Northwest Atlantic ⬤ Fisheries Organization

SCIENTIFIC COUNCIL MEETING - JUNE 1980

Some Recent Changes in the Status of the Cod Stock in Divisions 2J+3KL

by

R. Wells and C. A. Bishop
Department of Fisheries and Oceans, Northwest Atlantic Fisheries Center
P. O. Box 5667, St. John's, Nfld, Canada A1C 5X1

Year-class size

Consideration by STACFIS of catch rates of 3-year-old cod by Soviet, French and Canadian research vessels led to the conclusion that the 1976 and 1977 year-classes were apparently very poor. These two year-classes were each assigned a stock size of 125 million individuals at age 4 roughly equivalent to the size of the 1970 year-class at the same age.

The table below shows projections of catch and spawning biomass to 1987 with inputs as before except that the size of the 1976 year-class at age 4 is 125 million instead of 200 million and that of the 1977 year-class 125 million instead of 500 million.

Cod in Div. 2J+3KL: projections of catch and spawning biomass
(000 tons) for 1980-87 at three levels of fishing mortality.
(Spawning biomass based on age-group 7 and older.)

Year	F=0.10 Catch	F=0.10 Spawning biomass	F=0.16 Catch	F=0.16 Spawning biomass	F=0.20 Catch	F=0.20 Spawning biomass
1980	180	800	180	800	180	800
1981	130	1300	200	1300	250	1300
1982	160	1800	230	1700	280	1600
1983	180	1800	260	1600	300	1500
1984	200	1800	280	1500	320	1400
1985	230	2100	310	1800	350	1600
1986	260	2500	350	2100	390	1900
1987	280	2800	370	2300	420	2100

Northwest Atlantic Fisheries Organization

SCIENTIFIC COUNCIL MEETING – JUNE 1980

Some Recent Changes in the Status of the Cod Stock in Divisions 2J+3KL

by

R. Wells and C. A. Bishop
Department of Fisheries and Oceans, Northwest Atlantic Fisheries Center
P. O. Box 5667, St. John's, Nfld, Canada A1C 5X1

Introduction

Average annual catches of cod from this area were at least 200 thousand tons in the period 1800-1950 (Lear, pers. comm.). In the early 1960's catches increased markedly and a record catch of about 800 thousand tons was reported for 1968. Catch regulation was introduced in 1973. Catches and TACs for the 1970's were as follows:

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Catch (000 tons)	520	430	460	350	370	290	210	170	140	160
TAC (000 tons)	–	–	–	670	660	550	300	160	135	180

To aid in the assessment of the status of this stock in 1979, a cohort analysis was completed using biological sampling and statistical data available for the period 1962-79.

Recent catches

In the 5-year periods beginning 1955, 1960, 1965, 1970 and 1975, average catches of cod were as follows:

Div.	55-59	60-64	65-69	70-74	75-79	Average
2J	37	217	309	139	42	149
3K	91	112	108	132	78	104
3L	149	171	232	156	74	156
TOTAL	277	500	649	427	194	409

The increase in catches in the 1960's was largely the result of increased fishing effort since catch rates (as given by Gavaris, 1980) show little trend over the period 1959-68 (Table 1). The largest increases in landings were from the northern part of the area, Division 2J, where average landings in the period 1965-69 were an order of magnitude larger than in the period 1955-59.

From Table 2 it is clear that the proportion of landings taken in the first two quarters of the year has increased in all three Divisions since 1955 as the large pre-spawning, spawning and post-spawning concentrations were discovered and exploited.

Age Composition of catches, 1962-79

Age compositions by year for the period 1962-78 were taken from ICNAF Res. Doc. 77/VI/26 and NAFO SCR Doc. 80/VI/63. Sampling data for 1979 listed in Tables 3-5 were used to derive the age composition for 1979 shown in Table 6. Cod of year-classes 1972-75 (ages 4-7) comprised 92% of the catch, with the 1974 and 1973 year-classes dominant.

Cohort Analysis

Weights-at-age used in the analysis are shown in Table 7. The substantial difference between the values for 1977 (and after) and years prior has been noted previously (ICNAF Res. Doc. 78/VI/66).

The catch in numbers ($x10^{-5}$), fishing mortalities and population numbers ($x10^{-5}$) are shown in Tables 8, 9 and 10 for an illustrative cohort run with maximum fishing mortality in 1979 of 0.20.

From a comparison in Table 11 of the number of 3-year-old cod taken per one-hour-tow by Soviet research vessels (SCS Doc. 80/VI/18) and the number of 4-year-old cod of the same year-classes estimated in the cohort run, for year-classes 1959-1972, the number of 4-year-olds in the stock in millions is about 8-10 times the number of specimens per hour tow in the survey. One might estimate the size of certain year-classes as follows:

Year-class	Catch from surveys	Population from surveys	Population from cohort run
1973	65	520-650	502
1974	68	544-680	518
1955	8	64-80	418

From the comparison with the Soviet research surveys, the cohort run presneted may include estimates of the 1973 and 1974 year-classes which are rather pessimistic and an estimate of the 1975 year-class which is outrageously optimistic.

The percentage distribution of fishing mortality with age for the years 1972-79 is shown in Table 12. It would appear that the pattern of fishing mortality in 1979 in the cohort run is within the bounds outlined in the recent past.

The results of the cohort run with respect to all age groups combined are shown in Table 13. The percentage discrepancy between the catches calculated by the summation of products of number and average weight at age and the reported catches varies from -12 to 15 but with all but 2 of the 18 comparisons less than 10%. There appears to be no trend and the average percentage discrepancy is about 0.4%. Regression parameters of fishing mortality with effort and biomass and CPUE are shown in Table 13. The 1974, 1975 and 1976 points appear to be anomalous and were excluded from the regressions. The regressions were used to estimate for 1979 the fishing mortality on ages 4-13 and the biomass. The values predicted in each case would suggest that the fishing mortality in the cohort run may be somewhat optimistic.

Yield Per Recruit

Table 14 indicates that the yield per recruit using the average weights and partial selection applied in 1979 is maximal at about F = 0.32, if ages 4-20 are considered. The corresponding $F_{0.1}$ = 0.17. The values of F_{max} and $F_{0.1}$ vary somewhat depending on the input.

Projection of Catches

For 1980, the 1976 year-class was considered to be poor with a strength of 200 million fish at age 4. If 180 thousand tons were taken in 1980, and assuming the same recruitment pattern and average weights in 1980 as in 1979, the fishing mortality in 1980 is projected to be somewhat less than in 1979 (Table 15).

For 1981 and after, the population size of the 4-year-olds was assigned an average value of 500 million. The average weights and partial recruitment pattern used for 1979 were used in the projections (Table 16). Three series of projections were made at constant F values of 0.20, 0.16 and 0.10 for the years 1981-87. The probable error in the projected catches and biomasses increased with the length of time between the year when making the projection and the year for which the projection is made. It is noted with particular emphasis that the average-weights-at-age are likely to decrease if the stock numbers increase as projected. In the period 1962-79, the highest biomass, that of 1962, was estimated to be about 3,000 thousand tons, with average weights-at-age considerably lower than those applying in 1977-79.

Other Survey Results

The Soviet young fish survey results can be construed to imply that the 73 and 74 year-classes were reasonably well estimated by the cohort run but that the 1975 year-class was overestimated by it. Results of Canadian research vessel surveys for this area are shown in Tables 17, 18 and 19. For year-class 73-76 the results are:

Year-class	Catch per tow at age 3			Catch per tow at age 4		
	2J	3K	3L	2J	3K	3L
1973	–	–	18.3	26.3	–	5.9
1974	8.7	–	4.1	16.4	14.1	6.3
1975	8.9	3.2	3.4	12.8	17.3	9.2
1976	1.5	2.5	0.8	–	–	–

From these results it might be concluded that the 1975 year-class was about as strong as that of 1974, and that the 1976 year-class was poor.

Conclusion

A cohort run incorporating a maximum fishing mortality of 0.20 in 1979 is not entirely incompatible with commercial catch rate and effort data nor with research vessel results.

References

Gavaris, S. 1980. Assessment of the cod stock in NAFO Divisions 2J+3KL. NAFO SCR Doc. 80/VI/81, Serial No. N135.

Konstantinov, K. G., and A. S. Noskov. USSR research report for 1979. NAFO SCR Doc. 80/VI/18, Serial No. N144.

Wells, R. 1977. Status of the cod stock in Div. 2J+3KL. ICNAF Res. Doc. 77/26, Serial No. 5051

1978. Status of the cod stock in Div. 2J, 3KL. ICNAF Res. Doc. 78/66, Serial No. 5236.

1980. Status of the cod stock in Div. 2J+3KL in 1978. NAFO SCR Doc. 80/VI/63, Serial No. N102.

Table 1. Nominal catches of cod from Divisions 2J, 3K and 3L for the years 1956-79. The standard CPUE (Gavaris 1980) and implied effort is included in the period 1962-1979.

YEAR	2J	3K	3L	2J3KL	CPUE	EFFORT
1955	25076	81005	157837	263918		
1956	34105	79386	187044	300535		
1957	31183	83360	161190	275733		
1958	37677	73515	105897	217089		
1959	57000	139267	133307	329574		
1960	141033	92125	160419	393577		
1961	260690	91733	145655	498078		
1962	250265	88370	164117	502752	1.920	262
1963	215583	125087	159234	499904	2.015	248
1964	215476	160465	227644	603585	1.937	312
1965	286316	74848	191490	552654	1.650	335
1966	247181	91051	184075	522307	1.792	291
1967	245198	103394	261943	610535	1.846	331
1968	373638	161534	272298	807470	1.861	434
1969	391775	107874	248784	748433	1.577	475
1970	210994	96589	208630	516213	1.388	372
1971	154495	81812	196189	432496	1.160	373
1972	150942	147334	159893	458170	1.035	443
1973	57727	172951	123831	354509	0.923	384
1974	121266	159954	91430	372650	1.036	360
1975	81988	128385	77135	287508	0.934	308
1976	34636	101190	78394	214220	0.894	240
1977	43632	56645	72443	172720	0.543	318
1978	28866	43023	66670	138559	0.479	289
1979	23132	63181	73647	159960	0.998	160

Table 2 . Percentages of the nominal catches of cod taken by quarter in three selected periods.

	2J	3K	3L	2J3KL
1955-1957				
Quarter 1			1	1
Quarter 2	56	86	239	175
Quarter 3	476	676	667	641
Quarter 4	468	238	93	183
Total	1000	1000	1000	1000
1965-1967				
Quarter 1	361	66	39	195
Quarter 2	375	194	370	345
Quarter 3	133	392	477	302
Quarter 4	131	348	114	158
Total	1000	1000	1000	1000
1975-1977				
Quarter 1	672	432	160	400
Quarter 2	51	193	360	214
Quarter 3	129	264	366	268
Quarter 4	148	111	114	118
Total	1000	1000	1000	1000

Table 3. Sampling data obtained from the commercial fishery in Division 3K in 1979 by Canadian observers. A. length measurements. B. age determinations.

A. Month	Inshore Can N	OT Can N	Cuba	FRG	GDR	Pol.	Port.	USSR	UK
Jan.		1399							
Feb.		4661	3580		8143	2431	1033		
Mar.		1470		5970	10096	2906	4497		
Apr.		3020			3277	1771	1230		
May		548						1137	
June						162			
July	12,394								
Aug.									
Sept.	2351								
Oct.							413		
Nov.							882		
Dec.		2160					2615		
B. Qtr.									
1		486	191	166	76	154	411		
2		396			23	177	14	50	
3	2313								
4		73					110		

Table 4. Sampling data obtained from the commercial fishery in Division 2J by Canadian observers. A. length measurements. B. age determinations.

A. Month	Inshore Can N	OT Can N	Cuba	FRG	GDR	Pol.	Port.	UK
Jan.		461	3584			4887	1510	
Feb.		2573	1716		3058	3613		
Mar.		3238		459	2441	815		
Apr.						195		
May		445						1137
June		424						
July	1902							
Aug.	5257							
Sept.								
Oct.								
Nov.							2288	
Dec.							1367	

B.

Qtr.	Inshore Can N	OT Can N	Cuba	FRG	GDR	Pol.	Port.	UK
1		336	303	12	215	502	204	
2		127				14		50
3	510							
4							124	

Table 5. Sampling data obtained from the commercial fishery in Division 3L by Canadian observers. A. length measurements. B. age determinations.

A.

Month	Inshore Can N	OT Can N	France	GDR	Pol.	Port.	GN Port.	OT Spain	PT Spain	OT UK
Jan.										
Feb.										
Mar.		3247			2673	1187				
Apr.		2916								691
May		1508	5604							379
June	11081	1161	1000				15795		3765	
July	8402	3432					11405		15494	
Aug.	983	1106							9687	
Sept.	4331									
Oct.						1221				
Nov.		2190		4655		1481		1598	1537	
Dec.		2071		1389		1502		390		

B.

Qtr.	Inshore Can N	OT Can N	France	GDR	Pol.	Port.	GN Port.	OT Spain	PT Spain	OT UK
1		338			66	53				
2		484	135						356	39
3	1550*	411					1324*		667	
4	454*	419		98		161		133	95	

*inshore quarters

Table 6. Catch at age data for the commercial cod catch from 2J3KL in 1979

OFFSHORE

				OT					GN	
Age	Can	Cuba	GDR	FRG	Pol.	Port.	Sub-total	Total O.T. All countries	Port	Total Offshore
3	120			1	4	9	134	154		154
4	3136	104	71	65	342	442	4160	4781	56	4873
5	12770	301	325	246	752	1340	15734	18083	413	18496
6	10716	313	421	316	847	1282	13895	15969	302	16271
7	3035	39	107	115	179	287	3762	4324	68	4392
8	611	6	25	39	15	66	762	876	11	887
9	275	7	10	14	6	23	335	385	3	388
10	158	3	5	9	5	15	195	224	1	225
11	95	1	6	8	7	14	131	151		151
12	32		2	3	4	3	44	51		51
13	24		1	2		2	29	33		33
14	7						7	8		8
15	1		1	1			3	3		3
15+	12		1	3			16	18		18
Total	30992	774	975	822	2161	3483	39207	45060	854	45194
Av.Wt.	1.66	1.33	1.59	1.79	1.38	1.59	1.63	1.63	2.07	1.64
Landing	51433	1031	1554	1471	2973	5532	63994	73547	1766	75313

	Inshore Gears - Canada (N)					Total Offshore	Grand Total
	Trap	GN	HL	LL	Total		
3	811	5	81	61	958	154	1112
4	4385	85	823	1081	6374	4837	11211
5	9187	692	2646	4273	16798	18496	35294
6	4491	2196	2157	2780	11624	16271	27895
7	1428	2791	996	1109	6324	4392	10716
8	284	1644	297	247	2472	887	3359
9	75	656	114	80	925	388	1313
10	35	391	61	30	517	225	742
11	17	310	39	21	387	151	538
12	2	103	16	6	127	51	178
13		56	9	12	77	33	110
14	1	36	3		40	8	48
15		29	6		35	3	38
15+	1	37	16	3	57	18	75
Ttl.	20717	9031	7264	9703	46715	45914	92 629
Av. Wt.	1.23	3.33	1.85	1.61	1.81	1.64	1.73
Landing	25540	30053	13412	15642	84647	75313	159960

Table 7. Average weights-at-age (gms) used in the cohort analysis for Div. 2J3KL cod.

Age	1962–1976	1977	1978	1979
4	550	770	700	740
5	880	1020	990	1120
6	1230	1730	1590	1680
7	1660	2510	2530	2490
8	2120	3290	3400	3600
9	2640	3990	4260	4460
10	3180	4810	4750	5310
11	3760	5610	5510	5860
12	4150	6480	7320	7180
13	6060	8050	8250	9020

Table 8. Catch numbers of cod in Div. 2J3KL for the period 1962-79

C A T C H   M A T R I X

AGE/YEAR	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
4	267.	271.	267.	280.	663.	785.	916.	381.	572.	690.
5	658.	592.	563.	456.	942.	1009.	1990.	964.	773.	921.
6	600.	1159.	590.	655.	632.	972.	1450.	1534.	940.	944.
7	486.	579.	981.	629.	598.	553.	809.	1006.	788.	557.
8	284.	288.	498.	671.	307.	338.	379.	493.	269.	241.
9	207.	152.	202.	334.	240.	172.	224.	184.	100.	113.
10	186.	114.	118.	147.	88.	161.	76.	115.	36.	43.
11	108.	81.	84.	68.	47.	60.	54.	60.	19.	21.
12	98.	41.	61.	37.	23.	34.	34.	42.	11.	12.
13	80.	39.	48.	39.	18.	21.	19.	28.	5.	11.

AGE/YEAR	1972	1973	1974	1975	1976	1977	1978	1979
4	798.	407.	138.	150.	644.	528.	169.	112.
5	1166.	945.	355.	259.	346.	464.	396.	353.
6	762.	592.	747.	347.	251.	143.	213.	279.
7	560.	353.	613.	389.	180.	62.	83.	106.
8	296.	273.	361.	356.	149.	38.	32.	34.
9	118.	142.	186.	133.	113.	33.	15.	13.
10	64.	76.	102.	77.	45.	20.	11.	7.
11	30.	38.	55.	24.	19.	8.	4.	5.
12	17.	22.	29.	13.	7.	3.	2.	2.
13	14.	12.	10.	9.	4.	3.	1.	1.

Table 9. Fishing mortalities on cod in Div. 2J3KL for the period 1962-79

2 JACKAL COD
F I S H I N G   M O R T A L I T I E S

AGE/YEAR	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
4	.056	.053	.059	.046	.094	.098	.163	.075	.125	.138
5	.113	.170	.149	.136	.215	.202	.386	.258	.216	.304
6	.197	.298	.256	.259	.284	.361	.499	.585	.432	.445
7	.323	.296	.446	.478	.401	.433	.583	.794	.692	.497
8	.333	.323	.449	.633	.454	.495	.604	.889	.503	.466
9	.360	.298	.395	.623	.488	.500	.601	.677	.438	.409
10	.364	.545	.400	.564	.326	.724	.431	.728	.263	.341
11	.299	.266	.463	.424	.351	.387	.571	.734	.243	.241
12	.399	.176	.329	.381	.246	.465	.396	1.317	.278	.239
13	.250	.270	.320	.360	.320	.370	.510	.660	.500	.490

AGE/YEAR	1972	1973	1974	1975	1976	1977	1978	1979
4	.203	.236	.121	.114	.258	.124	.037	.030
5	.365	.394	.333	.351	.415	.300	.128	.100
6	.444	.319	.627	.637	.688	.301	.219	.125
7	.522	.380	.644	.809	.832	.355	.286	.160
8	.540	.524	.863	1.024	.874	.407	.313	.180
9	.439	.545	.853	.958	1.176	.474	.277	.200
10	.430	.567	1.008	1.141	1.091	.663	.284	.200
11	.425	.494	1.124	.694	1.026	.561	.261	.200
12	.315	.642	.906	.916	.441	.423	.261	.200
13	.480	.380	.680	.800	.810	.340	.240	.200

Table 10. Population numbers of cod in Div. 2J3KL for the period 1962-79

2 JACKAL COD

POPULATION NUMBERS

AGE/YEAR	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
4	5401.	5787.	5122.	6872.	8184.	9261.	6729.	5794.	5379.	5913.
5	6790.	4181.	4493.	3952.	5373.	6100.	6872.	4680.	4399.	3886.
6	3716.	4963.	2887.	3169.	2823.	3547.	4082.	3826.	2960.	2902.
7	1945.	2500.	3015.	1830.	2002.	1740.	2024.	2030.	1744.	1573.
8	1110.	1153.	1523.	1581.	929.	1098.	924.	925.	752.	715.
9	756.	651.	683.	796.	687.	483.	548.	413.	312.	372.
10	673.	432.	396.	377.	350.	345.	240.	246.	172.	165.
11	462.	383.	250.	217.	175.	207.	137.	128.	97.	108.
12	329.	280.	240.	129.	116.	101.	115.	63.	50.	62.
13	397.	181.	192.	141.	72.	74.	52.	63.	14.	31.

AGE/YEAR	1972	1973	1974	1975	1976	1977	1978	1979
4	4801.	2143.	1334.	1541.	3127.	5018.	5177.	4179.
5	4217.	3209.	1386.	967.	1126.	1977.	3631.	4086.
6	2348.	2398.	1772.	814.	558.	609.	1199.	2614.
7	1522.	1233.	1427.	775.	352.	229.	369.	789.
8	784.	739.	690.	614.	283.	126.	132.	227.
9	367.	374.	358.	238.	181.	97.	68.	79.
10	202.	194.	177.	125.	75.	46.	49.	42.
11	96.	109.	90.	53.	33.	21.	19.	30.
12	70.	51.	54.	24.	22.	10.	10.	12.
13	40.	42.	22.	18.	8.	11.	5.	6.

Table 11. Comparison of population estimates of age 4 cod and catch rates of age 3 cod from USSR surveys.

YEAR CLASS	SURVEY CPUE AT AGE 3	VPA POPULATION AT AGE 4	CONVERSION FACTOR
1959	51	578	11.33
1960	27	512	18.96
1961	71	687	9.68
1962	78	818	10.49
1963	95	926	9.75
1964	79	673	8.52
1965	44	579	13.16
1966	99	538	5.43
1967	84	591	7.04
1968	164	480	2.93
1969	79	214	2.71
1970	16	133	8.31
1971	16	154	9.63
1972	15	313	20.87
1973	65	502	
1974	68	518	
1975	8	418	
AVERAGE 59-72	65	514	9.92

The average of the conversion factors is about 10, and the mean population estimate is about 8 times as large as the mean survey CPUE.

Table 12. Partial recruitment pattern for the years 1972-79. The average of the percentage F values for ages 7-10 is 1.00 for each year.

Age	1972	1973	1974	1975	1976	1977	1978	1979
4	.42	.47	.14	.12	.26	.26	.13	.16
5	.76	.79	.40	.36	.42	.63	.44	.54
6	.92	.64	.75	.65	.69	.63	.76	.68
7	1.08	.76	.77	.82	.84	.74	.99	.86
8	1.12	1.05	1.03	1.04	.88	.85	1.08	.97
9	0.91	1.09	1.02	.97	1.18	.99	.96	1.08
10	0.89	1.13	1.20	1.16	1.10	1.38	.98	1.08
F_{7-10}	0.48	0.50	0.84	.98	.99	.48	.29	.19

Table 13 . Cohort results for 2J3KL Cod

Year	Ages 4-13 Population Number	Ages 4-13 Population Biomass	Av Wt	F	Calculated Catch	% Discrepancy	CPUE	Effort
1962	2158	2875	1.33	.164	531	+6	1.920	262
1963	2051	2635	1.28	.196	514	+3	2.015	248
1964	1880	2472	1.31	.223	582	-4	1.937	312
1965	1907	2305	1.21	.212	582	+5	1.650	335
1966	2071	2250	1.09	.210	491	-6	1.792	291
1967	2296	2406	1.05	.223	572	-6	1.846	331
1968	2172	2360	1.09	.360	748	-7	1.861	434
1969	1817	2034	1.12	.345	708	-5	1.577	475
1970	1588	1699	1.07	.280	456	-12	1.388	372
1971	1573	1673	1.06	.287	442	+2	1.160	373
1972	1445	1593	1.10	.346	474	+3	1.035	443
1973	1049	1304	1.24	.358	387	+9	0.923	384
1974	731	1017	1.39	.498	429	+15	1.036	360
1975	517	672	1.30	.470	293	+2	0.934	308
1976	576	556	0.97	.411	215	0	0.894	240
1977	814	874	1.07	.194	172	-1	0.543	318
1978	1066	1185	1.11	.101	133	-4	0.479	289
1979	1207	1573	1.30	.087	148	-7	0.998	160

For the period 1962-77 but excluding 1974, 1975 and
1976 points

(a) $F = .000933f - 0.0673$, whence $F_{(4-13)}$ in 1979 = .082
   and $r = .91$ with 11 df.

(b) $Biomass_{(4-13)} = 1.2234$ CPUE $+ 0.1774$, whence $B_{(4-13)}$ in 1979 =
   1.4 million tons and $r = .97$ with 11 df.

Table 14. Yield per recruit for 2J3KL cod

Age	Av.Wt. (kg)	Partial Selection	F	Y/R
4	.74	.15	.10	.897
5	1.12	.50	.17	1.092 — $F_{0.1}$
6	1.68	.625	.20	1.130
7	2.49	.80	.30	1.176
8	3.60	.90	.32	1.177 — F_{MAX}
9	4.46	1.00	.40	1.167
10	5.31	1.00	.50	1.141
11	5.86	1.00	.60	1.111
12	7.18	1.00	.70	1.082
13	9.02	1.00	.80	1.054
14	8.42	1.00	.90	1.029
15	9.58	1.00	1.00	1.007
16	11.00	1.00		
17	13.14	1.00		
18	14.50	1.00		
19	15.87	1.00		
20	14.38	1.00		

Table 15. Projection of numbers-at-age in the catch in 1980, assuming that 180,000 tons will be taken. The numbers are expressed as n X 10^{-5} and the weights as w X 10^{-2}.

CATCH PROJECTION FOR 1980

AGE	POPULATION NUMBERS (000S)	POPULATION WEIGHT (MT)	FISHING MORTALITY	CATCH NUMBERS (000S)	CATCH WEIGHT (MT)	RESIDUAL NUMBERS (000S)	RESIDUAL WEIGHT (MT)
4	2000.	1480.	.026	47.	34.	1595.	1181.
5	3320.	3718.	.087	251.	281.	2492.	2791.
6	3027.	5085.	.108	283.	475.	2223.	3735.
7	1889.	4704.	.139	222.	554.	1340.	3352.
8	550.	1980.	.156	72.	260.	385.	1387.
9	155.	691.	.174	22.	100.	107.	476.
10	53.	281.	.174	8.	41.	36.	194.
11	28.	164.	.174	4.	24.	19.	113.
12	20.	144.	.174	3.	21.	14.	99.
13	8.	72.	.174	1.	10.	6.	50.
TOTAL	11050.	18320.		913.	1800.	8224.	13377.

Table 16. Projections of cod catches and population biomasses for the years 1981-87.

Year	Catch	F = 0.20 Population Biomass (4-13)	Population Biomass (7-13)	Catch	F = 0.16 Population Biomass (4-13)	Population Biomass (7-13)	Catch	F = 0.10 Population Biomass (4-13)	Population Biomass (7-13)
1981	263	2287	1319	213	2287	1319	137	2287	1319
1982	317	2651	1637	265	2711	1691	177	2805	1775
1983	357	2941	1632	305	3066	1741	212	3269	1920
1984	392	3189	1880	342	3377	2052	244	3692	2343
1985	429	3442	2133	380	3693	2368	279	4128	2779
1986	465	3663	2354	418	3975	2650	314	4533	3184
1987	493	3832	2522	448	4200	2874	343	4874	3525

The partial recruitment pattern and average wieghts-at-age- were as follows:

Age	% Recruited	Mean Weight (gms)
4	.15	740
5	.50	1120
6	.63	1680
7	.80	2490
8	90	3600
9	1.00	4460
10	1.00	5310
11	1.00	5860
12	1.00	7180
13	1.00	9020

Table 17. Mean number of cod per standard tow from research surveys in 2J.

Age	1977	1978	1979
1			
2	2.98	.60	.34
3	8.68	8.86	1.52
4	26.28	16.35	12.80
5	12.03	33.07	18.78
6	2.67	11.32	18.10
7	1.25	2.51	2.58
8	1.13	.91	.82
9	.91	.72	.55
10	.50	.52	.31
11	.18	.28	.32
12	.09	.13	.12
13	.04	.16	.05
13+	.08	.28	.09
Total	56.83	75.70	56.37
# Sets	117	53	54

Table 18 . Mean number of cod per standard tow from research surveys in 3K

Age	1978	1979
1		
2	.31	.15
3	3.21	2.54
4	14.08	17.31
5	17.24	28.49
6	7.91	16.94
7	2.52	4.35
8	1.18	2.18
9	.73	.53
10	.57	.46
11	.04	.31
12	.12	.07
13	.04	.05
13+	.04	.14
Total	48.00	73.51
No. Sets	70	69

Table 19. Mean number of cod per standard tow from research surveys in Division 3L.

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	.12	0.0	0.0	.16	0.08	0.0	0.0	0.0	.06
2	7.81	1.54	3.77	.51	1.56	2.07	0.91	0.07	.08
3	22.07	5.55	12.93	5.77	3.46	18.26	4.13	3.35	.84
4	6.99	15.19	7.33	8.20	4.95	9.39	5.94	6.26	9.16
5	4.58	1.23	3.89	5.82	2.64	3.76	4.61	4.98	13.89
6	1.62	1.23	.54	2.38	2.11	2.63	2.15	3.22	6.48
7	1.70	.53	.41	.57	1.78	1.47	0.64	1.45	1.53
8	.61	.59	.28	.24	0.29	0.70	0.66	0.47	.46
9	.46	.31	.28	.17	0.16	0.12	0.44	0.40	.12
10	.49	.24	.15	.09	0.05	0.03	0.15	0.23	.19
11	.18	.08	.12	.04	0.08	0.03	0.10	0.17	.08
12	.24	.06	.17	.07	0.02	0.06	0.06	0.12	.04
13+	1.17	.31	.41	.12	0.20	0.09	0.16	0.17	.18
Total	48.04	26.86	30.28	24.14	17.38	38.58	19.95	20.89	33.12
# Sets	57	38	29	70	55	64	102	94	141

Northwest Atlantic   Fisheries Organization

SCIENTIFIC COUNCIL MEETING - JUNE 1980

Some Recent Changes in the Status of the Cod Stock in Divisions 2J+3KL

by

R. Wells and C. A. Bishop
Department of Fisheries and Oceans, Northwest Atlantic Fisheries Center
P. O. Box 5667, St. John's, Nfld, Canada   A1C 5X1

Year-class size

Consideration by STACFIS of catch rates of 3-year-old cod by Soviet, French and Canadian research vessels led to the conclusion that the 1976 and 1977 year-classes were apparently very poor. These two year-classes were each assigned a stock size of 125 million individuals at age 4 roughly equivalent to the size of the 1970 year-class at the same age.

The table below shows projections of catch and spawning biomass to 1987 with inputs as before except that the size of the 1976 year-class at age 4 is 125 million instead of 200 million and that of the 1977 year-class 125 million instead of 500 million.

Cod in Div. 2J+3KL: projections of catch and spawning biomass
(000 tons) for 1980-87 at three levels of fishing mortality.
(Spawning biomass based on age-group 7 and older.)

Year	F=0.10 Catch	F=0.10 Spawning biomass	F=0.16 Catch	F=0.16 Spawning biomass	F=0.20 Catch	F=0.20 Spawning biomass
1980	180	800	180	800	180	800
1981	130	1300	200	1300	250	1300
1982	160	1800	230	1700	280	1600
1983	180	1800	260	1600	300	1500
1984	200	1800	280	1500	320	1400
1985	230	2100	310	1800	350	1600
1986	260	2500	350	2100	390	1900
1987	280	2800	370	2300	420	2100