International Commission for the Northwest Atlantic Fisheries

Serial No. 5074
(B.g. 7)

ICNAF Summ. Doc. 77/VI/16
Corrigendum

ANNUAL MEETING - JUNE 1977

Report of Assessments Subcommittee, 19-27 April 1977

1. After the preparation and distribution of the Report of the Assessments Subcommittee (Summ. Doc. 77/VI/16), the following errors have been noted:

   a) Page 5, Sec. 2, line 6: "the TAC for 1977" should read "the TAC for 1978".

   b) Page 6, para. 2, line 5: The recruitment values in parentheses should read "recruitment values of 350, 550 and 400 (millions of fish) derived from".

   c) Page 6, para. 2, line 7: Between "recruitment" and "was". insert "for 1975 year-classes and onwards".

   d) Page 6, first text table: The values for catch under F = 0.10 for 1979 and 1980 should be "112" and "140" instead of "108" and "123".

   e) Page 8, line 4: "MSY and 2/3 MSY" should be "F_{MSY}" and "2/3 F_{MSY}".

   f) Page 10, line 2: Insert "minimum" between "otter trawl" and "mesh size".

   g) Page 11, para. 2, line 7: Change "1965-70 level" to "pre-1976 level".

   h) Page 12, Sec. 17, para. 2, line 1: Change "Subcommittee" to "Scientific Advisers to Panel 1".

2. The above-mentioned corrigenda will be incorporated in the Report of the Assessments Subcommittee, which will be published in *Redbook* 1977, as Appendix I to the STACRES Report of the 1977 Annual Meeting.

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REPORT OF ASSESSMENTS SUBCOMMITTEE

Chairman: A. T. Pinhorn

The Assessments Subcommittee met at Dartmouth, Canada, during 19-27 April 1977 to review the state of and to advise catch levels in 1978 for certain stocks in Statistical Area 0 and Subareas 1 to 4. Representatives attended from Canada, Cuba, Denmark, France, Federal Republic of Germany, German Democratic Republic, Japan, Poland, Portugal, Spain and USSR, and observers from USA. The review of catch levels was carried out in two working groups of the Subcommittee as follows: Working Group No. 1 (convened by E. C. Lopez-Veiga) reviewed the relevant stocks of cod, redfish, Greenland halibut, roundnose grenadier and shrimp; and Working Group No. 2 (convened by G. H. Winters) reviewed the relevant stocks of American plaice, witch, yellowtail, silver hake, argentine, capelin and squid.

I. SUMMARY OF RECENT CATCHES AND TACs

The Subcommittee used as the basis for discussion the Canadian request for advice on 18 stocks which lie within or partly within its 200-mile fisheries management zone in Subareas 2 to 4, and three stocks which overlap the Canadian and Danish fisheries zones in Statistical Area 0 and Subarea 1 (Comm. Doc. 77/VI/4). The Subcommittee also reviewed the cod stock in Subarea 1 at the request of Denmark, and the three stocks which lie completely outside of the national fisheries zones in Division 3M. In reviewing the state of the various stocks, the Subcommittee took account of the Canadian view on options to be considered in providing advice on the scientific basis for management in 1978 (Comm. Doc. 77/VI/12). A summary of recent catches and TACs relevant to stocks reviewed at the present meeting of the Subcommittee is given in Table 1, together with advised TACs for 1978. Details of the stock reviews are given in the following section.

Table 1. Summary of recent catches (1972-76) and TACs (1974-77) for stocks reviewed at the April 1977 Meeting of the Assessments Subcommittee, together with advised TACs for 1978 in parentheses.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)				
		1972	1973	1974	1975	1976[1]	1974	1975	1976	1977	1978
Cod	1	111	63	48	48	34	107	60	45	31	( )[6]
	2GH	14	+	4	7	6	20	20	20	20	(20)
	2J+3KL	458	355	373	288	216	657	554	300	160	( )[7]
	3M	58	23	25	22	25	40	40	40	25	(40)
	3NO	103	80	73	44	25	101	88	43	30	( )[8]
Redfish	2+3K	20	39	30	26	24	30	30	30	30	(30)
	3M	42	22	35	16	16	40	16	16	16	(16)
	3LN	29	33	22	18	18	28	20	20	16	(16)
	3O	16	9	13	15	15	16	16	16	16	(20)
Silver hake	4VWX	114	299	96	116	97	100	120	100	70	(81)
A. plaice	2+3K	9	5	6	6	7	10	8	8	8	(6)
	3M	1	1	2	2	1	2	2	2	2	(4)
	3LNO	59	53	46	43	51	60	60	47	47	( )[9]
Witch	2J+3KL	17	24	16	12	11	22	17	17	17	(17)
	3NO	9	7	8	6	8	10	10	10	10	(10)
Yellowtail	3LNO	39	33	24	23	8	40	35	9	12	(15)
G. halibut	0+1	14	10	14	25	15	-	-	20	20	(25)
	2+3KL	30	29	27	29	24	40	40	30	30	(30)
R. grenadier	0+1	8	5	12	5	7	-	10	14	8	(8)
	2+3	24	18	28	27	24	32	32	32	35	(35)
Argentine	4VWX	6	1	17	15	9	25	25	25	20	(20)
Capelin	2+3K	46	136	127	199	209	110[2]	160[2]	160[2]	212.5[2]	(300)
	3LNOPs	25	132	161	167	134	148[3]	180[3]	180[3]	200	(200)
Squid-*Illex*	3+4	2	10	+	18	37	-	25[4]	25[4]	25[4]	(25)
Shrimp	1	10	13	18	38	50	-	-	-	36[5]	( )[10]

1 Provisional statistics for Assessments Meeting.
2 In addition, countries without specific allocations may each take up to 10,000 tons.
3 In addition, countries without specific allocations may each take up to 5,000 tons.
4 In addition, countries without specific allocations may each take up to 3,000 tons.
5 TAC pertains to offshore fishing grounds in Subarea 1.
6 See section II(1) for TAC options.
7 See section II(3) for options.
8 See section II(5) for options.
9 See section II(13) for options.
10 Conservation measures for 1978 depend largely on data derived from the fishery during 1977; see section II(24).

II. STOCK ASSESSMENTS

1. Cod in Subarea 1 (Res. Doc. 77/VI/8)

Provisional statistics for 1976 indicate that the nominal catch of cod decreased futher to 33,700 tons in 1976 from the low catch of 47,900 tons in 1975. The 1976 catch is about 75% of the TAC of 45,100 tons adopted by the Commission for that year but is slightly above the TAC of 31,000 tons adopted for 1977. The decrease in catch from 1975 to 1976 is not evenly distributed among divisions, as there was a slight increase in Div. 1E and 1F and the decrease in the northern part of the Subarea (Div. 1A to 1D) was somewhat greater than the overall decline of 14,200 tons. In Div. 1B, where a significant fishery took place in earlier years, there was practically no offshore cod fishing in 1976. About one-third of the 1976 catch was taken in Div. 1E. There was no noticeable change in the breakdown of the catches by gear categories, otter trawls accounting for about 60% of the catch in 1975 and in 1976. The overall catch-per-unit-effort of Greenland trawlers decreased only slightly (about 8%) from 1975 to 1976, and, on the basis of data from this fleet, the overall effort appears to have declined by about 25% from the 1975 level.

In terms of numbers of fish caught, the removals increased from about 16.7 million fish in 1975 to about 21 million fish in 1976, of which about 10 million fish belong to the 1973 year-class which started to recruit to the otter trawl and poundnet fisheries in 1976. The mean weight of fish in the catches decreased from about 2.9 kg in 1975 to 1.7 kg in 1976 but was as low as 1.0 kg in some samples from otter trawl and poundnet landings. The 1973 year-class dominated (up to 90%) in some commercial catches by Federal Republic of Germany trawlers in the latter part of 1976.

The small number of older age-groups in the stock and the recruitment of the relatively good 1973 year-class to the fishery seems to have led to a change in fishing pattern so far as partial recruitment is concerned. When fishing conditions were much more favourable in the 1960's, the distant water fleets of otter trawlers concentrated their activity in the first half of the year on schools of mature fish. Catch rates were relatively high and the fishery did not concentrate on newly-recruited age-groups. By 1976, however, it seems that the best catch rates were achieved when fishing took place on concentrations of the 1973 year-class. It is thus likely that a considerably greater part of the effort was directed toward the taking of smaller fish in 1976 than had been the case in former years. Consequently, the use of partial recruitment information from earlier assessments of this stock leads to quite unrealistic estimates of the number of fish in the stock. Since the Subcommittee did not have available the information required to calculate new partial recruitment factors, some likely upper and lower limits were used in the assessment. Although it was not possible to calculate the present stock size and the number of pre-recruits, the analyses clearly show the relative changes in stock size, spawning biomass and catches that will result from using various management strategies. The Subcommittee was concerned that the spawning stock is at a critically low level, and, although it is not possible at present to indicate a biological optimum level for the spawning stock (target spawning biomass), it was the general feeling that management strategy should allow for improvement in the stock size. Since a TAC of 31,000 tons has been adopted by the Commission for 1977, the analyses using various strategies assume that this quantity will be fully taken. The likely implication of the various strategies are given in Table 2. On the basis of present estimates of stock size and forthcoming recruitment, the figures given for Strategy 1 show what would have been the implication, if the Commission had adopted a zero TAC for 1977.

In computing the spawning biomass and catch estimates of Table 2, the following assumptions were made: the 1973 year-class is exposed to the same fishing mortality as age-groups 6 and older; partial recruitment for other age-groups is 60% for age 3, 72% for age 4 and 88% for age 5; recruitment of 3-year-olds is 85 million fish for the 1973 year-class, 30 million for the 1974 year-class, 40 million for the 1975 year-class, and 20 million for the 1976 year-class.

If a zero TAC had been set for 1977 (Strategy 1), the improvement in spawning biomass by 1979-80 would have been about two-thirds of the TAC actually set for 1977 (31,000 tons). Similar, or even relatively greater improvement in spawning stock by 1970 would likely occur if a zero TAC were set for 1978 (Strategies 6-8), although it should be realized that some by-catches of cod (possibly 2,000

Table 2. Estimated catch and spawning biomass (000 tons) for different management strategies: the figures for Strategy 1 show what the results would have been in 1978-80 for F = 0.25 in 1978 and 1979 if the TAC had been set at zero for 1977; Strategies 2 to 8 assume that the 1977 TAC of 31,000 tons will be taken.

Strategy No.		1	2	3	4	5	6	7	8
1978	Spawning biomass at start of year	141	119	119	119	119	119	119	119
	Fishing mortality(F)	0.25	0.25	0.15	0.15	0.10	-	-	-
	Projected catch	51	44	27	27	19	-	-	-
1979	Spawning biomass at start of year	163	137	151	151	159	175	175	175
	Fishing mortality(F)	0.25	0.25	0.15	0.10	0.15	0.25	0.15	0.10
	Projected catch	46	40	27	19	28	50	31	21
1980	Spawning biomass at start of year	151	129	156	165	164	163	180	189

tons) would be taken in fisheries for species other than cod. In any case, unless fishing mortality is increased above the levels indicated in Table 2, some improvement in spawning stock biomass is expected by 1979-80, due to the recruitment of the relatively good 1973 year-class to the spawning stock by that time. However, since the present level of spawning stock is considered to be very low (about one-tenth of the level prevalent in the 1960's), the Subcommittee advises that the cod stock in Subarea 1 be managed in such a way as to allow the greatest possible improvement in the spawning stock, that is, that the 1978 catch should be kept at the lowest possible level.

Although the spawning stock is expected to improve by 1979-80, the improvement will be only of short-term duration unless good year-classes are produced after 1976 that are at least as good as the 1973 year-class is thought to be. As indicated above, there are uncertainties about the actual level of stock size and recruitment, and the figures in Table 2 can only be considered as indicative of trends. The actual prediction of catch level and stock size is greatly dependent on the estimates of the recruiting year-classes. Thus, when the 1973 year-class enters the spawning stock by 1979, it will constitute about one-third and probably even one-half of the spawning biomass in 1979 and 1980. The individuals of the 1973 year-class are likely to increase their weight by about one-third from 1978 to 1979 (and die at a rate of about 20% annually). Thus, in terms of yield-per-recruit, there would be some reason to keep fishing low in 1978, but not as strong as for keeping fishing low in 1977. However, the major concern of the Commission should be the desirability of increasing the spawning stock biomass.

2. Cod in Divisions 2G and 2H

The provisional catch of 6,300 tons in 1976 is slightly lower than the 1975 catch of 6,960 tons. The catches from this area are generally unpredictable due to variable ice conditions. Because of the small catch in 1976, there was a complete lack of biological sampling, and it was not possible to reassess the stock. Catch rates of FRG trawlers indicate little or no change in the state of the stock from 1975 to 1976. Lacking new biological information, the Subcommittee could find no reason to recommend a change in the TAC, and therefore advises that the TAC for 1977 should remain at 20,000 tons.

3. Cod in Divisions 2J, 3K and 3L (Res. Doc. 77/VI/26; Summ. Doc. 77/VI/8, 15)

a) Stock assessment

Catches in this area declined from an average of about 640,000 tons in 1966-70 to about 380,000 tons in 1971-75. Recent annual catches (1976 being provisional) and TACs are as follows:

	1973	1974	1975	1976	1977
TAC (000 tons)	666	657	554	300	160
Catch (000 tons)	355	373	288	216	

Seasonally adjusted catch rates, derived from Spanish otter trawl catch and effort data, declined about 40% in the 1967-74 period, but there appears to have been some improvement in 1975. USSR survey data indicates that the stock in 1976 was at a relatively low level due to a series of poor year-classes (especially those of 1970 and 1971) but that the biomass should improve substantially in 1977 and 1978 with the recruitment of the much stronger 1972 and 1973 year-classes. From these surveys, it was observed that the mean catch (by weight) per hour trawling in Div. 3K increased by 6.4 times and in Div. 3L by 2.4 times, with respect to the catch per hour in 1975. Sampling data indicate that the 1972 year-class was dominant in the commercial catches in 1976. Length frequencies of Polish cod catches in Div. 2J and 3K during the first quarter of 1977 show average lengths of about 40 cm, implying that the 1972 and 1973 year-classes will comprise the bulk of the catches in 1977. FRG research vessel surveys in recent years show that the 1972 year-class is very much stronger than those of adjacent years.

The fishing mortality generated on this stock in 1975, estimated from regressions of F against two standard units of effort (Spanish otter trawl, USSR otter trawl), was in the order of 0.5. The Subcommittee considered a virtual population analysis for the stock, together with projections of catch and spawning biomass based on the analysis, assuming that the 1977 TAC of 160,000 tons would be taken and using recruitment values (3500, 5500 and 4000) derived from USSR young fish surveys for the 1972, 1973 and 1974 year-classes respectively. In making the projections, recruitment was taken at the average value as no stock-recruitment relationship incorporating biotic and abiotic environmental factors has been determined. The Subcommittee stresses that the long-term forecasts should be considered as indicating trends, as the actual recruitment in future years may be much better or worse than the average. While not advising a specific TAC for 1978, the Subcommittee indicates that catches and spawning biomass (000 tons) for 1978-80 at $F_{0.1}$ and at two lower levels of F are projected as follows:

	$F_{0.1}$ = 0.2		F = 0.15		F = 0.10	
Year	Catch	Spawning biomass	Catch	Spawning biomass	Catch	Spawning biomass
1978	162	392	125	392	85	392
1979	199	481	159	506	108	533
1980	233	695	192	768	123	850

The Subcommittee considered the relationship between spawning biomass as derived from virtual population analysis and recruitment as indicated from young fish surveys, and advises that an adequate spawning biomass for this stock might be in the range of 1.2-1.8 million tons, with 1.5 million tons as the reference point. It was further noted that stock-recruit relationships generally show a great deal of variation. Poor recruitment may result from a large spawning stock and very good recruitment from a small spawning stock. Assuming average recruitment, catches and biomasses were estimated in 1985 for three levels of F. In view of the uncertainty in predicting recruitment, these estimates may be considered only as indicative of trends. Comparing the projected catches in 1985 at the various levels of F with the TAC of 160,000 tons in 1977 and comparing the corresponding projected biomasses in 1985 with the target spawning biomass of 1.5 million tons (under average conditions), the percentage changes are indicated as follows:

	F = 0.20	F = 0.15	F = 0.10
Percentage change in 1985 catch relative to 1977 TAC	198	177	142
Percentage of target spawning biomass reached in 1985	78	98	123

The USSR scientists felt that the management strategy for stocks subject to large natural fluctuations cannot be exercised on a long-term basis, and the aim of continually increasing the spawning biomass has no substantial biological evidence. Such action could only be justified when the spawning stock fails to generate strong year-classes. With respect to cod in Div. 2J+3KL, two strong year-classes of 1972 and 1973 are evident and the stock itself will tend to increase by fishing at $F_{0.1}$ = 0.2. Consequently, it is the view of USSR scientists that the 1977 TAC of 160,000 tons can be maintained for 1978.

b) Inter-relationships of cod stocks in Divisions 2J, 3K and 3L

The Subcommittee reviewed the information presented to its 1974 Meeting and reiterates the advice given at that time (*Redbook* 1974, page 80). Returns from cod tagged offshore in Div. 2J, 3K and 3L indicate that large numbers of cod seasonally migrate inshore where they are exploited by the inshore fishery. Templeman (J. Fish. Res. Bd. Canada 1974, Vol. 31, pages 1073-1092) showed that returns from the offshore fishery of cod tagged in inshore areas were substantial. The Subcommittee considered it very unlikely, due to topographic and hydrographic conditions, that large concentrations of cod could successfully overwinter inshore, except in the deepwater bays in Div. 3L. This is in contrast to the situation at West Greenland where local cod stocks may be found in certain fjords. The Subcommittee therefore concluded that the cod being exploited by the inshore and offshore fisheries comprise one stock, this being in accord with the conclusion of the Subcommittee at its 1974 Meeting. The relationship between the inshore and offshore fisheries is, therefore, one of competition between components of the fishery. It was noted that hydrographic conditions would tend to affect availability of cod to the inshore gears more than to the mobile offshore fleet.

The Subcommittee advises that it is not possible at present to project in a precise way the effects upon the inshore fishery of fishing at $F_{0.1}$ or at other levels of F. Nevertheless, it is clear that, if fishing is conducted at levels of F which result in increased stock biomass, catch rates for both the inshore and the offshore fisheries would improve. The faster the rate of recovery of the biomass, the faster the catch rates will improve.

4. Cod in Division 3M (Res. Doc. 77/VI/15, 28; Summ. Doc. 77/VI/15)

The cod catch in this area declined from an average of 42,000 tons during 1965-69 to about 25,000 tons annually since 1973. As assessment presented in 1973 indicated that the average long-term yield is about 40,000 tons annually, an estimate which was confirmed by a general production model assessment presented at the 1976 Meeting of the Subcommittee and updated at the present Meeting (Res. Doc. 77/VI/28). In 1976, the Subcommittee considered that the stock was not in a condition to support catches at the MSY level and consequently recommended a reduction in TAC to 25,000 tons for 1977. However, some evidence presented at the present meeting indicates an improvement in the stock. Catch rates for the Portuguese fleet were somewhat higher in 1976 than in 1975, and USSR young fish surveys indicate that an exceptionally strong 1973 year-class will likely enter the fishery by 1978. Although it was felt that the TAC for 1978 could be set above the level of the long-term MSY, due to the recruitment of the 1973 year-class, the Subcommittee considered it unwise to do so. By setting the TAC at the MSY level, the benefits of the strong 1973 year-class would be expected to extend over a period of 3-4 years, stabilizing the catches and making a significant contribution to a complete recovery of the spawning biomass. The Subcommittee therefore advises that the TAC for 1978 should be set at 40,000 tons.

5. Cod in Divisions 3N and 3O (Res. Doc. 76/VI/108, 77/VI/17; Summ. Doc. 77/VI/8, 15)

Cod catches in this area declined from a high level of 227,000 tons in 1967 to 44,000 tons in 1975. The provisional catch in 1976 was about 25,000 tons. Catches and shortfalls (000 tons) in relation to TACs since 1973 have been as follows:

	1973	1974	1975	1976
TAC	103	101	88	43
Catch	80	73	45	25
Shortfall	23	28	43	18

Sampling data for 1975 and 1976 were insufficient to produce satisfactory age compositions of the catches for these years, and, consequently, it was not possible to complete a reliable analytical assessment of the stock.

Seasonally adjusted catch rates of Spanish pair trawlers showed a marked decline from 1.5 tons per hour in 1971 to 0.4 tons per hour in 1975, implying continued high effort and a low level of stock size. Effort data in terms of catch-per-hour were not available for 1976, but an estimate of the catch-per-day-fished in Div. 3LNO was derived for 1976 and compared with values calculated for previous years. These values indicated that fishing effort in 1976 for Div. 3LNO (and possibly for Div. 3NO) was below that in 1975. A general production analysis, using catch-per-unit-effort data for Spanish pair trawlers during 1960-75, indicates that the stock in 1975 was at a relatively low level. Canadian survey data show the stock in 1973-76 to be considerably below the level in 1971-72. USSR young fish surveys indicate that the incoming 1973 and 1974 year-classes are somewhat better than average. The lack of adequate sampling data makes the assessment of this stock difficult, but

there was general agreement in the Subcommittee that the present stock size is at a lower level than in the 1960's. Assuming that the effective fishing effort in 1976 and 1977 is at about the same level as in 1975, the Subcommittee advises that catches of 30,000 tons and 20,000 tons in 1978 would correspond approximately to fishing at the MSY and 2/3MSY respectively.

USSR scientists consider that a catch of 30,000 tons in 1978 would be conservative.

6. Redfish in Subarea 2 and Division 3K (Res. Doc. 77/VI/18)

General production model analysis indicates that this stock can sustain catches of 40,000-45,000 tons per year under equilibrium conditions. The catch increased from about 20,000 tons in 1972 to 39,000 tons in 1973 but declined to 30,000 tons in 1974 due to the implementation of a TAC of 30,000 tons in that year. Even though the TAC has remained at 30,000 tons, the catch further declined to 26,000 tons in 1975 and to 24,000 tons in 1976. Catches in relation to fishing effort during 1966-74 were below the equilibrium curve, and both the effort and catch-per-unit-effort have remained relatively stable over the last decade. Statistics reported for 1975 indicate that much of the redfish may have been taken as by-catch in fisheries for other species. There was insufficient catch and effort data for cases where redfish could be designated as the main species sought, and consequently it was not possible to determine realistic effort and catch-per-unit-effort values for 1975 that correspond with the standardized method used for earlier years.

Commercial bottom trawl sampling data for recent years show a broad range of length and age groups, and midwater trawl samples for 1976 were similar. Recent research vessel sampling data also confirm the existence of a wide range of sizes and ages in the stock with the 1960-64 year-classes dominant and those of the late 1950's and early 1960's proportionately more abundant at greater depths. The TAC for 1974 to 1977 was set at 30,000 tons in order to allow the stock to rebuild from the relatively low levels prevalent from the late 1960's to 1975. In order that stock rebuilding may continue, the Subcommittee advises that the TAC for 1978 should remain at 30,000 tons.

7. Redfish in Division 3M (Res. Doc. 77/VI/7, 18)

General production modal analysis indicates that an MSY in the range of 13,000-17,000 tons can be sustained for this stock. Yield-per-recruit analysis indicates that $F_{0.1}$ is in the range of 0.2-0.3 and that, during 1963-73, when catches averaged 13,600 tons, the fishing mortality may have been at or in excess of $F_{0.1}$ under average recruitment conditions. Updating of the yield-per-recruit assessment has not been possible due to the lack of age composition data for 1974-76. Catches averaged 8,500 tons during 1966-71, increased to 42,000 tons in 1972 with an increase in effort, declined to 22,000 tons in 1973, and increased to 35,000 tons in 1974 under a TAC regulation of 40,000 tons for that year. The TAC was substantially reduced to the MSY level of 16,000 tons in 1975 and remained at that level for 1976 and 1977. Catches in 1975 and 1976 were at the TAC level of 16,000 tons.

Effort and catch-per-unit-effort data presented in Res. Doc. 77/VI/7 and 77/VI/18 show similar trends although slightly different standards were used. The catch-per-standard-day fished (Res. Doc. 77/VI/18) increased from 3.4 tons in 1969 to 7.8 tons in 1972 but decreased to 5.5 tons in 1974 and 5.4 tons in 1975. Both catch and effort declined substantially from 1974 to 1975 due to the reduction in TAC from 40,000 to 16,000 tons. Commercial length frequency data indicate that the 1963 year-class comprised a relatively high proportion of catches during 1973-76. Both research and commercial sampling data indicate that the 1972 year-class is better than average. Therefore, based on the evidence of stabilizing catch-per-unit-effort and the recruitment of a better-than-average year-class to the fishery, the Subcommittee advises that the TAC should remain at 16,000 tons, approximately the level of the estimated MSY.

8. Redfish in Division 3LN (Res. Doc. 77/VI/18)

Catches in this area have increased from about 10,000 tons in 1964 to 34,000 tons in 1971, declined to 29,000 tons in 1972 and increased again to 33,000 tons in 1973. These latter catches were in excess of the estimated MSY level of 20,000 tons derived previously from a general production model analysis of catch and effort data. From 1974 the fishery has been regulated with TACs of 28,000, 20,000 and 20,000 tons in 1974-76 respectively. Consequently the annual catch declined to 22,000 tons in 1974 and to 18,000 tons in 1975 and 1976. The TAC was reduced to 16,000 tons for 1977. In 1974 there was a significant shift from fishing with bottom trawl when 80% of the catch was taken with midwater trawl, but the pattern was reversed in 1975 when 89% of the catch was taken with bottom trawls mainly in Div. 3N. The previous general production model analysis was updated with data for 1974 and 1975. The catch of 17,870 tons in 1975 was slightly less than the MSY, and the fishing effort of 15,370 hours was close to the level of effort required to take the catch equivalent to the MSY. With the decline in both catch and effort after the introduction of TAC regulation, the catch rate has increased slightly from 1.3 tons per hour in 1973 to 1.5 tons per hour in 1975.

Despite the high level of catches in 1971-73, no length or age composition data were collected from

the commercial catches. From midwater trawl samples in 1975, most of the males were in the range of 36-40 cm and the length distribution of females was biomodal at 30-34 cm and 40-46 cm. Canadian length composition data taken in Div. 3L during May-July of 1976 with midwater trawl were similar to those for 1975, but later in the year smaller males in the 29-33 cm range appeared in both the midwater and bottom trawl catches. Bottom trawl samples from Div. 3N contained smaller redfish in the range of 22-25 cm for males and 25-28 cm for females. Since the catches, catch rates and length composition data for 1976 do not indicate any significant change in the state of the stock from 1975 to 1976, the Subcommittee advises that the TAC should remain at 16,000 tons for 1978 so that the effort will be less than the F_{MSY} level in order to compensate for the high fishing effort in excess of the F_{MSY} level during 1971-73.

9. Redfish in Division 3O (Res. Doc. 77/VI/18)

Catches in this area declined from 20,000 tons in 1971 to 9,000 tons in 1973, but increased to 13,000 tons in 1974 and to 15,000 tons in 1975 and 1976. The fishery has been regulated by a TAC of 16,000 tons since 1974. The catch-per-standard-hour-fished has stabilized at 1.1-1.2 tons in 1973-75 from a much lower level of 0.4 tons in 1965. USSR catch/effort data for 1976 indicate the same catch rate as for 1975. The significant upward trend in the catch rate from the low level of the mid-1960's indicates that an increase in abundance or availability has occurred in recent years. Canadian length composition data from commercial catches in 1976 indicate a high proportion of newly recruited young fish.

Although the general production model for this stock has no built-in time lag, the data points fit the curve reasonably well. In view of the favourable catch rate, good recruiting year-classes and improved condition of the stock as reflected in the general production model, the Subcommittee advises that the TAC for 1978 should be increased to 20,000 tons, which is the estimated MSY level from the simplified application of the general production model.

10. Silver hake in Divisions 4V, 4W and 4X (Summ. Doc. 77/VI/13; Res. Doc. 77/VI/6, 25, 34, 44)

a) Review of ageing problems

The Subcommittee reviewed the report of the Silver Hake Ageing Workshop held at St. Andrews, Canada, during 14-18 March 1977 and attended by ageing experts from Canada, USSR and USA (Summ. Doc. 77/VI/13). There was general agreement that both whole otoliths stored in glycerine and sections from dry-stored otoliths were acceptable for ageing silver hake and that age readers should be familiar with both methods. Age validation studies using length frequencies or other potential ageing structures were recommended. It was noted that past discrepancies on the estimation of the age composition of commercial catches could be due to the presence of a pelagic zone laid down during the first year of life. The Subcommittee

recommends

that further otolith exchanges should take place to establish whether a need exists for a silver hake ageing workshop in 1978.

Following the ageing workshop at St. Andrews, the newly agreed techniques were applied to otoliths collected on a Canadian research cruise in Div. 4W in July 1976 (Res. Doc. 77/VI/25). Age compositions of the catches from the entire survey were obtained by using age-length keys from otolith ageing and by using corresponding age-length keys constructed from the modal analysis technique used in Canadian assessments. Excellent agreement was observed between the two methods for age-groups 1 to 3.

b) Stock assessments

The provisional nominal catch in 1976 was 97,100 tons, slightly less than the TAC of 100,000 tons. A total of 81,200 tons was reported by USSR, 12,600 tons by Cuba, 3,100 tons by Bulgaria and small quantities by five other countries. Cuban scientists presented a preliminary estimate of the natural mortality rate for silver hake (Res. Doc. 77/VI/6). On the basis of this study, the Subcommittee agreed that the natural mortality was likely to be less than 0.5 and that M = 0.4 would be the best value for assessing the 1978 TAC.

Assessments of the silver hake stock were presented by USSR (Res. Doc. 77/VI/34) and Canadian (Res. Doc. 77/VI/44 + Corrigendum) scientists. When the USSR catch projection was recalculated to allow for a total reported catch of 97,100 tons in 1976, the projected 1978 catch at $F_{0.1}$ = 0.50 under the historical pattern of fishing was 70,000 tons, compared with 81,000 tons in the Canadian assessment. The Subcommittee noted that the difference in projected catches was slight and accepted the Canadian estimates of the age composition of the commercial catch and of the natural mortality rate as the basis for calculating options for 1978.

The Canadian assessment included a theoretical analysis of the possible effects of limiting the otter trawl mesh size to 60 mm manila equivalent (effective 1 April 1977) based on mesh selection experiments carried out by USA in Subarea 5. The Subcommittee noted that firm predictions about the consequences of the mesh size regulation could not be made without stronger experimental evidence, and accordingly

recommends

that mesh selection experiments be carried out in 1977 to determine the consequences of the silver hake mesh size regulation in Div. 4VWX.

The Subcommittee noted the results of Canadian calculations on the possible effects of the 60 mm manila equivalent mesh regulation. By changing the partial recruitment at age, fishing at $F_{0.1}$ = 0.65 in 1978 might correspond to a catch of as little as 61,000 tons. However, even if this is the true selection pattern in 1978 and a catch of 81,000 tons is taken (rather than 61,000 tons), the biomass of all age-groups (age 1 and older) will still increase to 265,000 tons at the beginning of 1979. This increase will be at least as great as the increase in biomass at this catch level, if the mesh regulation does not modify the partial recruitment at age from that observed historically. This is due to the projected release of more fast-growing young fish under the assumption of a modified selection pattern than under the historical pattern, even though the exploitation of older age-groups will be at an F greater than $F_{0.1}$ = 0.65. The Subcommittee therefore advises that the 1978 TAC should be 81,000 tons, recognizing that the stock biomass will likely increase to 255,000-265,000 tons in 1979. Although an analytical assessment of this stock is available, the Subcommittee considered that the projection of catch and biomass beyond 1978 would be unrealistic because of the large fluctuations in recruitment observed in this stock.

11. American Plaice in Subarea 2 and Division 3K (Res. Doc. 77/VI/9)

Nominal catches since 1973 have averaged about 6,000 tons. A TAC of 8,000 tons, aimed at management at the $F_{0.1}$ level, has been in effect since 1974. This fishery has been to a certain extent a by-catch fishery, at least for the offshore otter trawl component. The Canadian inshore gillnet fishermen have, in the past few years, experienced declines in catch rates. USSR survey data also indicate a reduction in abundance. An assessment presented at this meeting indicates that the fishing mortality was approximately at $F_{0.1}$ during 1966-76 when catches averaged 6,300 tons. The Subcommittee therefore advises that the TAC for 1978 should be reduced to 6,000 tons.

12. American plaice in Division 3M

Nominal catches from this stock were as high as 5,300 tons in 1965 and 4,100 tons in 1966. Recent catches (1974-76) have averaged 1,500 tons. The TAC, based on catch statistics only, has been 2,000 tons since 1974. USSR survey data indicate a continuing increase in abundance indices during the 1971-76 period. Therefore, the Subcommittee advises that the TAC for 1978 should be increased to 4,000 tons.

13. American Plaice in Divisions 3L, 3N and 3O (Res. Doc. 77/VI/20)

Nominal catches from this stock have declined from a peak of 94,000 tons in 1967 to 68,000 tons in 1971 and subsequently to 43,000 tons in 1975. Provisional statistics for 1976 indicate that the catch is about 51,000 tons. Since 1976 the TAC has been aimed at managing the fishery at the $F_{0.1}$ level. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977
TAC (000 tons)	60.5	60	60	47	47
Catch (000 tons)	53.5	46	43	51	

The assessment of this stock has been based on a virtual population analysis for Div. 3LN with allowance made for the part of the stock in Div. 3O based on historical catches. The present assessment includes virtual population analyses for Div. 3LN and Div. 3O, indicating a somewhat lower value for Div. 3O than previously allowed for. Stock size and catch predictions were carried out based on fishing at the $F_{0.1}$ (0.43) level of fishing mortality and also at a level lower than $F_{0.1}$, namely F = 0.33. In addition, the projections were extended to 1985 using both management options. Recruitment values used in the projections to 1985 are averages of 1971-73 recruits at age 6 for males (64 million fish) and age 7 for females (125 million fish). The projections are listed in the following table, together with data for 1962-64, 1965-70 and 1976:

		1962-64	1965-70	1976	1978	1982	1985
A.	Fishing mortality	0.23	0.50	0.57	0.43	0.43	0.43
	Biomass (000 tons)	560	425	430	453	488	495
	Catch (000 tons)	27	72	52	47	56	56
B.	Fishing mortality				0.33	0.33	0.33
	Biomass (000 tons)				453	528	542
	Catch (000 tons)				32	48	52

Estimates of the biomass for the 1962-70 periods were based on virtual population analysis for Div. 3LN, and biomass estimates for Div. 30 were added, using the ratio of biomass in Div. 3LN to that calculated for Div. 30 in 1973.

The Subcommittee points out that the projections to 1985 are only intended to indicate relative trends in recovery of the stock at two different levels of fishing mortality, as the actual biomass that will result from fishing at these levels of F is subject to environmental fluctuation which is unpredictable. However, Option A indicates that management at $F_{0.1}$ (= 0.43) would increase the potential catch to 56,000 tons by 1985, which is close to the 60,000-ton TAC of 1973-75. Under Option B, on the other hand, while the biomass would increase more rapidly, the catch would remain somewhat lower and not reach the 1965-70 level until sometime after 1985.

14. Witch Flounder in Divisions 2J, 3K and 3L (Res. Doc. 77/VI/10)

The nominal catch from this stock increased from 4,400 tons in 1961 to 24,000 tons in 1973, and then declined to about 11,000 tons in 1976, with Canada, Poland and USSR accounting for most of the catches. The TAC was initially set at 22,000 tons in 1974, but, on the basis of an assessment in 1974, it was set at 17,000 tons for 1975 and remained at the level for 1976 and 1977 based on management at $F_{0.1}$ (0.30 for males and 0.25 for females). While catches from this stock are, to a certain extent, by-catches in fishing for other species, the fishery is of considerable importance to Canadian gillnet fishermen and a Canadian otter-trawl fishery in the offshore part of the area has developed in 1977. An update of the yield-per-recruit assessment at this meeting indicates that fishing at the $F_{0.1}$ level has been achieved. The Subcommittee therefore advises that the TAC for 1978 should remain at 17,000 tons.

15. Witch Flounder in Div. 3N and 3O (Res. Doc. 77/VI/12)

Recent nominal catches have ranged from 15,000 tons in 1971 to 6,200 tons in 1975 and 7,800 tons in 1976. The TAC has been constant at 10,000 tons since 1974. Removals from this stock are primarily as by-catch of other fisheries, although Canada began developing a directed fishery in 1976. The level of fishing mortality (F) during 1966-76 has been relatively close to $F_{0.1}$ (0.45 for males and 0.40 for females), with removals averaging about 8,500 tons. The Subcommittee advises that the TAC should remain at 10,000 tons for 1978.

16. Yellowtail Flounder in Divisions 3L, 3N and 3O (Res. Doc. 77/VI/19)

This stock has been subject to TAC regulation since 1973 as indicated in the following table together with the nominal catches (1976 catch is provisional):

	1973	1974	1975	1976	1977
TAC (000 tons)	50.0	40.0	35.0	9.0	12.0
Catch (000 tons)	32.8	24.2	22.9	7.8	

The assessment presented in 1975 pointed to a drastic reduction in stock abundance and indicated that very high fishing mortality (F in the range of 1.0-2.0) was required to take the catches in 1973-75. Abundance indices from both the Canadian and USSR surveys and from catch-per-unit effort of Canadian trawlers indicate that the stock has at least stabilized and may in fact have increased in abundance.

The major difficulty in assessing this stock is the problem of obtaining estimates of fishing mortality and recruitment for the most recent year of fishing (i.e. for 1976 in the present assessment). Abundance indices (average number per haul) from research vessel surveys gave excellent correlations for ages 6 to 8 with estimates of population size-at-age from cohort analysis for 1971-75. However, abundance indices of age 5 fish from survey data are of little use in determining the size of the

incoming year-class. In view of this problem, the catch projections for 1977 and 1978 were made for a range of recruitment of 5-year-old fish in 1976 to 1978, using F = 0.5 in 1977 and 1978:

Recruitment at age 5 (10^6 fish)	Catch in 1977 at F = 0.5 (000 tons)	Catch in 1978 at F = 0.5 (000 tons)
80	12.7 (15.5)	16.6
70	12.1 (13.7)	15.2
60	11.4 (12.0)	13.8
50	10.7 (10.3)	12.4

The figures in parentheses for 1977 are the catches predicted for the indicated levels of recruitment in the assessment presented to the 1976 Meeting of the Subcommittee (*Redbook* 1976, page 81).

As an additional exercise, the stock size (numbers at age) in 1976 was determined directly from the regression of population size on abundance indices of ages 6 to 9 from research vessel surveys (Res. Doc. 77/VI/19), and the stock size was projected to 1978. Using the same series of recruitment values as above, the catches in 1977 and 1978 were projected as follows:

Recruitment at age 5 (10^6 fish)	Catch in 1977 at F = 0.4 (000 tons)	Catch in 1978 at F = 0.5 (000 tons)
80	12.1	17.3
70	11.9	16.7
60	11.8	16.0
50	11.7	15.4

Based on an assumed annual recruitment of 60 million fish (age 5) in 1976 to 1978, the Subcommittee advises that the TAC for 1978 should be 15,000 tons.

17. Greenland Halibut in Statistical Area 0 and Subarea 1 (Res. Doc. 76/VI/109)

The nominal catch increased from less than 5,000 tons prior to 1972 to 14,000 tons in that year. There was a decline to 10,000 tons in 1973, but the catch increased rapidly to 25,000 tons in 1975. A precautionary TAC of 20,000 tons was introduced in 1976, and the provisional catch for that year is reported at 15,000 tons. Lacking adequate data for assessment, the precautionary TAC of 20,000 tons was continued for 1977.

At the 1976 Annual Meeting, the Subcommittee reviewed a paper (Res. Doc. 76/VI/109) which gave estimates of stock size based on observations from USSR scouting and commercial vessels. This paper was again reviewed by the Subcommittee at the present meeting. On the basis of a number of observations (catch per hour fishing) in a trawl survey at depths greater than 500 m between Greenland and Baffin Island-Labrador, USSR scientists conclude that the stock size in this area could support a catch of 50,000 tons. One of the determining factors in the basic calculation of the stock size is the efficiency of the trawls used, which was set as low as 10% (i.e. only 10% of the fish in front of the trawl would be caught and retained by the trawl). The Subcommittee welcomed the new information, but, noting the lack of detailed background data and pointing out the implications of small changes in the efficiency factor, considered that further data would be required in order to justify a significant increase in the TAC. Pending the provision of further information and taking account of the by-catch of immature Greenland halibut in the recently established shrimp fisheries in Subarea 1, the Subcommittee considered the possibility of increasing the precautionary TAC to 25,000 tons, corresponding to the highest catch in the history of the fishery in this area (in 1975). USSR scientists thought that a TAC of 35,000 tons would still be on a precautionary level, but other members of the Subcommittee considered it necessary to have more information before a TAC higher than 25,000 tons could be advised. The Subcommittee accordingly advises that a precautionary TAC of 25,000 tons should be set for 1978.

It was pointed out that, although the biological population may cover a wide area, a significant increase in the TAC would raise the question of a breakdown of the TAC by smaller areas in order to avoid local overfishing. It was noted that additional information might be available at the forthcoming Annual Meeting in June 1977, and the Subcommittee stressed the need for information on the magnitude and composition of the by-catch of Greenland halibut in the shrimp fisheries.

18. Greenland Halibut in Subarea 2 and Divisions 3K and 3L (Res. Doc. 77/VI/11)

Nominal catches averaged about 29,000 tons annually in 1972-75. The provisional catch for 1976 is somewhat below this level at 24,000 tons. The TAC for this stock was set at 40,000 tons for 1974-75 and reduced to 30,000 tons for 1976-77.

Biological studies indicate that most of the mature fish in this area are concentrated in deep water to the north of Div. 3K. A considerable part of the fishery for this species has therefore been directed at immature fish in shallower depths. This is especially the case for the Canadian gillnet fishery which is concentrated in the Canadian coastal waters of Div. 3K and 3L. Since proper assessment of this stock is impossible without adequate sampling from all components of the fishery, the Subcommittee

recommends

that scientific investigation of the probable segregation of mature and immature fish be continued and expanded, together with intensive sampling of the commercial catches.

Although USSR survey data indicate a substantial population of Greenland halibut in the northern part of this stock area, the only evidence available on exploitation rates indicates that the stock is presently being exploited at the $F_{0.1}$ level of fishing mortality. The Subcommittee accordingly advises that the TAC for 1978 should remain at 30,000 tons.

19. Roundnose Grenadier in Statistical Area 0 and Subarea 1 (Res. Doc. 77/VI/30)

Nominal catches in 1972-75 were in the range of 4,900-12,300 tons. Provisional statistics for 1976 indicate a catch of 7,400 tons, compared with 5,000 tons in 1975. The TAC was initially set at 10,000 tons for 1975, increased to 14,000 tons for 1976, and reduced to 8,000 tons for 1977, based on an assessment presented at the 1976 Annual Meeting, which determined that fishing at the level of $F_{0.1}$ should give a sustainable yield in the range of 7,400-9,800 tons. Lacking any evidence to warrant revising the TAC, the Sucommittee advises that the TAC for 1978 should remain at the 1977 level of 8,000 tons.

20. Roundnose Grenadier in Subareas 2 and 3 (Res. Doc. 77/VI/30)

Nominal catches in 1972-75 were in the range of 17,600-28,400 tons. Provisional statistics for 1976 indicate a catch of 23,600 tons, a decrease from the 1975 catch of 27,400 tons. The decline was mainly due to decreases in catch by German Democratic Republic (2700 to 500 tons) and by Poland (1500 to 100 tons).

The fishery, conducted in the most recent years, has had no noticeable effect on the age and size composition of the population. Lacking any evidence to warrant revising the TAC, as determined from an assessment at its 1976 Meeting, the Subcommittee advises that the TAC for 1978 should remain at the 1977 level of 35,000 tons.

21. Argentine in Divisions 4V, 4W and 4X

Provisional statistics for 1976 indicate a catch of 8,800 tons, which is approximately one-half of the catches in 1974 and 1975. The TAC, which was initially set at 25,000 tons in 1974, remained at that level in 1975 and 1976 but was reduced to the estimated MSY level of 20,000 tons for 1977. The Subcommittee noted the comment in its report to the 1976 Annual Meeting that, despite regulation of the fishery with a precautionary TAC since 1974, very few data have become available with which to determine the effect of fishing on the stock. Again, no data were available at the present meeting to determine the status of the stock, and the Subcommittee hence advises that the TAC should remain at 20,000 tons for 1978.

22. Capelin Stocks in Subarea 2 and Division 3K and in Divisions 3L, 3N, 3O and 3Ps (Res. Doc. 77/VI/5, 14, 16, 22, 32, 33)

Nominal catches from these stocks increased from 71,000 tons in 1972 to 288,000 tons in 1974, 366,000 tons in 1975 and to 343,000 tons in 1976. From survey and commercial sampling data, the 1973 year-class of capelin was identified as being relatively strong both with regard to the mature components spawning offshore in Div. 3N and inshore in Div. 3L and 3P as well as in the autumn fishery in Div. 2J and 3K. Despite the observed relative strength of this year-class, the spawning biomass of capelin on the Southeast Shoal (Div. 3N) in 1976 was lower than in 1975, although the abundance (in numbers) was higher. The lower spawning biomass in 1976 compared with 1975 was probably due to slow growth and lower maturation rate of the 1973 year-class. Consequently, the reduction in biomass does not appear to be related to the capelin fishery. The presence of the relatively strong 1973 year-class in samples taken in the autumn of 1976 indicates that capelin will

likely be abundant in 1977 and that this year-class may also contribute to the spawning biomass in 1978. This latter conclusion is based on the observation that the relatively strong 1969 year-class contributed to the spawning biomass in 1972, 1973 and 1974. There is some uncertainty about the size of the 1974 year-class, but it is considered to be of average strength and not as strong as the 1973 year-class. Estimates of consumption of capelin by cod were similar to those presented at the 1975 Annual Meeting. No new data were available to assess the effect of the capelin fishery on the capelin stock or on its predators. Consequently, the Subcommittee advises that the present management strategy should be continued for 1978, the overall TAC being 500,000 tons for both stock areas with 300,000 tons allocated to Subarea 2 and Div. 3K and 200,000 tons to Div. 3LNOPs.

The Subcommittee recognizes that priority should be given to estimating the strength of the incoming year-class(es) as close as possible to the year for which TACs are to be set. This could be achieved from autumn surveys in Div. 2J and 3K and the data used for advising on the TAC for the following calendar year. The Subcommittee suggested that pre-recruit surveys (cooperative surveys involving countries with an interest in the capelin fishery) be initiated in Div. 3K and 3L. USSR scientists were requested to collect data on the influence of the capelin fishery on major predators of capelin and present a report to the 1978 Meeting of the Subcommittee. All countries participating in the capelin fishery were requested to conduct studies to delineate the capelin stocks and describe the migratory patterns.

23. *Illex* in Subareas 3 and 4 (Res. Doc. 77/VI/4)

The nominal catches of *Illex* fluctuated greatly during 1972-75 in the range of 400-17,800 tons. The provisional catch of 37,400 tons in 1976 was more than twice the level of the 1975 catch of 17,800 tons. The sharp increase in catch apparently reflected high abundance of *Illex* over a broad area not only in Subareas 3 and 4 but also on Georges Bank and further southward.

Little information is available on the basic biology of *Illex* in Subareas 3 and 4. Some studies of age and growth have been made based on monthly length (mantle) frequencies. The Subcommittee discussed the two different hypotheses regarding the life span of this species, namely, a one-year cycle and a 1.5-year cycle, but could not reach a definite conclusion on the problem. It was noted that further study on the biology of *Illex* based on more extensive data is urgently needed in view of the increasing commercial interest in this species.

Estimates of stock biomass of *Illex* are not available for Subareas 3 and 4. However, French scientists estimated by the areal expansion method, using research vessel survey data, that the minimum stock biomass in Subareas 5 and 6 (excluding the Georges Bank area) in October-December 1976 was 95,000 tons. USSR surveys indicated a minimum biomass in the Georges Bank area in September-October 1976 was 258,000 tons. Due to the short life-span of this species and the large fluctuations in abundance, the Subcommittee considers it extremely difficult to predict TACs well in advance of the fishing season and indicates that the effectiveness of effort regulation should be evaluated for management against that of catch limitation as currently applied. The scientists of countries involved in fishing for squid are requested to provide catch and effort data for *Illex* in Subareas 3 and 4 for preliminary examination by STACRES at the 1977 Annual Meeting. Lacking any firm evidence to warrant changing the present pre-emptive TAC, the Subcommittee advises that the TAC of 25,000 tons should remain in effect for 1978.

24. Shrimp (*Pandalus borealis*) in Subarea 1

Nominal catches of shrimp (northern deepwater prawn) have increased rapidly from less than 10,000 tons prior to 1973 to 38,000 tons in 1975. Provisional statistics for 1976 indicate a total catch of about 50,000 tons, of which nearly 42,000 tons were taken offshore. The 1976 catches listed in the following table reflect more up-to-date statistics than those available at the Ninth Special Meeting in December 1976:

Country	1976 catch (000 tons)
Denmark (F)	11,179
Denmark (G)	9,771
Denmark (M)	2,717
France	1,100
Japan	146
Norway	11,605
Spain	6,931
USSR	6,468
Total catch	49,917
Total offshore catch	41,871

All available biological information related to the fishery in 1976 and earlier years was presented at the Ninth Special Meeting in December 1976. Lacking additional data, the Subcommittee is unable to advise on conservation measures for 1978. The major problems associated with assessing this stock are (a) the great lack of experience in this fishery due to its rapid development, (b) the lack of adequate models for assessment, and (c) difficulty in predicting recruitment to the fishery. The conservation measures adopted for 1977 were based on events that occurred during the 1976 fishing season, and the Subcommittee considered it too risky to use these events to extrapolate conservation measures for 1978. It is considered much more appropriate to assess the stock and advise on conservation measures for 1978 at a meeting near the end of 1977 when data for the 1977 fishing season would be available. The Subcommittee stresses the need for conducting stratified random surveys on the offshore shrimp fishing grounds, for an intensive sampling program, and for the development of a method to enable a proper assessment of the species.

III. OTHER MATTERS

In addition to the stock assessments, the Subcommittee preliminarily reviewed several items which will be discussed in greater detail by STACRES at its 1977 Annual Meeting.

1. Progress Report on International Herring Tagging Program

The Subcommittee was informed that the herring tagging program planned for 1976/77 (*Redbook* 1976, pages 153-156) was progressing favourably with several projects completed and one in progress. The following is a synopsis of work to date:

a) Gulf of St. Lawrence (Div. 4RST) - About 55,000 herring were tagged during April-December 1976 by Canadian scientists from the St. Andrews, New Brunswick, and St. John's, Newfoundland, laboratories.

b) Chedabucto Bay area (Div. 4W(a)) - Scientists from the St. Andrews laboratory tagged about 20,000 herring in January 1976, but only about 1,000 fish were tagged in January 1977 due to poor weather conditions.

c) Gulf of Maine (Div. 5Y) - USA scientists from the Woods Hole laboratory tagged 10,700 herring on Jeffreys Ledge in October 1976, and about 23,000 juvenile fish were tagged in coastal waters by State of Maine scientists from the Boothbay Harbour laboratory.

d) Georges Bank (Subdiv. 5Ze) - Canadian, USA and USSR scientists, utilizing a research vessel and purse seiner supplied by USSR, tagged 29,400 herring during September 1976.

e) South of Cape Cod (Subdiv. 5Zw) - USA scientists tagged a few herring (32 fish) near Rhode Island in November 1976, and a cooperative USSR-USA project to tag about 60,000 herring is currently in progress in Subdiv. 5Zw and Div. 6A.

The Subcommittee noted that "seeding" experiments (for estimating recovery rates on fishing vessels) were to have been carried out during the 1976 autumn fishery, and that tags had been supplied to certain countries for that purpose. No reports of such experiments have been received to date, and the countries involved are urged to submit their reports for the STACRES Meeting in May 1977, when the herring tagging program will be reviewed in detail.

2. Progress Report on International Larval Herring Surveys

The Subcommittee was informed that the larval herring surveys of the Georges Bank area were conducted again in 1976, continuing a series which began in 1971. Seven cruises were undertaken between October 1976 and March 1977 by research vessels of Federal Republic of Germany (November, March), Poland (October-November), USSR (October), and USA (October, November-December, February). Standard sampling procedures were used. Preliminary results indicate that the 1976 larval herring production on Georges Bank was the lowest observed during the 6-year history of the surveys.

The Subcommittee was informed that plankton sorting and analysis of the time series (1971-76) of larval herring data, as well as the processing of all available hydrographic and phytoplankton data, was continuing. It is expected that sorting of all fish larvae in the 0.333 mesh samples will be completed in June 1977, at which time a workshop will be held at Szczecin, Poland, to review the results of analyses carried out to date, including the first complete analysis of the 0.505 mesh larval herring data to compare production, growth, mortality and dispersal of larvae. It is also expected that analysis of larval gut contents and associated fine-mesh zooplankton samples for several winters will be completed, to evalutate whether larval growth and mortality are related to average density of food organisms during the over-wintering period.

The Subcommittee noted that the reports of the 1976/77 surveys and any available analyses of the 1971-76 data would be of great interest to the Environmental and Biological Surveys Subcommittee.

3. Progress Reports on Cod and Silver Hake Ageing Workshops

The Subcommittee noted, in accordance with a request by STACRES at its 1976 Annual Meeting, that an ageing workshop on cod was convened by Mr R. Wells at St. John's, Newfoundland, Canada, during 31 January-5 February 1977 (Summ. Doc. 77/VI/12). The experts dealt specifically with problems in ageing cod from the stock in Div. 2J, 3K and 3L and, on the basis of the material examined and the discussions at the workshop, expressed the desirability that a set of guidelines for ageing cod in this area be published. Mr R. Wells was designated to prepare a draft of the guidelines which will be discussed at a later stage and prepared for publication.

The Subcommittee also noted that a workshop on the ageing of silver hake was held at St. Andrews, New Brunswick, Canada, during 14-18 March 1977. This workshop was convened by Mr J. Hunt, with representatives from Canada, USSR and USA, and its report is given in Summ. Doc. 77/VI/13.

4. Study on Proposed Implementation of ICNAF Sampling Data Base

The Subcommittee noted the STACRES recommendation from the 1976 Annual Meeting (*Redbook* 1976, pages 59 and 131) that a small group of experts (one from Canada, USA and USSR) should meet with the Secretariat before the 1977 Annual Meeting to explore the problems associated with the implementation of an adequate base of sampling data. The Subcommittee was informed that a small group of scientists met on 25 April 1977, and a report of that meeting will be presented to STACRES at its May 1977 Meeting.

5. General Production Studies

There were no papers for consideration under this agenda item, but some general comments were noted. Canadian studies include the effect of the Labrador Current on food productivity in the Flemish Cap area, as well as plans for studying the Labrador Current in Davis Strait and southward along the continental shelf in relation to its effect on plankton and fish production. The USA observer noted that physical oceanographers are beginning to take a more active interest in the environment of the continental shelf areas, thus indicating the emergence of closer ties with biologists.