tagging	0+1+2+3	Jul-Aug
	Capelin	3	May-Jun
	Larval herring	4+5	Sep- ?
-----			
USA	Groundfish	5YZ	16 Apr-2 May
	" (juvenile fish)	5Z	14-23 May
	" ( " " )	5Z	18-22 Aug
	" (US-USSR comp.)	6	2-12 Sep
	"	6	17-30 Sep
	"	5Z	7-23 Oct
	"	5Y	28 Oct-13 Nov
	Larval herring	5YZ	2-19 Dec

In addition to the above schedule, further experiments and survey activities to be conducted in 1975 in conjunction with the larval herring surveys in Subarea 5 have been definitely and/or tentatively planned, e.g. the "Helgoland experiment", UOR (Undulating Oceanographic Recorder) trials, and other activities relevant to recommendations of the Environmental Subcommittee. As those would require additional vessel time, the Subcommittee agreed that the details of these could best be coordinated directly by a "task force leader" to be appointed by the Environmental Subcommittee. It was noted that the US R/V *Delaware* will be available for about 15 days in October to conduct an inshore larval survey in Subarea 5 and other vessels may conduct inshore surveys in September and November. Also Canada plans to conduct larval herring surveys in the Bay of Fundy (Div. 4X) in September to November, the USSR R/V *Belogorsk* may conduct trawl comparison studies with the US R/V *Albatross IV* in Subarea 5 and Statistical Area 6 in September 1975, and the Polish R/V *Wieczno* may be available to participate in the "Helgoland experiment".

The continuation of the juvenile herring surveys in the spring of 1976 was agreed. The participating countries (except German Democratic Republic, not present) confirmed that their vessels would be able to conduct the surveys at about the same times as in 1975 but firm dates for the cruises were not available:

R/V *Wieczno* (Poland)  
R/V *Anton Dohrn* (Fed. Rep. Germany)  
R/V *Ernst Haeckel* (German Dem. Rep.)  
R/V *Albatross IV* (USA)

Concurrent larval herring sampling will form a part of the programs as in previous years.

#### 4. Assignment of Priorities to Survey Programs

At the April 1975 Meeting of the Subcommittee, Dr Edwards (USA) stressed the need for some group within ICNAF to assign priorities to the various survey programs in the ICNAF Area, and indicated that this Subcommittee was probably the most appropriate body to do this. Mr Pope (UK) suggested that the Assessments Subcommittee should be requested to put forward its survey requirements and the rationale behind them. It was agreed that this matter be further considered at the Annual Meeting in June 1975.

At the request of STACRES during the Annual Meeting, the Subcommittee further considered the question of the future assignment of priorities to the various survey programs in the ICNAF Area. Mr R.C. Hennemuth (USA) suggested that the Subcommittee should consider what survey work is required throughout the ICNAF Area and how much research vessel time these various requirements would take, as it may be difficult for some countries to initiate field work except as part of an agreed international program with priorities set by ICNAF. Dr Sahrhage (FRG) pointed out that the execution of surveys recommended by ICNAF was primarily a national problem and that countries would have to consider them within their own overall priorities.

Dr J. Messtorff (FRG) indicated that the existence of time series tends (of itself) to set priorities since there clearly are strong reasons for continuing successful surveys for which a considerable time series have been accumulated. Dr Grosslein (USA) pointed out that there were two types of surveys, those concerned with routine monitoring and those concerned with the evaluation of the underlying mechanisms of fish stocks. The interest shown by various countries in the "Helgoland experiment", for example, suggested considerable interest in this latter type of surveys.

The Subcommittee felt that the assignment of priorities was desirable but that it would require both an input from the Assessments Subcommittee and a great volume of work in considering the precision of the various programs. Some of the estimates of precision would only become available after a reasonable time series had accumulated. Whether or not the Biological Surveys Subcommittee set those priorities was, of course, a question for STACRES to decide.

#### 5. Reporting and Processing of Survey Data

The Subcommittee discussed the desirability of using a standardized format for the recording and processing of survey data. Canada provided examples of forms and punch cards used to record the results of their surveys. It was suggested that those countries that have not yet adopted standard forms should confer with those countries that have, and where possible adopt the same form. Examples of forms will be shown in the survey manual. Some laboratories do not yet have computer facilities to process their survey data and the possibility of using the facilities of the Secretariat was raised. The Assistant Executive Secretary explained that this is not possible at present but, if the funding is approved at the Annual Meeting, the Secretariat expects to install a terminal with access to large computer facility by January 1976. Under these circumstances, some time might be allocated to the processing of survey data. It was noted that the USA now processes all of the data from all countries participating in the juvenile herring surveys. The USA also hopes to compile a complete record of all of the larval herring surveys. It was noted that the USA already has available on magnetic tape the complete results of all joint bottom trawl surveys in Subarea 5 and Statistical Area 6. Dr Edwards stressed that these data may be readily obtained from the USA upon request.

6. Review of Stratification Schemes

A stratification scheme for the Baffin Island area (Statistical Area 0) was presented by Dr Messtorff (FRG). This was approved by the Subcommittee, but it was felt that the scheme might need to be modified in the light of future experience in the area. It was recommended that the stratification should be extended into the adjacent waters of Subarea 1 (Div. 1C and 1D) and Dr Messtorff agreed to do this.

Canadian scientists indicated that some of the strata boundaries in Subarea 3 may be modified.

7. Manual on Coordinated Surveys

The Subcommittee considered an outline of the major elements of trawl survey methods as presented by Dr Heyerdahl (USA) and set up a small working group to draw up a list of contents for the Manual on the basis of Dr Heyerdahl's proposals.

The Subcommittee concurred with the Group's suggestion that the Manual should be concerned only with groundfish surveys. It was indicated that the Manual should serve as a "recipe book" for any country wishing to conduct surveys in the ICNAF Area and not as a general review of survey methods and design. Consequently, the Manual should contain descriptions of current practices and stress the need for consistency rather than innovation. The proposed outline for the Manual is at Annex 1.

It was felt that members of the Subcommittee should have time to consider the proposed outline and a decision on its adoption was deferred until the Annual Meeting in June 1975, at which time an editorial group would be set up and representatives requested to draft the various sections.

At the Annual Meeting, the Subcommittee agreed to the proposed outline for the Manual with the addition of a section on "comparative fishing" under the heading "Standardization", and adopted the procedure of requesting appropriate experts to draft the various sections as follows:

Dr Messtorff (Fed.Rep. Germany)	- Section I, A to F Section II, D and E (for SA 1, 2, and Div. 3K)
Dr Doubleday (Canada)	- Section II, A to C, F
Dr Sahrhage (Fed.Rep. Germany)	- Section IV, B
St. John's Laboratory (Canada)	- Section II, D and E (for SA 3 except Div. 3K) Section V, A
St. Andrews Laboratory (Canada)	- Section II, D and E (for SA 4)
NMFS, Woods Hole (USA)	- Section II, D and E for (SA 5 and 6) Section III, A and B Section IV, A Section VI, B and C Section VII, A and B
ICNAF Secretariat	- Section VI, A Section VI, C.2.c.

The Subcommittee requests that drafts of these sections should be completed and forwarded to the Chairman in advance of the 1976 Annual Meeting, at which time an editorial group will be set up to prepare the final document.

Dr Boerema (FAO) expressed the particular interest of FAO in the Manual.

8. Hydroacoustic Surveys

Mr Shotten (Canada) (Res.Doc. 75/16) described the equipment developed at the Bedford Institute of Oceanography (Canada) for computerized echo-counting and some statistical considerations relative to its use. Mr Sandeman (Canada) reported that the St. John's Laboratory (Canada) is developing an integrator system which should be functional by autumn 1975.

Mr Doubleday (Canada) (Res.Doc. 75/34) described the problems involved in the design of hydroacoustical surveys using zigzag tracks and of analyzing the results. A combined trawl and hydroacoustic survey using the methods he suggests is to be made in the autumn. Capelin surveys made by the USSR (Res.Doc. 75/7) and by Norway (Res.Doc. 75/3, 53) were noted.

Dr Smith (USA) reported that the Fed.Rep. Germany underwater laboratory "Heligoland" would be used by the USA in the autumn of 1975, in collaboration with Fed.Rep. Germany, Poland and USSR, to measure target strength. Further information on this project was given by Dr Cooper (USA) at a lecture arranged by the Woods Hole Laboratory.

Mr Suomala (USA) and Mr Gankov (USSR) reported on the recent joint hydroacoustic cruises of the research vessels *Poisk* (USSR), *Delaware II* (USA), *Ernst Haeckel* (GDR), and *Wieczno* (Poland). A complete body of raw hydroacoustic data is now available along with the appropriate logbooks, charts, catch data, etc., which forms a comprehensive and detailed history of a prototype hydroacoustic survey.

9. Review of Relevant Matters from the Environmental Working Group Report

Mr Sandeman (Canada) reviewed the Report of the Environmental Working Group (Summ.Doc. 75/7). The Environmental Working Group intends to concentrate its attention on the cod stock of Flemish Cap and the herring stock of Georges Bank, with the intention of considering those parameters likely to be of greatest importance in the production of good and poor year-classes of these two stocks. They recommend "that through the Chairmen of the Environmental Working Group and Biological Surveys Subcommittee, the scientists involved in the larval herring program be asked to put a high priority on the analyses of the data available and documentation of their results so that the knowledge gained from these surveys can form a base upon which the Working Group can build".

The attention of members of this Subcommittee was also directed to the recommended hydrographic standard sections proposed in this document. It is hoped that final agreement on standard sections for the ICNAF Area will be reached at the next meeting of the Working Group at Aberdeen in May 1975.

Outline Contents of Manual on ICNAF Groundfish Surveys

- I. Introduction
  - A. Need for survey information<sup>1</sup>
  - B. Historical development of surveys in ICNAF Areas
  - C. Major objectives of a coordinated survey program
  - D. Existing survey manuals
    - 1. FAO
    - 2. National programs - USA, Canada, Fed.Rep. Germany
  - E. Need for ICNAF manual
  - F. Planning of joint international surveys
- II. Survey design and statistical considerations
  - A. Definition of groundfish surveys
    - 1. Random
    - 2. Stratified
    - 3. No searching
  - B. Factors influencing design procedures
    - 1. Diurnal behaviour patterns
    - 2. Seasonal migrations - calendar/environment
    - 3. Habitat preferences - ability to sample
    - 4. Demersal/semi-pelagic/pelagic species differences
    - 5. Age/size variability between species
    - 6. Multi-species/single species
    - 7. Cruise track to be consistent
  - C. Statistical considerations
    - 1. Statistical reliability of estimates-accuracy/precision
    - 2. Measurement of bias
    - 3. Sources of error
  - D. Stratification
    - 1. Pre-stratification: fathoms/meters
    - 2. Bottom type/depth/species distribution/temperature
    - 3. Ice conditions
    - 4. Area overlap of existing stratification schemes
  - E. Physical description of strata
    - 1. Strata charts
    - 2. Areas
    - 3. Strata numbering
  - F. Station selection procedure
    - 1. Randomization technique
- III. General requirements for vessels and trawl gear
  - A. Vessels

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<sup>1</sup> Throughout this outline, "survey" should be taken to mean only groundfish survey.

1. Type: side *vs* stern
2. Precise speed and location control
3. Ability to monitor trawl performance during surveys
4. 24-hour operations/12-hour operations
5. Provision for concurrent sampling programs
  - a) Environmental-hydrography, meteorology
  - b) Plankton
  - c) Biological (maturity, food habits)
6. Long-term availability
7. Ability to carry sufficient staff

B. Trawl gear

1. Selection criteria
  - a) Species caught
  - b) Bottom type
  - c) Desired sampling potential
  - d) Vessel size and long-term availability
2. Standardization of construction and rigging
3. Consistency of gear

IV. Standardization

A. Definition of gear operations for each particular vessel

1. Documentation of performance
2. Speed of tow
3. Trawl scope *vs* depth
4. Time of tow
5. Direction of tow
6. Convention for dealing with untowable bottoms
7. Gear damage decisions and repeat criteria
8. Selection of shooting position

B. Comparative fishing

V. Data collection

A. Trawl station methodology

1. Collection of trawl catch data: multi- *vs* key-species
  - a) Minimum data requirements: weights and numbers and length/sex distribution
  - b) Additional data requirements: biological samples for ageing
  - c) Sample size/sub-sampling samples
  - d) Need for standardized log forms/assigned area
  - e) Sampling conventions: length, weight, scales, otoliths
2. Collection of trawl station data
  - a) Position/depth
  - b) Weather conditions
  - c) Time: ships/local/GMT
  - d) Tow direction/duration
  - e) Trawl performance criteria
  - f) Bottom type and condition of gear
3. Concurrent sampling programs
  - a) Environmental-hydrography, meteorology
  - b) Plankton
  - c) Biological (maturity, food habits)
  - d) Need for standardized log forms (op-scan)

## VI. Data analysis

- A. Need for automatic data processing facilities
  - 1. Central ICNAF data bank
  - 2. International data exchange
  - 3. Requirements of Assessments Subcommittee for timely summaries
- B. Data processing procedures
  - 1. Standard form, if possible
  - 2. Need for standard codes
  - 3. Need for standard data format
  - 4. Data recording through optical scanning
  - 5. Verification and checking procedures
- C. Data summaries
  - 1. Standardization procedures and program parameter requirements
    - a) Area/volume swept by trawl
    - b) Stratum area
    - c) Weighting coefficients
    - d) Data transformations, i.e. logarithms
    - e) Catchability coefficients (q)
    - f) Tests of significance - estimates of variability
  - 2. Biological statistics
    - a) Numbers-weights per tow/strata/area
      - i) Pre/post-recruitment definitions
      - ii) Individual species - total community
      - iii) Length frequencies
      - iv) Biological samples - food habits, maturity
    - b) Standard program requirements
      - i) Population abundance trends
      - ii) Species/community biomass
      - iii) Age frequencies
      - iv) Year-class strength
      - v) Growth/mortality rates
      - vi) Seasonal changes in distribution
      - vii) Other
    - c) Standard procedures for reporting to ICNAF
      - i) Assessments Subcommittee requests
      - ii) Timely data submission and distribution

## VII. Validation of survey results

- A. Correlation with independent estimates
- B. Comparison with commercial CPUE



APPENDIX III - REPORT OF STATISTICS AND SAMPLING SUBCOMMITTEE

Chairman: Sv. Aa. Horsted

Rapporteur: L.P.D. Gertenbach

The Subcommittee met on 5 and 7 June 1975 to consider and report on matters referred to it by STACRES (see Part C for Agenda), including comments on the proposed international observer program (Summ. Doc. 75/9, page 25). The following documents were reviewed in relation to the various agenda items: Summ. Doc. 75/11, 14, 18, 20, 21, 32, 33, 34, 35, 37; and Res. Doc. 75/11, 12, 17, 20, 35, 36, 54, 99, 105.

1. ICNAF Statistical Activities during 1974/75

The Assistant Executive Secretary presented his report (Summ. Doc. 75/35), and he reiterated the difficulties experienced as a result of some countries failing to meet the agreed deadlines for submitting (a) advance monthly catch statistics (for assessments), (b) annual nominal catch statistics by species and division on STATLANT 21A (for Annual Meeting), and (c) detailed catch and effort statistics on STATLANT 21B (for Statistical Bulletin). The Subcommittee noted with concern that these delays caused serious gaps in tabulations which are prepared at the Secretariat for the use of various subcommittees and working groups and for scientists designated to do preparatory work prior to the meetings of these groups. The Subcommittee accordingly

recommends (10)

*that the Commission reiterate its request to all Member Countries to make provision for the timely submission of statistical reports and to ensure that all such materials are dispatched in clearly marked airmail envelopes.*

2. CWP Activities Relevant to ICNAF

The Secretary of the CWP (Mr. L.P.D. Gertenbach) presented the Report of the Eighth Session of the Coordinating Working Party on Atlantic Fishery Statistics held in Paris, France, during 12-20 September 1974 (Summ. Doc. 75/21). ICNAF was represented at that session by Mr. V.M. Hodder (Assistant Executive Secretary), Mr. Sv.Aa. Horsted (Chairman of Statistics and Sampling Subcommittee) and Mr. R.A. Hall (USA), with Dr. E.G. Heyerdahl (USA) as observer.

Matters reported on by the CWP, which are of direct and immediate concern to ICNAF, have been extracted and summarized in Summ. Doc. 75/14. The Subcommittee decided to consider these matters under the appropriate agenda items.

The Subcommittee noted the intention to organize the Ninth Session of the CWP at a convenient time during the biennium 1976-77, possibly at ICNAF Headquarters in Dartmouth, Canada.

3. Statistical Activities of Other Agencies

The Subcommittee's attention was drawn to the detailed reports on the statistical activities of not only ICNAF but also of FAO, ICES, ICSEAF and ICCAT, which are given in the Report of the Eighth Session of the CWP (Summ. Doc. 75/21).

The Subcommittee also reviewed Summ. Doc. 75/34, which presents extracts of resolutions, passed at the 62nd. Statutory Meeting of ICES, relevant to the statistical activities of ICNAF. It was noted that ICES had an opportunity to review the draft version of the Report of the 8th. Session of the CWP, and some of the ICES resolutions relate to matters in the CWP Report.

4. The ICNAF Statistical Bulletin

- a) The Subcommittee noted with satisfaction that Vol. 23 for 1973 was issued in January 1975 but regretted that the late arrival of STATLANT 21B from one country prevented the earlier release of that volume. It was stressed that all countries should endeavour to dispatch their submissions promptly by airmail in accordance with the deadline.
- b) The Subcommittee considered the proposal of the CWP to introduce as a matter of great urgency a standardized set of abbreviations for fishing gear categories, based on FAO's ISSCFG (8th. CWP Report, Appendix 5). These are intended for use not only by FAO and its regional fishery agencies but also by all other regional bodies. It was noted that ICES, at its 1974 Annual Meeting, has already decided to adopt the new inter-agency abbreviations. Noting the usefulness of such standardized abbreviations in regional and international statistical publications, the Subcommittee

recommends (11)

- i) that the new inter-agency version of gear abbreviations, as formulated by the CWP, be used in all future ICNAF documents and publications; and
- ii) that the CWP Secretary inform FAO, ICES, ICCAT and ICSEAF about ICNAF's decision to adopt the CWP version, with the request that the list of abbreviations be extended to include

GN for "Gillnets (not specified)",  
FIX for "Traps (not specified)", and  
MIS for "Miscellaneous gears".

The Subcommittee noted that the gear classification and the inter-agency standard abbreviations do not provide for a distinction between side trawlers and stern trawlers and considered that this distinction should be retained in ICNAF tabulations. The Secretariat was requested to ensure that catch and effort data of side and stern trawlers separately be retained in ICNAF tabulations. The Subcommittee also advised that there was no need to list "shrimp trawls" as a separate gear category from "otter trawls" as this small-meshed gear can be readily identified in the statistics by means of "main species sought".

- c) The Assistant Executive Secretary informed the meeting that many countries are not yet reporting their squid catches broken down by *Illex* and *Loligo* separately. In view of the necessity to obtain statistics for these species separately for assessment purposes, the Subcommittee

recommends (1)

that Member Countries take steps immediately to collect and report their catch and effort statistics for squids by *Illex* and *Loligo*, and also to provide the Secretariat with estimated breakdowns by species of data for preceding years.

- d) The Subcommittee, on being informed that the 1974 statistics contained data for two species not previously reported, accordingly

recommends (12)

that the Secretariat add "*Tarpon*, *Megalops atlantica*" to the "other fish" group, and "*Jonah crab*, *Cancer borealis*" to the "Invertebrates" group.

- e) The Subcommittee noted that at present the "Invertebrates" group, which recently replaced the former "Shellfish, etc." group, still includes "Seaweeds" as an anomaly, and, to correct this situation,

recommends (13)

that seaweeds be removed from the "Invertebrates" group and listed under a new group heading "Seaweeds".

- f) The Subcommittee reviewed the various differences in common and scientific names of species items between the ICNAF List of Species and the FAO List of Species Items for the Northwest Atlantic (FAO Statistical Area 21). It was agreed that as far as possible there should be full agreement between ICNAF and FAO nomenclature and terminology in view of the expanding use of ADP procedures by ICNAF and FAO in collecting, processing and publishing fishery data. Accordingly, the Subcommittee

recommends (14)

that the Assistant Executive Secretary and the Secretary of the CWP consult and decide on nomenclatural features to ensure agreement on the English and scientific names for the Northwest Atlantic, circulate their findings to Member Countries, and submit a joint report to the 1976 Annual Meeting.

##### 5. Advance Monthly Statistics for Assessments

The requirement for Member Countries to report advance nominal catch statistics (broken down by month) for TAC species was adopted by STACRES at the 1973 Annual Meeting. Attempts by the Secretariat, through Circular Letters, to obtain these data for circulation to assessment scientists well in advance of the Meetings of the Assessments Subcommittee in May 1974 and again in April 1975 were not very successful, in that a small number of countries with significant fisheries in the ICNAF Area failed to comply with the requests to provide the data in advance of the meetings.

The Subcommittee also noted that the Commission itself has introduced a monthly reporting system for the nominal catches of all TAC species by stock areas, and countries are required to report these

data to the Secretariat within 30 days following the calendar month in which the catches were made. These data could be utilized for stock assessments early in the following calendar year provided that the catch figures are properly revised and broken down by ICNAF divisions (or subdivisions, where necessary) and also by major gear categories if possible. Having considered these recent developments in statistical reporting, the Subcommittee

recommends (2)

- i) that the Secretariat at the end of the calendar year compile the data obtained from the monthly submissions for as many months as are available for each country and forward the appropriate tabulations to both scientists and national statistical offices for updating, with the request that the revised data be broken down by ICNAF divisions and/or subdivisions and also, where possible, by major gear categories; and*
- ii) that the revised data be airmailed to reach the Secretariat, with copies of relevant information to designated assessment scientists, at least two months prior to the start of the Assessments Subcommittee Meeting.*

6 Statistics on discards

The Assistant Executive Secretary referred the Subcommittee to the form designed for use by Member Countries in reporting by the 30 June deadline the statistics on discards by gear, tonnage class and division for selected species. He indicated that only a few countries had supplied the information for 1973 and the incompleteness of the data precluded the inclusion of suitable tables on discard statistics in the Statistical Bulletin, as suggested at the 1974 Annual Meeting. Noting the difficulties in obtaining data on discards with a satisfactory breakdown by species, the Subcommittee

recommends (3)

- i) that all available data on discards be presented annually in a Summary Document; and*
- ii) that the Secretariat contact Member Countries with a view to improving the collection and reporting of statistics on discards by species, especially for TAC species.*

The Subcommittee also considered the possibility of obtaining data on discards through a proposed international observer program (see Item 16 below).

7. Adequacy of National Reporting on STATLANT A and B Forms

The Subcommittee, while welcoming the availability of the 1974 provisional nominal catch data by species and division (Summ. Doc. 75/32) in the format of Tables 1, 2 and 3 of Statistical Bulletin, regretted that the failure of four countries to submit STATLANT 21A data prior to the Annual Meeting prevented the tabulations from being complete.

The Assistant Executive Secretary reported that some countries are still reporting their catch and effort data by the now defunct tonnage classes and gear categories, and the Subcommittee accordingly

recommends (15)

- i) that the Secretariat once again remind all countries that they should conform to the gear and tonnage categories adopted at the 1972 Annual Meeting as reflected in the notes for completing the STATLANT 21B forms, and*
- ii) that the Secretariat urge countries to improve their breakdown of catches by division (or sub-division) instead of reporting appreciable quantities under "Division (NK)".*

8. Review of STATLANT Forms

- a) The Subcommittee noted that FAO intends to issue the new STATLANT A forms, including 21A, as computer-printed sheets to be completed by national offices. After reviewing a draft version of the 21A form, the Subcommittee

recommends (16)

- i) that the Assistant Executive Secretary and the Secretary of the CWP redesign the STATLANT 21A form, where necessary, to conform with ICNAF requirements; and*
- ii) that the Secretary of the CWP introduce the new version of the form early in 1976 when requesting 1975 data.*

- b) The Subcommittee also reviewed the draft STATLANT 21B form, developed in the light of CWP recommendations to increase the usefulness of this form for automatic data-processing while generally retaining the lay-out currently used. The new form was designed to deal with not only the present degree of details required but also any future requirements for more detailed reporting, such as by small unit areas and twice-monthly time periods. The Subcommittee noted that the draft version required minor modifications and accordingly

recommends (17)

- i) *that the Assistant Executive Secretary and the Secretary of the CWP revise the draft version of the STATLANT 21B form to conform with ICNAF requirements; and*
- ii) *that the Secretary of the CWP revise the notes for completion of the new 21B, and introduce the new form with its accompanying notes early in 1976 when requesting catch and effort data for 1975.*
- c) With regard to the effort concept "days on ground", even though more refined effort measures are not used, the Subcommittee

recommends (18)

*that provision be made on the new STATLANT 21B and in the notes for its completion for retaining the effort unit "days on grounds".*

- d) The CWP Secretary referred the Subcommittee to the proposals for fishing effort measures by gear categories, as presented in detail in the Report of the 8th. Session of the CWP (Appendix 7). It was noted that the Assistant Executive Secretary had extracted from this detailed list the gear and effort elements of concern to ICNAF (Summ. Doc. 75/14). The Subcommittee accordingly

recommends (19)

*that the CWP Secretary use the new listing of gear and effort elements in the revised notes for the completion of STATLANT 21B forms.*

9. Effort Concept "Days on Ground"

The Subcommittee noted that the CWP, at the request of the Commission, had reviewed the effort concept "days on ground" (Report of 8th. Session of CWP) and concluded that the current definition is adequately expressed as "the number of days (24-hour periods, reckoned from midnight to midnight) in which the craft was on the fishing ground, and includes in addition the days fishing and searching and all other days while the craft was on the ground". The CWP, however, suggested that each regional commission should define the words "fishing ground" within its own management regime when attempting to collect these effort statistics for management purposes.

10. Early Requirement for Sampling Data

The Subcommittee noted with satisfaction that Institutes responded promptly to the request for advance sampling data for TAC species with the result that most of the available data for 1974 were in the hands of designated assessment scientists well in advance of the April 1975 Meeting of the Assessment Subcommittee. It was agreed that the same arrangement be followed in soliciting the 1975 data for the 1976 Assessment Subcommittee Meeting.

11. Review of Sampling Yearbook

Although a recommendation of the 1974 Annual Meeting requested that lists of sampling data for 1973, be published in Redbook 1974, the Subcommittee endorsed the action taken by the Secretariat in issuing the lists as Sampling Yearbook Vol. 18, since the delay by some countries in submitting their revised data would have significantly delayed the publication of Redbook. In view of this, the Subcommittee

recommends (20)

*that the annual lists of sampling data continue to be issued as a volume of Sampling Yearbook.*

12. Review of Sampling Forms and Requirements

- a) The various sampling forms currently in use were reviewed. The Subcommittee was informed that some countries still fail to supply the number of samples relevant to the length and age data contained on the submitted forms. There was some discussion on the proper length to be measured for the individual (i.e. fork length, total length, etc.). In the light of the evidence

that the method of measuring differs among countries for the different species, it was strongly emphasized that information on sampling methods as well as on the method of measuring be reported by countries in their notes to sampling data. In order to ensure that the measuring method is recorded for all samples, the Subcommittee

recommends (21)

*that the Secretariat redesign the sampling forms to provide for an entry for reporting the length measurement (fork length, total length, etc.) appropriate to the sampling data reported on the form.*

- b) The Subcommittee, noting the need for uniformity in measuring mackerel,

recommends (22)

*that length frequencies and age/length keys reported for mackerel be based on measuring the fork length to the centimeter below.*

- c) The Subcommittee was concerned that some of the sampling data for flatfish are not provided by sex as required, and that such data was not very useful for stock assessments. Member Countries are urged to comply as closely as possible to the sampling requirements for flatfishes as adopted at the 1974 Annual Meeting (Redbook 1974, page 128).
- d) The Subcommittee noted the difficulties in ageing silver hake and encouraged the continuation of validation studies and analyses like those described in Res. Doc. 75/99. Because of the relatively few age-groups in recent silver hake catches, the Subcommittee

recommends (23)

- i) that silver hake be reported in 1-cm length groups and also by sex, if possible, and*
- ii) that silver hake length frequencies not reported by sex should be supported by age-length keys for males and females separately.*

13. Adequacy of Sampling and Other Statistical Studies

The Subcommittee noted the review of the adequacy of national sampling programs, prepared by the Secretariat (Summ. Doc. 75/11), in which the level of sampling in 1973 is compared with those in 1969 and 1970, and also the concern of the Assessments Subcommittee that many stocks are inadequately sampled or not sampled at all. Although the supply of sampling data has been improving in recent years, it nevertheless remains below the required levels for many stocks. The Subcommittee emphasizes that the current deficiencies should again be stressed by the Commission.

Several research papers (Res. Doc. 75/11, 12, 17, 20, 54, 99 and 105) dealing with sampling problems were presented to the Subcommittee this year. Three of the papers described actual sampling situations and provided estimated variances of numbers at age. In each of these cases the sample size required to obtain the target of estimating numbers at age with a coefficient of variation of not more than 10% considerably exceeded the ICNAF minimum requirement of one sample for each 1,000 tons of fish per division, quarter and gear. Four studies dealt with particular estimation problems as follows: a) the proper estimator for mean size on a random stratified sample; b) the effect of varying strength of adjacent year-classes on estimates of mean size at age; c) the effect of inter-mixture in the fisheries of fish from two or more stocks with different growth rates; and d) the problem of stratification of herring by size in tanks prior to processing. In general, it was concluded from these studies that each sampling situation can present particular problems and considerable effort must be directed towards reducing the biases and increasing the precision as well as determining what they are.

One study described a procedure for estimating age composition by fitting successive normal distribution curves to length frequency samples. The Subcommittee felt that this procedure would be useful in conjunction with age samples to improve the precision of estimated age composition in some cases. The Subcommittee was grateful for these research efforts, and

recommends (24)

- i) that countries continue studies to estimate the precision and accuracy of their biostatistical data and to determine procedures to improve them;*
- ii) that the level of precision of estimation of numbers at age with a coefficient of variation of not more than 10% continue to be the goal in ICNAF;*

- iii) that countries make every effort to meet this goal by reaching and exceeding where necessary the ICNAF minimum sample requirement of one sample for each 1,000 tons caught of each species per division, quarter and gear; and*
- iv) that, considering the problem of errors from inaccurate aging as compounding the sampling difficulties, continued effort should be made for age validation studies.*

It was noted that some of the papers presented had been previously presented at the 1974 ICES Meeting. Although this implies some overlapping and duplication of work, the Subcommittee considers that the need of achieving not only a higher level of sampling but also a better understanding of the problems is a matter so important and urgent that continued discussion of the matter in ICES as well as in ICNAF is necessary and fruitful. Authors of such studies are therefore urged to present their reports for discussion in both bodies.

14. Report on Special Sampling Project

At the 1974 Annual Meeting STACRES recommended that a pilot study based on individual length and age samples for some specific stocks be undertaken to analyse differences in age and length composition and to investigate the practicability of a more adequate data base for assessment. Dr. W.G. Doubleday (Canada) who agreed last year to undertake the analyses and report them to the present meeting did, however, indicate that only four countries had submitted samples and that the material so far received was insufficient for a proper study. The Subcommittee again emphasizes the importance of such a study, reiterates its recommendation from the 1974 Annual Meeting, extended to include material for 1974, and

recommends (25)

- i) that countries, which have not yet reported their individual length and age samples for silver hake in SA 4, 5 and 6 (three stocks), mackerel in SA 3 to 6 (one stock), and cod in Div. 2J+3KL (one stock) for the years 1972 and 1973, forward these data to the Secretariat as soon as possible; and*
- ii) that individual length and age samples for the species and stocks listed in (i) above for the year 1974 be reported to the Secretariat by 31 December 1975.*

15. List of Fishing Vessels for 1974

The Subcommittee reviewed the statistical items appearing in the list of fishing vessels over 50 gross register tons in the ICNAF Area. It was noted that computer-printed lists will now be submitted annually to national reporting offices for updating and revision. The Subcommittee was informed that requests for 1974 data were made in December 1974 with a suggested deadline of 31 January 1975, but only about one-half of the countries had reported prior to the end of May 1975. It is expected that the 1974 List of Fishing Vessels will be issued during the latter part of 1975.

In connection with the information to be provided in the 1974 List, the Secretariat was requested to use the new inter-agency gear abbreviations, if possible. It was suggested that the Secretariat delete the actual names of the gears and the engine while retaining the types of gears and kinds of engines. The Subcommittee also considered the possibility of including under the subarea designations the actual number of days fished in each subarea, but it was noted that this might give rise to legal and other difficulties in many countries. It was decided that the vessel lengths should be given in the nationally used units (metres, feet, etc) and not converted to a common unit.

16. Consideration of the Proposal for an International Observer Program (STACRES Agenda Item 14(e))

Noting the Resolution Relating to the Enforcement of the Commission's Fishery Regulations (Implementation of an International Observer Program) adopted by STACTIC at its Meeting in Leningrad, USSR, March 1975 (Summ. Doc. 75/9, page 25), and having the considerations referred to it by the Assessments Subcommittee, some of the aspects in the proposed program were further considered.

The Subcommittee recognizes that such a program, if initiated, could be of very great value for the work of STACRES, provided that the observers were properly trained. However, in its consideration of this matter the Subcommittee distinguished between two groups of information, viz (a) such information on catch, effort and fishery performance which the fishermen themselves are supposed to be requested to supply, and (b) such additional scientific information which an observer could collect if properly trained.

With respect to (a), the Subcommittee noted that an observer could be of immense value in supplying information which is at present almost completely lacking for most fisheries; this applies especially to catch composition of by-catch and discards by species for the various gears. It was also thought that an observer program would lead to a more general improvement in the statistical reporting on board of the vessels. It was pointed out that, if the presence of an observer changes the pattern

of fishing the vessel concerned, the information obtained would be less valuable, and it was felt that this would likely happen if the data were ever used for enforcement purposes. However, in view of the present lack of information on by-catch and discards, any way of improving the situation should be considered.

With respect to (b), additional scientific information could be acquired by the proper sampling of catches (including fish to be discarded). Several members pointed out, however, that proper sampling requires proper training and insight into sampling theory, and also that in many cases the sampling would conflict with the fishermen's work. Sampling might therefore better be done as special programs independently of the observer program currently being discussed by the Commission.

There was general agreement that a clear distinction should be made between a possible scientific observer program and an observer program initiated to ensure better compliance with fisheries regulations.

17. Importance to Stock Assessment of Incomplete Reporting of By-catch (STACRES Agenda Item 14(c)).

This matter was referred to the Subcommittee by STACRES as a result of the request in Comm. Doc. 75/13. It was noted that for some stocks the precision with which the Assessments Subcommittee is able to recommend TACs is far from satisfactory due to lack of knowledge of by-catch and discards. This applies, for example, to many flounder stocks and also to silver hake (see Report of the Assessment Subcommittee this volume, page 23). The Subcommittee feels that one way of achieving better information on by-catch and discards could be through observers on board of fishing vessels (see 16 above).

18. Acknowledgement

The Subcommittee expressed its appreciation for the great amount of work by the ICNAF Secretariat and by the CWP Secretary in collecting and presenting the steadily increasing volume of fishing statistics and biostatistical data.



APPENDIX IV - REPORT OF AD HOC WORKING GROUP ON FISHING EFFORT STUDIES

Chairman: R.C. Hennemuth

Rapporteur: D.A. MacLean

The Working Group met on 3 June 1975 to consider relevant items referred to it by STACRES. Representatives attended from Canada, Denmark, Federal Republic of Germany, Japan, Norway, Poland, Portugal, Spain, USSR, UK and USA.

1. Review of Available Documentation

The Chairman briefly reviewed the proceedings of previous meetings of the Working Group and called attention to a Polish report concerning "Investigations of fishing power of Polish fishing vessels", a note on mixed fishery problems by J.A. Pope (Res. Doc. 75/119), and several working papers prepared by US scientists.

2. Status of Division 5Z Pilot Study Data Base

The Working Group was informed that four countries had submitted the requested catch and effort statistics: Canada, Japan, Poland and USA. Representatives from USSR indicated that it was very difficult for them to meet the full requirements but that a partial report had recently been sent to the Secretariat.

The Secretariat agreed to prepare the data for computer processing and would make the data available to Member Countries, upon request, either on magnetic tape or computer printout.

Proposed analyses of the Pilot Study Data are outlined in Annex 1. These were designed to elucidate the effects of several factors on catchability which were previously discussed in the Working Group (Fourth Special Commission Meeting, Rome, January 1974, Proc. No. 4). It was pointed out that it was difficult to contemplate the application of the specific analyses without first examining the available data.

3. Other Fishing Effort Studies

- a) The USSR representative briefly reviewed the reports of the ICES Gear and Behaviour Committee's Working Groups which met at Ostends, Belgium in April 1975. It was noted that a manual had been prepared on guidelines for evaluating fishing power by the swept volume method and that copies would be distributed to ICNAF Member Countries later in the year.
- b) Mr. Parrish (UK) noted that FAO's Advisory Committee on Marine Resource Research (ACMRR) will hold a meeting in September 1975 to consider the problems and techniques of using commercial catch per unit effort to measure abundance and fishing mortality. The results of this meeting will be of interest to ICNAF's study of fishing effort.
- c) Canada reported on studies of changes in efficiency that have been in progress. One study showed that the change from bottom trawling to midwater trawling had increased catch per unit effort by a factor of 4 to 5. Other studies related to fitting production curves (Res. Doc. 75/43, 55) provided estimates of increases in efficiency of 2 to 11% per year over the long-term in Subareas 2, 3 and 4 fisheries. The method of analysis does not permit inferences about the causes of variability of such changes. It was noted that some Member Countries have reported catch and effort statistics separately for bottom and midwater trawls since 1973, and that the effect of this change might be estimated by analysing the available data. Several countries indicated that sometimes changes between bottom and midwater trawling occurred frequently during the fishing operations, depending on the area, season and species sought. It was further noted that changes in fishing technology were not generally documented by national offices, particularly those changes involving operational procedures as opposed to specific fishing gear, but that such changes could significantly affect the reported catch per unit effort and the fishing mortality generated per unit of effort. This is particularly a problem with the broader effort measures, e.g. days on ground or days fished, within which such changes are integrated and therefore not measurable.

4. Simulation Study of Effort Regulation

A simulation study of the effort regulation proposed for Subarea 5 by USA in 1973 (ICNAF Meet. Proc. 1973, page 27) was presented (Table 1). The US Commissioners had proposed an overall reduction in fishing effort of 25% from 1971 to 1973. In that proposal, USA, Canada, Romania and Spain were to have no reduction and the effort for the remaining countries were to be reduced by 31% each. This was expressed in terms of fishing days standardized to the US side trawler tonnage class 2 and based on 1971 data.

The simulation study presented the results that might have been expected if that regulation had been in effect for 1973. This was done by assuming that there had been no change in efficiency in the standard vessel class and recomputing relative catchabilities based on 1973 data. Furthermore, it was assumed

Table 1. Simulation of a 1973 effort regulation established from 1971 relative fishing coefficients (FPC = fishing power coefficient; SDF = standard days fished).

Country	Gear-tonnage class	(1)	(2)	(3)=(1)x(2)	(4)	(5)= $\frac{(1)x(4)}{(3)}$	(6)	(7)=(5)x(6)	(8)=(1)x(6)
		1973 actual days fished	1971 FPC <sup>1</sup> (USA OTSI-2)	1973 SDF if no change in efficiency	1973 suggested SDF <sup>2</sup>	1973 suggested actual days fished	1973 FPC <sup>3</sup> (USA OTSI-2)	1973 SDF under simulation	1973 actual SDF
BULGARIA	OTST-7	993	7.68	7626	6704	873	10.76	9383	10685
FRG	OTST-6	134	8.72	1168	1209	138	8.69	1199	1164
	OTST-7	78	8.82	688	712	80	7.29	586	569
	MT-6	112	8.72	977	1011	115	6.93	799	776
	MT-7	535	8.82	4719	4883	551	9.81	5406	5248
			859		7552	7815	884		7990
JAPAN <sup>4</sup>	OTST-6	22104	0.13	2874	2835	21883	0.36	4595	7978
	OTST-7	7462	0.42	3134	3100	7387	0.214	1581	1597
		29566		6008	5935	29270		6176	9575
POLAND	OTST-5	1733	1.57	2720	2424	1560	3.87	6037	6707
	OTST-6	2057	6.92	14234	12683	1851	10.58	19583	21763
	OTST-7	2246	8.29	18619	16732	2021	12.16	24563	27311
		6036		35573	31839	5432		50183	55781
SPAIN	OTSI-6	14	1.68	24	12	7	5.11	36	72
	OTST-5	2024	1.68	3400	1768	1052	1.99	2094	4028
	PT-4	233	3.16	736	383	121	3.55	430	827
	PT-5	125	3.16	395	205	65	7.09	461	886
	PT-6	9	3.16	28	15	5	9.10	46	82
		2405		4583	2383 <sup>5</sup>	1250		3065	5895
USSR	OTSI-4	2911	1.32	3843	3320	2515	2.29	5759	6666
	OTSI-5	6333	1.91	12096	10451	5472	2.86	15650	18122
	OTST-7	7630	7.26	55393	47861	6592	11.10	73121	84693
		16874		71332	61632	14580		94580	109481
GDR	OTSI-5	1302	1.72 <sup>6</sup>	2239	1331	774	1.51	1169	1964
	OTSI-6	125	7.82	978	581	74	1.98	147	248
	OTST-7	30	7.31	219	130	18	5.23	94	157
	MT-6	32	1.72	55	33	18	0.85	15	27
	MT-6	977	7.82	7640	4540	581	6.54	3780	6393
	MT-7	1786	7.31	13056	7758	1061	19.05	20212	34016
		4252		24187	14373	2526		25417	42805
CANADA	OTSI-2	9	1.00	9	20	20	0.76	15	7
	OTSI-3	60	1.00	60	136	136	1.03	139	62
	OTSI-4	337	1.09	367	830	762	1.19	914	401
	OTST-3	21	1.00	21	47	47	0.94	46	20
	OTST-4	32	1.00	32	72	72	1.06	76	34
	OTST-5	326	1.83	596	1348	737	3.41	2513	1112
	Other	2194	1.00	2194	4961	4961	1.00	4961	2194
		2979		3279	7414 <sup>5</sup>	6735		8664	3830
ROMANIA	OTST-7	333	4.52	1505	1505 <sup>5</sup>	333	8.92	2970	2970
FRANCE	OTSI-6	85				85	2.23	190	190
	OTST-6	43				43	12.98	558	558
		128				128		748	748
USA	OTSI-2	9841	1.00	9841	9100	9100	1.00	9100	9841
	OTSI-3	12034	1.12	13478	12463	11128	1.37	15245	16543
	OTSI-4	1760	1.44	2534	2343	1627	1.97	3205	3461
	Other	(7520)	1.00	7520	6954	6954	1.00	6954	(7520)
		31155		33373	30860 <sup>5</sup>	28809		34504	37365
TOTAL							243680	286892	

<sup>1</sup> As in Redbook 1973, Part I, page 18.

<sup>2</sup> Meet. Proc. 1973, page 33.

<sup>3</sup> Average ratio of monthly CPUE (gear/tonnage class) to CPUE (US OTSI-2)

<sup>4</sup> Figures relate to "hours fished".

<sup>5</sup> No reduction required - coastal state preference or catch less than 2500 tons in 1971.

<sup>6</sup> Average of gear/tonnage class for all countries.

that each country would have distributed its allowable effort proportionally among its vessel/gear categories as reported in 1973.

The study indicated that the number of standard days fished in 1973 would have amounted to a 43% overrun. Thus, instead of a 25% reduction in fishing effort, the simulation implied that a 7% increase would have occurred. A 47% reduction from the 1971 level would have been required to have achieved the desired 25% reduction in 1973. It was also noted that there were considerable differences in the changes in relative catchabilities among countries, so that the effect on individual countries' catches would have been variable.

During the discussion it was noted that several factors could have influenced these changes, such as possible changes in fishing power of the standard vessel, and shifts to species with differing changes in abundance during the period. It was further noted that the effect on fishing mortality was not necessarily reflected in the simulation. It was suggested that since estimates of F were now available for a number of years for some of the major stocks, the observed changes in fishing activity could be related to the fishing mortality changes.

5. Future Fishing Effort Studies

Since it is anticipated that in the future, fishing effort will probably be directly controlled by some method, it was agreed that the *ad hoc* Working Group should be maintained under STACRES to monitor continuing technical studies and to meet again at the 1976 Annual Meeting to review such studies. The Working Group

agreed (26)

*that Member Countries submit, for the 1976 Annual Meeting, qualitative descriptions (and, if possible, quantitative data) of changes in gear and operating factors that have occurred over the years 1971-75 relative to various fishing vessel types;*

With regard to the Div. 5Z Pilot Study Data, representatives of Canada, UK and USA indicated that they would probably undertake studies of the available data. The Secretariat was requested to provide summaries of the Pilot Study Data as well as printouts of the actual data to countries requesting such data for study.

Mr. Hennemuth (USA) agreed to act as coordinator for any fishing effort studies carried out during the ensuing year, and the Working Group

recommends (27)

*that Member Countries intending to conduct fishing effort studies during the year report their intent to Mr. Hennemuth (USA) and keep him informed of progress made in such studies.*

ANNEX I - PROPOSED ANALYSES FOR EFFORT WORKING GROUP PILOT STUDY DATA

by

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At the June 1974 Annual Meeting, the Working Group on Fishing Effort Studies recommended that methodology for studying the variability of "q", as well as other aspects of fishing procedures elucidated by twice-monthly 30-minute area data, be developed and reviewed by the Group (*Redbook 1974*, page 54). This recommendation provided for the next step toward evaluation of the data requested for the Pilot Study initiated by the STACREM Working Group of Experts on the Practicability of Effort Limitation (ICNAF Meet. Proc. 1974, page 59). The request involved the reporting of catch and effort data by 30-minute unit areas and twice-monthly time periods for at least two years (1971 and 1972) for March, April, September and October for SA 5 and 6, for vessel classes 2 to 7 and for 20 vessels (or the entire fleet, if less than 20 vessels). In accordance with the recommendation, the following analyses are proposed:

1. Calculation of  $a/b$ , where  $a = \frac{\sum_{i=1}^n (\text{catch}_i)}{\sum_{i=1}^n (\text{effort}_i)}$ , and  $b = \frac{1}{n} \sum_{i=1}^n \left( \frac{\text{catch}}{\text{effort}} \right)_i$ , and the correlation coefficients - CPUE *vs* catch and CPUE *vs* effort - separately for the following sets of data: (a) for each bi-monthly period and 30-minute area for each vessel, (b) for each bi-monthly period and 30-minute area over all vessels of a particular country, (c) for each bi-monthly period over all vessels of a particular country and over all 30-minute areas, and (d) over all data within a month and by country. Plots of  $a$  *vs*  $b$  for these sets of data should also be done.

Purpose: To gain insight into fishing procedures and/or stock distributions (random or patchy) within a small area (30-minute square) x time (bi-monthly period) block. To observe an increased ability to detect changes in fishing patterns with a finer breakdown of data.

Additional data requirements: None

Output: Calculations as described.

Shortcomings: The quotient calculated is asymmetrically distributed and has no upper bound, it is consequently difficult to interpret probabilistically.

2. Canonical correlation between two sets of variables,  $X = (x_1, x_2, \dots, x_p)$  and  $Y = (y_1, \dots, y_q)$ , where, for example,

$x_i$  = catch of species  $i$ , where  $i = 1 \dots p$ , when conditions  $Y' = (y_1', y_2', \dots, y_q')$  prevail,

$y_1$  = year

$y_2$  = season

$y_3$  = effort

$y_4$  = stock size or size of dominant year-class of species 1 during year  $y_1$

$y_5$  = stock size or size of dominant year-class of species 2 during  $y_1$

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$y_{p+3}$  = stock size or size of dominant year-class of species  $p$  during year  $y_1$

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$y_q$  = quarter degree square.

Purpose: To determine how well stock size or strength of year-class, gear type, country, 30-minute area, etc., reflect resultant catches (or CPUEs). Such an analysis may indicate the need for including a learning function, or a function correcting for a change in efficiency, in the data. An example of such a problem: to determine the strength of the relationship between herring and mackerel catches, and their respective stock sizes, gear type used, country, etc.

Additional data required: Stock sizes, or size of the dominant year-class of the species considered, with a certain degree of precision.

Output: A correlation coefficient which reflects the strength of the association between the two sets of variables. Also, linear combinations of each set of variables.

$$\begin{aligned} u_1 &= a_{11}x_1 + a_{12}x_2 + \dots + a_{1p}x_p & v_1 &= b_{11}y_1 + b_{12}y_2 + \dots + b_{1q}y_q \\ u_2 &= a_{21}x_1 + a_{22}x_2 + \dots + a_{2p}x_p & v_2 &= b_{21}y_1 + b_{22}y_2 + \dots + b_{2q}y_q \\ &\vdots & &\vdots \\ u_s &= a_{s1}x_1 + a_{s2}x_2 + \dots + a_{sp}x_p & v_s &= b_{s1}y_1 + b_{s2}y_2 + \dots + b_{sq}y_q \end{aligned}$$

where  $s = \min(p, q)$ , and where the sample correlation between  $u_1$  and  $v_1$  is the greatest of all linear combinations of each set of variables, the sample correlation between  $u_2$  and  $v_2$  is the greatest over all linear combinations uncorrelated with  $u_1$  and  $v_1$ , etc. These linear combinations, in particular  $u_1$  and  $v_1$ , reflect the relative importance of each variable to the correlation. Also, they can be used to assess the correlation between new observations of these variables. A test of the hypothesis that there is independence between the two groups of variables, as well as the statistics to test for hypothetical linear combinations of the variables in each set.

Shortcomings: The analysis assumes the observed variables are each from normal distributions. Also, the linear combinations produced are not always interpretable; for example, the results may not indicate that a "general factor", say time (year, bi-monthly period) or technological factors (gear type, country) or biological factors (stock size, season), was responsible for a high catch.

- Multiple covariance analysis, with 30-minute square designation determining group classification. The model hypothesized could be

$$y_{ij1} = x_i + b_{1i}x_{ij} + b_{2i}x_{2i} = b_{3i}x_{ij}x_{2i} + e_{ij1}$$

for a one-way classification with two concomitant variables, and an interaction term. The variable  $y_{ij1}$  could be, for example, catch (or CPUE) of some species, with

$x_i$  = 30-minute square from which catch was taken,

$x_{ij}$  = gear type used in taking the catch,

$x_{2i}$  = time of catch

$x_{ij}x_{2i}$  = interaction term between  $x_{ij}$  and  $x_{2i}$ ;

$e_{ij1}$  = error associated with the  $i$ - $j$ -1 observations, assumed to be  $N(0, \sigma^2)$ .

The model can be easily extended to a  $n$ -concomitant variable case.

Purpose: To ascertain whether the 30-minute square breakdown is helpful in explaining the variability in CPUE. In particular, to determine whether predictive equations of CPUE as dependent on stock size, country, year, bi-monthly period, learning, and related interactions, differ by 30-minute square areas. Also, to determine whether seasonal breakdown of data, or bi-monthly recording, explains significant amounts of the variability in CPUEs.

Additional data requirements: Stock sizes of species caught, or sizes of dominant year-classes, with a certain (known) degree of precision.

Output: If the linear relationships assumed fit the data, and if interactive terms can be included which allow for an adequate estimate of mean square error, differences between predictive equations of CPUE for different 30-minute square areas, can be tested. Also, the relative importance of the independent variables in accounting for variability in CPUE can be assessed.

Shortcomings: Lack of knowledge about the distribution of variables may result in an inability to achieve equality of variances of the independent variables, or to achieve linearity, by conventional transformations.

4. Factor analysis, in which the model hypothesized, for the case in which  $p$  responses described by the  $p$  observable random variables are  $(x_1, \dots, x_p)$ , is

$$\begin{aligned}x_1 &= b_{11}y_1 + b_{12}y_2 + \dots + b_{1m}y_m + e_1 \\x_2 &= b_{21}y_1 + b_{22}y_2 + \dots + b_{2m}y_m + e_2 \\&\vdots \\x_p &= b_{p1}y_1 + b_{p2}y_2 + \dots + b_{pm}y_m + e_p.\end{aligned}$$

Here  $y_i = i^{\text{th}}$  common-factor variable,

$b_{ij}$  = coefficient reflecting the importance of the corresponding  $j^{\text{th}}$  factor to the  $i^{\text{th}}$  response,

$e_i = i^{\text{th}}$  error estimate, assumed to be  $N(0, \sigma^2)$

For example, the variables  $x_i$  could be catches (or CPUEs) of  $p'$  species, along with gear type, year, etc., such that  $p$  observable variables are involved.

Purpose: To determine if certain covariance structures between the variables are present in the data. To get an estimate of the sampling variation of the observed variables.

Additional data requirements: As specified in (2) and (3).

Output: The number of factors hypothesized in the model, each assigning a coefficient to the variables by which the importance of that variable to the covariance structure can be delineated. Also, the contribution of each factor to the total variance. A measure of the residual variance.

Shortcomings: The resultant factors may not be meaningful, i.e., they may not relate to a general factor such as "stock changes during the year."

The aforementioned analyses are suggested for the data submitted for the Pilot Study. Additional insight into the causes of variability of CPUE could be gained if analogous data were available for years back to the early sixties, in particular, data of stern trawlers, or at least a random selection of about 20 vessels. These data, submitted to analysis as outlined, could provide documentation of changes in efficiency or learning. In addition to these data, however, known changes in efficiency, estimates of percentage of vessels changing from bottom trawling to pelagic trawling from 1965, any notable changes in the reporting of "days fished" data or any increases in the number of hours fishing per day, and estimates of stock size or size of dominant year-classes during the years, are needed for these analyses. A polling of the Member Countries could be helpful in determining a set of data which would be most appropriate to complete back to the early sixties. This would avoid a lot of unnecessary labor on the part of all.

APPENDIX V - REPORT OF ENVIRONMENTAL SUBCOMMITTEE

Chairman: H.W. Hill

Rapporteur: J.H.A. Martin

The Subcommittee met on 4 June 1975 at Aberdeen, Scotland, to consider the agenda items referred to it from STACRES (see Part C, this volume) and the Report of the Environmental Working Group which met for five days in the preceding week, 26-31 May 1975 (Annex 1). Following its establishment at the 1974 Annual Meeting, the Working Group held preliminary discussions at a meeting in Charlottenlund, Denmark, during 23-25 September 1974 and the report of that meeting is given in Summ. Doc. 75/7. Other documents reviewed by the Subcommittee at this Annual Meeting were Res. Doc. 75/29, 66, 67, 71, 76 to 81, 90 and 96, and Summ. Doc. 75/15, 16, 22, 24, 25, 28, 30, 31 and 43.

1. Review of Environmental Conditions in 1974

a) West Greenland

From January to April and generally down to a depth of 75 m, there was a pronounced cooling on Fyllas Bank and this was particularly evident in March when surface temperatures were below  $-1^{\circ}\text{C}$  and bottom temperatures were below  $2^{\circ}\text{C}$  down to 500 m. From July onwards, the surface water over the bank was generally warmer than in 1973, and in October-November the water temperatures in the 0-200 m layer were  $1.3^{\circ}\text{C}$  warmer than normal. However, in deeper water (200-500 m) water temperatures were generally similar to those of the unusually cold year of 1972.

b) Labrador Shelf to Grand Bank

In the early part of the year water temperatures were generally similar to the long-term means but rather cooler in the spring, particularly in the core of the Labrador Current, and in the summer. The volume of water below  $0^{\circ}\text{C}$  associated with the Labrador Current was generally lower than average, but similar to those encountered on the average in recent years on the Seal Island section in August, whereas in November the temperatures were considerably lower and nearer to those recorded in 1972 but in December they were closer to normal conditions. On the southern and southeastern slopes of the Grand Bank, the temperatures in the 200-500 m layer were also cooler and similar to those of 1972 in April, May and July.

Small negative anomalies of salinity predominated in the Labrador Current on the Labrador Shelf and along the edge of the Grand Bank during the spring and early summer, but a positive anomaly of 0.08‰ was noted in the Labrador Current (0-200 m) on the Seal Island section in July.

The transport of the Labrador Current was lower than normal on the whole between April and August.

On the Flemish Cap a strong inverse correlation between temperature in the 0-50 m layer and abundance of 1-year-old cod in the following spring was reported (Res. Doc. 75/115). Particularly high catches (219 fish per hour of trawling) in 1974 were related to unusually cold temperatures ( $0.86^{\circ}\text{C}$ ) in the spawning area in late April 1973, and it was noted that the early May 1974 temperatures in the 0-50 m layer was higher and would likely be related to a much reduced catch of 1-year-old cod in 1975.

c) Nova Scotian Shelf and Georges Bank

Surface temperatures on Georges Bank decreased from  $14-16^{\circ}\text{C}$  in September to  $12-14^{\circ}\text{C}$  in October and to  $10-13^{\circ}\text{C}$  in November, while bottom temperatures were  $7-16^{\circ}\text{C}$ , depending on depth, in September and dropped by about  $2^{\circ}\text{C}$  in mid-October over the shallower parts of the bank.

The salinity distribution appeared to be fairly typical of that expected both on Georges Bank and the Scotian Shelf during the autumn.

It was noted that there appeared to be discrepancies in the various Research Documents concerning the oceanographic conditions on Georges Bank and how they compared with normal. This illustrated the need for a better coordinated data base so that all available data could be utilized in the analysis of environmental conditions.

d) Ice conditions in 1974

West ice conditions in the area of Baffin Island and polar ice along the West Greenland coast were both reported as being similar to normal. In the Labrador and Newfoundland areas, ice conditions were reported as being very severe, due largely to a continued and persistent easterly wind regime.

2. Continuous Plankton Recorder Results for 1974 (Res. Doc. 75/90)

The spring blooms of phytoplankton and copepods were later than normal in 1974, continuing the trend since 1968. The seasonal cycle of *Calanus finmarchicus* was most unusual in that there were two major peaks of adults in the second half of the year and only one peak of stages I to IV. There has been a general decline in abundance of all copepods except adult *Calanus* and *Euchaeta norvegica* in Subarea 5 since 1961. However, these two species, together with *Euphausiacea*, which has shown an increasing trend, form the major part of the biomass of the area, so that there has not been an overall decrease in zooplankton. Young fish were very scarce for most of the year in most areas and Clupeidae were absent from all samples.

3. Gdynia Plankton Sorting Centre (located at Szczecin, Poland)

Dr Grosslein (USA) reported that the establishment of the Centre was very encouraging. The Centre has moved into a new building, and a staff of twelve has been established, ten of whom were sorters who had begun processing samples from the US MARMAP Program. The initial samples have been completed, and it was hoped to commence processing the backlog of herring larval samples taken with the 0.333 mm mesh. Plans are to sort at least the invertebrate components of these samples back to 1971 and perhaps the complete sort on the ichthyoplankton as well. This would give a complete data set of both, processed at one sorting centre, with standard sorting procedures and quality control. The data could then be fed into the MARMAP Information System to produce standardized reports which would be available to all participants.

Augmentation of the schedule may be possible by increasing the staff in 1975. If this occurs, sorting of the special fine mesh samples taken in 1974/75 might also be possible, giving further insight into the abundance and composition of larval food organisms.

4. Marine Environmental Data Service Report

It was reported that the Marine Environmental Data Service (MEDS) is at present able to accept three kinds of data: (a) physical and chemical data acquired from Nansen casts, (b) STD data, and (c) BT data. The data should be provided in 80-column punch cards or compatible magnetic tape. In terms of format, any one of several is acceptable and these are identified in Summ. Doc. 75/7. Additionally, MEDS is prepared to accept any format agreed by the IODE Working Group of IOC. In this connection it is noted that the GATE (Global Atmospheric Tropical Experiment) format has recently been approved.

Most of the ICNAF data would qualify for submission to the World Data Centre System. MEDS will automatically deliver a copy of the data submitted by ICNAF countries to World Data Centre A, unless otherwise instructed by the country submitting the data.

MEDS, in its role as ICNAF's regional data centre for oceanographic data, is currently preparing several reports; these include (a) monthly summaries of oceanographic stations in the ICNAF Area, 1950-73, (b) oceanographic station positions in the ICNAF Area, 1950-73, and (c) temperature, salinity and sigma-t at station 27 (47°33'N, 52°35'W), 1950-59. In addition to these reports, which will soon be completed, other data summaries are expected to be prepared in the continuing study of variability and base periods. Provision of machine contoured distributions of oceanographic parameters can now be provided.

MEDS is actively attempting to locate all available T/S data for the ICNAF Area. The task, however, is time-consuming and progress has been slow. It is essential to have as complete a data inventory as possible, if meaningful proposals concerning base periods are to be forthcoming. Noting that MEDS will eventually be expected to provide data products for ICNAF annually, the Subcommittee emphasizes the need for the prompt submission of all available data, and accordingly

recommends (4 and 6)

- i) *that a national representative be designated and made responsible for the submission of his country's oceanographic data to MEDS and that the name of the representative, if not yet identified, be communicated to the Secretariat as soon as possible; and*
- ii) *that Member Countries submit their oceanographic data to MEDS<sup>1</sup> within 6 months of collection so that a summary of environmental conditions in the preceding year can be provided to the Subcommittee at the Annual Meeting.*

In considering the types of reports that MEDS may be requested to prepare, the Subcommittee further

recommends (28)

*that the Chairman of the Environmental Working Group liaise with the Task Force Leader for the Georges*

<sup>1</sup> Address: Mr. J.R. Wilson, Marine Environmental Data Service, Marine Services Directorate, Environment Canada, 615 Booth Street, Ottawa, Ontario K1A 0E6, Canada.

*Bank-Gulf of Marine Program and the nominees for the Flemish Cap data analysis to provide an indication of the types of data products which will subsequently be requested of MEDS.*

5. Weather and Ice Reporting by Fishing Vessels

Following a report by the Assistant Executive Secretary suggesting procedures for weather and ice reporting by fishing vessels (Summ. Doc. 75/22), the Subcommittee

recommends (5)

*that the Secretariat contact the national meteorological offices, suggesting that they negotiate with the national fishing industries to select a representative sample of fishing vessels, operating in the area of interest, which should be equipped to a sufficient standard of instrumentation to complete the SHRED (shortened weather report form) report.*

Dr. Sahrhage (FRG) indicated that it could be advantageous for fishing vessel officers to take close-up photographs of ice conditions which could be correlated with remote photography supplied by satellites.

6. Review of Environmental Working Group Reports

The Working Group, chaired by Mr. E.J. Sandeman (Canada), met twice since its establishment at the 1974 Annual Meeting. The full report of the first meeting is contained in Summ. Doc. 75/7 and that of the second meeting is appended to this report as Annex 1.

At the first meeting held in September 1974 at Charlottenlund, Denmark, the Working Group agreed that a combination of the correlation and experimental approaches was desirable and that the most progress could be made in looking at a single fish stock or stock complex in sufficient detail to test hypotheses about causal mechanisms. It was agreed to limit the proposals to an important stock or stock complex of a pelagic species and of a groundfish species. After considerable discussion and recognizing the urgency of making progress, the Group recommended that consideration be given at its next meeting (to be held prior to the 1975 Annual Meeting) to the following proposals:

- (1) Preliminary definition of a research proposal aimed at determining the factors involved in the production of good and poor year-classes in one or more of the herring stocks in the Gulf of Maine-Georges Bank-Southwest Nova Scotia area.
- (2) Consideration of Flemish Cap as an area worthy of special international coordinated study aimed at determining the factors involved in the production of good and poor year-classes of major groundfish stocks in the area.
- (3) Consideration of progress on (i) standardization of oceanographic sections and stations, and (ii) standardization of base periods for anomalies.
- (4) Standard data formats and arrangements for exchange of data.

At the second meeting of the Working Group at Aberdeen, Scotland, during 27-31 May 1975, the above proposals were developed further, resulting in a number of specific recommendations for research activity.

a) Research proposal for herring in Gulf of Maine-Georges Bank-Southwest Nova Scotia area

Three invited review papers and some 20 research documents and working papers were examined. Following acceptance by the Working Group that Georges Bank-Nantucket Shoals herring stock was to a large extent separate from the other herring stocks of the area during the larval and adult phases of the life cycle, the Group agreed to initially proceed under the hypothesis that the relative success of a year-class is determined during the first year of life and that the major thrust of research efforts should be exerted in the Georges Bank-Nantucket Shoals area.

The Group briefly reviewed each stage of the life cycle and the various physical and biological factors which might exert an influence on the determination of relative year-class success in the light of research requirements. Following the review of the present state of knowledge and the possible mechanisms involved in the production of herring year-classes in the area, the Group agreed that there was a need for a clearer definition of the state of knowledge (including available data not yet analyzed) in relation to a conceptual recruitment model, which incorporates a detailed evaluation of the relative payoff in terms of improved understanding of controlling processes as well as predictability for alternative research strategies. A number of specific suggestions were made for revising and augmenting the present field research program, and there was general consensus that a much more comprehensive analysis of the existing data base should be accomplished in the next year.

A broad range of research proposals for the Georges Bank-Gulf of Maine area, both in the biological and physical fields, were generated by the Working Group to fill gaps and test hypotheses. These were discussed by the Subcommittee which, in the following approximate order of priority,

recommends (29)

- i) *that monitoring of larval production should continue at least for the next two years in the Georges Bank-Gulf of Maine area during the first six months of larval life, using standard methods of sampling and consisting of four or five cruises in September to December and two cruises in February and March;*
- ii) *that the spring bottom trawl surveys should be continued to provide estimates of age 2 herring;*
- iii) *that a task force leader be appointed to ensure adequate coordination of the program, and to facilitate a division of labour and ensure proper documentation, where gaps occur, through correspondence with the responsible scientists of participating Member Countries;*
- iv) *that efforts be intensified toward a comprehensive analysis of the available data base;*
- v) *that a concerted effort be made to understand the circulation and diffusive processes above and around the Georges Bank-Nantucket Shoals area;*
- vi) *that a special sampling study to follow an isolated patch of larvae on Georges Bank be attempted in 1975 and/or 1978, in addition to the standard surveys, with a view to identifying the physical processes responsible for larval loss from the system, and providing information on the finer-scale variations in growth mortality, dispersion, feeding and vertical distribution, as the basis for evaluating the feasibility of quantitative estimation of these processes and contributing to a knowledge of sampling errors inherent in the present data base;*
- vii) *that quantitative studies of primary and secondary productivity should be conducted to provide a better basis for relating these phases of organic production to potential fish production; and*
- viii) *that Member Countries encourage further studies on specific problems as outlined under this item in Annex 1.*

Details associated with the development of the above recommendations are given in the Report of the Working Group at Annex 1. In particular, Dr. M.D. Grosslein (USA) volunteered to accept the assignment as Task Force Leader in relation to item (iii) above. With regard to item (v), the Subcommittee welcomed the US plans for a pilot experiment which would not only go a considerable way towards meeting the research proposals but also provide the nucleus of a meaningful international coordinated program of research. With reference to item (viii), both Canadian and USSR representatives indicated the possibility of such projects being included in their national research programs for 1976.

Dr. Stobo (Canada) pointed out that there may be difficulties in attempting to follow a specific larval patch over an extended period. The Subcommittee recognized the difficulties involved but maintained that such a project could and should be attempted using tracer techniques and extensive plankton sampling.

b) Flemish Cap as possible study area for cod and redfish

The Subcommittee reviewed the discussions within the Working Group on the consideration of Flemish Cap as an area worthy of a special international coordinated study aimed at determining the factors involved in the production of good and poor year-classes of the major groundfish stocks in the area. Although there were some reservations as to how well the results and conclusions from an exhaustive study there might be extrapolated to other areas, the Subcommittee endorsed the Working Group's proposal that Flemish Cap was a most suitable area for such a study on cod and redfish, and, noting that there exists a long time series of data available from USSR and US Coast Guard sources, accordingly

recommends (30)

- i) *that an attempt be made to identify relationships between the various currents around Flemish Cap, the water temperature at appropriate depths and any other relevant environmental factors with the year-class strengths of cod and redfish on the bank, and to identify other major gaps which still exist in knowledge of the area as well as research programs needed to fill them; and*

- ii) *that a joint study be carried out by one scientist from each of USSR and North America on the long time series of USSR and US Coast Guard data, and a report presented to the Environmental Subcommittee at the 1976 Annual Meeting.*

Dr. Konstantinov was nominated by USSR, and the Subcommittee requested the Chairman of the Working Group (Mr. E.J. Sandeman) to approach the US Coast Guard representative of the Working Group with a view to his becoming the North American nominee.

c) Standardization of oceanographic sections, stations and base periods

The Subcommittee noted that the Environmental Working Group had thoroughly discussed the matter of standardization both at its September 1974 and May 1975 Meetings and, in adopting the proposals of the Working Group, accordingly

recommends (31)

- i) *that the standard sections listed in the Report of the Environmental Working Group (Section C of Annex 1) be accepted as ICNAF standard oceanographic sections; and*
- ii) *that Mr. Wilson and Dr. Trites (Canada) continue their investigation of base periods, with emphasis on the data base for the recommended standard sections, and circulate the results as soon as possible.*

With regard to (i) above, the Subcommittee noted that oceanographic data for the Georges Bank, Gulf of Maine and Southwest Scotian Shelf areas had not yet been examined in sufficient detail to enable the recommendation of specific sections, but anticipated that these would be developed at the next meeting of the Working Group. Furthermore, the precise locations of many of the stations on the recommended sections have not yet been defined, but Dr. Trites (Canada) agreed to prepare a complete listing of suggested station positions and to circulate them to Member Countries for comment.

With regard to (ii) above, it was noted from preliminary studies by MEDS that a common base period is unlikely to be found for the entire ICNAF Area.

d) Data exchange and standardization

The Subcommittee noted the discussions within the Working Groups on standardization of data formats for exchange of both physical and biological data. While there appears to be no difficulty with the formats for physical environmental data acceptable to MEDS, including the GATE format recently adopted by the IOC Working Committee for International Data Exchange, progress on formatting biological data has been rather slow due to the complexity and range of the data. However, it was noted that IOC has recently approved for use on an experimental basis the ROMBI form for biological data inventory, which supplements the existing ROSCOP form and expands the detail available. In order to provide support for the IOC effort in this regard, the Subcommittee accordingly

recommends (32)

*that Member Countries of ICNAF should encourage the use of the ROMBI forms on an experimental basis to supplement the existing ROSCOP forms and report on the feasibility of adopting these for routine reporting.*

7. Status of ICNAF Special Publications No. 9 and 10

The Executive Secretary reported that Special Publication No. 9, containing four papers on ice conditions and forecasting techniques which were presented to the Environmental Subcommittee in May 1973, is expected to be ready for distribution in August 1975. He also indicated that Special Publication No. 10, containing twelve contributions to the ICNAF Symposium on Environmental Conditions in the Newfoundland-Grand Bank Area in 1972 and their Effects on Fishery Trends, May 1974, is expected to be ready in October 1975.

8. Other Matters

- a) With reference to the Georges Bank-Gulf of Maine experiment, Dr. Stobo (Canada) emphasized the importance of selectivity studies and the inter-calibration of plankton sampling equipment, and it was agreed that Mr. Sandeman should take this into account in subsequent meetings of his Working Group.
- b) There was further discussion on the need to ensure the participation of workers, who are actively engaged in relevant research projects, at future Working Group Meetings, and the Subcommittee therefore

recommends (33)

*that all Member Countries be encouraged to ensure appropriate representation at the working level at subsequent meetings of the Environmental Working Group.*

- c) The Chairman expressed the thanks of the Subcommittee to Mr. Sandeman and his Working Group for the considerable amount of work that had been accomplished during the year since the 1974 Annual Meeting.

9. Future Meetings

In anticipation of considerable progress during 1975/76 in relation to the availability of a much better data base, the Subcommittee

recommends (34)

*that the Environmental Working Group should meet prior to the 1976 Annual Meeting of STACRES to review progress and report to the next meeting of the Environmental Subcommittee.*

ANNEX I - REPORT OF SECOND MEETING OF ENVIRONMENTAL WORKING GROUP

Chairman: E.J. Sandeman

The Environmental Working Group was established, following a recommendation of the 1974 Annual Meeting (*Redbook* 1974, page 72), "to suggest a proposal aimed at determining the factors involved in the production of good and poor year-classes in some of the major fisheries of the ICNAF Area". The first meeting of the Group was held at Charlottenlund, Denmark, 23-25 September 1974, during which proposals were made for the study of herring stocks in the Gulf of Maine-Georges Bank area and cod on Flemish Cap in so far as they relate to the terms of reference of the Group. The second meeting of the Working Group was held at Aberdeen, Scotland during 27-31 May 1975 to further consider these proposals and also to consider such matters as standardization of oceanographic sections, stations and base periods, and standardized formats for exchange of environmental data. Representatives attended from Canada, Denmark, Federal Republic of Germany, Union of Soviet Socialist Republics, United Kingdom, and United States of America, and an observer from Cuba.

A. Preliminary Definition of a Research Proposal Aimed at Determining the Factors Involved in the Production of Good and Poor Year-classes in One or More of the Herring Stocks of the Gulf of Maine-Georges Bank-Southwest Nova Scotia Area.

1) Consideration of available data base

The Working Group reviewed the data base of herring in the area under consideration as well as the more important features of the physical and biological environment likely to influence year-class success and failure. In this respect the Group records its appreciation and gratitude to the authors of the 3 basic review papers: (i) review of the physical oceanography of Georges Bank, by Dean F. Bumpus (Res. Doc. 75/107); (ii) an overview of the plankton communities of the Gulf of Maine, by E.B. Cohen (Res. Doc. 75/106); and (iii) a conceptual model of stocks of herring (*Clupea harengus*) in the Gulf of Maine, by G.J. Ridgeway (Res. Doc. 75/100). The highlights of these and other contributed papers are given in Attachment 1.

Following acceptance of the view that the Georges Bank-Nantucket Shoals herring stock was to a large extent separate from the other herring stocks of the area during the larval and adult phases of the life history, and for reasons of logistic constraints, the Working Group agreed to initially proceed under the hypothesis that the relative success of a year-class is determined during the first year of life and that the major thrust of research efforts should be exerted in the Georges Bank-Nantucket Shoals area.

It was noted that in the Research Documents a conceptual model of the stock-ecosystem dynamics of herring in the area had been presented and that preferably a prerequisite to any formulation of a research program was a preliminary application of a model to determine the sensitivity of the various input parameters. However, as this cannot be done at this time, the Group agreed that it would be useful to briefly examine each stage of the life cycle and the various physical and biotic factors which might exert an influence on the determination of relative year-class success and to attempt to prioritise these relative to possible research requirements.

a) Parent stock and pre-spawning processes

The Working Group noted that the larval surveys and the operations of the fleets had provided a reasonable knowledge of the location of the main spawning concentrations as well as the timing and duration of spawning. However, it was clear that only very general information is available at present on the relation between the spawning stock and egg production and no information on possible relationships between fecundity and age-length characteristics with respect to stock biomass. The Group recognized the desirability of filling some of these data gaps and suggested that for the present it is probably sufficient to utilize material which could be available from the commercial fisheries as well as the present research vessel surveys.

b) Spawning and the egg stage

The Working Group noted that there were several rather serious gaps in the knowledge of this stage of the life history and that it was desirable to acquire further data on egg mortality in relation to egg size, quality and predation, as well as on environmental variables. The Group agreed that, for the time being, the acquiring of additional data would have to depend on such special programs as might be available (e.g. the *Helgoland* experiment planned for the autumn of 1975).

It was noted that current plans are for positioning the *Helgoland* Underwater Habitat on a known herring spawning site on Jeffrey's Ledge off Cape Ann, Massachusetts, about 10 September 1975. Five 4-man diving teams are scheduled to occupy the Habitat from 15 September to 18 November, during which time intensive studies will be conducted on the spawning and density distribution of eggs, subsequent egg survival and hatching success. Also, the dispersal of larvae from the site will be monitored, pending availability of a research vessel. Following completion of the herring study (about 15 October), the second phase of the experiment will begin, involving hydroacoustic studies of several species (cod, herring, pollock and dogfish) held captive in underwater corrals. Emphasis will be placed on estimates of target strength of individual fish and aggregations, sound scattering by aggregations, and reactions of fish to sound signals.

c) Larval stage

The principal information available at present on the life history of herring in their first year has been derived from the ICNAF Larval Herring Surveys since 1971. This has included the timing and location of herring spawning in the Gulf of Maine and in the Georges Bank-Nantucket Shoals areas, and, apart from preliminary data for Jeffreys Ledge, gross measures of larval abundance, dispersal, growth and over-winter mortality have been obtained. Virtually no data on the feeding of larvae or the available food organisms have been reported for this period (1971 to present), nor is there any definitive information on predation on larvae or on the primary and secondary production cycles in relation to larval growth. Progress on studies of circulation in the region has been very limited from the standpoint of being able to relate larval drift to the water motion except in a very general way. All of the available oceanographic data have not yet been analyzed, but the data base is clearly not adequate for more than general inferences regarding rates and patterns of flow over Georges Bank.

The major advantage of continuing the larval surveys in their present form is to provide a time series of larval production and over-winter mortality estimates for comparison with subsequent success of year-classes and to determine whether these are correlated. Substantial differences in larval production were apparent in the Georges Bank-Nantucket Shoals area (an order of magnitude greater in 1973 and 1974 compared with 1971 and 1972), and these are presumed to be due to the recruitment of the large 1970 year-class to the spawning stock in 1973 and 1974. However, preliminary pre-recruit estimates based on spring bottom trawl surveys suggest that the 1973 year-class may be weaker than the 1971 and 1972 year-classes. Although it was considered useful to determine whether production and/or over-winter mortality of larvae were related to year-class success, the Working Group questioned whether the survey program in its present form was adequate to achieve this goal except in cases of large fluctuations. Furthermore, it was noted that the present investigation was not adequate by itself to provide insight into processes controlling such factors as growth, mortality and dispersal during the first year of life. Distribution of sampling through time and space is too sparse to permit accurate identification of larval origin or age, and hence growth, mortality and dispersal mechanisms cannot be precisely identified and can only be related in the broad scale to factors which operate over relatively long periods throughout the larval stage. One suggestion was that an intensive one-year study of a single year-class, followed through all of its stages from hatching to its first birthday, would help to fill gaps in knowledge and provide a better chance for identifying controlling mechanisms.

d) Post-metamorphosis and juvenile stages

The distribution and abundance of post-metamorphosis and juvenile stages are documented only very generally. They are known to occur in coastal and estuarine areas as indicated by some inshore survey work and by the juvenile fisheries, and their general offshore distribution (age 2 and older) is known from spring bottom trawl surveys. There are good estimates of growth and some data on mortality and seasonal movements of juvenile herring in unpublished studies of the inshore fisheries in the Gulf of Maine. However, there is little information on feeding migrations and predation for the inshore areas and virtually no information on factors related to growth and mortality of juveniles for the Georges Bank region.

2. Proposed program for 1975/76

Following the review of the present status of knowledge and the possible mechanisms involved in the production of herring year-classes in the area, the Working Group agreed that there was a need for a clearer definition of the state of knowledge (including available data not yet analyzed) in relation to a conceptual recruitment model, which incorporates a detailed evaluation of the relative payoff in terms of improved understanding of controlling processes as well as predictability for alternative research strategies. A number of specific suggestions were made for revising and augmenting the present field research program, and there was general consensus that a much more comprehensive analysis of the existing data base should be accomplished in the next year. These suggestions are summarized in the following recommendations which are listed in approximate order of priority.

a) Monitoring larval production

The Working Group recommends (29(i))

*that monitoring of larval production should be continued at least for the next two years in Georges Bank-Gulf of Maine area during the first six months of larval life, using standard methods of sampling and consisting of 4 or 5 cruises between September and December, one cruise in February and one cruise in March.*

It is noted that the autumn cruises, as tentatively planned, will be conducted by the Federal Republic of Germany, German Democratic Republic, Poland, USSR and USA, and the February and March cruises by USA. During each of the cruises, the sampling intensity should be increased in areas of high larval density, and sampling should be extended over the southern edge of Georges Bank to monitor the slope-front boundaries. If necessary, the sampling in the Gulf of Maine could be curtailed to permit more intensive coverage of the Georges Bank area. Additional effort and revised procedures for the sampling programs should include:

- i) efforts to ensure that larval herring measurements are obtained by a standard method;
- ii) fine mesh samples (0.053 mm) for abundance of larval food organisms;
- iii) complete series of temperature, salinity, oxygen and nutrient profiles;
- iv) estimation of the sampling errors associated with larval production and mortality estimates, and examination of the experimental design of the survey pattern with a view to decreasing the variability of the estimates in both space and time; and
- v) some intercalibration of oceanographic instruments and standardization of techniques, as well as a more complete data exchange in accordance with IOC procedures.

b) Juvenile surveys

The Working Group recommends (29(ii))

*that the spring bottom trawl surveys should be continued to provide estimates of the abundance of age 2 herring.*

The standard US bottom trawl surveys provide the longest time series and therefore represent a valuable link with past stock changes. It is also considered especially important to continue coverage equivalent to that of the *Walther Herwig* at least at the present level of sampling, since this is the only time series with a large commercial trawl. Continued standard sampling by other vessels, particularly *Wieczno* and *Ernst Haeckel*, would be valuable for comparison with results of the 1975 surveys by these vessels. It should be noted that the *Walther Herwig* surveys in March have provided systematic sampling of herring larvae (at night) over the Georges Bank area, and these data thus represent a valuable supplement to the February surveys for the study of over-winter mortality.

Appropriate log transformation techniques should be applied to the analysis of the spring trawl survey base and statistical confidence limits should be estimated for pre-recruit abundance indices. The desirability of an intensified analysis of the available data on predation of 0-group herring by demersal and pelagic fishes was noted.

c) Program coordination

The Working Group recommends (29(iii))

*that a task force leader should be appointed to ensure adequate coordination of the program, and to facilitate a division of labour and ensure proper documentation, where gaps occur, through correspondence with the responsible scientists of participating Member Countries.*

d) Data analyses

The Working Group recommends (29(iv))

*that efforts be intensified toward a comprehensive analysis of the available data base.*

In particular, these efforts should include:

- i) processing of the current backlog of standard larval herring samples (at least 0.333 mm mesh) for invertebrate components, and perhaps the 1975 samples as well for both ichthyoplankton and invertebrates; it is suggested that sorting might be done at the newly

established Sorting Center at Gdynia, Poland, to allow more complete sorting and to facilitate the reporting of results in standard form;

- ii) biological studies by ICNAF scientists on: fine mesh samples from the 1974/75 surveys for abundance of larval food organisms and possible predation, gut contents of larvae from the 1974/75 surveys, gut contents of potential larval predators in the standard Bongo series for 1974/75, and analysis of available data on predation of 0-group herring by demersal and pelagic fishes;
  - iii) transfer of survey time series on larval herring catches to computer format, and a more thorough documentation of the characteristics of a standard data base with respect to production, dispersal, growth, mortality and diurnal variations, and the preparation of charts of basic distribution and abundance of larvae in standard format;
  - iv) documentation of existing hydrographic data base in chart form, which should be specified by the task force leader in consultation with oceanographers and biologists involved in the program; and
  - v) the development of a recruitment model for Georges Bank herring, based on available documentation, for presentation to the next meeting of the Working Group (Mr. P. Lett, Canada, volunteered to undertake this task).
- e) Circulation and diffusive processes

The Working Group recommends (29(v))

*that a concerted effort should be made to understand the circulation and diffusive processes above and around the Georges Bank-Nantucket Shoals area.*

It was felt that as an essential part of this study a model of the area should be developed to provide a better understanding of the residual and tidal current systems. A series of current meter arrays and/or other direct measurements of current (both Lagrangian and Eulerian) are required to provide the associated input and validation data for the model. The Working Group noted and welcomed the US plans for a pilot experiment in the area which would go a considerable way towards meeting these research proposals and also would provide the nucleus of a meaningful international coordinated program of research based on the Group's proposals.

- f) Special study on isolated patch of larvae

The Working Group recommends (29(vi))

*that a special sampling study to follow an isolated patch of larvae on Georges Bank be attempted in 1975 and/or 1976, with a view to identifying the processes responsible for larval loss from the system, and providing information on the finer-scale variations in growth, mortality, dispersion, feeding and vertical distribution, as the basis for evaluating the feasibility of quantitative estimation of these processes and contributing to knowledge of sampling errors inherent in the present data base.*

This study should include recording current meters in the path of the drifting larval patch, as well as drifting buoys and/or dye releases in measure Lagrangian and Eulerian advection and dispersion parameters.

- g) Primary and secondary productivity studies

The Working Group recommends (29(vii))

*that quantitative studies of primary and secondary productivity should be conducted to provide a better basis for relating these phases of organic production to potential fish production.*

From the standpoint of gaining insight into the factors controlling the survival of larval fish, a better understanding of zooplankton dynamics, especially predator-prey interrelations between larval fish and other zooplankton, must be achieved. In addition, the effects of zooplankton on the phytoplankton community (including regeneration of nutrients and grazing) are needed. The effect that various physical factors, such as the loss of water from the Gulf of Maine gyre over Georges Bank and such biological factors as the timing and species composition of the phytoplankton bloom, have on the abundance and life cycles of the zooplankton need to be delineated. Transitional experiments of predator-prey relationships should be carried out in enclosed environments within the natural habitat to bridge the gap between field and laboratory observations.

h) Other specific studies

The Working Group recommends (29(viii))

*that Member Countries encourage further studies on specific problems as outlined below.*

- i) In view of the complexities of diurnal movements, a quantitative description of diurnal distribution of herring larvae will require a coordinated program of intensive field sampling of all length groups of larval herring under different conditions in conjunction with laboratory studies of larval behaviour. These laboratory and field studies should attempt to analyze the phototactic and/or photokinetic behaviour of the larvae at various stages of development as may be modified by extrinsic and intrinsic factors, i.e. temperature, presence of predators and prey, appetite. *In situ* observations of recently hatched larvae should be made by divers. Priority should be given to the acquisition of opening-closing controlled sampling gear with real-time ship-board environmental sensing monitors to investigate the detailed vertical distribution of larvae, their food organisms, and predators.
- ii) Since the size of larvae provide but a crude measure of their age and physiological state of development, an attempt should be made to establish a complete series of larvae of known age in order to explore the possibility of ageing by morphological maturity.
- iii) New ways should be explored for monitoring abundance of phytoplankton and zooplankton with Continuous Plankton Recorders (CPR). Regular CPR sampling from ships of opportunity would provide a valuable supplement to the larval herring surveys by description of major anomalies in primary and secondary production cycles. The Working Group notes that a field trial of a new model of Undulating Oceanographic Recorder (UOR) is planned for October 1975 to coincide with the on-going larval herring survey on Georges Bank. This recorder is designed to provide vertical distribution data on plankton organisms while being towed from ships of opportunity, and it may also prove useful for the ICNAF studies on larval fish. There is the possibility that the *Wiecano* may be available for such an experiment.
- iv) The acquisition of further data on egg mortality in relation to egg size and egg quality in response to environmental variables and stock biomass should be encouraged.

B. Consideration of Flemish Cap as an Area Worthy of a Special International Coordinated Study Aimed at Determining the Factors Involved in the Production of Good and Poor Year-classes of Major Groundfish Stocks in the Area.

1. Review of available data base

The Working Group reviewed the data base for the major groundfish stocks as well as the major features of the oceanography of the Flemish Cap. In particular, the Group welcomed the excellent review paper presented by Dr. W. Templeman (Canada) and records its appreciation and gratitude to him for his efforts on its behalf: "Biological and oceanographic background of Flemish Cap as an area for research on the reasons for year-class success and failure in cod and redfish" (Res. Doc. 75/97). Other documents relevant to this section are Res. Doc. 75/76, 78, 79, 85, 90 and 115.

It was noted that information from the review paper and research documents confirmed the reasons summarized in the First Report of the Working Group (Summ. Doc. 75/7) as to why the Flemish Cap might provide a suitable area for study:

- a) Cod and redfish appear to be the only significant groundfish stocks in the area, and fluctuations in year-class strength of both species have been observed since the start of exploitation by modern fishing methods in 1956.
- b) Both the cod and redfish stocks are relatively isolated from the stocks on the adjacent Grand Bank.
- c) The water circulation patterns are likely to be amenable to study.
- d) The area is reasonably restricted in size.
- e) The area is one which, because of its major oceanographic features, has been of interest to physical oceanographers for many years, and there exists a useful historical data base of fish production and physical environmental data. With respect to the latter, while there exist relatively long time series of oceanographic observations made by the US Coast Guard and the USSR, no fully coordinated and comprehensive analysis has yet been carried out.

Although there are some reservations as to how well the results and conclusions from an exhaustive study on Flemish Cap might be extrapolated to other areas, the Working Group agreed that the Flemish Cap area was a most suitable area in which to mount a special international coordinated study aimed at determining the production of good and poor year-classes of cod and redfish.

## 2. Research proposals

The Working Group agreed that for the planning of a specific program of research the complete data base must be available, and accordingly recommends (30)

- i) *that an attempt be made to identify relationships between the various currents around Flemish Cap, the water temperatures at appropriate depths and any other relevant environmental factors with the year-class strengths of cod and redfish on the bank, including the role of predation of cod on redfish, and to identify other major gaps which still exist in knowledge of the area as well as research programs needed to fill them; and*
- ii) *that a joint study be carried out by one scientist from each of USSR and North America on the long time series of data collected by US Coast Guard and USSR, and a report presented to the Environmental Subcommittee at the 1976 Annual Meeting.*

All Member Countries having relevant data for the area are requested to make the data available for this study. Dr. Konstantinov was nominated by USSR as its participant in the joint study.

The Working Group recognized that the examination of cod stomachs provided a convenient means of sampling small redfish at times when the latter are not available to bottom trawls.

## C. Standardization of Oceanographic Sections, Stations and Base Periods.

### 1. Oceanographic sections and stations

There was considerable discussion on this topic at the first meeting of The Working Group (Summ. Doc. 75/7), and Dr. Trites (Canada) agreed to examine the suggested standard sections and to submit a proposal with regard to standard sections, stations and depths (Res. Doc. 75/116). The Working Group further considered the proposed sections and accordingly recommends (31(i))

*that the standard sections listed below and illustrated in Fig. 1 be considered for adoption as standard ICNAF oceanographic sections.*

- a) Cape Farewell - *Section line is slightly altered from the Danish section so as to line up with the Seal Island section; station position nearest to Cape Farewell is identical to the Danish inboard station.*
- b) Cape Desolation - *Section line and station positions are identical to those in Res. Doc. 74/82.*
- c) Frederikshaab - *Same as in Res. Doc. 74/82.*
- d) Fylla Bank - *Same as in Res. Doc. 74/82.*
- e) Little Hellefiskebanke - *Same as in Res. Doc. 74/82.*
- f) Holsteinsborg - *Same as in Res. Doc. 74/82.*
- g) Egedesminde - *Same as in Res. Doc. 74/82.*
- h) Cumberland - *Inboard station is identical to that of USSR section 11A (Res. Doc. 75/96), and the seawardmost station is the same as that on the Fylla Bank section.*
- i) Ryans Bay - *Alignment of section determined by extending the Frederikshaab section to the Labrador coast.*
- j) Ryans Bay-Frederikshaab - *Includes all stations on both sections plus additional stations on the line joining the two sections.*
- k) Beachy Island - *Alignment of section determined by extending the Cape Desolation section to the Labrador coast.*
- l) Beachy Island-Cape Desolation - *Includes all stations on both sections plus additional stations on the line joining the two sections.*
- m) Seal Island - *Section and station positions identical to Canadian standard section.*

- n) Seal Island-Cape Farewell - Includes all stations on both sections plus additional stations on the line joining the two sections.
- o) White Bay - Section and station positions identical to USSR section 40A as given in Res. Doc. 75/96.
- p) Bonavista - Section and station positions identical to USSR Northwest "Triangle" section (Res. Doc. 75/96); positions of "end" stations identical to those of US Coast Guard.
- q) Triangle - Consists of three sections with positions identical to those given for "Triangle" in Res. Doc. 75/96; northwest side of "Triangle" is same as Bonavista section; corner stations of "Triangle" are same as those of US Coast Guard.
- r) Flemish Cap - Section and station positions identical to those of USSR section 6A as given in Res. Doc. 75/96.
- s) Coast Guard 3 - Section and station positions identical to Line 3 of US Coast Guard as given in Summ. Doc. 75/7.
- t) Coast Guard 4 - Section and station positions identical to Line 4 of US Coast Guard as given in Summ. Doc. 75/7.
- u) Southwest Grand Bank - Section and station positions identical to USSR section 1A as given in Res. Doc. 75/96.
- v) Laurentian - Section across Laurentian Channel runs along USSR section 44A but extends southwestward to junction with the Banquereau section.
- w) Banquereau - Section is identical to the Canadian line which was occupied in the 1950s.
- x) Halifax - Section and station positions identical to Canadian section referred to in Summ. Doc. 75/7.
- y) Coast Guard 5 - Section and station positions as given by US Coast Guard; section is very close to that identified in Summ. Doc. 75/7.
- z) Coast Guard 6 - Section and station positions identical to Line 6 of US Coast Guard as given in Summ. Doc. 75/7.
- aa) Coast Guard 7 - Section and station positions identical to Line 7 of US Coast Guard as given in Summ. Doc. 75/7.

The Working Group noted that Canada has occupied a section in Cabot Strait for many years and strongly endorses the continued occupation of this section.

While station positions for some of the sections have been included in the foregoing proposals, the precise location of others required more information than was available to the Working Group at this time. However, Dr. Trites (Canada) agreed to prepare the station positions for all of the proposed sections and these will be circulated to Member Countries later.

Oceanographic data for the Georges Bank, Gulf of Maine and Southwest Scotian Shelf areas have not yet been sufficiently examined to enable proposals for specific sections in these areas. It is anticipated that a section south of Cape Sable, one across Northeast Channel and two or more across Georges Bank will subsequently be proposed. Dr. Schlitz (USA) agreed to examine the Georges Bank and Gulf of Maine data in order to identify the most appropriate sections. Drs. Trites and Schlitz agreed to correspond with members of the Working Group in developing proposals for presentation to the next meeting of the Working Group, due note being taken of the work of AtlantNIRO in the Gulf of Maine-Georges Bank area.

The standard physical oceanographic sampling depths are recommended as follows: 0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1500 and 2000 meters. A sample should also be taken, if possible, within 5 m of the bottom.

## 2. Base periods

At the first meeting of the Working Group (Summ. Doc. 75/7), it was recommended that MEDS (Marine Environmental Data Service) should examine the environmental time series in the ICNAF Area specifically to evaluate the possibility of finding useful base periods. The illness of Dr. Wilson (Canada) has prevented the completion of the study, but preliminary results indicate that it is

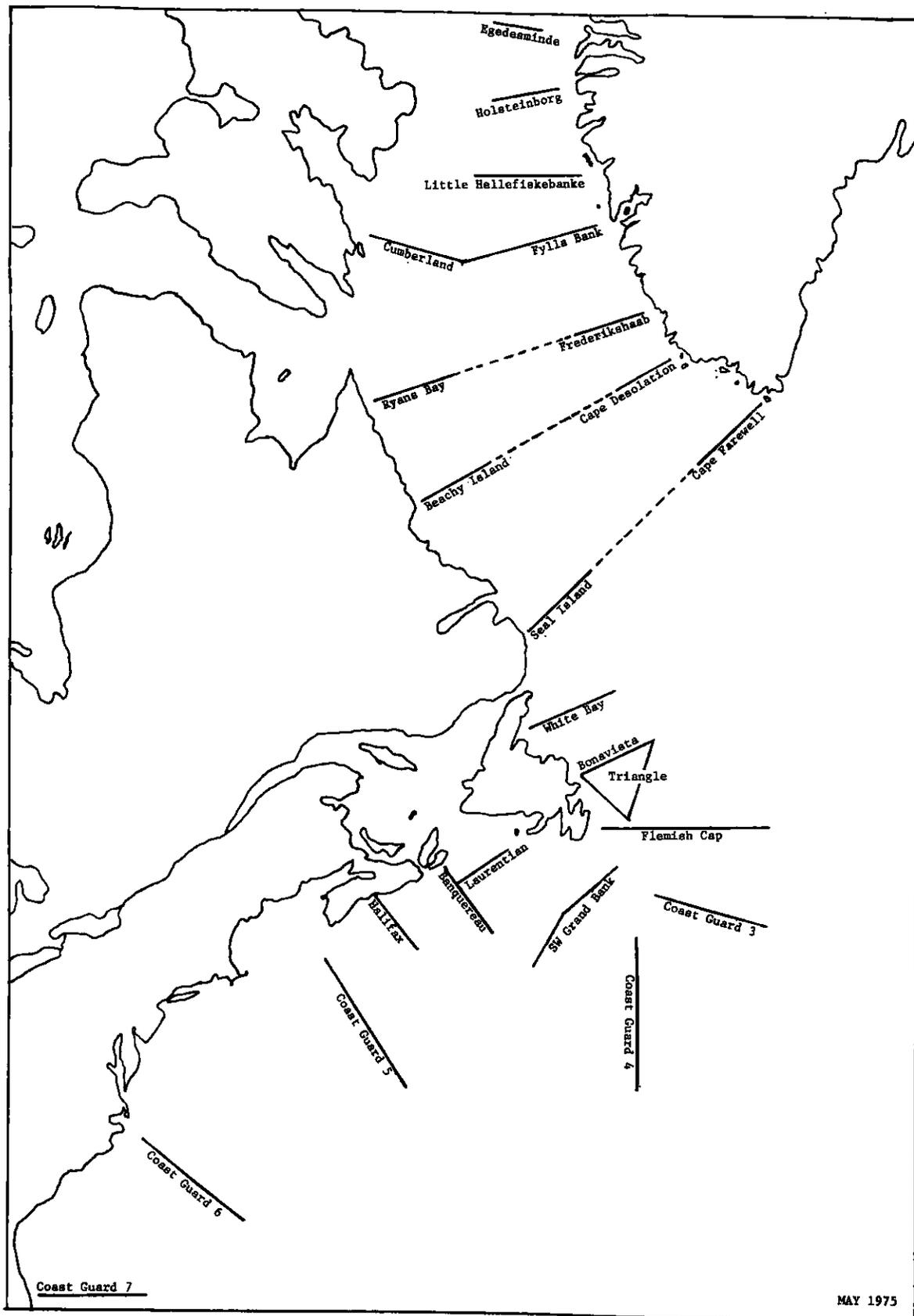


Fig. 1. Oceanographic sections proposed as standard sections for the ICNAF Area.

unlikely to find a common base period for the entire ICNAF Area. Since biologists attach importance to the descriptive aspects of anomalies, the Working Group recommends (31(ii))

*that Drs. Wilson and Trites (Canada) continue their investigation of base periods, with emphasis on the data base for the recommended standard sections, and circulate the results as soon as possible.*

D. Data Exchange and Standardization

1. International data exchange

For investigations of the type described in Section C to be successful, complete data files are necessary. The Working Group noted that oceanographic data have not yet been received by MEDS from several Member Countries. To facilitate the submission of data to MEDS, the Working Group recommends (4)

(i) *that a national representative must be designated and made responsible for the submission of his country's data to MEDS.*

(ii) *that physical and chemical oceanographic data be forwarded to MEDS with a time delay of not more than six months after collection.*

Where possible, this representative should be the director of the national oceanographic center (or its equivalent) or the appointed representative of the director (or in the case of certain ICES countries, the Service Hydrographique). The name of the representative should be forwarded to the Secretariat and MEDS as soon as possible.

Many of the fishery management decisions are made within ICNAF with short lead times, and the rapid exchange of data is necessary to provide the required environmental reports to support these decisions. For MEDS to prepare various reports on the status of the environment for the preceding year and present these at the Annual Meeting, a strict schedule of data transfer should be followed.

Examples of a number of outputs from MEDS were presented to the Working Group. These were noted with interest, and specific requests to aid the Group's planning of research proposals for Flemish Cap and Georges Bank were appreciated. However, specific suggestions for outputs on an annual basis were deferred pending further study, and the Working Group recommends (28)

*that a person be designated by the Environmental Subcommittee to consider the outputs that would be generally useful to ICNAF and to report on these at the next meeting of the Subcommittee.*

2. Standard data format for exchange of physical environmental data

As indicated in Summ. Doc. 75/7, no difficulties were encountered in the formats that are acceptable to MEDS. However, Dr. D. Grosshart (UK) reported that the IOC Working Committee for International Oceanographic Data Exchange has just accepted the GATE data format as the standard for data exchange (GATE Report No. 13, April 1974). This flexible magnetic tape format would allow for simplification of data retrieval, especially for long time series. Since MEDS is a member of the IOC Working Group, there should be no problems in this regard.

3. Consideration of formats for exchange of biological data

Progress on formatting of biological data for exchange has been slow because of the complexity and range of the data. Recently IOC has approved a biological data inventory form (ROMBI) for use on an experimental basis as a logical first step. This supplements the existing ROSCOP form and expands the detail available for biological data.

Recognizing the lead that IOC has taken in this area and providing support for the effort, the Working Group recommends (32)

*that Member Countries of ICNAF should encourage the use of the ROMBI forms on an experimental basis to supplement the ROSCOP forms and report on the feasibility of adopting these for routine reporting.*

Dr. M.D. Grosslein (USA) described the biological data management system under development by the MARMAP group of NMFS, known as SELGEM. Plans involve incorporating the ICNAF larval herring data base into the system, beginning first with the 1972 and 1973 data. Various listings from the system were shown as examples of output from SELGEM, and the system shows promise for efficient handling of large and complicated data bases.

E. Other Matters

1. The Working Group, anticipating considerable progress during 1975/76 on improvements to the data base, accordingly recommends (34)

*that the next meeting of the Working Group be held prior to the 1976 Annual Meeting.*

2. Appreciation

Finally the Working Group wishes to draw attention to the valuable contributions of Drs. D.F. Bumpus and W. Templeman to the discussions during the course of the meeting and records its appreciation for the time and effort expended by these distinguished scientists on behalf of the Working Group.

HERRING IN GULF OF MAINE, GEORGES BANK AND SOUTHWEST NOVA SCOTIA AREAS:  
HIGHLIGHTS OF CONTRIBUTED PAPERS

1. Review papers

Relevant points raised in the discussion of the following papers have been included in section 2 below:

- a) Review of the physical oceanography of Georges Bank, by D.F. Bumpus (Res. Doc. 75/107).
- b) An overview of the plankton communities of the Gulf of Maine, by E.B. Cohen (Res. Doc. 75/106).
- c) A conceptual model of stocks of herring in the Gulf of Maine, by G.F. Ridgeway (Res. Doc. 75/100).

2. New or unpublished studies related to early life history of herring in the Georges Bank, Gulf of Maine and southwest Nova Scotia areas

- a) Maturation and spawning (Res. Doc. 75/37, 38 (revised), and 93).

Ridgeway (Res. Doc. 75/100) notes that recently a large proportion of age 3 fish (1970 year-class) were recruited to the Georges Bank fishery than in previous years, and also that the size of age 3 fish had increased.

Polish observations (Res. Doc. 75/37) on Georges Bank herring confirm that the onset of spawning in 1972 and 1973 occurred late in September and early October. Additional evidence, however, suggests that spawning took place later in 1974. The major sites and general periods of spawning may be summarized as follows:

<u>Stock</u>	<u>Spawning Period</u>	<u>Major Sites</u>
Southwest Nova Scotia	Late August-October	Trinity Ledge Lurcher Shoals
Southwestern Gulf of Maine	Late September-November	SW Jeffrey's Ledge
Georges Bank	Late September-early December	N edge of bank and Nantucket Shoals

US observations (Res. Doc. 75/93) on herring on Jeffrey's Ledge in 1974 indicate that spawning occurred during 29 Sep-3 Oct at a site off Cape Ann and about 25 days later at another site somewhat further offshore. In both areas the substrate consisted of boulders, rocks and gravel. At the prevailing water temperature (9.5°C), the eggs hatched in 9 days. Newly hatched larvae stayed close to the algal growth on the spawning bed near Cape Ann for several days until the yolk sac was absorbed. The larvae began to disperse 3-5 days after peak hatching. Several species of fish were observed feeding on the eggs, and predation occurred primarily at night. Hatching success, excluding predation, was about 99%. Total mortality was of course much higher than 1% but the proportion of eggs lost by predation is not known.

- b) Distribution and abundance of herring larvae (Res. Doc. 75/49, 50, 66, 67, 71, 108, 109 and 112).

A summary of the results of the 1974 larval herring surveys was presented by Dr. Schnack (Res. Doc. 75/112). In September and October larvae were found off western Nova Scotia and around the northern and western coasts of the Gulf of Maine in about the same pattern as observed in previous years. The major concentrations of small larval were again observed on the northeastern Georges Bank and on Nantucket Shoals, but hatching was somewhat later than usual on Georges Bank as indicated by the absence of larvae there in the latter half of September and only a few >10 mm larvae were found in early October. Hatching also appeared to be later on Nantucket Shoals with peak numbers of larvae occurring in mid-November. The aggregation of small larvae on Georges Bank was again separated from the one on Nantucket Shoals to a greater degree than in 1973 but less so than in 1972. A slight shift in 1974 spawning activity to the south and west seems apparent as indicated by the general distribution of newly hatched larvae of the Georges Bank and Nantucket Shoals areas. Total 1974 larval production estimates for these two areas showed about the same abundance on Georges Bank but somewhat lower abundance on Nantucket Shoals as compared with 1973. Thus the total production for both areas combined was slightly lower than in 1973, or about one order of magnitude greater than production observed in 1971 and 1972.

Detailed reports of individual surveys are given in Res. Doc. 75/50, 66, 67, 71 and 109. Hydrographic conditions reported for several of these cruises indicated generally higher water temperatures in 1974 compared with previous years, particularly on Georges Bank. Total plankton biomass data were reported by France and USSR and the biomass patterns were compared with hydrographic conditions and distribution of larval herring.

A study of diurnal variations in larval catches from 6 larval herring surveys of previous years was reviewed (Res. Doc. 75/108). An overall night/twilight/day catch ratio of 5/3/2 was observed for all sizes of larvae combined (4-30 mm), suggesting avoidance of gear during daylight hours. Night/day ratios appeared constant for all 3 mm size groups except for the smallest category (4-6 mm yolk-sac larvae) for which the ratio was about 7:1. Considerations of avoidance reactions and possible swimming speed were examined by the author in an attempt to explain the apparent constant level of daytime avoidance by larvae >6 mm; and he concluded that the most likely explanation was that the larvae detected the net far enough away (assumed reaction distance about 8 m) so that smaller larvae could escape as easily as the larger ones. With respect to the high night/day ratio for the yolk-sac larvae, the suggested explanation was that these may be on or close to the bottom during the day and move into the water column at night, thus becoming available to the samplers (deployed about 5 m off the bottom). The Working Group noted that this degree of directed vertical movement by yolk-sac larvae seemed unlikely. In any case the Group considered that a more definitive analysis was desirable. Other studies have shown extreme variability and inconsistency in night/day ratios and the simple pooling of data over cruises can mask real differences or yield spurious ratios, if proper statistical weighting methods are not employed.

A special study of the vertical distribution of herring larvae was conducted on Georges Bank in October 1974 (Res. Doc. 75/50). A partial summary of the experiment revealed that herring larvae (mostly <8 mm) occurred at all depths (surface to bottom at the 80 m experiment site) but that the bulk of larvae was at mid-depths of 30-50 m, with some indication of movement towards the surface at night. Also it was noted that yolk-sac larvae of the 4-6 mm size were found throughout the water column. Total plankton volume was rather evenly distributed by depth and time whereas chaetognaths showed a prominent diurnal movement from near bottom during daylight to the 20-30 m level at night.

An oral description of the larval fish survey program conducted by the Lowestoft Fisheries Laboratory was presented by D. Harding. The program represents a comprehensive and intensive investigation of the primary and secondary production and physical oceanographic regime associated with the egg and larval stages of fish, in an attempt to identify mechanisms controlling survival of the planktonic stages. Characteristics and advantages of the high speed sampling methods of this program were described as well as the laboratory and analytical techniques for accurate age and mortality determinations. It was noted that careful intergration of both biological and physical sampling programs was essential to insure maximum cost effectiveness of such studies.

c) Hydrographic studies on larval herring cruises

A preliminary summary of hydrographic data collected during larval herring cruises for the years 1971-73 was reported in Res. Doc. 75/111. A description of the collection, quality control, reporting procedures and the data base was presented. Much of the report dealt with temperature data as salinity data were sparse. Horizontal temperature sections were reviewed and two areas of relatively cold water were noted throughout the period - on the northeast part of Georges Bank and in the South Channel west of the bank. Several suggestions for these phenomena were offered, including local upwelling, intrusions of Scotian Shelf water and slope-front interactions.

Observations on the location of the slope water boundary along the southern edge of Georges Bank indicated that large amounts of shelf water might be lost at times through meanders of the frontal zone, and it was noted that the associated plankton communities could be lost through this mechanism.

Mean temperature trends were examined for the 3-year period and the most striking features noted were the sharp rises in temperature at 100 m through the autumn and the generally higher temperatures in all areas in 1973. Causes of this increase were not apparent from the data but there is accumulating evidence of a rise in temperature throughout the continental shelf area off the US east coast during the last few years. Further evidence of warming in the Gulf of Maine was indicated by a significant increase in bottom water temperatures of the deep basin (Res. Doc. 75/110).

d) Estimation of growth and mortality of herring larvae and factors related to these processes

Information given in Res. Doc. 75/112, 113 and 118 was reviewed and discussed. From the autumn 1974 larval herring surveys data an attempt was made to follow the growth of a recently-hatched group of larvae on Georges Bank from October to December. An increase in modal length of 6 mm per month (from about 8 to 19 mm) was noted, which value was slightly lower than the 7-8 mm per month estimated for 1973. Additionally, the increase in length of the largest larvae from the start to the end of the hatching season was indicated to be about 8 mm per month in 1974 as it was in the previous year.

Results of comparisons of the December and February cruises for 1973/74 and 1974/75 are presented in Res. Doc. 75/113. The decline in abundance from December to February was followed for two

different length groups of larvae as well as for all sizes combined. In both years the estimated instantaneous mortality rate was about 0.04 per day. Larval growth appeared to be less in 1973/74 than in 1974/75, despite slightly higher water temperatures in the latter period.

In discussing these results, it was noted that the length groups chosen in February may not necessarily correspond in age to those identified in December. Mortality could be size dependent and also different in the two years, thereby confounding the picture with respect to apparent growth changes. It was agreed, however, that approximate mortality values derived from total numbers of larvae may serve as a basis for comparison with succeeding years.

Discussion also centered on the assumption that there was no mixing of larvae between the Georges Bank and Nantucket Shoals areas. Significant transport of larvae from Nantucket to Georges Bank could contribute toward underestimating mortality, whereas significant loss of larvae from Georges Bank (most likely to the southwest) would tend to overestimate mortality. A rough estimate derived from the data at hand, including Nantucket Shoals, gave an instantaneous mortality rate of 0.06 per day for both years considered. Thus, it may be concluded that mortality rate during winter (December to February) was in the range of  $Z = 0.04-0.06$  on a daily basis for 1973/74 and 1974/75. Size ranges of the main proportion of larvae were as follows:

	<u>December</u>	<u>February</u>
1973	14-23 mm	16-30 mm
1974	10-24 mm	21-31 mm

Distribution of herring larvae on Georges Bank in May 1974 is presented in Res. Doc. 75/118. Three different types of nets were used - Bongo, Neuston, and Isaac Kidd trawl. The Bongo failed to catch any larvae, but many were caught in the other two gears, chiefly in the range of 40-50 mm, with the greatest catches occurring in the Neuston net. Virtually all larvae were caught at night, and sampling over western Georges Bank and Nantucket Shoals indicated that larvae were restricted to the northwest quarter of Georges Bank. There is some uncertainty as to the larval distribution on eastern Georges Bank because relatively few night hauls were made there. As most of the larvae were caught in the Neuston net, it was recognized that these results cannot provide a quantitative estimate. Thus, quantitative estimates of over-winter mortality may be feasible only with Bongo samplers in February and March, certainly no later than April by which time the larvae may be able to escape this type of sampler.

e) Juvenile stages (post metamorphosis to final maturity)

The geographic distribution of juvenile and adult herring caught in the US winter and spring surveys of 1964-66 is summarized in Res. Doc. 75/110, and these data produced estimates of relative abundance of recruitment to the Georges Bank stock. Juvenile herring were not found south of Hudson Canyon or in deep water in the southern New England area. They were usually found in depths less than 80 m on Georges Bank but in much deeper water (100-200 m) in the Gulf of Maine and off southern Nova Scotia. The densest aggregations of juveniles have occurred off southern New England but they were found most consistently off the mouth of the Bay of Fundy and off southern Nova Scotia. In general, the proportion of juveniles in survey catches increased from south to north. Thus more sampling within the Gulf of Maine and off southern Nova Scotia might improve the precision of pre-recruit estimates.

Estimates of recruitment in the Georges Bank stock were made from survey catches of *Albatross IV*, *Walther Herwig*, *Wieczno*, *Khronometer*, and *Ernst Haeckel* from the combined areas of Gulf of Maine and southern Nova Scotia and the combined areas of Georges Bank and southern New England. Survey data for the Gulf of Maine-southern Nova Scotia area appears to be useful in predicting recruitment to the Georges Bank stock. The recruitment estimates were within 34% of those calculated by cohort analysis and assumed by the Assessments Subcommittee. Survey estimates for the Georges Bank-southern New England area were less useful in predicting recruitment to the Georges Bank stock as the recruitment estimates agreed only within 93% of those derived from cohort analysis for assessments. Estimates of abundance of recent year-classes were consistently less than those assumed by The Herring Working Working Group. The size of the 1973 year-class appears to be considerably smaller than either of the 1971 or 1972 year-classes.

3. General papers related to year-class success and failure of herring in the Georges Bank-Gulf of Maine area

A correlation analysis between the monthly mean river runoff from the St. Lawrence River and temperature and salinity records along the Scotian Shelf and in the Gulf of Maine is described in Res. Doc. 75/9. The temperature correlations were quite high from the mouth of the St. Lawrence River

along the coast to Boston when appropriate lags on the order of oceanic drift speeds were introduced. Discussion of the paper revealed problems based on the inability of the correlation technique to explain (i) the salinity distributions, (ii) the results in the Gulf of Maine with delay times being of the order of one year, and (iii) the possibility that climatic conditions of a longer scale controls the total area and therefore the correlations.

In order to test any cause and effect mechanisms for the influence of the St. Lawrence River runoff on the hydrographic conditions in the Gulf of Maine, further work must be carried out; better salinity records and chemical techniques that uniquely tag a river system were given as examples.

4. General papers related to year-class success and failure

The Working Group reviewed the information in Res. Doc. 75/10, 32 and 33, including a paper "The role of stock biomass and temperature in the recruitment of Gulf of St. Lawrence cod" by P.F. Lett, A.C. Kohler and D.N. Fitzgerald, J. Fish. Res. Bd. Canada (in press).

Between 1965 and 1974 egg and larval surveys were conducted in the Gulf of St. Lawrence to determine factors affecting the year-class strength of groundfish. However, all eggs and larvae for both pelagic and demersal species were counted and identified. A model of the stock recruitment mechanism was constructed after a gross analysis, the purpose of which was to study the structure of the data. It was anticipated that the output from this model would provide hypotheses around which future surveys could be planned.

In summary, density-dependent growth and fecundity act simultaneously in providing a coarse population regulatory mechanism; however, the fine tuning of the system is the reliance of demersal juvenile abundance on coincident population biomass and related numbers of larvae. Density dependence at the cod larval stage was not strong, although this effect was profound for mackerel. It was suggested that this represented a distinct difference in the recruitment mechanism for these two species. The density-dependent mechanism during the transition of larvae to juveniles was similar for Gulf of St. Lawrence cod and herring, although for herring no attempt was made to evaluate the importance of this stage in relation to other stages in the recruitment mechanism. Temperature was analyzed as the key environmental factor. It was found that the survival of cod eggs could be fitted to an optimum occurring at an estimated temperature of 6.25°C. The effect of temperature on egg numbers was greatest when egg abundance was highest. At the larval stage the effect of temperature is mediated directly through a bioenergetic response and indirectly through the effects on the food supply. However, in relation to cod, biomass effects were more important than temperature effects.

APPENDIX VI - REPORT OF STEERING AND PUBLICATIONS SUBCOMMITTEE

Chairman: A.W. May

Rapporteur: V.M. Hodder

1. Organization and Operation of STACRES

The Subcommittee considered the problem of the greatly increased workload of the Assessments Subcommittee and agreed that some of the activities could be undertaken by Scientific Advisers to Panels. In particular, it was agreed that Chairmen of Scientific Advisers to Panels should be responsible for organizing the updating of TACs for their respective subareas under the general direction of the Chairman of the Assessments Subcommittee. The reporting to the Commission would continue as now, i.e., through the Assessments Subcommittee and STACRES, but the Chairmen of Scientific Advisers would be responsible for summarizing the advice and presenting the details to the Panels.

2. ICNAF Observer for 1975 ICES Meeting

The Subcommittee noted the oversight of STACRES last year in not designating an observer for the 1974 Meeting of ICES, and agreed that Dr. A. Schumacher be the designated observer for the 1975 Meeting of ICES.

3. Ageing Workshop

The Subcommittee noted the STACRES recommendation regarding the Ageing Workshop to be held at the Institute of Fisheries Investigations, Vigo, Spain, and proposes (a) that the tentative dates be 20-25 October 1975, and (b) that Messrs Lopez-Veiga (Spain) and R. Wells (Canada) be designated as co-ordinators, and Mr. Blacker (UK) be requested to assist in the preparation of otolith photograph material. The co-ordinators should ensure that a report of the Workshop is prepared for distribution as a Summary Document well in advance of the April 1976 Meeting of the Assessments Subcommittee.

4. Interim Scientific Meetings

The Subcommittee reviewed the matter of scheduling meetings of the Assessments and Biological Surveys Subcommittees well in advance of the Annual Meeting at a place where suitable computer facilities are available. Noting that the installation of a computer terminal at ICNAF Headquarters is planned for January 1976, the Subcommittee

recommends (35)

*that meetings of the Assessments and Biological Surveys Subcommittees be held at ICNAF Headquarters, Dartmouth, Canada, during the period 30 March to 9 April 1976.*

5. Review of ICNAF Publications on Research and Statistics

a) Publication Guidelines for Research Bulletin

At the 1974 Annual Meeting the Secretariat was requested to write the heads of Institutes concerned with research in the ICNAF Area for comments on the question of guidelines for selecting, editing and refereeing papers for the Research Bulletin. The Subcommittee reviewed the responses received from four Institutes and agreed to the following points:

- i) There should be an editorial group to determine the overall editing policy for the Research Bulletin and other associated publications. The Steering and Publications Subcommittee was considered to be the appropriate body for this function.
- ii) An editor should be designated either from within or outside the Secretariat who would be responsible for carrying out the editorial policy established by the Editorial Group. Pending further consideration of this matter at the 1976 Annual Meeting, it was tentatively agreed that the Secretariat carry out the duties of Editor during the ensuing year.
- iii) There should be an established refereeing system in which all papers would be forwarded to appropriate experts for comment on their suitability for inclusion in the Research Bulletin and suggestions for improvement. This could be achieved by two methods: the editor could select a panel of experts on various subjects who would agree to act as referees from time to time as required, and/or the editor could forward submitted papers to Institute Directors as appropriate who would ensure that the papers are reviewed by appropriate experts in their Institutes. The Subcommittee tentatively agreed that the second method be followed for the ensuing year.

- iv) Papers for publication in the Research Bulletin should be submitted by authors rather than selected from Research Documents as in the past. Authors submitting papers for presentation as Research Documents to the Annual Meeting should indicate at the time of submission if they wish the papers to be considered for Research Bulletin, but papers for consideration as Research Bulletin material may be submitted at any time during the year whether or not they have appeared as meeting documents.
- v) There should be a rigid deadline for acceptance of papers for publication in a given issue, and papers not received in their final form before this deadline would appear in a succeeding issue.
- vi) The Editor should ensure that manuscripts comply with instructions to authors and be written in acceptable English before they receive consideration by the Editor or the referees.

Pending the transition stage from "selected" to "submitted" material for the Research Bulletin series, the Subcommittee agreed that the Chairmen of Subcommittees together with the Chairman of STACRES review the Research Documents and agree on a list of papers for consideration as Research Bulletin material. The following 1975 Research Documents were selected for possible publication, subject to appropriate revision, refereeing and editing: 12 and 54 combined, 18 and 65 combined, 32, 33, 35, 60, 61, 97, 99 and 121. The Secretariat is requested to contact the authors of these papers to determine whether they wish to submit their papers to the Research Bulletin, and in the case of suggested combinations of papers whether the various authors wish to submit a combined paper.

b) Selected Papers Series

The Subcommittee agreed that an annual volume comparable to Redbook Part III be reinstated, and accordingly

recommends (36)

- i) that a volume to be known as "Selected Papers" from the Annual Meeting be reinstated as an annual feature; and
- ii) that the Steering and Publications Subcommittee assume the primary responsibility, under STACRES, for overall publication policy and selection of papers for the "Selected Papers" series from year to year.

The following papers from the 1975 Research Documents were selected for possible publication: 25, 26, 43, 45, 55, 69, 104, 106, 107, 111 and 119. The Secretariat is requested to contact authors to determine whether they wish these papers to be published in the "Selected Papers" series with revision as appropriate.

c) Publication and Distribution of Sampling Data

The Subcommittee concurred with the action taken by the Secretariat in not delaying the publication of Redbook 1974 for the purpose of including lists of sampling data, and agreed that the Secretariat should continue to issue subsequent lists of sampling data together with sampling notes, as was done for the 1973 data.

As a matter of clarification about the distribution of detailed sampling data, the Subcommittee agreed that these data should be distributed upon request only to those scientists and/or institutes engaged directly in the Commission's work.

d) Publication of Redbook 1975

The Subcommittee agreed that Redbook 1975 should include the STACRES Report of the January 1975 Special Meeting (Summ. Doc. 75/8) and the STACRES Report of the 1975 Annual Meeting (Proceedings No. 1), together with the Reports of the Assessments Subcommittee (Summ. Doc. 75/18 and Addendum) and the Biological Surveys Subcommittee (Summ. Doc. 75/17 and Revised Addendum). It was further agreed that the Report of the Environmental Working Group should be appended to the Environmental Subcommittee Report, but that the Report of the Herring Working Group (Summ. Doc. 75/19) should not be included.

e) Status of Working Papers

The Subcommittee reviewed the status of the Working Paper series, and agreed that, although these are intended only for use at the particular meetings for which they were prepared, they should be numbered consecutively for each calendar year, a file maintained at the Secretariat, and individual

copies issued on request only to institutes or individuals engaged directly in the Commission's work, if copies are not available at the institutes concerned.

- f) The Subcommittee welcomed the recent issue of Special Publication No. 11, which contains subject and author indexes and lists of titles of ICNAF publications from 1950 to 1974 covering research papers and reports published in Annual Proceedings, Research Bulletins, Special Publications, and Redbooks, and commended the Assistant Executive Secretary for the great amount of work involved in compiling the indexes in such detail.

It was noted that an index covering the Research and Summary Document series was being compiled and might be ready for distribution in 1976.



PART C

STACRES AGENDA

LIST OF RECOMMENDATIONS

LISTS OF DOCUMENTS



AGENDA FOR STACRES MEETING - MAY-JUNE 1975

1. OPENING

- (a) Rapporteurs
- (b) Adoption of Agenda
- (c) Plan of Work of STACRES

2. ASSESSMENTS (Chairman: D.J. Garrod)

- (a) Review of catch statistics and fishing activity in 1974
- (b) Review of abundance indices for 1974
- (c) Stock assessments
  - (i) Cod (1, 2GH, 2J+3KL, 3M, 3NO, 3Ps, 4Vn(Jan-Apr)+4T, 4Vn(May-Dec), 4VsW, 4X(offshore), 5Y, 5Z)
  - (ii) Haddock (4VW, 4X, 5)
  - (iii) Redfish (2+3K, 3M, 3LN, 3O, 3P, 4VWX, 5)
  - (iv) Silver hake (4VWX, 5Y, 5Ze, 5Zw+6)
  - (v) Red hake (5Ze, 5Zw+6)
  - (vi) Pollock (4VWX, 5)
  - (vii) American plaice (2+3K, 3LNO, 3M, 3Ps)
  - (viii) Witch (2J+3KL, 3NO, 3Ps)
  - (ix) Yellowtail (3LNO, 5(E69°), 5(W69°)+6)
  - (x) Greenland halibut (0+1, 2+3KL)
  - (xi) American plaice, witch and yellowtail (4VWX)
  - (xii) Flounders except yellowtail (5+6)
  - (xiii) Roundnose grenadier (0+1, 2+3)
  - (xiv) Herring (4VW(a), 4XW(b), 5Y, 5Z+6)
  - (xv) Mackerel (3+4, 5+6)
  - (xvi) Argentine (4VWX)
  - (xvii) Capelin (2+3K, 3L, 3NO, 3Ps)
  - (xviii) Other finfish (5+6)
  - (xix) Squid - *Illex* (3+4, 5+6)
  - (xx) Squid - *Loligo* (5+6)
  - (xxi) Overall TAC for finfish + squids (5+6)
- (d) Other matters

3. BIOLOGICAL SURVEYS (Chairman: J. Messtorff)

- (a) Review of survey activity in 1974, including results relevant to assessments (see Item 2(b) above).
- (b) Proposed survey activity in 1975
- (c) Reporting and processing of survey data
- (d) Review of progress on Manual for ICNAF Surveys
- (e) Review of further experimental work on hydroacoustic surveys
- (f) Review of relevant matters from Environmental Working Group Report
- (g) Other matters

4. STATISTICS AND SAMPLING (Chairman: Sv.Aa. Horsted)

- (a) Reports on statistical activities
  - i) ICNAF statistical report, 1974/75
  - ii) CWP activities as they pertain to ICNAF
  - iii) Statistical activities of other regional agencies
- (b) Fishery statistics
  - i) Statistical Bulletin, Vol. 23 for 1973
  - ii) Advance monthly statistics for selected species, 1974
  - iii) Statistics on discards
  - iv) Adequacy of national reporting on STATLANT forms
  - v) Review of STATLANT and other forms used to solicit fishery statistics, including deadlines
- (c) Sampling data
  - i) Sampling Yearbook, Vol. 18 for 1973
  - ii) Early requirement for sampling data
  - iii) Adequacy of sampling and/or reporting of national sampling data
  - iv) Review of sampling forms and deadlines
  - v) Report on special sampling project

- (d) List of Fishing Vessels, 1974
  - (e) Other matters
5. ENVIRONMENTAL (Chairman: H.W. Hill)
- (a) Review of environmental conditions in 1974
  - (b) Consideration of Reports of Working Group on Coordinated Environmental Studies (Convener: E.J. Sandeman)
  - (c) Progress report by Canadian Marine Environmental Data Service on processing and exchange of ICNAF Area data
  - (d) Report on technique adopted by Gdynia Institute for sorting of plankton samples (Redbook 1973, Part I, p. 121; Redbook 1974, p. 136)
  - (e) Review of plankton studies in ICNAF Area in 1974, carried out by UK Institute for Marine Environmental Research
  - (f) Review of weather and ice reporting (Redbook 1973, Part I, p. 122; Redbook 1974, p. 136)
  - (g) Status of publication of papers on ice dynamics presented at 1973 Annual Meeting
  - (h) Status of publication of papers on hydrography of the Newfoundland-Grand Bank area in 1972 presented at the 1974 Annual Meeting
  - (i) Other matters
6. AD HOC WORKING GROUP ON FISHING EFFORT STUDIES (Convener: R.C. Hennemuth)
- (a) Status of national reporting of data required for fishing effort studies (January 1974 Mtg.Proc. No. 4, p. 60-61; Redbook 1974, p. 13; Circular Letter 74/32)
  - (b) Review of national reports on statistical studies (Redbook 1974, p. 52)
  - (c) Progress on development of methodology for analysis of fishing effort data (June 1974 Mtg.Proc. No. 5, App. I, p. 133)
7. GEAR AND SELECTIVITY
- (a) Trawl materials and mesh size sampling for 1973 and provisional data for 1974
  - (b) Consideration of any recent selectivity experiments
  - (c) Consideration of any recent developments in fishing gear research
  - (d) Other matters
8. AGEING TECHNIQUES AND VALIDATION STUDIES
- (a) Need for further otolith exchange programs and/or workshops
  - (b) Inventory of age validation studies in ICNAF Area
9. COOPERATIVE RESEARCH PROJECTS
- (a) Status of preparation and/or publication of Greenland Salmon Tagging Experiment
  - (b) Status of publication of papers presented at Symposium on Acoustic Methods in Fishery Research, Bergen, June 1973
10. STEERING AND PUBLICATIONS
- (a) Organization and operation of STACRES
  - (b) Review of meeting agenda and timetable
  - (c) Review of ICNAF publications relating to research and statistics
  - (d) Review of distribution of publications and meeting documents
  - (e) Other matters
11. MID-YEAR MEETINGS
12. ARRANGEMENTS FOR 1976 ANNUAL MEETING OF STACRES
13. ELECTION OF OFFICERS
14. OTHER MATTERS
- (a) Effects over next 15 years of 20, 30, 40 and 50% reduction in fishing mortality below 1973 level for as many groundfish stocks as possible in Subareas 2, 3 and 4 (Comm. Doc. 75/8)
  - (b) Stock boundaries for Div. 2J+3KL cod and Div. 3LNO American plaice (Comm. Doc. 75/9 revised)
  - (c) Importance to stock assessment of incomplete reporting of by-catch (Comm. Doc. 75/13)
  - (d) Difficulties for Faroese fleet in Cape Breton area (June 1974 Mtg.Proc. No. 10, p. 160-161, 170-172)
  - (e) Consideration of proposal for an international observer program (Summ. Doc. 75/9, p.25)

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LISTS OF RESEARCH AND SUMMARY DOCUMENTS - 1975

SUMMARY DOCUMENTS

<u>Sum. Doc. No.</u>	<u>Serial No.</u>	
75/1	3420	<u>ICNAF</u> . Proceedings of Fifth Special Commission Meeting, Miami, Florida, USA, 11-15 November 1974 (40 pages) + Addendum 1 (1 page).
75/2	3424	<u>NEAFC</u> . Northeast Atlantic Fisheries Commission, Twelfth Meeting: press notice (3 pages).
75/3	3425	<u>NEAFC</u> . Northeast Atlantic Fisheries Commission, Mid-term Meeting: press notice (3 pages).
75/4	3423	<u>ICNAF Secretariat</u> . Stock records for some species considered at the 1974 Assessment Meetings (29 pages).
75/5	3437	<u>ICNAF</u> . Report of Meetings of Standing Committee on Research and Statistics (STACRES), Sixth Special Commission Meeting, January 1975, (8 pages)
75/6	3441	<u>ICNAF</u> . Proceedings of Sixth Special Commission Meeting, Bergen, Norway, 13-18 January 1975 (28 pages) + Addendum 1 (1 page).
75/7	3442	<u>ICNAF</u> . Report of Meeting of ICNAF Environmental Working Group, Charlottenlund, Denmark, 23-25 September 1974 (18 pages).
75/8	3447	<u>NEAFC</u> . Northeast Atlantic Fisheries Commission, Special Meeting: press notice (2 pages).
75/9	3500	<u>ICNAF</u> . Report of Joint ICNAF/NEAFC Meeting on International Enforcement, Leningrad, USSR, 4-7 March 1975 (44 pages).
75/10	3456	<u>ICNAF Secretariat</u> . Nominal catches of finfish and squids in Subarea 5 and Statistical Area 6, 1964-73 (10 pages).
75/11	3466	<u>ICNAF Secretariat</u> . Efficiency of sampling the major fisheries of the Northwest Atlantic in 1973 (9 pages).
75/12	3474	<u>Ikeda, Ikuo</u> . Japanese Research Report, 1974 (4 pages).
75/13	3476	<u>Lopez-Veiga, E.C., J.R. Fuertes and E. Labarta</u> . Spanish Research Report, 1974 (16 pages).
75/14	3485	<u>ICNAF Secretariat</u> . Major CWP recommendations of direct importance to ICNAF (10 pages).
75/15	3487	<u>May, A.W., and J.S. Scott</u> . Canadian Research Report, 1974 (12 pages).
75/16	3490	<u>Anon</u> . United States Research Report, 1974 (15 pages).
75/17	3495	<u>ICNAF</u> . Report of Biological Surveys Subcommittee, April 1975 (9 pages) + Addendum 1 revised (6 pages).
75/18	3498	<u>ICNAF</u> . Report of Assessments Subcommittee, April 1975 (43 pages) + Addendum 1 (7 pages) + Corrigendum (1 page).
75/19	3499	<u>ICNAF</u> . Report of Herring Working Group, April 1975 (31 pages).
75/20	3567	<u>CWP Secretary</u> . ADP developments in the STATLANT Forms NS, A and B (8 pages).
75/21	3572	<u>CWP Secretary</u> . Report of the Eighth Session of the CWP (Coordinating Working Party on Atlantic Fishery Statistics), Paris, France, 12-20 September 1974 (39 pages).
75/22	3577	<u>ICNAF Secretariat</u> . Procedures for weather reporting by fishing vessels (9 pages).
75/23	3578	<u>ICNAF Secretariat</u> . Summary of trawl materials and mesh size sampling, 1974 (6 pages).
75/24	3579	<u>Jones, B.W.</u> United Kingdom Research Report, 1974 (3 pages).

- 75/25 3581 Anon. French Research Report, 1974: Part II for St. Pierre and Miquelon (7 pages) and Part I for France (Metropolitan) as Addendum (1 page).
- 75/26 3644 ICNAF Secretariat. Provisional nominal catches in 1974 by country and stock area for species proposed for regulation in 1976 (9 pages).
- 75/27 3533 Ulltang, Ø. and T. Øritsland. Norwegian Research for 1974: Part I - Subareas 1 to 4; and Part II - Seals (6 pages).
- 75/28 3536 Giedz, M., A. Paciorewski, and E. Stanek. Polish Research Report, 1974 (27 pages).
- 75/29 3545 Ernst, P., U. Berth, and H. Ritzhaupt. GDR Research Report, 1974 (12 pages).
- 75/30 3546 Konstantinov, K.G., and A.S. Noskov. USSR Research Report, 1974 (34 pages).
- 75/31 3589 Horsted, Sv.Aa., Erik Smidt, and H.H. Valeur. Danish Research Report for 1974: Part I - Subareas 1 and 2, Statistical Area 0 and East Greenland; and Part III - Ice conditions off West Greenland in 1974 (15 pages).
- Hermann, F. Danish Research Report for 1974: Part II - Hydrographic conditions off West Greenland (8 pages).
- 75/32 3590 ICNAF Secretariat. Provisional nominal catches in the Northwest Atlantic, 1974 (Subareas 1 to 5 and Statistical Areas 0 and 6) (61 pages).
- 75/33 3591 ICNAF Secretariat. Provisional sealing statistics for the Northwest Atlantic in 1974 (2 pages).
- 75/34 3592 ICES. Extracts from resolutions passed at the 1974 ICES Meeting relevant to the research and statistical activities of ICNAF (2 pages).
- 75/35 3596 ICNAF Secretariat. Report on statistical activities during the year 1974/75 (6 pages)
- 75/36 3612 Meyer, A., J. Messtorff, and H. Dornheim. Federal Republic of Germany Research Report, 1974 (18 pages) + Corrigendum (1 page).
- 75/37 3613 CWP Secretary. Discrepancies in ICNAF and FAO catch statistics by species items (3 pages).
- 75/38 3616 Ulltang, Ø. Status of fisheries and research carried out in Subarea 1, Statistical Area 0 and off East Greenland in 1974 (11 pages).
- 75/39 3617 Clark, S., and V.C. Anthony. Status of fisheries and research carried out in Subarea 5 and Statistical Area 6 in 1974 (16 pages).
- 75/40 3618 Pinhorn, A.T. Status of fisheries and research carried out in Subarea 2 in 1974 (7 pages).
- 75/41 (Rev.) 3619 Halliday, R.G. Status of fisheries and research carried out in Subarea 4 in 1974 (6 pages).
- 75/42 (Rev.) 3621 Parrish, B.B. Status of fisheries and research carried out in Subarea 3 in 1974 (9 pages).
- 75/43 3622 Dumitrescu, V., and Gh. Vaslaban. Romanian Research Report, 1974 (7 pages).
- 75/44 (Rev.) 3628 Mansfield, A.W. Status of the harp and hood seal fisheries and research carried out in 1974 (2 pages).
- 75/45 3668 ICNAF Secretariat. Statistics on discards, 1973 (13 pages)
- 75/46 3669 NEAFC. Northeast Atlantic Fisheries Commission, Thirteenth Annual Meeting: press notice (7 pages).

RESEARCH DOCUMENTS

<u>Res. Doc. No.</u>	<u>Serial No.</u>	
75/1	3428	<u>Sergeant, D.E.</u> Results of Canadian research on harp seals, 1974 (4 pages).
75/2	3430	<u>Winters, G.H.</u> Review of capelin ecology and estimation of surplus yield from predator dynamics (25 pages).
75/3	3431	<u>Ulltang, Ø.</u> A summary of Norwegian research carried out on capelin in Newfoundland and Labrador waters, 1969-1974 (17 pages).
75/4	3432	<u>Ulltang, Ø.</u> The present capelin situation in the Barents Sea (1 page).
75/5	3433	<u>Stanek, E.</u> The percentage of capelin in the stomach contents of cod in ICNAF Subareas 2 and 3 (9 pages).
75/6	3434	<u>Gulimov, A.V., and S.M. Kovalev.</u> Estimation of commercial stock of Newfoundland capelin within a single mathematical model (13 pages).
75/7	3435	<u>Serebrov, L.I., V.S. Bakanev, and S.M. Kovalev.</u> The state of Newfoundland capelin stock (11 pages).
75/8	3436	<u>Smedstad, O.M.</u> Some notes about the influence of the capelin fishery on the food supply of Arcto-Norwegian cod (7 pages).
75/9	3451	<u>Sutcliffe, W., R.H. Loucks, and K.F. Drinkwater.</u> Consideration of coastal circulation and fish production on the Scotian Shelf and in the Gulf of Maine (33 pages).
75/10	3452	<u>Lett, P.F., A.C. Kohler, and D.N. Fitzgerald.</u> A model of the interaction of temperature with the recruitment mechanism for the Gulf of St. Lawrence cod stock (27 pages).
75/11	3453	<u>Johnston, C., M.D. Nicholson, and J.A. Pope.</u> Fish market sampling in Scotland (6 pages).
75/12	3454	<u>Nicholson, M.D., and D.W. Armstrong.</u> A note on a possible source of bias in the estimation of mean length at age (6 pages).
75/13	3457	<u>Anderson, E.D., and F.E. Nichy.</u> A comparison between US and USSR silver hake ageing (5 pages).
75/14	3458	<u>Anderson, E.D.</u> The effect of a combined assessment for mackerel in ICNAF Subareas 3, 4 and 5, and Statistical Area 6 (14 pages).
75/15	3465	<u>Anderson, E.D.</u> Relative abundance of Atlantic mackerel off the northeastern coast of the United States (20 pages).
75/16	3468	<u>Shotton, R., and R.G. Dowd.</u> Current research in acoustic fish stock assessment at the Marine Ecology Laboratory (17 pages).
75/17	3469	<u>Doubleday, W.G.</u> Beaver Harbour herring sampling experiment (4 pages).
75/18	3470	<u>Brown, B.E., J.A. Brennan, M.D. Grosslein, E.G. Heyerdahl, and R.C. Hennemuth.</u> The effect of fishing on the marine finfish biomass in the Northwest Atlantic from the eastern edge of the Gulf of Maine to Cape Hatteras (29 pages).
75/19	3471	<u>Ikeda, I., and S. Kawahara.</u> Age and growth of common American squid ( <i>Loligo</i> ) estimated from size composition (11 pages).
75/20	3472	<u>Hamre, J., Ø. Ulltang, and O.J. Østvedt.</u> Report on the Norwegian sampling program for industrial catches of herring, mackerel and capelin (10 pages).
75/21	3475	<u>Fuertes, J.R.</u> Observations on board a Spanish pair trawler in Subarea 1 of the ICNAF Area (16 pages).
75/22	3477	<u>Pitt, T.K.</u> An assessment of American plaice in ICNAF Subdivision 3Ps (3 pages) + Corrigendum (1 page).

- 75/23 3478 Bowering, W.R., and T.K. Pitt. Yield-per-recruit assessment of witch (*Glyptocephalus cynoglossus*) for ICNAF Divisions 3N and 30 (5 pages).
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