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Status of the cod stock in Division 3NO

by

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Introduction

Cod catches in this area declined from a high level of 227,000 tons in 1967 to 24,300 tons in 1976 when the TAC was 43,000 tons. Seasonally adjusted catch rates of Spanish pair trawlers declined from 1.5 tons/hour in 1971 to 0.4 tons per hour in 1975. Canadian survey results showed that the stock in 1973-76 was considerably lower than in 1971-72. A general production model indicated that the stock was at a relatively low level in 1975. There was some indication that effort on this stock in 1976 was lower than in 1975. Soviet young fish surveys indicated that the 1973 and 1974 year-classes were somewhat better than average.

At the 1977 Assessments Subcommittee meeting in 1977, the preceding data led to the advice that catches of 30,000 tons and 20,000 tons in 1978 could correspond approximately to fishing at  $F_{MSY}$  and  $2/3 F_{MSY}$ . A TAC of 15,000 tons was set for 1978 by the Commission to allow rapid rebuilding of the stock.

Abundance estimates of cod in Division 3N

The results of a Canadian survey of Division 3N were added to the series beginning in 1971 and yearly abundance estimates were calculated by the 4 methods shown in Bishop (1977). See Tables 1-3. A fifth estimate is shown in Table 4. Abundance estimates of strata of the same depth range were added and the average abundance per square mile was adjusted to the total area of the depth range.

From summary table 5, it was apparent that the abundance of the stock in 1977 has shown marked improvement. Regressions of seasonally adjusted Spanish catch/hour against survey abundance indices were calculated and the parameters are shown in Table 5.

Estimation of effort in 1977

Catch and effort supplied by Spain for 1977 for the entire Spanish catch was: catch = 8901 tons, days fished = 1119, catch/day = 7.95 tons. In 1976, catches and effort for PT class 4 comprised 48 and 58% respectively of the total Spanish catch in Divisions 3NO. If the same proportions of catch and effort were obtained in 1977, the catch/day for PT class 4 = 6.58 tons.

In 1975 and 1976, the number of hours fished per day was 14.55. Using this relationship, the catch/hour in 1977 was 0.452 tons. The relationship between the catch/hour of PT-4 vessels and the seasonally adjusted catch/hour was 1.16 seasonally adjusted C/hour - .0738 ( $r = .97$ ). The seasonally adjusted C/hour implied is about .453.

In 1977, the provisional catch in Divisions 3NO was 14,700 tons, and the effort is therefore estimated at 32,450 hours.

General Production Model

The regression of catch/hour on effort (Fig. 1) with the inclusion of the 1976 datum gave a fitted line and consequently a yield curve (Fig. 2) similar to those constructed at the 1977 Assessments Subcommittee meeting.

The 1976 point on the curve is very much different from that of 1975 and if catch rates in 1979 were at the 1976 level in 1977 and 1978, would yield a catch at  $2/3$  effort MSY of 55,000 tons.

The 1977 point on the curve similarly would imply a catch at 2/3 effort MSY of 25,000 tons.

The large discrepancy between the 1975, 1976 and 1977 points is difficult to explain but possible reasons may include one or more of the following:

- (1) the seasonally adjusted catch/hour used may not be a good indicator of biomass
- (2) incoming year-classes have been unexpectedly strong
- (3) the catch/hour index used may be subject to very wide variation.

#### Age Composition in 1977

The age composition of 1977 plotted on a semi-logarithmic scale is shown in Fig. 2. The Z value derived is .55 implying an average F of .35 has been operating on the stock for the past number of years. F values calculated in 1977 for the years 1974 and 1975 were considerably higher (Res. Doc. 78/VI/17, Addendum I).

#### Conclusion

The stock of cod in Divisions 3NO in 1977 is depressed below the level that could support the equilibrium level of catch at 2/3 effort MSY. Because of great variability from year to year in the catch rate data, it is difficult to project with confidence a yield for 1979.

Table 1. Cod abundance estimates (numbers in thousands) from stratified random cruises - Division 3N. Also data obtained using Method 4.

Strata	1971	1972	1973	1974	1975	1976	1977	Conversion factors Method 4
359		845	639			4709	1359	1.386
360		1559			2302	3425	4211	2.386
361	6894	5961	858	904	3624	723	5610	2.124
362	2432	12160	1012	1466	431	1021	5830	1.000
373	18511	3940	146	426		76	946	1.434
374	1390	180	180		140		1607	0.273
375	3701	3936	410	1435	6617		7474	3.311
376		810	39		1294	113	3601	0.767
377		1096	147	613	413		2800	0.418
378	586	3778	472	1683			657	0.456
380	12	139	756	80			21	0.164
381	865	1259	1391	123	149		3123	0.466
382	146	5252	20	152		23	2521	0.178
383	69	1546	48	23		16	307	0.048
Ave. Values Method 4	5695	3776	494	987	4600	2182	4455	

Table 2. Cod abundance estimates (numbers in thousands) from stratified random cruises in Division 3N using Method 1.

Strata	1971	1972	1973	1974	1975	1976	1977
359	2145	845	639	545	933	4709	1359
360	3078	1559	617	782	2302	3425	4211
361	6894	5961	858	904	3624	723	5610
362	2432	12160	1012	1466	431	1021	5830
373	18511	3940	146	426	2190	76	946
374	1390	180	180		140	122	1607
375	3701	3936	410	1435	6617	872	7474
376	1492	810	39	379	1294	113	3601
377	1212	1096	147	613	413	227	2800
378	586	3778	472	1683	689	296	657
380	12	139	756	80	81	35	21
381	865	1259	1391	123	149	262	3123
382	146	5252	20	152	730	23	2521
383	69	1546	48	23	162	16	307
Average	3038	3033	481	615	1411	851	2862
Sp. (PT CPUE 151-500 T	1.493	0.924	0.769	0.583	0.402	1.019	

Table 3. Cod abundance estimates (numbers in thousands) from stratified random cruises in Division 3N using Method 2.

Strata	1971	1972	1973	1974	1975	1976	1977	Area
359	1304	845	639	258	540	4709	1359	421
360	9265	1559	1387	1832	2302	3425	4211	2992
361	6894	5961	858	904	3624	723	5610	1853
362	2432	12160	1012	1466	431	1021	5830	2520
373	18511	3940	146	426	3233	76	946	2520
374	1390	180	180		140	717	1607	931
375	3701	3936	410	1435	6617	1226	7474	1593
376	4642	810	39	918	1294	113	3601	1499
377	310	1096	147	613	413	77	2800	100
378	586	3778	472	1683	178	107	657	139
380	12	139	756	80	149	89	21	116
381	865	1259	1391	123	149	140	3123	182
382	146	5252	20	152	830	23	2521	647
383	69	1546	48	23	865	16	307	674
Average	3580	3033	536	708	1483	890	2862	

Table 4. Cod abundance estimates (numbers in thousands) from stratified random research cruises in ICNAF Division 3N using Method 5.

Depth Range	Strata	1971	1972	1973	1974	1975	1976	1977
0-30	375	3,701	3,936	410	1,435	6,617		7,474
	376		810	39		1,294	113	3,601
Total		3,701	4,746	449	1,435	7,911	113	11,075
Total Strata Area (sq. miles)		1,593	3,092	3,092	1,593	3,092	1,499	3,092
31-50	360		1,559			2,302	3,425	4,211
	361	6,894	5,961	858	904	3,624	723	5,610
	362	2,432	12,160	1,012	1,466	431	1,021	5,830
	373	18,511	3,940	146	426		76	946
	374	1,390	180	180		140		1,607
	377		69	1,546	48	23		307
	383							16
Total		29,296	25,346	2,244	2,819	6,497	5,261	18,511
Total Strata Area (sq. miles)		8,498	11,490	8,498	8,498	8,296	10,559	11,490
51-100	359		845	639			4,709	1,359
	377		1,096	147	613	413		2,800
	382	146	5,252	20	152		23	2,521
Total		146	7,193	806	765	413	7,732	6,680
Total Strata Area (sq. miles)		647	1,168	1,168	747	100	1,068	1,168
101-150	378	586	3,778	472	1,683			657
	381	865	1,259	1,391	123	149		3,123
Total		1,451	5,037	1,863	1,806	149		3,780
Total Strata Area (sq. miles)		321	321	321	321	182		321
151-200	380	12	139	756	80			21
Total Strata Area (sq. miles)		116	116	116	116			116
<b>TOTAL AREA PER DEPTH RANGE</b>								
0-30	3,092	7,184	4,746	449	2,785	7,911	233	3,601
31-50	11,490	39,611	25,346	3,034	3,812	8,998	5,725	18,511
51-100	1,168	264	5,252	806	1,196	4,824	8,456	6,680
100-150	546	2,468	8,568	3,169	3,072	447		6,430
151-200	386	40	463	2,516	266			70
TOTAL		49,567	44,375	9,973	11,131	22,180	14,414	35,292

Table 5. Comparison of cod abundance estimates (numbers in thousands) in ICNAF Division 3N using five different methods and values obtained from regressions of Spanish PT catch/hour on abundance estimates

Year	Spanish PT Catch/hour	Method 1	Method 2	Method 3	Method 4	Method 5
1971	1.493	3,038	3,580	4,663	5,695	49,567
1972	0.924	3,033	3,033	9,060	3,776	44,375
1973	0.769	481	536	935	494	9,973
1974	0.583	615	708	1,185	987	11,131
1975	0.402	1,411	1,483	2,028	4,600	22,180
1976	1.019	851	890	872	2,182	14,414
1977		2,862	2,862	5,720	4,455	35,292
Slope		.00019	.00019	.00013	.000078	.000014
Intercept		.5603	.5330	.6575	.6332	.5051
r		.5999	.6611	.5489	.4264	.6515
Estimated c/hr 1977		1.104	1.077	1.293	.9807	.999

Table 6. Catch per hour (Spanish PT, 151-500 +) total catch and total effort expended in Division 3NO cod fishery.

Year	Catch/hour	Catch	Effort (hrs)	Effort (4 year moving average)
1960	1.298	79,677	61,384	
1961	1.180	72,724	61,631	
1962	0.921	34,984	37,985	
1963	1.856	69,742	37,577	49,644
1964	1.647	64,461	39,138	44,083
1965	1.826	99,187	54,319	42,255
1966	1.706	108,919	63,845	48,720
1967	1.706	226,784	132,933	72,559
1968	1.722	165,511	96,116	86,803
1969	1.499	117,705	78,522	92,854
1970	1.429	111,561	78,069	96,410
1971	1.493	126,296	84,592	84,325
1972	0.924	103,371	111,873	88,264
1973	0.769	80,429	104,589	94,781
1974	0.583	73,379	125,864	106,730
1975	0.402	44,174	109,886	113,053
1976	1.019	24,283	23,830	91,042

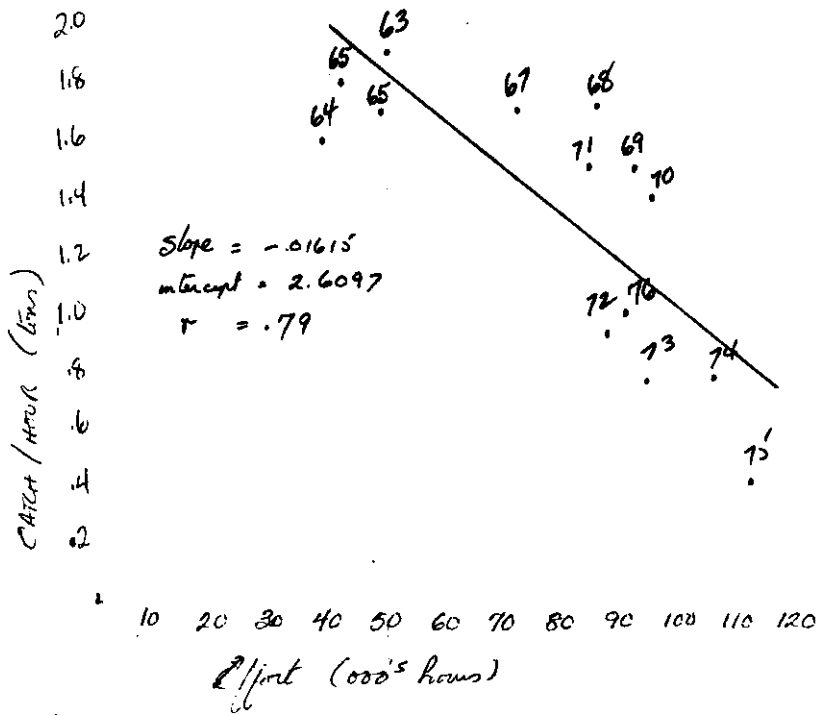


Fig. 1. Relationship of catch/hour (seasonally adjusted PT) to effort (000's hours).

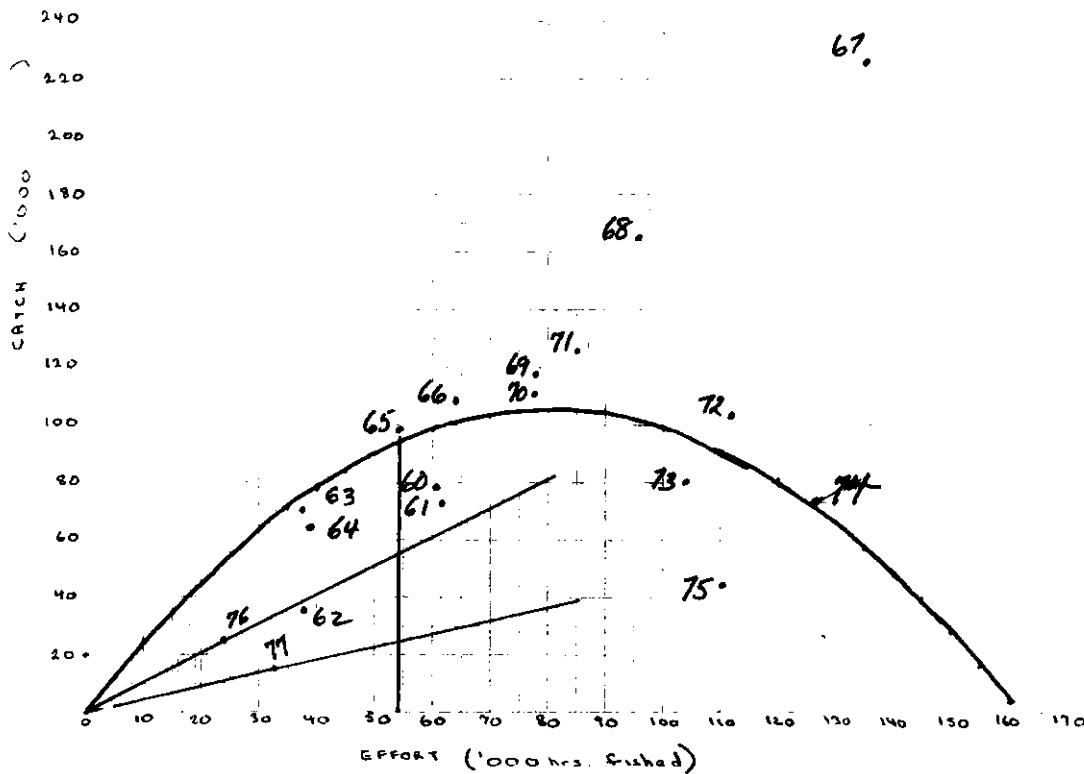


Fig. 2. Yield curves Division 3N0 cod.

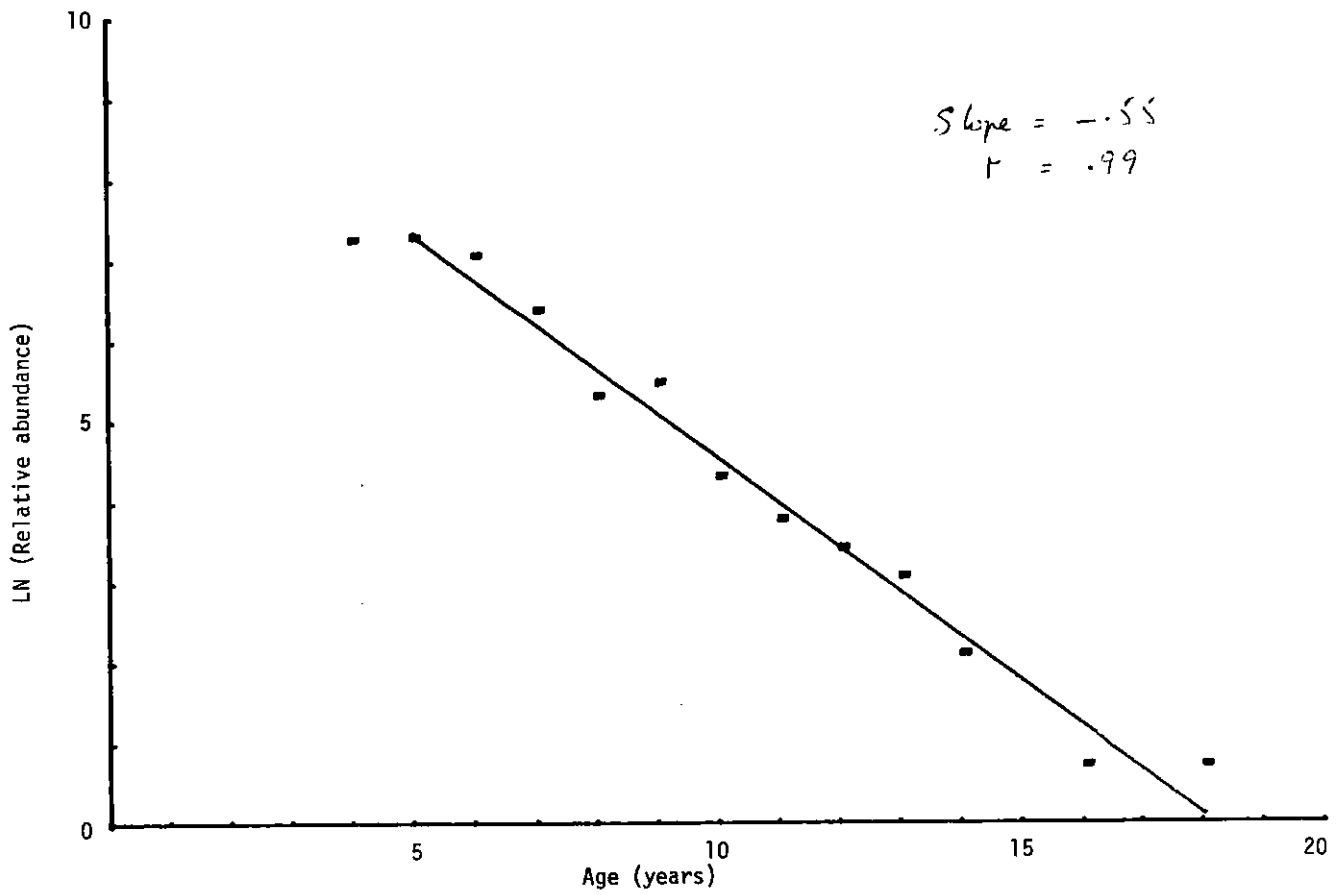


Fig. 3 . Estimate of Z from catch curve of cod in 3NØ in 1977.

