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Status of the Cod Stock in Divisions 2J+3KL in 1978

by

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Nominal catches

Catches of cod declined from an average of about 640,000 tons in 1966-70 to about 380,000 tons in 1971-75. The catches in 1976-78 were about 214,000, 170,000, and 136,000 tons, respectively.

Estimation of age composition of the catch in 1978

Sampling reported by Canada, Federal Republic of Germany, German Democratic Republic, Poland, and the USSR was used to derive the age compositions.

Effort and fishing mortality

Reports on catch and effort by the USSR and Spain to the Canadian FLASH system indicated that the standardized effort values adjusted to catches by all countries were 6,650 and 29,350 days. The regressions of fishing mortality upon effort taken from Res. Doc. 78/VI/66 of

$$F = 0.1373 + 0.0000206 \text{ effort in days (USSR series)}$$

$$F = 0.1539 + 0.00000048 \text{ effort in hours (Spanish series)}$$

led to estimates of F in 1978 of 0.27 and 0.29, respectively. The effort estimate of 29,350 days for the Spanish standardized effort was adjusted to 293,500 hours on the basis of the ratio of about 10 fishing hours per fishing day from Table 6 of the 1976 Statistical Bulletin.

An F of 0.27 was used as the terminal F in 1978.

Recruitment estimates

Regressions of the geometric mean of abundance of age 1-, 2-, and 3-year-old cod of each year-class (USSR young fish survey) against stock sizes of age 4 cod from the virtual population analysis were not significant. A similar regression

using Federal Republic of Germany estimates of age 2- and 3-year-old from surveys was also not significant.

The regression of the abundance of 3-year-olds in USSR surveys and the abundance of corresponding year-classes from the latest VPA for year-classes 1959-1975 was used. The regression coefficients were:

	3K	3L	3KL
Slope	94.71	19.47	24.98
Intercept	3006	4665	3803
r	0.63	0.27	0.44

and the estimates of stock size were:

Year-class	Estimated stock size at age 4 ($\times 10^{-5}$)			
	3K	3L	3KL	Average
1973	6,890	5,132	5,427	5,800
1974	3,953	5,794	5,502	5,100
1975	3,195	4,782	4,003	4,000

The 1976 year-class apparently is weak and was given an arbitrary stock size of 2000×10^5 . A nominal value of $5,000 \times 10^5$ was assigned to all subsequent year-classes.

Partial recruitment pattern

A partial recruitment similar to that of last year was used for 1978. A new partial recruitment value for 4-year-olds was used to reconcile the stock size in 1978 of 510 million and the observed catch of 4-year-olds in 1978.

In addition, the partial recruitment value for 5-year-olds in 1978 (1973 year-class) was adjusted so that the size of this year-class as 4-year-olds in 1977 was 500 million. This value is roughly the average between the abundance estimate from young fish surveys (580 million) and the VPA estimate (400 million) using the old partial recruitment value. The final partial recruitment values used were:

Age	4	5	6	7	8	9	10 and older
% Recruited	14	47	76	87	93	97	100

Weight-at-age

The weight-at-age calculated from the Canadian sampling in 1978 was:

Age	4	5	6	7	8	9	10	11	12	13	14
Weight	0.70	0.99	1.59	2.53	3.40	4.26	4.75	5.51	7.32	8.25	8.43

For comparison, the 1977 average weight-at-age for the same ages were:

	0.77	1.02	1.73	2.51	3.29	3.99	4.81	5.61	6.48	8.05	9.46
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Cohort analysis

Tables 1, 2 and 3 show the catches of cod at age, estimated population numbers and fishing mortalities for the period 1972-78.

Projection of catches for 1979-82

Assuming that a catch of 170 thousand tons would be taken in 1979, projections of catches and population biomasses for the period 1980-82 are shown in Table 4. A rapid increase in spawning stock biomass is projected.

Table 1. Catches of cod (10^5) by age-group in Div. 2J+3KL, 1972-78.

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

Table 2. Population numbers (10^5) of cod in Div. 2J+3KL from VPA, 1972-78.

	1972	1973	1974	1975	1976	1977	1978
4	4760	2136	1378	1633	3259	4980	5132
5	4168	3179	1383	1004	1202	2089	3602
6	2319	2365	1754	813	589	673	1293
7	1501	1216	1405	769	356	258	423
8	763	728	679	602	282	131	155
9	359	360	351	234	177	99	73
10	200	188	168	122	73	45	51
11	95	106	86	47	32	20	19
12	57	50	53	22	17	9	9
13	36	31	22	18	6	8	5
14	47	17	15	9	6	2	3
	14305	10377	7292	5271	5999	7315	9948

Table 3. Fishing mortality for cod in Div. 2J+3KL from VPA, 1972-78.

	1972	1973	1974	1975	1976	1977	1978
4	0.204	0.235	0.117	0.107	0.245	0.124	0.037
5	0.366	0.394	0.331	0.333	0.379	0.280	0.129
6	0.446	0.321	0.625	0.627	0.626	0.266	0.200
7	0.524	0.383	0.647	0.801	0.801	0.306	0.243
8	0.552	0.528	0.865	1.026	0.853	0.384	0.256
9	0.446	0.564	0.858	0.961	1.179	0.457	0.256
10	0.432	0.583	1.078	1.152	1.095	0.674	0.270
11	0.427	0.496	1.180	0.820	1.059	0.572	0.270
12	0.396	0.646	0.904	1.056	0.605	0.457	0.270
13	0.552	0.541	0.699	0.817	1.213	0.572	0.270
14	0.350	0.480	0.810	0.770	0.740	0.400	0.270

Table 4. Projected catch, population biomass, and spawning biomass (000 tons) for cod in Div. 2J+3KL, at three levels of fishing mortality for 1979-82.

YEAR	F = 0.10			F = 0.16			F = 0.20		
	CATCH	POPULATION BIOMASS	SPAWNING BIOMASS	CATCH	POPULATION BIOMASS	SPAWNING BIOMASS	CATCH	POPULATION BIOMASS	SPAWNING BIOMASS
1979	170	1502	409	170	1502	409	170	1502	409
1980	110	1731	802	172	1731	802	212	1731	802
1981	145	2245	1341	217	2167	1275	259	2116	1232
1982	176	2689	1739	254	2518	1579	296	2413	1480