Status of the Cod Stock in Div 4RS 3Pn

by

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Nominal catches

In the periods 1962-66, 67-71 and 72-76 average catches were 76,000, 86,000 and 66,000 t respectively. TACs were introduced in 1976. Recent catches and TACs were:

	1973	1974	1975	1976	1977	1978	1979
TAC (000's tons)				55	55	75	75
Catch (000's tons)	66	66	60	77	74	70*	

* Preliminary

Catch Compositions

Age compositions are available for the years 1973-78. For the age composition in 1978, samples were available from the Can (N) landings

In addition, from sampling by Canadian observers on the French commercial fleet, an age composition for the French landings was derived. The age composition for the estimated 70,000 t landed in 1978 by both countries is shown in Table 1. Ages range from 3-18 but the bulk of the cod landed were 4-8 years old.

Catch rates

Catches per hour fished by Canadian vessels in the January-March period 1973-79 are shown in Table 2 for Div. 4R where the bulk of the winter fishery is prosecuted. The Can (N) tonnage classes 4 and 5 catch rates are well correlated (r=.92). The tonnage class 4 series was adjusted by the calculated regression parameters and this adjusted series was averaged with the observed tonnage class 5 series. These average values were:

1973	1974	1975	1976	1977	1978	1979
.954	1.19	.624	.522	.786	.970	.150

This series was well correlated with the catch rate series of Can (N) tonnage class 5 for the period 1973-78 (r=.90).

Assessment of the status of the stock in the period 1973-78

The average weights-at-age and partial recruitment pattern are shown below.

Age	Average Weight	% Recruited
4	.679	.045
5	.865	.283
6	1.299	.558
7	1.840	.705
8	2.559	.822
9	3.008	.910
10	2.880	1.000
11	3.229	1.000
12	3.961	1.000
13	4.121	1.000
14	5.838	1.000
15	9.334	1.000

A series of cohort runs were made with the parameters outlined above and terminal F's ranging from 0.2 to 0.7.

Since the catch rate series is for the otter trawl winter fishery, it was considered that estimates of total effort would be suspect, bearing in mind the large portion of the catch taken by a variety of inshore gears operating mainly in the spring and summer. Correlations were therefore sought between population biomass and catch rates. In Table 3, the best correlation (r=.95) between population biomass of

cod age 6 and older and catch rates in the period 1973-78 was obtained
by the use of population estimates from the cohort run with terminal
F = 0.45. This cohort run comprises Table 4.

Year-class strength

Estimates of the relative strengths of year-classes 1969-74 were derived
from research vessel surveys. For each year of a series of 5 years, the catch
rate at-age in numbers per tow was determined and the average catch at-age
over the series was calculated. The catch rates at-age for each year-class
was then determined as a percentage of the average catch rate at-age. For
example, the 1969 year-class at ages 2,3,4,7 and 9 was 16, 35, 68, 69 and
41 percent of the average catch at-age in numbers per tow over the series
at these ages. The relative strength of the 1969 year-class was therefore
considered to be 46.

The relative strengths of year-classes 1969-74 from research vessel
surveys were compared to the number of 4 year olds of the same year-classes
from the cohort run. See Table 5. The correlation was good (r=.91). The
strength of the 1975 and 1976 year-classes are predicted from the correlation
to comprise 120 and 68 million cod as 4 year olds. The average year-class
abundance at age 4 from this series is 100 million. The low estimate for
the 1976 year-class coincides with low estimates of the size of the same
year-class in Division 3M and Division 2J3KL.

Fishing mortality and effort

The effort estimates derived from the catch rates of the Can (N) otter
trawl fishery in winter and the total catch by all gears were 69, 55, 96, 148
and 72 thousands of hours for 1973-78. No correlation between F and effort
was found.

Projection of the status of the stock to 1986

For illustrative purposes, the effects upon the stock of a constant catch of 75,000 t in 1979-1986 are shown below:

	1979	1980	1981	1982	1983	1984	1985	1986
Terminal F	.42	.35	.32	.31	.30	.30	.29	.28
Biomass	454	459	479	488	495	496	502	514
(000's t)								

The population biomass of ages 6 and older in 1979 is estimated in this projection at 266,000 t which is very close to the figure predicted from the catch rate data in Table 3.

Discussion

The status of the stock in 1978 is essentially the same as determined in September, 1978 by CAFSAC, at which time the bulk of the biological sampling for this stock - with the exception of the sampling of the French commercial fishery - was already available.

It is clear that year-class size at age 4 has varied considerably over the short period of observation and that projections of catch for a period longer then a few years must be treated with caution. It is

nevertheless true that the average catch from 1959-78 was about 75,000 t with a range from 54-105 thousand ÷ tons. With the recruitment pattern and average weights-at-age used in this assessment and with an average long-term recruitment at age 4 equal to 100 million fish, the average yield for this stock at $F_{0.1}=.265$ is about 75,000 t.

Table 1. Age compositions of cod taken in the commercial fishery in Div. 3Pn 4Rs in 1978.

| | Can (N) | | | Can (M) | | Can (Q) | | |
Age	Inshore	OT	Total	OT	OT	Sub Total	3Pn4Rs	Grand Total
3	48	3	51	2	41	94	8	102
4	1204	426	1630	216	723	2569	232	2801
5	3701	2169	5870	1098	2190	9158	826	9984
6	4196	4313	8509	2183	3742	14434	1303	15737
7	3147	2006	5153	1016	2313	8482	765	9247
8	1032	324	1356	164	477	1997	180	2177
9	492	157	649	79	228	956	86	1042
10	399	237	636	120	219	975	88	1063
11	119	140	259	71	49	379	34	413
12	117	80	197	41	76	314	28	342
13	90	25	115	13	32	160	14	174
14	34	27	61	14	12	87	8	95
15	10	3	13	2		15	1	16
16	5	4	9	2		11	1	12
17		1	1	1	1	3		3
18		1	1			1		1
Total	14594	9916	24510	5022	10103	39635	3574	43209
Landings	26836	14543	41379	7380	15536	64295	5794	70089
AV. WT.	1.84	1.47	1.69	1.47	1.54	1.62	1.62	1.62

Table 2(a). Catch rates of cod   (mt/hr) in Div. 4R 1973-79 in the
period January-March (Can (N)).   The TC4 catch rate is
adjusted to TC5 catch rate before averaging.

	1973	1974	1975	1976	1977	1978	1979
TC 4	.701	.895	(.527)	.515	.568	.693	1.08
TC 5	.986	1.15	(.593)	.408	.855	1.03	1.48

TC 5 Catch rate = 1.5385 TC 4 catch rate -.1567 r=.92, df=4

	1973	1974	1975	1976	1977	1978	1979
TC 4 ADJ	.922	1.22	.654	.636	.717	.909	1.51
TC 5	.986	1.15	.593	.408	.855	1.03	1.48
Average	.954	1.19	.624	.522	.786	.970	1.50

Table 2(b). Catch rates of cod (mt/hr) in Dov. 4R 1973-79 in the
period January-March (Can (M)).

	1973	1974	1975	1976	1977	1978
TC 5	1.22	1.73	1.00	0.936	1.16	1.70

Table 3.   Correlation & population biomass ages 6 and older with CPUE, 3Pn 4RS cod.

		.40	.45	.50	C/HR	TCS adjusted
	1973	216	214	212	.954	
	1974	241	238	236	1.19	
	1975	186	183	180	.624	
	1976	157	152	148	.522	
	1977	187	176	166	.786	
	1978	245	222	203	.970	
Slope		129.97	125.39	122.42		
Intercept		96.03	92.05	87.87		
R		.92	.95	.93		
"T"		4.81	6.23	5.24		
Predicted 1979 Biomass (C/HR = 1.50)		291	280	272		

Table 4. Cohort analysis of cod in Div. 4RS3Pn

ESTIMATED POPULATION

AGE YEAR	1973	1974	1975	1976	1977	1978
4	51220.	52613.	116391.	132250.	115753.	154112.
5	81133.	33951.	41745.	92647.	106482.	91929.
6	36417.	47910.	23163.	30215.	62530.	77867.
7	40020.	20718.	28787.	13132.	17888.	37333.
8	17120.	27775.	10309.	15382.	7336.	7721.
9	9789.	11125.	12799.	5371.	7285.	3398.
10	3815.	6081.	5578.	5224.	2573.	3213.
11	1062.	2482.	2516.	3076.	1939.	1248.
12	458.	592.	1395.	1322.	965.	1034.
13	628.	325.	238.	355.	540.	525.
14	161.	497.	133.	137.	113.	287.
15	25.	103.	363.	62.	31.	48.

KNOWN CATCHES

AGE YEAR	1973	1974	1975	1976	1977	1978
4	8824.	1471.	2924.	1984.	3141.	2801.
5	20463.	5121.	4380.	14724.	10292.	9984.
6	10055.	11537.	6446.	7570.	15321.	15737.
7	5515.	7353.	9048.	3775.	7653.	9247.
8	3196.	10987.	3392.	5867.	2882.	2177.
9	2137.	3902.	5808.	2016.	3041.	1042.
10	709.	2722.	1647.	2584.	949.	1063.
11	306.	704.	815.	1717.	612.	413.
12	56.	273.	870.	600.	292.	342.
13	19.	147.	64.	196.	171.	174.
14	31.	48.	52.	90.	49.	95.
15	5.	40.	150.	27.	11.	16.

ESTIMATE FISHING MORTALITY

AGE YEAR	1973	1974	1975	1976	1977	1978
4	0.2112	0.0314	0.0282	0.0167	0.0304	0.0
5	0.3268	0.1824	0.1233	0.1931	0.1130	0.0
6	0.3641	0.3094	0.3675	0.3242	0.3158	0.0
7	0.1652	0.4950	0.4267	0.3823	0.6402	0.0
8	0.2311	0.5748	0.4520	0.5474	0.5695	0.0
9	0.2761	0.4904	0.6962	0.5358	0.6187	0.0
10	0.2299	0.6826	0.3950	0.7912	0.5235	0.0
11	0.3836	0.3761	0.4432	0.9593	0.4290	0.0
12	0.1450	0.7122	1.1688	0.6962	0.4071	0.0
13	0.0340	0.6940	0.3529	0.9425	0.4311	0.0
14	0.2401	0.1130	0.5670	1.2980	0.6507	0.0
15	0.2500	0.5500	0.6000	0.6500	0.5000	0.4500

Table 5. Relationship of relative year-class abundance from
research vessel surveys to the abundance of
4-year-olds from the cohort analysis.

Year-class	Relative Abundance	
	Abundance (Research Survey)	Age 4 Cohort
1969	46	51
1970	74	53
1971	157	116
1972	141	132
1973	108	116
1974	150	154
		Predicted
1975	132	120
1976	71	68
Average 1969-76	110	101

Slope = 0.8536
Intercept = 7.5
R = .91
T = 4.3