



SCIENTIFIC COUNCIL MEETING - JUNE 1988

Assessment of the Cod Stock in NAFO Div. 3NO\*

by

J. W. Baird and C. A. Bishop

Science Branch, Department of Fisheries and Oceans  
P. O. Box 5667, St. John's, Newfoundland, Canada A1C 5X1

Nominal catch and catch at age

Cod catches, along with corresponding TACs, from NAFO Div. 3NO for a recent period are as follows ('000 t):

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	25	26	26	17	17	26	33	33	33	40
Catch	28	20	24	32	29	27	37	51	38	

Catches for 1986 & 1987 are provisional.

TAC's for 1982 & 1983 excludes expected catches by Spain.

Catches of cod from this stock declined from a peak of about 225,000 t in 1967 to a low of about 15,000 t in 1978 and have subsequently increased (Figure 1). The average catch for the past three years has been just over 40,000 t. Historical catches by country are presented in Table 1. Catches by Canada have been stable for the 1985-87 period. Table 2, which shows 1987 catches by month for Canada, indicates that most of the 1987 catch was taken by Newfoundland based vessels and is distributed over all months.

Sampling data available (Table 3), obtained by Canadian Port Samplers, were used to adjust monthly catches (Table 2) to produce catch, average weight and length at age for that portion of the commercial catch taken by Canada in 1987. Average weights-at-age were determined by applying a length-weight relationship ( $\log \text{ weight} = 3.0849 \log \text{ length} - 5.2106$ ) to length frequencies age-length keys. For Canadian vessels the calculated catch was about 95% of the reported catch. The dominant year-classes in the catch by Canada were those of 1981 and 1982. These year-classes were among those that dominated the commercial catch by all countries from the previous year.

Research vessel survey data

Stratified-random research vessel surveys have been conducted by Canada in Div. 3N since 1971, with the exception 1983, and in Div. 30 since 1973 with the exception of 1974 and 1983. Surveys from 1971 to 1982 were conducted by the research vessel A. T. CAMERON, and those since 1984 were conducted by the sister ships A. NEEDLER and W. TEMPLEMAN. Biomass estimates by strata for these surveys are presented in Tables 5 and 6, with mean number and weight per tow values in Table 7. Biomass in both divisions increased sharply from 1982 to 1984, was somewhat stable from 1984 to 1986, and increased sharply again in 1987, especially in Div. 30. Estimates for 1988 indicate that biomass levels were similar to the 1984-86 period. The stratification scheme used for the stratified-random research vessel surveys in Div. 3NO is shown in Figure 2.

As survey coverage is incomplete, mostly in the earlier period, estimates of abundance for non-sampled strata were obtained using an analysis of variance of the  $\ln$  catch per tow for sampled strata. The method used is the same as that described in Bishop et. al. (1984), with the exception of the weighting factors. The previous weighting factor used was the inverse of the  $\ln$  variance for each sampled stratum mean. The current analysis weights each stratum mean by its stratum area in square nautical miles. Tables 8 and 9 show survey abundance estimates for Div. 3N and 30 respectively with estimated values for strata which were not surveyed. While estimated abundance for 1987 in both Divisions were the highest in their respective time series, estimates for 1988 are amongst the lowest.

\* See Appendix (page 25) for additional information.

Estimates of mean number of cod per standard tow at age are given in Table 10, with these same estimates adjusted for non-sampled strata shown in Table 11. The 1981 and 1982 year-classes, which dominated the commercial catch, are also relatively strong in the survey catch. There appears to be more older fish in the survey population than previously observed, with the age group 14 and older about double the next highest value in the time series.

#### Commercial catch-effort data

Catch and effort data for 1977 to 1985 was obtained from NAFO statistical bulletins, while that for the Canadian otter trawl fleet for 1986 and 1987 was provided by the Department of Fisheries and Oceans, Canada. Spanish pair trawl data for 1986 was taken from Vasquez (1987). Seasonal patterns for otter trawls and pair trawls are different (Tables 12 and 13) and are therefore analyzed separately. Data with greater catch and effort were less variable, so estimated weights calculated according to Judge et. al. (1980 p. 132) were applied in a weighted regression of a multiplicative model. Four categories used in this model are country/gear/tonnage class, month, NAFO Division and year. The possible effects of truncation and rounding errors were reduced by eliminating data with less than 10 t catch or 10 hours effort from the analysis. The model explained about 35% of the variation in the otter trawl data, but, with the exception of division, all categories were significant. The model explained about 60% of the variation in the Spanish pair trawl data and all categories were significant. Canadian otter trawl catch rates (Table 14, Figure 3) increased from 1977 to 1982 and have subsequently declined. Spanish pair trawl catch rates have generally increased from 1977 to 1984 and declined to 1986.

The current method for determining directed fishing effort by the Canadian otter trawl fleet for cod in NAFO Div. 3NO is by identifying those trips that have cod defined as main species (MSP) from vessel logbooks. Main species is that species comprising the largest portion of the catch. These records are then aggregated to produce monthly catch and effort statistics. It is this type of database that is used for the catch rate standardization mentioned previously. An alternate method for determining directed fishing effort was attempted for this assessment. The data used for this analysis was aggregated monthly as described above. Directed fishing effort for the new analysis was defined as those months when (1) 50% (2) 60% (3) 70% of the total groundfish catch was cod. Catch rate standardization was conducted and results are presented in Tables 16 to 19. All of the regressions were significant. For the analysis when the cod catch was 70% of the total, significance was marginal so this analysis was not considered further. CPUE trends derived from the original analysis and those from the 50% and 60% analyses are shown in Figure 5. Trends in all three analyses are the same, so it appears that the original analysis is adequate. For a more appropriate analysis the calculation of percentage cod catch of the total should be done on a trip basis, and these trips aggregated by month. These data are available and this analysis will be forthcoming at the next assessment of this stock.

#### References

- Bishop, C. A., S. Gavaris, and J. W. Baird. 1984. An assessment of the cod stock in Subdivision 3Ps. NAFO SCR Doc. 84/53. Ser. No. N840. 27 p.
- Judge, C. C., W. E. Griffiths, R. C. Hills, and T. C. Lee. 1980. The theory and practice of econometrics. John Wiley and Sons, New York. 793 p.
- Vasquez, A. 1987. Spanish Research Report. NAFO SCS Doc. 87/13. Ser. No. N1309. 9 p.

Table 1. Catch (metric tons) of cod in NAFO Divisions 3NO.

Year	Canada	Spain	Portugal	USSR	Others	Total
1953	39,884	12,633	7,919	-	5,761	66,197
1954	17,392	88,674	24,045	-	4,650	134,761
1955	6,053	64,987	27,711	-	15,605	114,356
1956	5,363	42,624	15,505	-	1,390	64,882
1957	9,641	51,990	21,740	-	6,819	90,190
1958	4,812	29,436	11,608	-	2,195	48,051
1959	3,687	39,994	17,730	48	2,911	64,370
1960	3,408	33,972	14,347	24,204	3,746	79,677
1961	5,428	32,284	9,059	22,854	3,099	72,724
1962	3,235	17,413	3,653	7,971	2,712	34,984
1963	5,079	37,632	10,004	10,184	6,843	69,742
1964	2,882	37,185	8,095	9,510	6,789	64,461
1965	4,229	64,652	1,692	17,166	11,448	99,187
1966	6,501	52,533	5,070	39,023	5,792	108,919
1967	3,446	77,948	9,703	118,845	16,842	226,784
1968	3,287	69,752	6,752	78,820	6,900	165,511
1969	3,664	71,160	4,940	29,173	8,768	117,705
1970	4,771	67,034	3,185	28,338	8,233	111,561
1971	2,311	89,915	6,589	19,307	8,174	126,296
1972	1,736	76,324	11,537	12,198	1,579	103,374
1973	1,832	42,403	7,759	27,849	586	80,429
1974	1,360	38,338	6,602	26,911	178	73,389
1975	1,189	16,616	5,560	20,785	24	44,174
1976	2,065	9,880	2,620	8,992	726	24,283
1977	2,532	8,827	1,742	4,041	462	17,604
1978	6,246	5,813	641	1,819	199	14,718
1979	9,938	13,782	1,140	2,446	545	27,941
1980	5,084	8,999	1,145	3,261	871	19,360
1981	6,096	13,299	1,091	3,187	671	24,344
1982	10,185	14,361	2,466	3,985	608	31,605
1983	11,374	12,320	1,109	3,238	778	28,818
1984	8,705	13,590	1,071	3,306	431	27,103
1985	18,179	13,682	608	3,968	462	36,899
1986 <sup>a</sup>	17,204	23,395	6,890	1,181	2,802	51,472
1987 <sup>a</sup>	18,426	15,788	4,108	375	233	38,930

<sup>a</sup>Provisional.

Table 2. Cod landings (t) from NAFO Divisions 3NO by country, month, and division in 1987.

Month	3N			3O			3NO							
	OT	LL	Can (N)	OT	LL	Can (M)	OT	LL	Can (M)	LL	EEC	Japan	USA	USSR
J	1								108					
F	7			16					97					
M	17			4				7	84					
A	167			38	8			79	294					
M	878	97		179	310			123	543					
J	947	134		1	291			20	221					
J	1224	33		383	277			4	44					
A	1294			53	126			13	13					
S	981		9	21	183									
O	1605			59	54									
N	1297			269	8				164					
D				8	15				693					
	<u>8418</u>	<u>264</u>	<u>9</u>	<u>1031</u>	<u>1272</u>			<u>246</u>	<u>2261</u>	<u>799</u>	<u>18479</u>	<u>15</u>	<u>218</u>	<u>375</u>

Total 3NO = 37512

Table 3. Commercial sampling by Can (N) for cod in NAFO Divisions 3NO during 1987.

Number Quarter	Number Gear	Total Div.	aged	Month	measured	Country/month	Can (N+M)			
1	OT	30	369	Jan.	122	265	374			
	OT	30		Feb.	307	421	541			
	OT	30		Mar.	642	559	675			
							<u>1590</u>			
2	OT	30	128 <sup>a</sup>	Apr.	230	916	1582			
				June	133	565	1068			
	3N	3N	254	May	286	878	3047			
				June	1099	947	1373			
							<u>7070</u>			
3	OT	3N	229	Aug.	323	1294	1570			
				Sept.	791	981	1367			
							<u>5217</u>			
4	OT	30	88 <sup>a</sup>	Oct.	246	55	59			
				3N	3N	544	Oct.	1440	1605	1777
							Nov.	491	1297	1574
							<u>4549</u>			
Total	OT	3NO	1612		6110		18426			

<sup>a</sup>Combined A/L keys for Div. 3N+30 by quarter were used to obtain age frequencies.

Table 4. Estimated catch, average weight, and average length at age for the commercial fishery for cod by Canada in NAFO Div. 3NO during 1987.

AGE	AVERAGE		CATCH		
	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
3	0.545	40.000	1	0.03	0.02
4	0.929	47.428	63	17.52	0.28
5	1.298	52.633	2425	150.94	0.06
6	1.749	57.924	2473	156.68	0.06
7	2.698	66.419	830	64.99	0.08
8	3.924	73.946	324	48.00	0.15
9	6.569	88.782	265	24.55	0.09
10	7.766	93.959	109	14.89	0.14
11	9.063	98.363	124	16.49	0.13
12	10.957	104.851	125	11.75	0.09
13	10.723	103.897	61	11.70	0.19
14	13.253	111.439	23	5.50	0.24
15	15.029	115.927	13	3.05	0.24
16	14.918	115.322	3	1.63	0.48
17	16.752	120.040	7	3.27	0.49
18	15.663	118.405	2	1.00	0.55
19	12.044	109.000		0.30	1.02
20	23.933	136.078		0.00	0.02
21	23.854	136.000	4	0.09	0.02

Table 5. Biomass estimates (MT) by stratum from survey cruises in Div. 3N.

Strata	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988
357			1383				29	52	332	135	92	0	2102	259			18
358		1061	1772				383	483	1054	229	236	182	122	547		1803	229
359		312	258			660	147	190	478	208	13	71	0	134		43	44
360		1966			306	1950	4040	2182	1416	1738	3743	1238	7877	9161	1945	1282	494
361	2909	4525	2525	350	3246	2618	5894	8203	2666	4173		8125	12838	29220	50957	27584	15887
362	2127	9695	4222	2233	306	1666	6836	6621	1632	5847	8701	3708	40764	16509	19686	69852	12714
373	8159	3423	1855	2362		1031	1750	4300	1838	857	4578	6647	17916	2446	2897	6788	5959
374	501	702	273	0	135		1248	1324	479	0	146	2359	8335	877	769	1058	4032
375	3270	9977	1042	955	1060		5429	3598	369	3229	29835	5943	2404	18475	14586	8034	16512
376		1892	806		383	77	9672	102	868	855	2208	2	1049	391	1883	2876	4454
377		550	14	83	283		1380	130	22	287	428	22	29	13	54	328	0
378	530	4146	404	632			687	90	281	939	104	303	133	470	256	73	96
379			1828	515			50	0	601	178	53	179	129	324	365	4	15
380	9	322	1317	206			52		232	57	25		224	847	135	454	181
381	480	1429	2386	359	122		2677	393	196	427	533	2186	478	1544	747	82	270
382	142	2458	9	69		42	948	2215	220	285	182	36	0	16	61	12	7
383	231	1479	1	16		44	324	1564	146	0	430	5	294	0	0	818	71
Total	18357	43935	20096	7781	15381	8088	41546	30722	11692	20736	51538	31104	92725	82515	95280	121091	60982
Upper limit	35959	58509	29260	13257	35224	13399	61360	37915	16334	28150	120675	46068	123845	108355	162513	159883	80483
Lower limit	755	29362	10931	2304	-4462	2776	21732	23529	7051	13322	-17600	16141	61605	56674	28046	82300	41481

Table 6. Biomass estimates (MT) by stratum from survey cruises in Division 30.

Strata	1973	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988
329	211		6422	180	2008	357	18	487	373	560	840	304	45335	9436
330	9251	475	287	593	2218	3753	470	3371	123	3626	4642	2130	5654	2767
331	288	729	454		342	150	609		38	2630	3423	685	804	1224
332		830	351	940	4525	2266	9		3474	2358	13471	2499	9808	8681
333		525	82	0	2	0	28		153	0	147	232	1057	0
334			6	0	6	0	43		8	0	570	3481	59	248
335	22		3		0	0	10		11	0	0	126	18	39
336	29	0	0	136	3	1	286		104	0	34	45	17	18
337	78	1906	32	630	614	23	133		610	434	1203	8497	2674	382
338	4298	5563	1876	6953	1334	5729	1795		5659	29905	7485	14405	9838	9124
339	1547	40			249	1475		505	610	1087	359	29	354	233
340		2029	2690	298	966	3718	386	4294	2849	6827	5431	5796	77479	12421
351	3092	1562	2684	8141	4334	47954	5629	6621	4498	43455	23490	38217	66032	15852
352	3075	426	1429	6120	3961	10008	5625		6236	34168	29692	15071	49765	57457
353	3265	77	2	262	84	1573	2		472	0	6083	951	9610	626
354	439		38	8		34	273	44	125	489	219	180	2179	530
355	76	0	4			24	367	32	135	0	135	12	114	19
356	11					12	49	9		0	0	32	7	102
<b>Total</b>	<b>25681</b>	<b>14161</b>	<b>16360</b>	<b>24261</b>	<b>20646</b>	<b>76966</b>	<b>15733</b>	<b>15363</b>	<b>25478</b>	<b>125339</b>	<b>92699</b>	<b>926699</b>	<b>280807</b>	<b>119157</b>
<b>Upper</b>														
Limit	35514	58392	65071	38015	34853	133278	24517	25164	33764	169942	126100	136099	382599	179304
<b>Lower</b>														
Limit	15848	30070	-32350	10508	6442	20645	6950	5561	17191	80736	68346	49299	179014	59009

Table 7. Mean number and weight of cod per standard tow from research vessel surveys in NAFO Division 3N, 3O, and 3NO.

Div.	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988
	<u>Mean Number per tow</u>																
3N	44.60	33.33	12.17	8.91	17.10	10.30	32.37	25.00	5.59	11.28	18.38	15.54	40.01	24.96	10.34	55.37	8.30
3O			10.48	10.31	12.63	18.93	16.93	16.93	46.36	8.52	8.62	21.86	36.36	15.84	33.72	116.31	16.20
3NO			12.46	13.23	11.61	25.70	20.78	26.28	26.28	9.85	14.60	18.77	38.03	20.24	22.44	87.07	12.39
	<u>Mean Weight per tow</u>																
3N	24.51	34.05	18.03	8.91	17.57	8.24	33.32	25.98	9.34	16.56	46.30	25.01	74.05	65.90	76.09	97.66	48.70
3O			25.19	12.17	12.63	19.42	15.93	57.28	57.28	12.17	22.32	19.13	93.8	72.35	68.98	208.96	88.67
3NO			21.40	14.48	10.71	26.36	20.72	32.74	32.74	14.29	37.00	21.92	84.01	69.24	72.41	155.55	69.39



Table 8. Cod abundance (000's) from stratified-random cruises in Division 3N. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata Area	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988
0-30	375	1593	5076	3826	398	1435	6616 (1328)	7474	4329	263	508	10583	1578	1746	3184	912	2167	1116
	376	1499	(1740)	788	37	(243)	1294	3601	225	225	113	225	33	7933	48	177	2813	375
31-50	360	2992	(7146)	1516	(863)	(1095)	2302	4211	1011	1273	2695	523	2118	5680	3005	552	1198	1422
	361	1853	5747	5796	835	904	3623	5610	4764	1166	1808	(4622)	4961	3283	10293	3310	10484	2841
	362	2520	2484	11823	984	1466	431	5830	7440	757	1203	3859	1608	18971	4385	2391	43871	1702
	373	2520	18897	3831	142	426	(1942)	76	946	5959	327	331	1892	1589	8160	770	675	4307
	374	931	1563	175	175	1	140	(186)	1607	1817	297	1	163	1677	2893	175	47	266
	383	674	74	1644	51	25	(124)	17	320	1493	34	1	118	25	34	1	422	51
51-100	359	421	(1903)	822	622	(303)	(688)	4705	1359	(1392)	549	2133	611	126	95	0	1264	332
	377	100	(621)	1066	143	613	413	(104)	2800	105	73	490	1146	278	56	105	23	758
	382	647	425	3447	16	130	(243)	24	2639	1943	243	255	146	194	0	134	12	16
101-150	358	225	(2425)	861	4189	(397)	(885)	(414)	262	(1776)	431	1993	135	1343	380	448	760	1478
	378	139	619	3673	459	1683	(620)	(290)	657	120	400	1445	193	1236	318	2181	433	151
	381	182	1195	779	861	79	156	(280)	3267	364	155	379	779	1851	301	2391	1312	68
151-200	357	164	(373)	(320)	1157	(57)	(133)	(60)	12	(272)	49	336	37	382	0	2381	137	(319)
	379	106	(406)	(349)	1802	785	(146)	(67)	24	0	671	408	40	322	175	525	801	4
	380	116	17	118	641	70	(104)	(47)	22	(212)	96	26	15	(104)	83	788	136	313
Total	16682	50712	41732	13373	9709	19861	12844	40640	33220	7008	14124	25085	19426	50108	31262	12943	68968	10397
Estimated mean																		
no. per tow		40.50	33.33	10.68	7.75	15.86	10.28	32.45	26.53	5.60	11.28	20.03	15.01	40.02	24.97	10.34	55.08	8.30

Table 9. Cod abundance (000's) from stratified-random cruises in Division 30. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata Area	1973	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	
31-50	330	2089	2144	419	679	889	1071	3674	1411	941	359	1921	1461	823	3763	993
	331	456	34	49	624 (325)	240	205	1284	(219)	377	993	548	214	650	240	
	338	1898	2451	4987	3230	9047	1311	2666	1681 (2621)	4103	10116	2391	2976	5305	1781	
	340	1716 (1739)	215	4164	258	708	1730	386	859	2340	2898	2733	2576	55431	1178	
	351	2520	2837	936	615	4843	2535	39981	1513	3689	8701	18538	4413	32509	28753	2913
	352	2580	3409	1290	1791	5965	4648	3486	2113 (3288)	3486	11814	4859	2988	12097	8821	
	353	1282	224	705	48	320	1732	4388	48 (310)	257	1	674	165	1700	1674	
51-100	329	1721	129	(551)	3682	172	1731	1012	65	129	753	775	501	501	42933	22133
	332	1047	(1255)	1729	367	1729	7309	2613	118 (930)	5678	236	1839	458	2546	1297	
	337	948	735	688	356	249	320	516	48 (276)	285	142	939	882	451	249	
	339	585	220	22 (212)	(250)	329	1361	(127)	198	2448	1054	88	29	278	102	
	354	474	261	(186)	712	36	(401)	729	2075	107	107	142	261	178	1975	160
101-150	333	151	(17)	958	85	0	4	0	6 (11)	60	0	17	53	340	0	
	336	121	9	0	0	141	5	2	95 (4)	41	0	9	45	9	5	
	355	103	19	0	4 (18)	(24)	19	128	19	151	0	398	12	54	12	
151-200	334	92	(8)	(4)	7	0	2	0	21 (5)	3	0	152	856	14	70	
	335	58	7	(0)	1 (1)	0	0	3 (0)	4	0	0	0	40	4	7	
	356	61	2	(0)	(1)	(1)	(2)	5	18 (2)	2 (2)	0	0	9	2	30	
Total		17902	15498	12738	16580	24242	22372	62388	11140	13609	29155	48628	21283	45316	156302	21767

Estimated  
mean no.  
per tow.

11.53 9.48 12.34 18.04 16.65 46.43 8.29 10.13 21.70 36.19 15.84 33.72 116.31 16.20

Table 10. Mean number of cod at age and per standard tow from research vessel surveys in NAFO Divisions 3NO.

#	1971 <sup>a</sup>	1972 <sup>a</sup>	1973	1974 <sup>a</sup>	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988
Sets	45	45	94	37	58	78	88	88	172	140	77	130	116	178	203	191	161
Age																	
1	0.0	0.01	0.07	0.05	0.46	0.58	0.01	0.55	3.09	0.01	0.35	1.56	0.01	0.01	0.02	.21	.01
2	4.18	1.17	2.64	1.39	3.16	3.89	2.35	0.71	0.93	5.39	0.38	9.37	3.28	0.41	.70	2.77	1.67
3	42.14	9.01	2.69	4.97	4.70	2.89	9.71	7.07	2.33	1.38	5.39	1.18	6.20	4.47	.71	2.85	2.22
4	5.80	19.28	1.88	0.89	2.64	1.83	6.29	8.17	9.25	0.67	1.58	3.54	9.90	6.05	7.71	9.33	.46
5	4.43	1.72	2.48	0.44	0.59	1.66	4.63	2.48	7.84	1.07	1.83	.60	5.29	2.41	6.46	34.86	.41
6	1.06	.71	0.50	0.38	0.31	0.26	1.54	0.96	1.76	0.44	2.32	.47	5.60	.88	1.62	21.25	1.06
7	1.08	.58	0.28	0.14	0.60	0.07	0.49	0.61	0.52	0.21	1.13	.78	1.87	.97	.68	8.33	1.17
8	0.48	.41	0.20	0.04	0.25	0.13	0.22	0.04	0.26	0.18	0.50	.58	1.00	.73	.65	1.78	.78
9	0.24	.30	0.22	0.01	0.25	0.06	0.10	0.01	0.10	0.18	0.53	.26	1.81	.88	.50	1.94	.82
10	0.03	.17	0.13	0.07	0.08	0.07	0.10	0.03	0.02	0.09	0.24	.16	1.57	1.34	.74	.69	.87
11	0.08	.08	0.06	0.03	0.01	0.02	0.01	0.04	0.06	0.05	0.04	.07	.86	.98	1.20	.77	.44
12	0.14	.05	0.09		0.02		0.04	0	0	0.07	0.14	.05	.32	.49	.65	.71	.55
13			0.14		0.01		0.09	0.04	0.04	0.03	0.06	.01	.11	.24	.36	.81	.79
14+	0.47	.36	0.50	0.15	0.15	0.05	0.12	0.01	0.10	0.12	0.17	.14	.22	.39	.52	.77	1.24
Mean no.																	
per tow	60.13	33.85	11.89	8.56	13.23	11.51	25.70	20.72	26.30	9.89	14.66	18.76	38.03	20.24	22.42	87.07	12.39
Upper																	
Limit	117.35	51.51	15.47	12.50	25.93	17.94	33.96	31.81	47.18	12.85	23.61	25.28	47.82	24.06	44.11	119.64	15.18
Lower																	
Limit	2.93	16.10	8.33	4.62	0.52	5.09	17.45	9.90	5.49	6.91	5.70	12.24	28.25	16.42	0.74	54.49	9.60

<sup>a</sup> Survey 3N only.

Table 11. Mean numbers of cod at age per tow from research vessel surveys in NAFO Divisions 3NO including estimates for non-sampled strata. (1971, 1972, and 1974 survey in 3N only.)

2/ 6/88

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.00	0.01	0.07	0.05	0.44	0.57	0.01	0.57	3.14	0.01	0.36	1.54	0.00	0.01	0.01	0.02	0.21	0.01
2	2.82	1.15	2.47	1.26	3.00	3.84	2.29	0.73	0.95	5.30	0.39	9.23	0.00	3.28	0.41	0.70	2.76	1.67
3	28.38	8.87	2.52	4.50	4.46	2.85	9.44	7.31	2.37	1.36	5.48	1.16	0.00	6.20	4.47	0.71	2.84	2.22
4	3.91	18.98	1.76	0.81	2.51	1.80	6.12	8.45	9.40	0.66	1.61	3.49	0.00	9.90	6.05	7.72	9.30	0.46
5	2.98	1.69	2.32	0.40	0.56	1.64	4.50	2.56	7.97	1.05	1.86	0.59	0.00	5.29	2.41	6.47	34.75	0.41
6	0.71	0.70	0.47	0.34	0.29	0.26	1.50	0.99	1.79	0.43	2.36	0.46	0.00	5.60	0.88	1.62	21.18	1.06
7	0.73	0.57	0.26	0.13	0.57	0.07	0.48	0.63	0.53	0.21	1.15	0.77	0.00	1.87	0.97	0.68	8.30	1.17
8	0.32	0.40	0.19	0.04	0.24	0.13	0.21	0.04	0.26	0.18	0.51	0.57	0.00	1.00	0.73	0.65	1.77	0.78
9	0.16	0.30	0.21	0.01	0.24	0.06	0.10	0.01	0.10	0.18	0.54	0.26	0.00	1.81	0.88	0.50	1.93	0.82
10	0.02	0.17	0.12	0.06	0.08	0.07	0.10	0.03	0.02	0.09	0.24	0.16	0.00	1.57	1.34	0.74	0.69	0.87
11	0.05	0.08	0.06	0.03	0.01	0.02	0.01	0.04	0.06	0.05	0.04	0.07	0.00	0.86	0.98	1.20	0.77	0.44
12	0.09	0.05	0.08	0.00	0.02	0.00	0.04	0.00	0.00	0.07	0.14	0.05	0.00	0.32	0.49	0.65	0.71	0.55
13	0.00	0.00	0.13	0.00	0.91	0.00	0.09	0.04	0.04	0.03	0.06	0.01	0.00	0.11	0.24	0.36	0.81	0.79
14	0.32	0.35	0.47	0.14	0.14	0.05	0.12	0.01	0.10	0.12	0.17	0.14	0.00	0.22	0.39	0.52	0.77	1.24
1+	40.50	33.33	11.11	7.75	12.56	11.35	24.99	21.42	26.74	9.73	14.91	18.48	0.00	38.05	20.25	22.54	86.80	12.49
2+	40.50	33.32	11.05	7.70	12.12	10.78	24.98	20.85	23.60	9.72	14.55	16.94	0.00	38.04	20.24	22.52	86.59	12.48
3+	37.68	32.17	8.58	6.45	9.12	6.94	22.70	20.12	22.65	4.42	14.17	7.72	0.00	34.76	19.83	21.82	83.83	10.81
4+	9.30	23.30	6.06	1.95	4.66	4.09	13.25	12.81	20.28	3.06	8.69	6.56	0.00	28.56	15.36	21.11	80.99	8.59
5+	5.40	4.31	4.30	1.14	2.16	2.29	7.14	4.36	10.88	2.40	7.08	3.07	0.00	18.65	9.31	13.39	71.69	8.13
6+	2.41	2.62	1.98	0.74	1.59	0.65	2.64	1.80	2.91	1.35	5.22	2.48	0.00	13.36	6.90	6.93	36.94	7.72

Table 12. Analysis of variance and regression coefficients from the regression of ln catch rate for cod in Div. 3N0 for the 1977-87 period using Canadian otter trawl data.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.595  
 MULTIPLE R SQUARED..... 0.354

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	4.483E1	4.483E1	
REGRESSION	25	4.306E1	1.722E0	7.504
TYPE 1	3	9.655E0	3.218E0	14.022
TYPE 2	1	5.933E-2	5.933E-2	0.258
TYPE 3	11	2.005E1	1.823E0	7.941
TYPE 4	10	8.845E0	8.845E-1	3.854
RESIDUALS	343	7.872E1	2.295E-1	
TOTAL	369	1.666E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
		INTERCEPT	-0.064	0.225	369
1	3124				
2	34				
3	1				
4	77				
1	3125	1	0.108	0.072	167
	27124	2	0.390	0.101	50
	27125	3	-0.463	0.085	72
2	35	4	-0.032	0.064	252
3	2	5	-0.385	0.162	26
	3	6	-0.563	0.154	29
	4	7	-0.653	0.153	33
	5	8	-0.874	0.149	41
	6	9	-0.877	0.147	42
	7	10	-0.819	0.162	28
	8	11	-0.712	0.166	26
	9	12	-0.707	0.171	19
	10	13	-0.840	0.155	32
	11	14	-0.401	0.144	44
	12	15	-0.250	0.151	35
4	78	16	-0.116	0.184	35
	79	17	-0.197	0.180	43
	80	18	-0.049	0.202	18
	81	19	0.171	0.200	19
	82	20	0.433	0.181	33
	83	21	0.398	0.178	39
	84	22	0.225	0.179	38
	85	23	0.224	0.178	39
	86	24	0.109	0.175	44
	87	25	0.058	0.173	51

Table 13. Analysis of variance and regression coefficients from the regression of ln catch rate for cod in Div. 3N0 for the 1977-86 period using Spanish pair trawl data.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.787  
 MULTIPLE R SQUARED..... 0.619

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	9.848E1	9.848E1	
REGRESSION	23	1.003E2	4.362E0	14.468
TYPE 1	2	2.954E0	1.477E0	4.900
TYPE 2	1	1.121E0	1.121E0	3.719
TYPE 3	11	8.225E0	7.477E-1	2.480
TYPE 4	9	8.069E1	8.966E0	29.742
RESIDUALS	205	6.180E1	3.015E-1	
TOTAL	229	2.606E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
		INTERCEPT	-1.224	0.285	229
1	19164	1	0.192	0.076	109
2	34	2	0.495	0.232	10
3	1	3	0.228	0.118	45
4	77	4	0.284	0.357	7
1	19165	5	-0.132	0.298	15
2	19166	6	-0.077	0.297	14
3	35	7	0.150	0.274	24
	2	8	0.396	0.272	27
	3	9	0.535	0.282	23
	4	10	0.168	0.288	20
	5	11	0.026	0.284	21
	6	12	0.149	0.277	25
	7	13	0.086	0.277	26
	8	14	0.436	0.285	20
4	78	15	-1.133	0.154	30
	79	16	-0.987	0.197	16
	80	17	-0.179	0.167	30
	81	18	0.631	0.183	20
	82	19	0.361	0.173	23
	83	20	0.592	0.181	20
	84	21	1.177	0.177	22
	85	22	0.664	0.177	21
	86	23	0.218	0.170	21

Table 14. Catch rate index for cod in NAFO Div. 3NO using Canadian otter trawl data for the period 1977-87.

PREDICTED CATCH RATE						
YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1977	-0.8658	0.0297	0.465	0.080	17604	37852
1978	-0.9820	0.0141	0.417	0.049	14718	35272
1979	-0.6687	0.0110	0.572	0.060	27941	48872
1980	-0.9144	0.0209	0.445	0.064	19360	43508
1981	-0.6949	0.0199	0.554	0.078	24344	43907
1982	-0.4332	0.0120	0.723	0.079	31605	43705
1983	-0.4678	0.0114	0.699	0.074	28818	41239
1984	-0.6407	0.0128	0.587	0.066	27103	46139
1985	-0.6418	0.0124	0.587	0.065	36899	62875
1986	-0.7564	0.0108	0.524	0.054	51472	98274
1987	-0.8083	0.0107	0.497	0.051	37512	75432

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.121

Table 15. Catch rate index for cod in NAFO Div. 3NO using Spanish pair trawl data for the period 1977-86.

PREDICTED CATCH RATE						
YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1977	-0.6363	0.0234	0.609	0.093	17604	28924
1978	-1.7696	0.0208	0.196	0.028	14718	75013
1979	0.3506	0.0352	1.623	0.303	27941	17213
1980	-0.8155	0.0248	0.508	0.080	19360	38078
1981	-0.0050	0.0264	1.142	0.185	24344	21308
1982	-0.2757	0.0222	0.873	0.130	31605	36186
1983	-0.0445	0.0253	1.099	0.174	28818	26226
1984	0.5404	0.0235	1.974	0.301	27103	13729
1985	0.0278	0.0233	1.182	0.180	36899	31208
1986	-0.4184	0.0210	0.758	0.109	51472	67933

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.156

Table 16. Analysis of variance and regression coefficients from the regression of ln catch rate for cod in Div. 3N0 for the 1977-87 period using Canadian otter trawl data when cod is at least 50% of the monthly catch.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.602  
 MULTIPLE R SQUARED..... 0.362

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.908E1	1.908E1	
REGRESSION	25	2.981E1	1.192E0	5.337
TYPE 1	3	6.486E0	2.162E0	9.678
TYPE 2	11	1.376E1	1.251E0	5.600
TYPE 3	1	8.665E-2	8.665E-2	0.388
TYPE 4	10	7.065E0	7.065E-1	3.163
RESIDUALS	235	5.250E1	2.234E-1	
TOTAL	261	1.014E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3124	INTERCEPT	0.126	0.255	261
2	1				
3	34				
4	77				
1	3125	1	0.133	0.083	115
	27124	2	0.382	0.115	33
	27125	3	0.472	0.099	58
2	2	4	-0.356	0.172	19
	3	5	-0.584	0.163	20
	4	6	-0.650	0.157	25
	5	7	-0.848	0.157	28
	6	8	-0.788	0.155	27
	7	9	-0.822	0.175	20
	8	10	-0.750	0.186	18
	9	11	-0.625	0.189	12
	10	12	-0.852	0.163	23
	11	13	-0.483	0.151	32
	12	14	-0.233	0.160	23
3	35	15	-0.049	0.079	190
4	78	16	-0.238	0.229	27
	79	17	-0.023	0.220	36
	80	18	-0.250	0.244	16
	81	19	0.117	0.246	13
	82	20	0.270	0.224	22
	83	21	0.277	0.217	33
	84	22	0.053	0.219	36
	85	23	0.118	0.234	17
	86	24	-0.032	0.307	5
	87	25	-0.079	0.211	50



Table 17. Analysis of variance and regression coefficients from the regression of ln catch rate for cod in Div. 3N0 for the 1977-87 period using Canadian otter trawl data when cod is at least 60% of the monthly catch.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R,..... 0.556  
 MULTIPLE R SQUARED,..... 0.310

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.392E0	3.392E0	
REGRESSION	25	1.805E1	7.218E-1	3.031
TYPE 1	3	2.531E0	8.438E-1	3.543
TYPE 2	11	8.238E0	7.489E-1	3.145
TYPE 3	1	1.243E-1	1.243E-1	0.522
TYPE 4	10	5.392E0	5.392E-1	2.264
RESIDUALS	169	4.025E1	2.382E-1	
TOTAL	195	6.169E1		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3124	INTERCEPT	0.187	0.400	195
2	1				
3	34				
4	77				
1	3125	1	0.166	0.101	73
	27124	2	0.243	0.129	32
	27125	3	0.365	0.114	51
2	2	4	-0.357	0.181	18
	3	5	-0.540	0.174	18
	4	6	-0.491	0.178	19
	5	7	-0.661	0.180	18
	6	8	-0.614	0.187	13
	7	9	-0.860	0.216	12
	8	10	-0.483	0.265	8
	9	11	-0.512	0.223	8
	10	12	-0.820	0.180	18
	11	13	-0.463	0.159	29
	12	14	-0.225	0.171	20
3	35	15	-0.077	0.106	152
4	78	16	-0.152	0.376	21
	79	17	-0.034	0.370	30
	80	18	-0.206	0.398	10
	81	19	0.126	0.407	7
	82	20	0.301	0.376	17
	83	21	0.315	0.368	26
	84	22	0.027	0.374	27
	85	23	-0.073	0.387	12
	86	24	-0.046	0.435	5
	87	25	-0.116	0.367	37

Table 18. Analysis of variance and regression coefficients from the regression of ln catch rate for cod in Div. 3N0 for the 1977-87 period using Canadian otter trawl data when cod is at least 70% of the monthly catch.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.531  
 MULTIPLE R SQUARED..... 0.282

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	5.019E-2	5.019E-2	
REGRESSION	25	1.189E1	4.756E-1	1.793
TYPE 1	3	1.475E0	4.918E-1	1.854
TYPE 2	11	4.707E0	4.279E-1	1.613
TYPE 3	1	1.594E-1	1.594E-1	0.601
TYPE 4	10	5.060E0	5.060E-1	1.907
RESIDUALS	114	3.024E1	2.653E-1	
TOTAL	140	4.218E1		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3124	INTERCEPT	-0.204	0.457	140
2	1				
3	34				
4	77				
1	3125	1	0.269	0.131	45
	27124	2	0.205	0.150	28
	27125	3	0.289	0.137	39
2	2	4	-0.318	0.211	14
	3	5	-0.530	0.207	13
	4	6	-0.378	0.218	13
	5	7	-0.436	0.226	12
	6	8	-0.603	0.254	8
	7	9	-0.728	0.282	6
	8	10	-0.209	0.338	4
	9	11	-0.207	0.301	5
	10	12	-0.714	0.233	9
	11	13	-0.531	0.182	23
	12	14	-0.281	0.191	20
3	35	15	-0.117	0.151	117
4	78	16	0.263	0.440	17
	79	17	0.576	0.437	20
	80	18	0.231	0.485	6
	81	19	0.450	0.462	6
	82	20	0.856	0.435	14
	83	21	0.766	0.433	21
	84	22	0.537	0.437	19
	85	23	0.594	0.473	6
	86	24	0.249	0.494	5
	87	25	0.373	0.431	24

Table 19. Catch rate indices for cod in NAFO Div. 3NO using Canadian otter trawl data for the 1977-87 period when cod is at least (A) 50%, (B) 60%, and (C) 70% of the monthly catch.

A) PREDICTED CATCH RATE

YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1977	-0.5787	0.0462	0.613	0.130	17604	28727
1978	-0.8163	0.0206	0.489	0.070	14718	30071
1979	-0.6016	0.0142	0.609	0.072	27941	45907
1980	-0.8286	0.0267	0.482	0.078	19360	40165
1981	-0.4616	0.0286	0.695	0.117	24344	35026
1982	-0.3087	0.0166	0.815	0.105	31605	38793
1983	-0.3014	0.0154	0.821	0.102	28818	35092
1984	-0.5252	0.0169	0.656	0.085	27103	41314
1985	-0.4610	0.0230	0.697	0.105	36899	52907
1986	-0.5464	0.0654	0.627	0.158	51472	82114
1987	-0.6582	0.0144	0.575	0.069	37512	65230

AVERAGE C.V. FOR THE RETRANSFORMED MEAN; 0.156

B) PREDICTED CATCH RATE

YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1977	-0.3380	0.1469	0.747	0.277	17604	23577
1978	-0.4897	0.0379	0.678	0.131	14718	21717
1979	-0.3724	0.0245	0.767	0.120	27941	36419
1980	-0.5438	0.0530	0.637	0.145	19360	30385
1981	-0.2116	0.0602	0.885	0.215	24344	27505
1982	-0.0367	0.0304	1.070	0.186	31605	29532
1983	-0.0226	0.0306	1.085	0.189	28818	26554
1984	-0.3107	0.0330	0.813	0.147	27103	33353
1985	-0.2650	0.0449	0.845	0.178	36899	43642
1986	-0.3840	0.0812	0.737	0.206	51472	69829
1987	-0.4542	0.0288	0.705	0.119	37512	53174

AVERAGE C.V. FOR THE RETRANSFORMED MEAN; 0.216

C) PREDICTED CATCH RATE

YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1977	-0.6554	0.2221	0.531	0.238	17604	33172
1978	-0.3922	0.0722	0.745	0.197	14718	19765
1979	-0.0795	0.0519	1.028	0.232	27941	27167
1980	-0.4239	0.1047	0.710	0.225	19360	27279
1981	-0.2050	0.0894	0.890	0.261	24344	27347
1982	0.2008	0.0605	1.355	0.330	31605	23317
1983	0.1109	0.0626	1.238	0.306	28818	23286
1984	-0.1187	0.0712	0.979	0.258	27103	27673
1985	-0.0617	0.0904	1.027	0.303	36899	35932
1986	-0.4064	0.1141	0.719	0.237	51472	71604
1987	-0.2828	0.0699	0.832	0.217	37512	45101

AVERAGE C.V. FOR THE RETRANSFORMED MEAN; 0.290

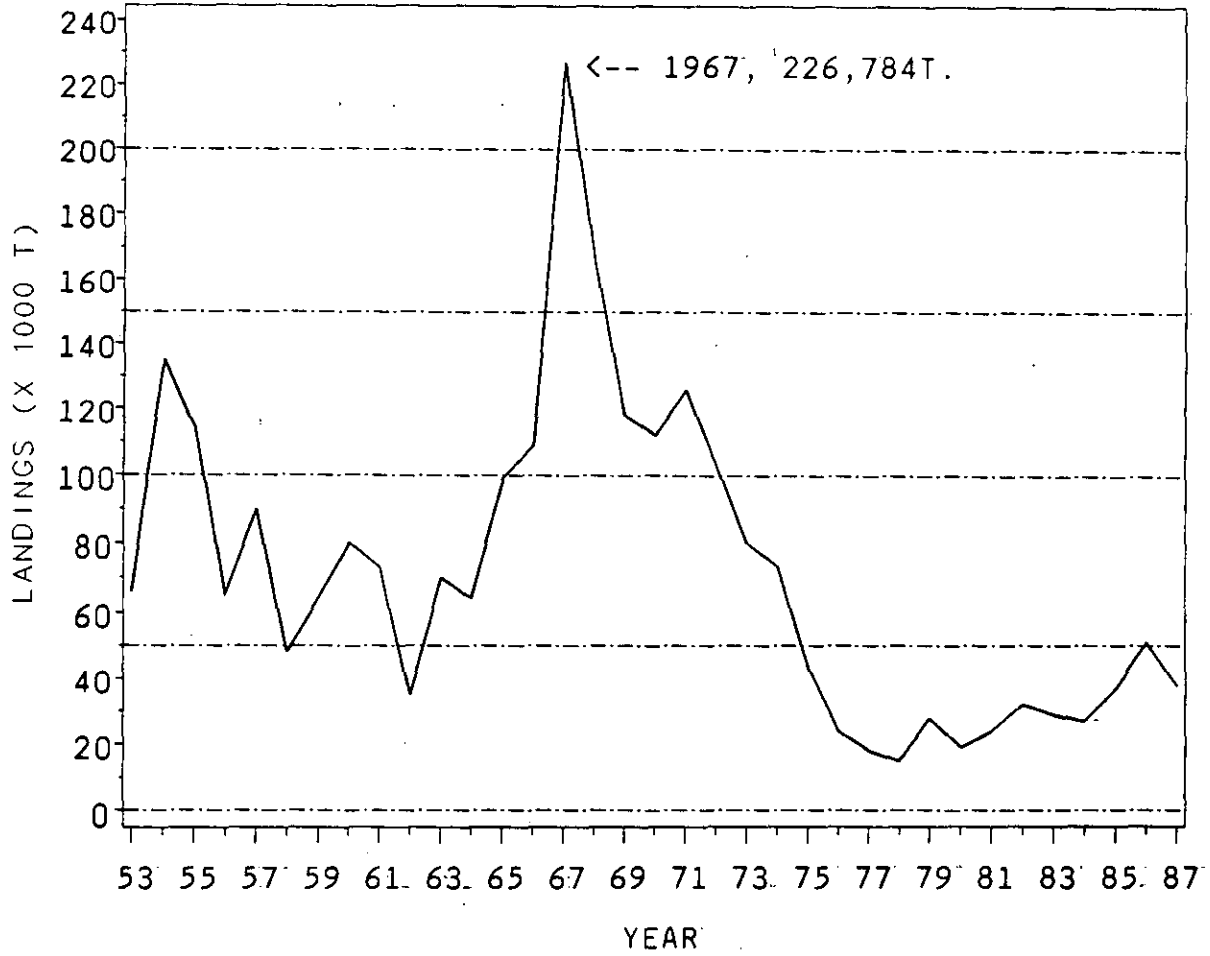


FIG. 1. LANDINGS OF COD IN DIVISIONS 3NO FOR THE PERIOD 1953-87.

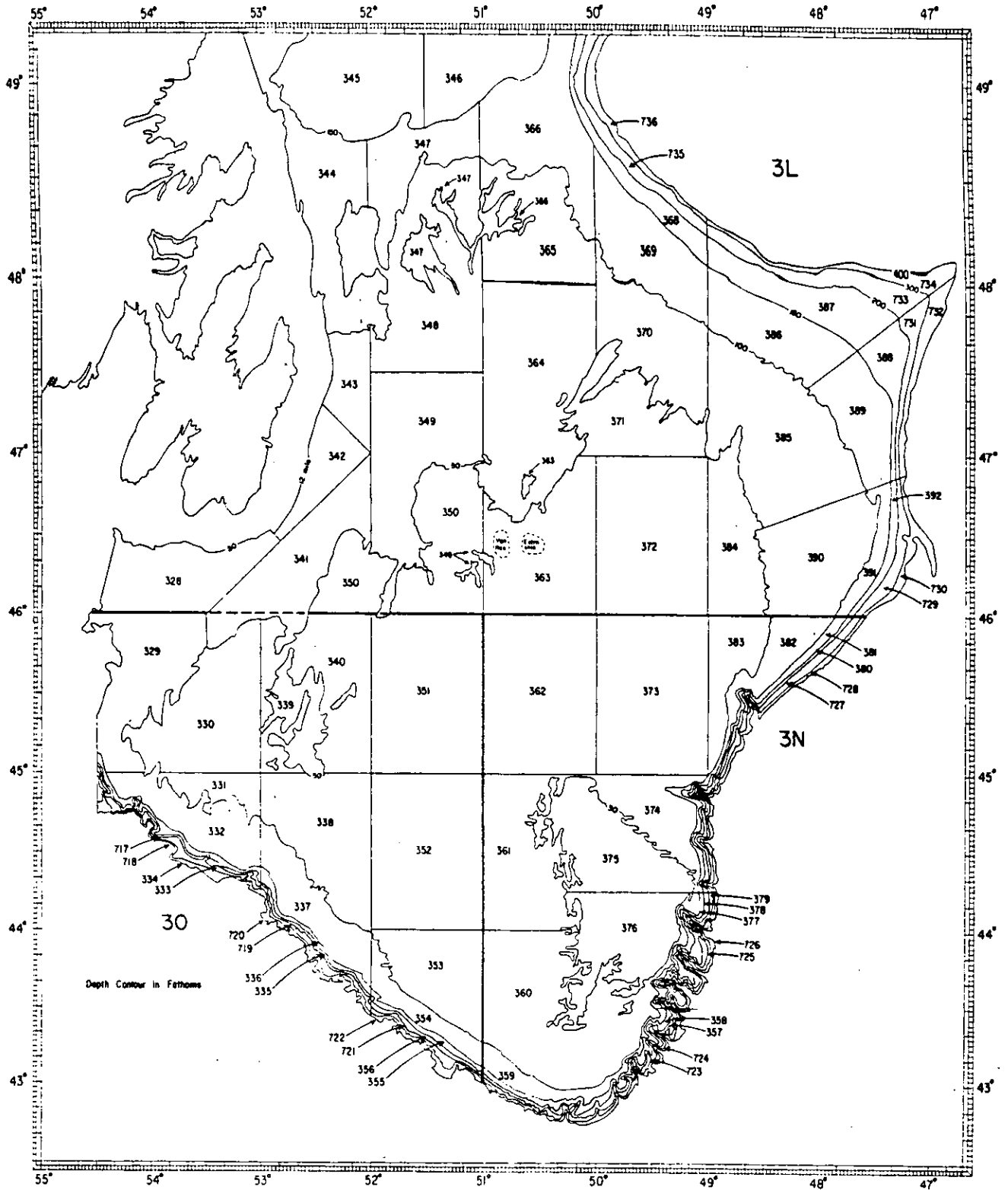


Fig. 2. Stratification scheme used for stratified-random research vessel groundfish surveys in NAFO Div. 3LNO

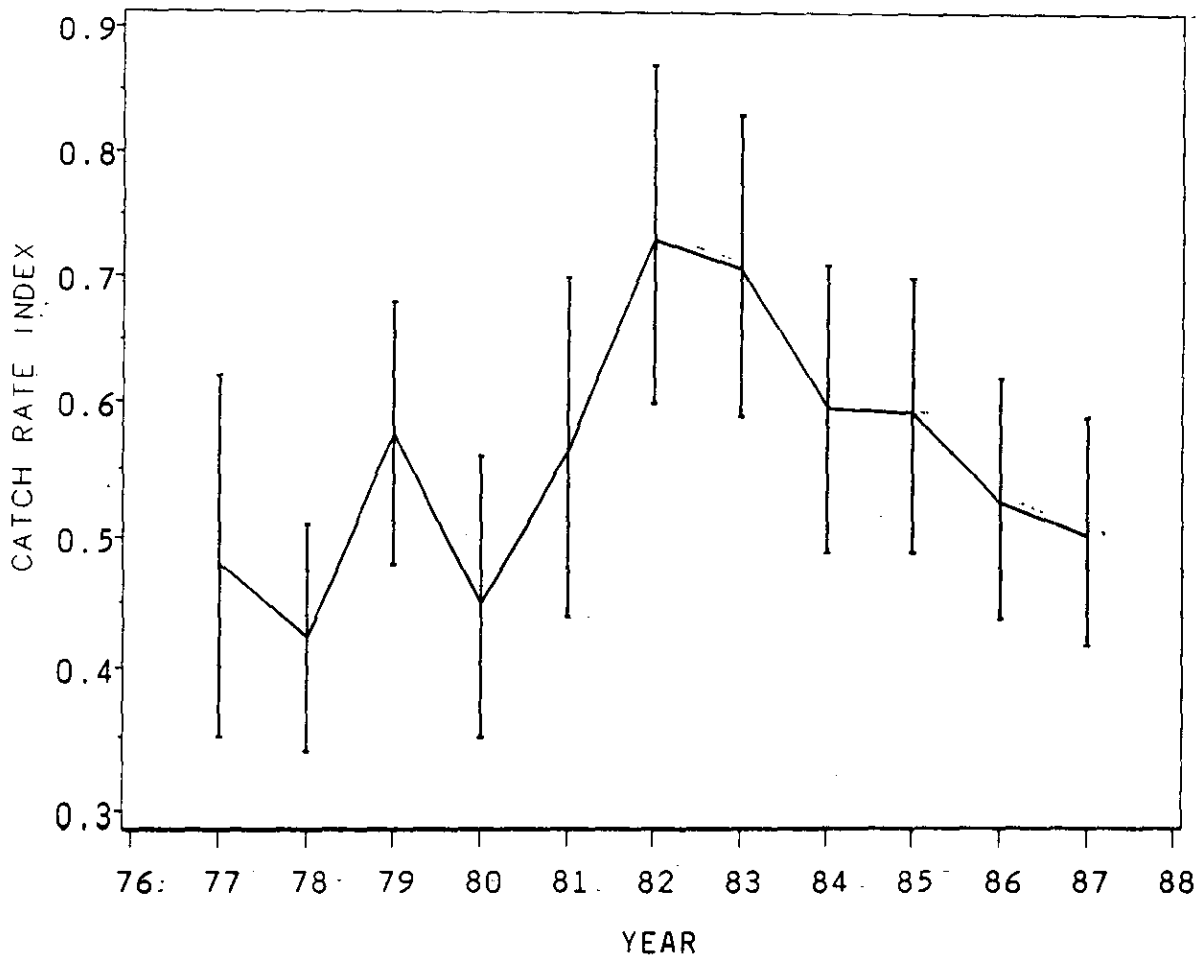


FIG 3. CATCH RATE INDEX WITH APPROXIMATE 90% CONFIDENCE INTERVAL FOR DIV. 3NO COD USING CANADIAN OTTER TRAWL DATA FOR THE PERIOD 1977-87.

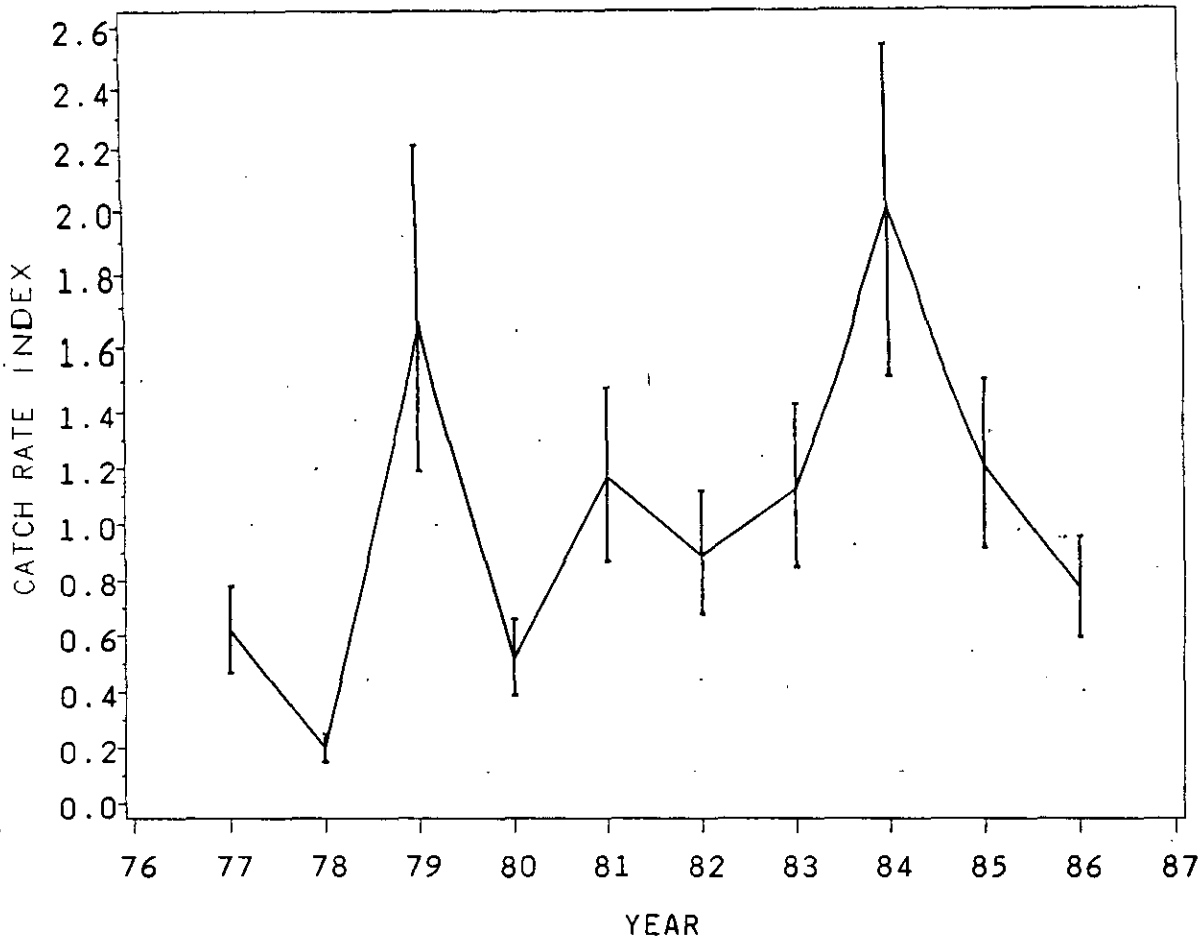


FIG 4. CATCH RATE INDEX WITH APPROXIMATE 90% CONFIDENCE INTERVAL FOR DIV. 3NO COD USING SPANISH PAIR TRAWL DATA FOR THE PERIOD 1977-86.

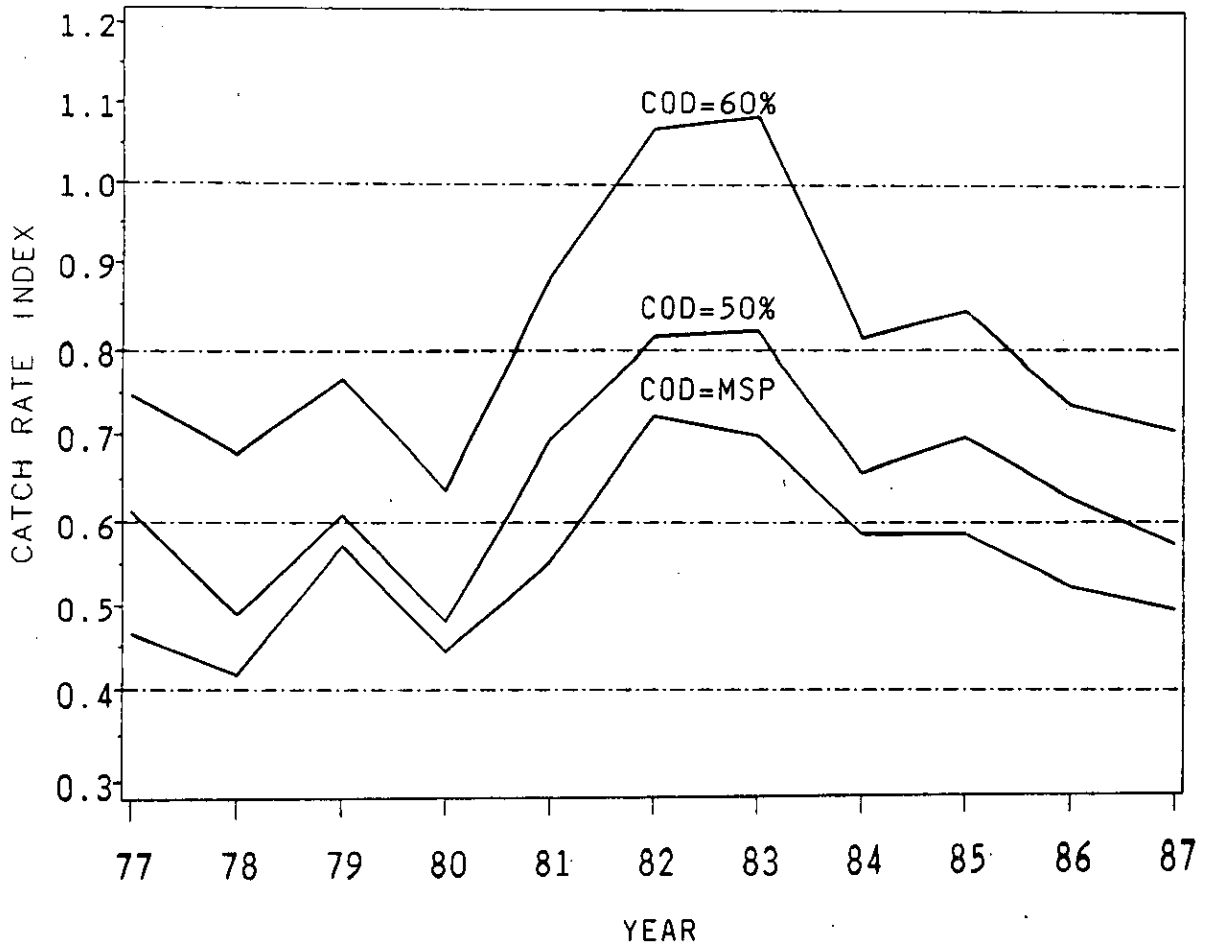


FIG 5. COMPARISON OF CATCH RATE INDICES FOR COD IN DIV 3NO WHEN COD IS A) IDENTIFIED AS MAIN SPECIES ON LOGBOOKS, B) 50% OF TOTAL CATCH, AND C) 60% OF TOTAL CATCH.



Appendix. Further Work on the Assessment of Cod in Division 3NO

Research Vessel Survey Data

Mean numbers of cod at age per tow, presented in Table 11 of NAFO SCR 88/19, suggest that results of the 1987 Canadian R/V survey may be anomolous. The age structure estimated from this survey was not consistent with those from adjacent years. Results of this survey indicate that age 6+ abundance for this stock had increased by a factor of 5 from 1986 to 1987 and then declined by about the same factor from 1987 to 1988. During the last assessment of this stock (NAFO SC Reports, 1987) the survey results for 1984 were also considered anomolous because of similar inconsistencies. The degree of inconsistency for the 1987 survey results is much greater than that of 1984.

A number of possible explanations for the discrepancy in the 1987 survey results were investigated.

Original data sheets were checked to determine if errors in coding or keypunching may have been included in the analysis of the 1987 survey data. From this investigation it was concluded that all data were appropriately coded and key-punched.

Average bottom temperatures (°C) by stratum for 1984-88 are presented in Tables 1 to 5 respectively. A summary of this data for strata which comprise a large portion of the biomass (84% of total 3NO survey biomass) in 1987 is as follows:

<u>NAFO Div.</u>	<u>Stratum</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
3N	361	2.76	0.86	1.43	1.02	1.59
	362	1.51	-0.03	0.04	-0.10	0.76
	373	0.36	-0.19	-0.11	-0.47	-0.25
3O	329	-1.30	-1.30	-1.14	-1.07	1.87
	338	1.94	-0.11	0.44	0.23	2.53
	340	0.02	-0.79	-0.63	-0.32	-0.60
	351	1.15	-0.23	-0.41	-0.19	0.35
	352	2.99	0.76	0.36	0.93	1.73

All of the above strata are in the 31-50 fathom depth range with the exception of stratum 329 in Div. 3O which is in the 51-100 fathom depth range. A summary of average temperature by depth range is presented in Table 6. From a preliminary examination of this temperature data by stratum and depth-zone, there is no reason to expect that changes in bottom temperature may have altered distribution or produced the large biomass estimated for 1987.

Research vessel survey biomass estimates from Div. 3L and Div. 3NO from strata

contiguous with the 3L/3NO boundary were examined (Table 7, Figure 1) to determine if increases in biomass in these strata in 3NO were consistent with decreases in the biomass for contiguous strata in Div. 3L. Although there may be incidences of a slight shift in divisional abundance, during 1987 when biomass increased in the Div. 3NO strata it also increased in the strata in Div. 3L that are contiguous with 3NO.

The inconsistencies in the age structure estimated from the 1987 survey certainly exist, but it is difficult to explain the discrepancy in the 1987 survey results from the investigations that are described above.

#### Commercial Fishery Data

Catch and average weights-at-age for the Spanish fishery for cod in Division 3NO were combined with Canadian estimates and the total catch-at-age was adjusted for catches for which no sampling data were available (Table 8). The calculated catch (the sum of the catch-at-age X average weights) was about 97% of the reported catch. The 1980-82 year-classes dominated the commercial catch and the 1983 year-class was not well represented.

Pair-trawl catch-rates, derived from an analysis conducted by Spain for the 1982-87 period, related quite well (Figure 2) with overlapping years from the pair-trawl index estimated from a multiplicative analysis conducted by Canada using data for the 1977-86 period.

The 1987 index, estimated by Spain was adjusted by this relationship (Table 9) and appended to the 1977-86 pair-trawl catch-rate series.

As was the case last year (NAFO SC Reports, 1987) Canadian otter-trawl and Spanish pair trawl CPUE indices were combined (Table 10) after weighting each to an estimate of the geographical area inside (80%) and outside (20%) the Canadian 200 mile fishing zone. The combined index, presented in Figure 3, although quite variable in the earlier period, shows an increase to 1982 stability to 1985 with a subsequent decline.

Catch-at-age values for fish at older ages (13 and older) are presented in Table 11 for the 1959-87 time period. It can be seen that in a number of years fish up to and in some cases exceeding age 20 were evident in the commercial catch. Catch and average weight-at-age data from the commercial fishery for the 1959-87 period, that were used in cohort analyses, are presented in Tables 12 and 13.

#### Fishing Mortality in 1987

Sequential population analysis for this stock was conducted assuming natural

mortality = 0.20 and fishing mortality for the oldest age group (12 years) set at the level for fully recruited ages (7-10). Partial recruitment for 1987 was estimated by iteration as the average for the 1981-85 period (Table 18).

Research vessel survey results, from Canadian and USSR surveys for the 1977-87 period were considered for calibration with cohort analyses. It was stated earlier that the 1984 and 1987 Canadian survey results were considered anomalous and were not included in further analysis. An examination of the USSR survey results indicated that the 1985 age structure was not consistent with adjacent years and this survey was also excluded from further analysis. Discrepancies with the age structure for the 1987 USSR survey results were identified and precluded the use of these data in calibration. The Canadian and Soviet survey indices, although not displaying a one-to-one correspondence showed the same general trend, that of lower abundance for the early time series (about 1977-82), with subsequent increases. Results from both of these surveys were combined (Table 14) to produce a single index of abundance from research vessel surveys. The relationship between Canadian, Soviet and Soviet/Canadian survey abundance for ages 6+ with cohort numbers averaged over the year for ages 6+ are presented in Tables 15-17 for a range of fishing mortalities. The relationships using a fishing mortality in the terminal year of 0.20 are shown in Figures 4-6. For each of these calibrations the  $r^2$  values increase as FT decreases. The only apparent discrimination between FT's is the pattern of residuals in the most recent few years. If the sum of residuals for the 1984-86 period were minimized the resultant FT would be in the range 0.20-0.30.

Results from a Canadian survey conducted during 1988 indicate that the age 6+ abundance is only slightly larger (about 10%) than that of 1985-86. It may be reasonable to assume, therefore, that the age 6+ average population abundance is relatively stable over the 1985-87 period although it is higher than the earlier period (1977-82). This conclusion would ignore the results of the 1987 Canadian survey. Average population biomass estimated using terminal fishing mortalities ranging from 0.20 to 0.30 (Table 17A) are not inconsistent with these trends in survey abundance. Results of cohort analysis, showing beginning of the year population numbers, average population biomass and fishing mortality matrix are presented in Tables 19-21 respectively using terminal fishing mortality of 0.20.

Calibration of SPA using the combined otter-trawl/pair-trawl CPUE index did not give any significant relationships. This may be due to the definition of directed

effort for this fishery. Further investigation into this possibility will be conducted for the next assessment of this stock. A plot of CPUE index and cohort exploitable biomass is shown for illustration in Figure 7.

Recruitment

Research vessel survey indices for Canada and the USSR at age 3 were correlated ( $r^2 = 0.77$ , Table 22) for overlapping years (1977-82), so they were normalized to their respective means and averaged to provide a single estimate of year-class strength. The relationship of this index with corresponding abundance estimates for the 1974-80 year-classes from cohort analysis indicated a significant regression ( $r^2 = 0.92$ , Table 23). The predicted sizes of the 1981 and 1983 year-classes were outside the range of the data examined, and there was no index value from which to predict the 1984 year-class. The sizes of the 1981-83 year-classes were determined by the average PR values at ages 4-7 in 1987. The 1984 year-class was also considered weak from results of the Canadian surveys and set at the lowest age 3 cohort abundance observed in the 1977-83 period (23.5 million fish).

TABLE 1. AVERAGE DEPTH & TEMPERATURE BY STRATUM FOR DIV 3NO (1984-88)

----- YEAR=84 -----						
UBS	STRATUM	NUMBER	DEPTH	TEMP	MIN_TEMP	MAX_TEMP
1	329	5	107.800	-1.3000	-1.4	-1.1
2	330	4	79.500	-0.7250	-1.2	0.1
3	331	3	89.667	1.5333	1.1	1.9
4	332	2	102.500	6.5000	6.1	6.9
5	333	2	212.500	7.2500	7.0	7.5
6	334	2	342.500	6.0000	6.0	6.0
7	335	2	316.500	5.8500	5.8	5.9
8	336	2	261.500	6.1000	5.1	7.1
9	337	2	99.000	3.8000	3.6	4.0
10	338	5	77.800	1.9400	-0.8	3.9
11	339	2	98.000	-1.0000	-1.1	-0.9
12	340	5	81.400	0.0200	-1.2	3.8
13	351	6	76.167	1.1500	0.1	2.8
14	352	7	69.571	2.9857	2.5	3.6
15	353	2	79.500	1.5000	0.9	2.1
16	354	2	96.500	1.6000	1.0	2.2
17	355	2	240.000	5.0500	5.0	5.1
18	356	2	311.000	5.7500	5.7	5.8
19	357	2	352.500	4.9000	4.6	5.2
20	358	2	223.500	5.4000	5.3	5.5
21	359	2	100.000	2.0500	1.6	2.5
22	360	7	64.857	1.9429	0.0	3.4
23	361	5	63.200	2.7600	2.0	3.3
24	362	7	71.143	1.5143	-0.4	3.1
25	373	7	66.429	0.3571	-0.9	2.0
26	374	3	59.667	1.1667	-0.4	2.5
27	375	5	52.400	1.6000	-1.1	3.9
28	376	4	47.500	3.8750	3.5	4.0
29	377	2	140.000	-1.2000	-1.3	-1.1
30	378	2	227.500	1.4000	1.0	1.8
31	379	2	312.000	2.9500	2.7	3.2
32	380	2	314.000	1.4000	1.0	1.8
33	381	2	257.500	1.6000	0.7	2.5
34	382	3	94.667	-1.4667	-1.5	-1.4
35	383	3	82.667	-1.2000	-1.4	-1.0

TABLE 2. AVERAGE DEPTH & TEMPERATURE BY STRATUM FOR DIV 3NO (1984-88)

----- YEAR=85 -----

UBS	STRATUM	NUMBER	DEPTH	TEMP	MIN_TEMP	MAX_TEMP
36	329	8	113.000	-1.3000	-1.7	-0.5
37	330	10	78.000	-0.8700	-1.5	-0.7
38	331	3	86.333	-0.5667	-0.9	-0.1
39	332	5	99.600	1.4600	0.4	2.7
40	333	2	200.000	8.4000	8.3	8.5
41	334	2	302.500	7.8000	7.7	7.9
42	335	2	334.500	5.6000	5.6	5.6
43	336	2	224.500	7.5500	7.2	7.9
44	337	5	110.800	0.3600	-1.0	3.8
45	338	9	82.333	-0.1111	-1.1	1.1
46	339	3	101.000	-1.3333	-1.4	-1.3
47	340	9	84.667	-0.7889	-1.4	0.5
48	351	12	74.500	-0.2250	-0.8	0.3
49	352	13	75.538	0.7615	-0.7	1.6
50	353	6	76.000	0.5333	-0.4	1.7
51	354	3	105.333	-0.9000	-1.0	-0.8
52	355	2	208.000	7.4000	7.1	7.7
53	356	2	311.000	6.3000	5.9	6.7
54	357	2	310.000	1.6500	1.0	2.3
55	358	2	214.500	3.7500	0.1	7.4
56	359	2	106.000	-1.1000	-1.1	-1.1
57	360	16	65.313	0.7500	-0.8	1.6
58	361	7	64.000	0.8571	0.1	1.2
59	362	11	72.000	-0.0273	-1.0	1.1
60	373	9	64.889	-0.1889	-0.9	0.4
61	374	4	62.500	-0.4750	-0.9	0.2
62	375	9	51.889	0.7444	0.0	1.3
63	376	7	51.857	0.5143	0.1	0.7
64	377	2	106.000	-0.9500	-1.1	-0.8
65	378	2	206.000	0.0500	0.0	0.1
66	379	3	318.667	1.2333	0.8	1.7
67	380	2	297.500	1.0500	0.1	2.0
68	381	2	223.500	-0.2500	-0.7	0.2
69	382	4	116.500	-1.1000	-1.4	-0.8
70	383	3	75.333	-1.0667	-1.3	-0.9

TABLE 3. AVERAGE DEPTH & TEMPERATURE BY STRATUM FOR DIV 3NO (1984-88)

----- YEAR=86 -----

UBS	STRATUM	NUMBER	DEPTH	TEMP	MIN_TEMP	MAX_TEMP
71	329	8	119.750	-1.1375	-1.3	-0.8
72	330	9	79.444	-0.6222	-1.0	-0.1
73	331	4	86.500	-0.7000	-1.0	-0.1
74	332	6	107.667	1.3167	0.1	4.7
75	333	3	217.667	7.4333	6.6	8.1
76	334	2	286.500	6.4500	6.3	6.6
77	335	2	325.000	4.5500	4.5	4.6
78	336	2	242.000	6.2000	5.4	7.0
79	337	5	101.800	1.1000	0.5	1.8
80	338	9	82.889	0.4444	-0.9	1.4
81	339	3	107.333	-1.0667	-1.1	-1.0
82	340	8	81.750	-0.6250	-1.0	0.0
83	351	14	74.071	-0.4071	-0.7	0.3
84	352	14	71.071	0.3571	-0.5	1.5
85	353	7	77.429	1.0000	-0.1	2.0
86	354	3	122.333	4.9000	3.6	7.2
87	355	2	252.500	4.9000	2.8	7.0
88	356	2	313.000	5.3500	5.1	5.6
89	357	2	302.500	3.3000	2.4	4.2
90	358	2	239.000	5.9000	4.6	7.2
91	359	2	122.500	5.8000	5.7	5.9
92	360	14	65.071	0.7357	-0.7	2.0
93	361	11	60.909	1.4182	0.2	1.8
94	362	14	70.786	0.0357	-0.7	0.9
95	373	14	62.429	-0.1143	-0.8	0.5
96	374	6	59.167	-0.5167	-1.2	0.4
97	375	8	50.125	0.6375	-1.2	1.7
98	376	9	49.889	0.9000	-0.6	1.5
99	377	2	124.000	1.2000	-1.1	3.5
100	378	2	226.500	1.4500	1.4	1.5
101	379	3	308.333	2.3667	2.0	3.1
102	380	3	318.333	2.2333	1.6	3.1
103	381	3	225.000	2.5667	0.7	6.0
104	382	4	116.250	-1.0250	-1.2	-0.9
105	383	4	80.250	-1.0000	-1.2	-0.7

TABLE 4. AVERAGE DEPTH & TEMPERATURE BY STRATUM FOR DIV 3NO (1984-88)

----- YEAR=87 -----

UBS	STRATUM	NUMBER	DEPTH	TEMP	MIN_TEMP	MAX_TEMP
106	329	9	120.444	-1.0667	-1.5	-0.7
107	330	11	77.273	-0.8909	-1.1	-0.7
108	331	2	85.500	-0.6000	-0.6	-0.6
109	332	5	109.400	2.8200	-0.7	4.5
110	333	2	250.000	4.7500	4.7	4.8
111	334	2	330.000	4.6500	3.9	5.4
112	335	3	321.333	4.9667	4.8	5.1
113	336	2	241.000	5.3000	5.2	5.4
114	337	6	123.500	4.4667	2.5	5.6
115	338	9	78.889	0.2333	-0.7	2.4
116	339	3	101.333	-0.5000	-0.6	-0.4
117	340	10	80.300	-0.3200	-0.7	0.1
118	351	13	76.000	-0.1923	-0.3	0.0
119	352	15	72.867	0.9267	0.0	2.2
120	353	6	73.167	1.7500	1.0	3.3
121	354	2	102.000	4.5500	2.8	6.3
122	355	2	249.000	4.8500	3.5	6.2
123	356	3	332.333	3.7333	3.2	4.0
124	357	1	340.000	3.9000	3.9	3.9
125	358	2	220.000	6.0000	5.7	6.3
126	359	2	105.500	6.1000	4.1	8.1
127	360	15	63.467	4.7733	0.7	8.7
128	361	9	63.000	1.0222	0.3	2.1
129	362	13	71.769	-0.1000	-0.5	0.1
130	373	13	63.846	-0.4692	-1.0	-0.1
131	374	5	60.400	-0.2600	-0.5	0.3
132	375	9	52.000	1.0222	-0.1	2.5
133	376	9	52.222	1.8333	-0.5	5.1
134	377	2	143.000	3.9000	2.8	5.0
135	378	2	216.500	5.3500	4.2	6.5
136	379	2	340.500	4.1000	3.8	4.4
137	380	2	316.500	2.3000	2.0	2.6
138	381	2	254.500	1.9500	1.5	2.4
139	382	3	121.667	-0.6000	-0.9	-0.1
140	383	3	74.333	-0.5667	-1.1	-0.3

TABLE 5. AVERAGE DEPTH & TEMPERATURE BY STRATUM FOR DIV 3NO (1984-88)

----- YEAR=88 -----

OBS	STRATUM	NUMBER	DEPTH	TEMP	MIN_TEMP	MAX_TEMP
141	329	7	113.429	1.8714	-1.2	7.6
142	330	9	76.667	-0.1333	-0.9	1.3
143	331	2	86.500	1.7500	-0.5	4.0
144	332	4	115.500	8.2000	6.6	9.6
145	333	2	222.000	7.3500	7.0	7.7
146	334	2	303.000	6.3000	5.8	6.8
147	335	2	315.000	5.9500	5.4	6.5
148	336	2	220.000	7.0000	6.7	7.3
149	337	4	107.250	8.2250	7.9	8.6
150	338	8	78.250	2.5250	-0.1	8.1
151	339	3	101.667	-0.7000	-0.9	-0.6
152	340	7	81.571	-0.6000	-1.1	0.0
153	351	10	75.900	0.3500	-0.1	0.9
154	352	11	71.091	1.7273	0.8	4.9
155	353	5	78.800	3.8600	0.7	5.6
156	354	2	114.000	8.4500	7.2	9.7
157	355	2	246.000	7.2000	6.9	7.5
158	356	2	313.500	5.6500	5.4	5.9
159	357	2	314.000	4.6000	4.2	5.0
160	358	2	241.500	7.8000	4.3	11.3
161	359	2	119.000	6.3500	3.6	9.1
162	360	12	67.333	1.5083	-0.6	3.2
163	361	9	62.000	1.5889	0.9	2.1
164	362	10	70.700	0.7600	0.2	1.2
165	373	10	64.300	-0.2500	-0.8	0.5
166	374	5	60.800	-0.2400	-1.2	0.8
167	375	6	51.500	1.5333	-0.7	2.5
168	376	6	48.500	1.9833	1.6	2.3
169	377	2	151.000	-0.5000	-0.5	-0.5
170	378	2	220.000	1.4000	0.2	2.6
171	379	2	323.500	4.8500	4.7	5.0
172	380	2	303.000	2.1500	1.7	2.6
173	381	2	240.500	1.2500	0.8	1.7
174	382	3	105.667	-1.1333	-1.5	-0.4
175	383	3	78.333	-1.0000	-1.5	-0.7



TABLE 6. AVERAGE DEPTH & TEMPERATURE BY DEPTH RANGE (FATH) FOR DIV 3NO.

----- YEAR=84 -----						
UBS	RANGE	NUMBER	DEPTH	TEMP	MIN_TEMP	MAX_TEMP
1	0-30	9	50.222	2.61111	-1.1	4.0
2	31-50	63	72.222	1.32857	-1.4	3.9
3	51-100	21	104.333	0.55238	-1.5	6.9
4	101-150	12	237.083	4.46667	0.7	7.5
5	151-200	12	324.750	4.47500	1.0	6.0
----- YEAR=85 -----						
6	0-30	15	51.533	0.68667	0.1	1.3
7	31-50	112	73.054	0.03571	-1.5	1.7
8	51-100	33	107.848	-0.53636	-1.7	3.8
9	101-150	12	212.750	4.48333	-0.7	8.5
10	151-200	13	312.846	3.73077	0.1	7.9
----- YEAR=86 -----						
11	0-30	15	49.200	0.74667	-1.2	1.7
12	31-50	128	70.977	0.12734	-1.2	2.0
13	51-100	35	112.686	0.74286	-1.3	7.2
14	101-150	14	232.000	4.77857	0.7	8.1
15	151-200	14	309.571	3.79286	1.6	6.6
----- YEAR=87 -----						
16	0-30	16	51.313	1.01875	-0.5	2.6
17	31-50	126	71.254	0.71111	-1.1	8.7
18	51-100	32	116.938	1.78438	-1.5	8.1
19	101-150	12	238.500	4.70000	1.5	6.5
20	151-200	13	328.846	4.00769	2.0	5.4
----- YEAR=88 -----						
21	0-30	12	49.833	1.77500	-0.7	2.5
22	31-50	101	71.802	0.92277	-1.5	8.1
23	51-100	27	113.889	3.77407	-1.5	9.7
24	101-150	12	231.667	5.33333	0.2	11.3
25	151-200	12	312.000	4.91667	1.7	6.8

Table 7. Research vessel survey biomass (x 1000 t) in Div 3L and 3NO from strata contiguous with the 3L/3NO boundary.

Biomass	Year											
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3L	18	15	43	29	21	26	--	--	99	62	79	--
3NO	22	25	62	14	30	21	--	115	56	70	273	60

Strata included:

3L - 328 341 350 363 372 384 390 391 392  
 3NO - 329 330 331 340 351 362 373 380 381 382 383

Table 8. Catch-at-age and average weights of cod in Div 3N0 during 1987.

Age	Age compositions (x 1000)				Average weight (kg.)		
	Spain	Canada	Spain+ Canada	Total 3N0	Spain	Canada	Spain+ Canada
2	161		161	183	0.28		0.28
3	426	1	427	486	0.49	0.54	0.49
4	283	63	346	394	0.79	0.93	0.82
5	431	2425	2856	3249	1.33	1.30	1.30
6	344	2473	2817	3204	2.40	1.75	1.83
7	157	830	987	1123	3.84	2.70	2.88
8	209	326	535	609	6.08	3.92	4.76
9	431	265	696	792	7.70	6.57	7.27
10	300	109	409	465	9.38	7.77	8.95
11	205	124	329	374	10.34	9.06	9.86
12	209	125	334	380	13.57	10.96	12.59
13	39	61	100	114	14.23	10.72	11.09
14	13	23	36	41	16.84	13.25	14.55
15		13	13	15		15.03	15.03
16	( )	3	3	3		14.92	14.92
17	( )	7	7	8		16.75	16.75
18	( 4 )	2	6	7	17.29	15.66	16.75
19	( )						
20+	( )	4	4	5		23.85	23.85
No.	3212	6854	10066	11450			
Catch	15788	18426	34214	38930	Reported catch	= 38,930 t	
					Calculated catch	= 37,719 t	
					Difference	= 3.1 %	
Av. Wt.	4.92	2.69	3.40	3.40			

Table 9. Estimation of "standardized" catch rate for Spanish pair trawls for 1987.

Pair trawl CPUE		
Year	Canadian Analysis(a)	Spanish Analysis(b)
1982	0.873	0.520
1983	1.099	0.698
1984	1.974	1.053
1985	1.182	0.576
1986	0.758	0.467
1987	(0.876)	0.510

a = 1.97b - 0.13  
R-Squared = 0.94

Table 10. Catch rate index obtained by averaging Canadian otter trawl and Spanish pair trawl catch rates.

Year	Standardized catch rates		Normalized catch rates		Weighted average OT&PT
	OT	PT	OT	PT	
1977	0.465	0.609	0.842	0.855	0.845
1978	0.417	0.196	0.755	0.199	0.644
1979	0.572	1.623	1.036	1.648	1.159
1980	0.445	0.508	0.806	0.818	0.809
1981	0.554	1.142	1.004	1.159	1.035
1982	0.723	0.873	1.310	0.886	1.225
1983	0.699	1.099	1.266	1.116	1.246
1984	0.587	1.974	1.063	2.004	1.251
1985	0.587	1.182	1.063	1.200	1.090
1986	0.524	0.758	0.949	0.770	0.913
1987	0.497	0.876	0.900	0.889	0.898
Mean	0.522	0.985			

Weight for OT = 80%, Weight for PT = 20%

Table 11. Catch-at-age (x 1000) for cod age 13 years and older from Div.3NO for the period 1959-87.(Weights in tons.)

Age	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
13	191	328	96	343	56	25	87	78	45	20
14	229	649	147	129	64	8	9	17	73	10
15	76	108	17	138	154	2	117	26		5
16	80	104	24	128	78	5	( )	9		
17	3	4	20	17	46	10	( )	26		16
18	549	211	46	29	11	2	(63)		144	
19		5	3	29	21	2	( )	9	73	
20+			39	33	43	2		18		
13+	1128	1409	392	846	473	56	276	183	335	51
3+	35718	42128	37557	15372	30686	53875	47107	67480	161847	149862
Wt.	62367	77721	71454	34405	69742	61964	95631	105943	226784	158855

Age	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
13	170	90			97	355	71	8	18	1
14	194	121			16	26	52	2	7	5
15	186	314			42	81	36	5		
16		239			8	7	45	1	2	
17		497			8	49	135	1		1
18		211			2	192	57		2	5
19						132				1
20+	24					39			7	8
13+	574	1472			173	881	396	17	36	21
3+	64562	49873	76700	53809	65302	46178	21813	20692	8234	9215
Wt.	117705	111561	126296	103374	80429	73389	44174	24283	17575	14738

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987
13	7		10	11	12	10	40	56	114
14			9	13	6	28	18	17	41
15	8		1	11	8	17	6	6	15
16			1	6	5	7	3	5	3
17		2	5	6	2	3	3	2	8
18			5	2		1	1		2
19	1				2	4			
20+			1	3	1				5
13+	16	2	32	52	36	70	71	86	188
3+	17149	8243	7546	8901	7895	8350	16914	14578	11267
Wt.	28049	18542	23034	31605	28818	27103	41750	42147	38930

Data for 1971 & 1972 is not available.

TABLE 12. CATCH-AT-AGE FOR 3ND COD, 1959-87.

14/ 6/88

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	1711	1846	812	1026	313	6202	1013	753	20086	16359	8154	2105	950	69	10058	6425
4	13036	8503	4400	3882	5757	15555	7611	18413	62442	56775	12924	19703	26900	19797	27600	9501
5	5068	22050	11696	2206	11210	19496	7619	19681	50317	48608	26949	10799	30300	12269	15098	10907
6	6025	3095	15258	1581	4849	7919	13258	11795	18517	18485	11191	9481	11700	13432	5989	10872
7	3935	2377	2014	3594	1935	2273	9861	8486	4774	6337	2089	3646	3500	5883	1971	2247
8	1392	2504	1672	773	3840	1109	4827	4467	4651	1592	1393	1635	2500	1686	972	2147
9	757	583	847	668	1165	788	1081	1025	236	505	518	541	500	285	707	1015
10	926	387	196	433	698	328	1248	1694	180	178	292	149	200	216	243	676
11	1220	898	25	226	322	37	163	122	71	90	134	227	100	78	137	428
12	103	242	245	216	208	112	141	57	45	45	202	90	50	74	116	257
3+	34173	40485	37165	14605	30207	53819	46822	67297	161319	148974	63846	48376	76700	53809	62891	44475
4+	32462	38639	36353	13579	29894	47617	45809	66544	141233	132615	55692	46271	75750	53740	52833	38050
5+	19426	32136	31953	9697	24137	32062	38198	48131	78791	75840	42768	26568	48850	33943	25233	28549
6+	14358	10086	20257	7491	12927	12566	30579	28450	28474	27232	15819	15769	18550	21654	10135	17642
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987			
3	671	4054	607	920	72	280	478	305	1179	58	57	155	486			
4	8781	7534	2469	4337	3827	1138	1032	1978	647	1000	2953	2836	394			
5	3528	5945	2531	2518	9208	3789	1194	1591	1893	1411	6203	6375	3249			
6	2505	1084	1500	818	2784	2057	2173	1012	1204	2324	3036	4357	3204			
7	3057	211	572	354	883	665	1805	1528	686	1220	2519	1505	1123			
8	1059	238	177	102	265	185	543	1492	1152	720	797	960	609			
9	921	44	209	58	58	75	182	595	774	918	459	568	792			
10	461	37	65	51	17	27	89	211	238	551	533	392	465			
11	252	13	41	8	12	7	39	162	31	106	261	379	374			
12	152	9	25	5	7	13	12	27	41	42	97	149	380			
3+	21387	19169	6196	9171	17133	8236	7547	8901	7895	8350	16915	17676	11076			
4+	20716	15115	7589	8251	17061	7956	7069	8596	6716	8292	16858	17521	10590			
5+	11935	7581	5120	3914	13234	6818	6037	6618	6069	7292	13905	14685	10196			
6+	8407	1636	2589	1396	4026	3029	4843	5027	4176	5881	7702	8310	6947			

TABLE 13. AVERAGE WEIGHTS-AT-AGE FOR 3ND COD, 1959-87.

14/ 6/88

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
3	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.46	0.48	0.48	0.48	0.48	0.48	0.54	0.57	0.42	0.38
4	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.90	0.90	0.90	0.90	0.90	0.90	0.97	1.00	0.73	0.89
5	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.35	1.35	1.35	1.35	1.35	1.35	1.44	1.43	1.20	1.28
6	1.95	1.95	1.95	1.95	1.95	1.95	1.95	2.14	2.14	2.14	2.14	2.14	2.14	2.08	2.19	1.96	2.13
7	2.82	2.82	2.82	2.82	2.82	2.82	2.82	3.16	3.16	3.16	3.16	3.16	3.16	2.89	3.63	2.86	3.14
8	3.39	3.39	3.39	3.39	3.39	3.39	3.39	4.21	4.21	4.21	4.21	4.21	4.21	3.56	4.63	4.67	4.16
9	3.98	3.98	3.98	3.98	3.98	3.98	3.98	6.34	6.34	6.34	6.34	6.34	6.34	5.95	6.25	7.32	5.53
10	4.68	4.68	4.68	4.68	4.68	4.68	4.68	7.69	7.69	7.69	7.69	7.69	7.69	7.95	9.56	5.46	6.74
11	5.25	5.25	5.25	5.25	5.25	5.25	5.25	8.46	8.46	8.46	8.46	8.46	8.46	8.32	11.17	8.40	5.27
12	6.17	6.17	6.17	6.17	6.17	6.17	6.17	10.24	10.24	10.24	10.24	10.24	10.24	10.14	13.99	7.51	7.09
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987					
3	0.50	0.57	0.72	0.65	0.71	0.90	0.94	0.85	0.79	0.48	0.39	0.49					
4	0.91	1.00	1.05	0.98	1.04	1.27	1.17	1.17	1.15	0.86	1.00	0.82					
5	1.41	1.48	1.55	1.39	1.69	1.84	1.50	1.87	1.51	1.37	1.65	1.30					
6	2.33	2.48	2.25	2.09	2.50	2.69	2.20	2.63	2.28	2.05	2.15	1.83					
7	3.25	3.51	3.74	2.87	3.69	3.55	3.83	3.80	3.04	3.25	3.50	2.88					
8	4.03	4.74	4.61	3.70	5.49	5.33	5.26	5.20	4.05	4.65	5.43	4.76					
9	6.67	7.17	6.19	4.75	7.98	7.13	7.49	6.27	5.76	6.62	7.95	7.27					
10	8.74	8.81	7.23	7.15	9.22	9.10	8.80	8.08	7.22	8.32	9.76	8.95					
11	9.14	11.70	9.48	7.98	10.60	9.01	9.82	8.99	8.92	9.15	9.91	9.86					
12	12.49	11.47	12.87	10.11	12.61	10.15	12.28	11.01	12.61	11.13	9.90	12.59					

Table 14. Age 6+ research vessel survey abundance index for Div. 3ND cod derived by averaging results from Canadian and USSR Surveys.

Year	Age 6+ Abundance		Normalized		Mean
	USSR	Canada	USSR	Canada	
1977	6.9	2.64	0.81	0.79	0.80
1978	6.5	1.80	0.77	0.52	0.65
1979	3.3	2.91	0.39	0.87	0.63
1980	4.8	1.35	0.57	0.41	0.49
1981	2.9	5.22	0.34	1.57	0.96
1982	10.8	2.48	1.28	0.74	1.01
1983	16.3	-	1.92	-	1.92
1984	13.5	(13.36)	1.59	-	1.59
1985	(25.9)	6.90	-	2.07	2.07
1986	24.1	6.93	2.85	2.08	2.47
1987	(5.2)	(36.94)	-	-	-
77-82,86					
Average	8.47	3.33			

Data in parenthesis not included in averages.

Table 15. Relationship of Canadian survey age 6+ numbers with cohort age 6+ (average) abundance for the years 1977-82,85-86.

Year	Survey Age 6+	F=0.10		F=0.15		F=0.20		F=0.25	
		Obs.	Res.	Obs.	Res.	Obs.	Res.	Obs.	Res.
1977	2.64	5.9	-15.0	5.4	-12.1	5.2	-10.6	5.0	-9.7
1978	1.80	7.8	-7.4	7.0	-6.6	6.6	-6.2	6.4	-6.0
1979	2.91	12.7	-10.1	11.4	-7.3	10.7	-6.0	10.3	-5.1
1980	1.35	21.5	9.5	19.2	7.7	18.0	6.8	17.4	6.2
1981	5.13	36.8	-2.0	30.7	1.3	27.6	2.9	25.8	3.9
1982	2.54	40.8	21.0	32.5	15.7	28.3	13.1	25.8	11.5
1983	-	-	-	-	-	-	-	-	-
1984	13.36	-	-	-	-	-	-	-	-
1985	6.90	51.9	1.4	38.1	1.0	31.3	0.7	27.2	0.6
1986	6.93	53.2	2.7	37.6	0.3	29.8	-0.8	25.1	-1.5
1987	36.94	-	-	-	-	-	-	-	-
R-Squared =		0.65		0.58		0.51		0.44	
Slope =		6.92		4.62		3.47		2.78	
Intercept =		2.66		5.29		6.59		7.38	

Table 16. Relationship of USSR survey age 6+ numbers with cohort age 6+ (average) abundance for the years 1977-84,86.

Year	Survey Age 6+	F=0.10		F=0.15		F=0.20		F=0.25	
		Obs.	Res.	Obs.	Res.	Obs.	Res.	Obs.	Res.
1977	6.9	5.9	-19.0	5.4	-15.1	5.2	-13.2	5.0	-12.0
1978	6.5	7.8	-16.4	7.0	-13.0	6.6	-11.3	6.4	-10.3
1979	3.3	12.7	-5.1	11.4	-4.5	10.7	-4.3	10.3	-4.1
1980	4.8	21.5	0.7	19.2	1.3	18.0	1.7	17.4	1.8
1981	2.9	36.8	19.7	30.7	15.2	27.6	13.0	25.8	11.7
1982	10.8	40.8	8.2	32.5	7.0	28.3	6.4	26.8	6.0
1983	16.3	44.9	1.5	34.7	2.3	30.0	2.5	26.5	2.7
1984	13.5	53.8	15.9	40.7	11.7	34.1	9.7	30.2	8.4
1985	-	-	-	-	-	-	-	-	-
1986	24.1	53.3	-5.6	37.6	-4.8	29.8	-4.5	25.1	-4.2
1987	-	-	-	-	-	-	-	-	-
R-Squared =		0.52		0.43		0.34		0.27	
Slope =		1.97		1.27		0.93		0.72	
Intercept =		11.31		11.74		11.94		12.07	

Table 17. Relationship of Canada/USSR survey age 6+ numbers with cohort age 6+ (average) abundance for the years 1977-86.

Year	Survey Age 6+	F=0.10		F=0.15		F=0.20		F=0.25	
		Obs.	Res.	Obs.	Res.	Obs.	Res.	Obs.	Res.
1977	0.80	5.9	-16.5	5.4	-13.3	5.2	-11.7	5.0	-10.8
1978	0.65	7.8	-11.2	7.0	-9.4	6.6	-8.6	6.4	-8.0
1979	0.63	12.7	-5.8	11.4	-4.7	10.7	-4.2	10.3	-3.9
1980	0.49	21.5	6.2	19.2	5.2	18.0	4.7	17.4	4.3
1981	0.96	36.8	10.7	30.7	9.5	27.6	8.9	25.8	8.6
1982	1.01	40.8	13.6	32.5	10.5	28.3	9.0	26.8	8.1
1983	1.92	44.9	-3.2	34.7	-1.1	29.6	-0.1	26.5	0.5
1984	1.59	53.8	13.3	40.7	9.9	34.1	8.2	30.2	7.2
1985	2.07	51.9	0.3	38.1	0.0	31.3	-0.1	27.2	-0.1
1986	2.47	53.3	-7.5	37.6	-6.6	29.8	-6.1	25.1	-5.8
1987	-	-	-	-	-	-	-	-	-
R-Squared =		0.70		0.61		0.52		0.45	
Slope =		23.00		15.25		11.38		9.05	
Intercept =		3.97		6.54		7.81		8.58	

Table 17A. Average age 6+ population abundance (x 1000000) for cod in Div. 3N0 over a range of fishing mortalities for the 1977-87 period.

Year	Fishing Mortality				
	0.10	0.15	0.20	0.25	0.30
1977	5.9	5.4	5.2	5.0	4.9
1978	7.8	7.0	6.6	6.4	6.3
1979	12.7	11.4	10.7	10.3	10.1
1980	21.5	19.2	18.0	17.4	16.9
1981	36.8	30.7	27.6	25.8	24.6
1982	40.8	32.5	28.3	25.8	24.1
1983	45.0	34.7	29.6	26.5	24.4
1984	53.8	40.7	34.1	30.2	27.6
1985	51.9	38.1	31.3	27.1	24.4
1986	53.3	37.6	29.8	25.1	22.0
1987	48.1	52.1	39.0	31.2	26.0

Table 18. Annual partial recruitment values for Div. 3N0 cod, 1959-87.

SELECTIVITY COEFFICIENTS

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
3	0.09	0.09	0.03	0.03	0.01	0.28	0.01	0.00	0.14	0.23	0.16	0.06	0.02	0.00	0.97	0.23	0.02	0.51	0.03	0.12	0.01	0.08	0.06	0.07	0.25
4	0.40	0.42	0.28	0.19	0.15	1.00	0.13	0.19	0.54	0.76	0.53	0.49	1.00	0.53	1.00	0.83	0.33	1.00	0.26	0.71	0.40	0.44	0.25	0.37	0.76
5	0.81	1.00	1.00	0.24	0.55	1.00	0.32	0.47	0.99	1.00	1.00	0.61	1.00	0.92	1.00	1.00	0.47	1.00	0.70	1.00	1.00	1.00	0.40	0.55	0.68
6	1.00	0.81	1.00	0.42	0.53	1.00	0.65	0.87	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	0.79	1.00	1.00	1.00	0.62	0.50	0.82
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

AGE	1984	1985	1986	1987
3	0.01	0.01	0.05	0.11
4	0.24	0.33	0.40	0.29
5	0.69	1.00	0.99	0.57
6	1.00	1.00	1.00	0.79
7	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00



Table 19. Beginning of the year population numbers for cod in Div. 3NØ from an analysis with terminal F = 0.20.

POPULATION NUMBERS

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	53690	53193	82103	107740	78245	112308	162565	210010	183244	100519	127870	80340	84482	62130	35153
4	93899	42410	41872	56486	87281	63779	86339	132180	171260	131853	57495	97313	63872	68308	50805
5	19533	65082	29838	30301	50921	66251	38143	63801	91559	83716	56580	43566	61845	27954	38013
6	16514	11407	33333	13028	22812	31547	36601	24335	34428	29434	24559	21939	25898	23218	11767
7	12460	8069	6539	13485	9236	14290	18663	17970	9251	11432	7372	9981	9383	10617	6855
8	4372	6641	4455	3531	7789	5811	9643	6358	7034	3254	3626	4146	4873	4516	3369
9	2886	2320	3171	2135	2192	2902	3754	3527	1163	1551	1224	1708	1915	1727	2171
10	3368	1678	1372	1830	1143	740	1663	2095	1233	739	813	533	909	1115	1156
11	2261	1919	1024	946	1106	386	309	232	183	646	444	401	302	563	718
12	331	748	759	816	570	614	283	106	80	85	612	242	123	157	391
3+	209315	193457	203467	240296	261296	298628	357962	460614	499435	363429	290594	260170	253601	200304	150399
4+	155624	140274	121364	132557	183050	186320	195397	250604	316191	262910	162724	179830	169120	138175	115246
5+	61725	97864	79491	66071	95769	122541	109058	118424	144931	131058	95229	82517	105248	69867	64441
6+	42192	32781	50653	35770	44848	56290	70916	54623	53372	47342	38649	38951	43403	41913	26428
AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	
3	37006	23398	27996	46587	45802	24151	25669	36031	23395	36816	58518	46439	9585	23574	
4	19680	24484	18549	19253	37593	36667	19708	20762	29067	18678	29675	47858	37967	7207	
5	16622	7516	12101	8370	13529	26854	26558	15106	16065	22008	14871	22900	36511	28520	
6	17461	3740	2961	4528	4562	8798	13655	18315	11287	11713	16306	10898	13136	24124	
7	4215	4459	795	1444	2350	2995	4684	9318	13029	8326	8501	11248	6176	6813	
8	3829	1418	884	460	664	1604	1653	3234	5996	9285	6196	5856	6929	3694	
9	1879	1192	203	509	217	452	1073	1186	2156	3559	6559	4421	4073	4805	
10	1138	620	143	126	227	125	317	811	807	1227	2214	4540	3204	2821	
11	727	320	90	84	44	140	37	235	583	469	789	1314	3235	2269	
12	464	208	34	62	31	29	104	65	157	331	311	550	839	2305	
3+	103021	67354	63757	81422	105021	101816	93509	105064	102543	112612	143340	156024	121658	106633	
4+	66015	43957	35761	34835	59219	77665	67840	69033	79140	75797	84822	109585	112073	83059	
5+	46335	19472	17211	15582	21625	40997	48132	48270	50081	56919	55746	61727	74104	75352	
6+	29713	11957	5111	7212	8096	14143	21574	33164	34016	34910	40876	38827	37593	46831	

Table 20. Average population biomass for cod in Div. 3N0 from an analysis with F = 0.20.

POPULATION BIOMASS (AVERAGE)															
AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	20088	19867	31088	40804	29722	41477	61677	91189	74948	39799	53710	34460	36532	30390	15204
4	64462	28855	29336	47853	62552	40891	61092	99567	110079	80074	49195	70419	39121	50139	30595
5	18885	59313	24871	32975	50580	62460	38404	64279	73904	65121	49362	45859	53226	26939	37778
6	22993	17059	42768	21495	35529	47862	51071	33375	44639	34102	34647	31636	36672	27899	16110
7	26076	17157	13766	29265	20843	33316	32224	36844	18138	21482	17712	22512	21031	18249	18862
8	10979	15913	10692	9520	16780	15959	20614	12876	15267	8741	10727	12159	12768	11398	11815
9	8867	7184	9709	6319	5322	8857	11321	13637	5929	7241	5271	8033	9378	8465	9997
10	12055	6197	5363	6730	3264	2311	3402	6028	7901	4452	4482	3128	5556	7170	8843
11	7180	6565	4807	3897	4391	1741	995	1208	1082	6113	2817	1990	1873	3925	6495
12	1524	3410	3464	3882	2519	3091	1109	661	487	540	4607	1767	871	1037	4122
3+	193110	181520	175864	202740	231503	257964	281909	359864	352373	267667	232531	231963	217030	185612	159820
4+	173022	161653	144776	161936	201781	216487	220232	268675	277426	227868	178821	197503	180498	155222	144617
5+	108559	132799	115440	114083	139229	175596	159140	169108	167346	147794	129626	127084	141377	105083	114022
6+	89675	73485	90569	81168	88649	113136	120736	104829	93442	82672	80264	81224	88151	78144	76244
AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	
3	12732	7934	11676	23900	29567	14205	16422	29182	19793	27874	41878	20190	3359	10354	
4	9225	15638	11640	16223	33520	30715	17997	23258	29688	19650	29745	36059	33020	9570	
5	10363	6259	10862	9287	17042	27128	37488	24112	20662	35558	19301	24068	49321	31520	
6	18668	4052	4922	8235	8379	13641	28372	41756	21409	26356	31055	17045	20706	37110	
7	7343	6937	1991	3524	7304	6481	14444	26751	42327	27392	21573	28973	16903	16171	
8	10555	2598	2737	1533	2541	4886	7724	14170	24575	40765	21298	22835	31507	14494	
9	8311	2736	1076	2504	1031	1807	7468	7017	12344	17765	31609	25025	27100	28789	
10	3521	1854	966	589	1302	749	2529	6286	5481	8015	12453	32035	26447	20809	
11	3482	673	690	622	343	965	798	1746	4372	3459	5909	9690	27190	18438	
12	2092	696	329	496	333	231	1104	535	1586	3079	3292	5011	6795	23921	
3+	86293	49377	46889	67014	101362	100808	134345	174813	182238	209934	218112	220931	242348	207177	
4+	73560	41443	35213	43114	71795	86603	117924	145631	162445	182059	176234	200741	238989	196823	
5+	64335	25805	23573	26891	38276	55888	99926	122372	132757	162409	146490	164682	205970	191252	
6+	53972	19545	12711	17604	21234	28761	62439	98261	112095	126851	127189	140613	156649	159732	

Table 21. Fishing mortality matrix for cod in Div. 3N0 from an analysis with terminal  $F = 0.20$ .

		FISHING MORTALITY																		
AGE		1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
3		0.036	0.039	0.011	0.011	0.004	0.063	0.007	0.004	0.129	0.198	0.073	0.029	0.013	0.061	0.386	0.213	0.032	0.174	0.015
4		0.167	0.186	0.123	0.067	0.076	0.314	0.103	0.167	0.516	0.646	0.238	0.253	0.626	0.386	0.917	0.763	0.505	0.596	0.153
5		0.338	0.469	0.595	0.084	0.279	0.393	0.249	0.417	0.935	1.036	0.747	0.320	0.780	0.665	0.578	1.292	0.731	0.783	0.407
6		0.516	0.356	0.705	0.144	0.268	0.325	0.511	0.767	0.902	1.184	0.700	0.649	0.692	1.020	0.827	1.165	1.348	0.518	0.456
7		0.429	0.394	0.416	0.349	0.263	0.193	0.877	0.738	0.845	0.948	0.376	0.517	0.531	0.948	0.382	0.890	1.418	0.347	0.576
8		0.434	0.539	0.536	0.277	0.787	0.237	0.806	1.498	1.312	0.778	0.553	0.572	0.837	0.532	0.384	0.967	1.746	0.353	0.553
9		0.342	0.325	0.350	0.424	0.885	0.357	0.383	0.851	0.254	0.446	0.631	0.431	0.340	0.201	0.446	0.909	1.922	0.274	0.695
10		0.362	0.294	0.172	0.303	0.886	0.673	1.768	2.240	0.176	0.310	0.506	0.369	0.279	0.241	0.264	1.068	1.725	0.337	0.844
11		0.907	0.728	0.027	0.307	0.388	0.112	0.874	0.868	0.561	0.125	0.406	0.982	0.456	0.166	0.237	1.052	2.039	0.173	0.782
12		0.417	0.438	0.436	0.343	0.509	0.224	0.784	0.883	0.947	0.853	0.449	0.522	0.588	0.723	0.394	0.922	1.549	0.342	0.578
AGE		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987									
3		0.022	0.003	0.012	0.015	0.015	0.036	0.001	0.001	0.018	0.023									
4		0.136	0.123	0.066	0.056	0.078	0.039	0.037	0.071	0.086	0.058									
5		0.230	0.476	0.172	0.091	0.116	0.100	0.111	0.356	0.214	0.134									
6		0.221	0.430	0.182	0.141	0.104	0.121	0.171	0.368	0.457	0.158									
7		0.182	0.394	0.171	0.241	0.139	0.095	0.173	0.284	0.314	0.200									
8		0.186	0.202	0.132	0.205	0.322	0.147	0.137	0.163	0.166	0.200									
9		0.351	0.153	0.080	0.136	0.364	0.275	0.168	0.122	0.167	0.200									
10		0.285	0.163	0.099	0.129	0.341	0.241	0.322	0.139	0.145	0.200									
11		0.222	0.160	0.093	0.202	0.367	0.212	0.161	0.248	0.139	0.200									
12		0.193	0.306	0.148	0.228	0.209	0.147	0.161	0.215	0.217	0.200									

Table 22. Survey abundance for age 3 from Canadian and Soviet research vessel surveys.

Year	Y/C	Canada Age 3	USSR Age 3	Normalized		Ave.
				Canada Age 3	USSR Age 3	
1977	1974	9.44	23.0	2.04	2.11	2.08
1978	1975	7.31	18.4	1.58	1.65	1.62
1979	1976	2.37	3.8	0.51	0.35	0.43
1980	1977	1.36	3.6	0.29	0.33	0.31
1981	1978	5.48	6.6	1.18	0.61	0.90
1982	1979	1.79	10.0	0.39	0.92	0.66
1983	1980	-	12.4	-	1.14	1.14
1984	1981	-	33.4	-	3.06	3.06
1985	1982	4.47	-	0.97	-	0.97
1986	1983	0.71	(12.4)	0.15	-	0.15
1987	1984	-	-	-	-	-
1988	1985	2.22	-	0.48	-	0.48
$r^2 = 0.77$						
1977-82 Ave.		4.625	10.90			

Table 23. Relationship between survey age 3 and cohort age 3.

Y/C	Survey Abundance (Age 3)	Cohort Numbers (Age 3)
1974	2.08	41.3
1975	1.62	38.8
1976	0.43	20.0
1977	0.31	21.3
1978	0.90	29.8
1979	0.66	19.4
1980	1.14	30.3
1981	3.06	(55.9)
1982	0.97	(28.0)
1983	0.15	(17.1)
1984	-	-
1985	0.48	(21.5)
$r^2$	.92	
slope	13.32	
intercept	15.12	

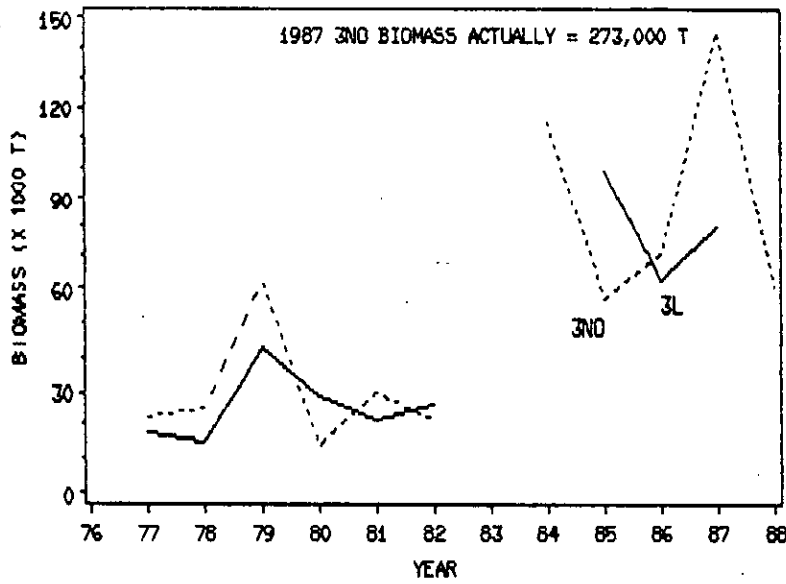


FIG. 1. R/V SURVEY BIOMASS (X 1000 T) IN DIV. 3L AND 3NO FROM STRATA CONTIGUOUS WITH THE 3L/3NO BOUNDARY.

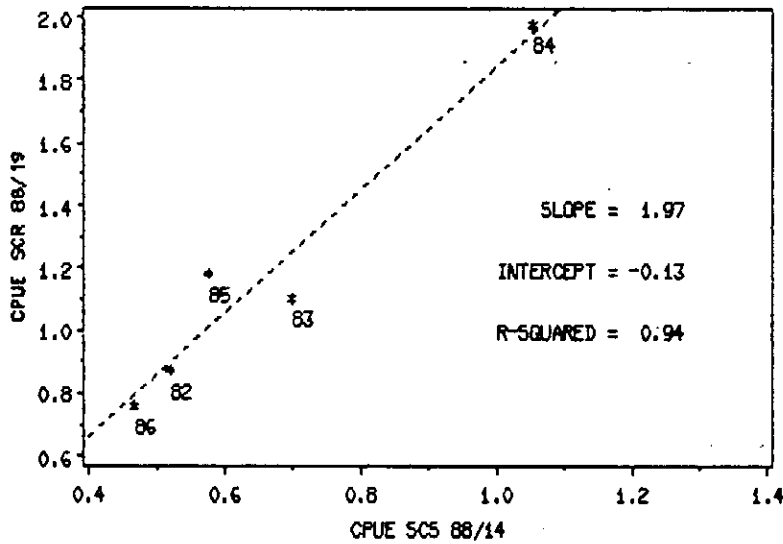


FIG. 2. THE RELATIONSHIP OF STANDARDIZED SPANISH PAIR TRAWL CATCH RATES FROM CANADIAN AND SPANISH ANALYSES.

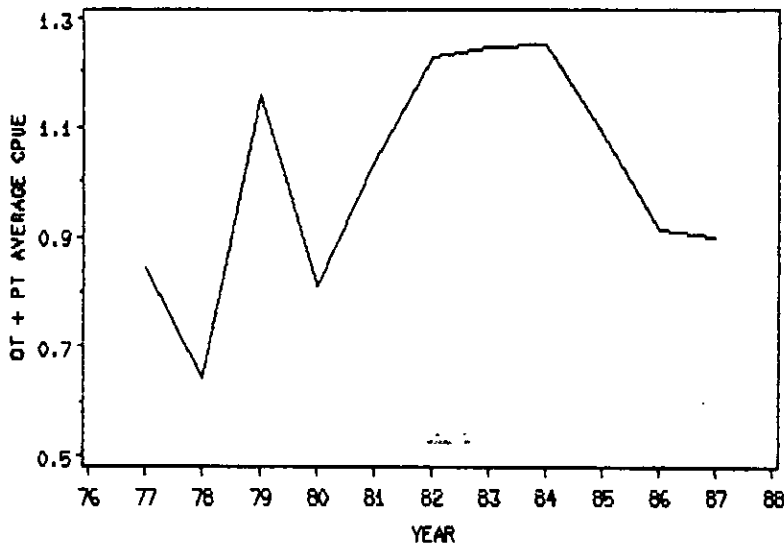


FIG. 3. CPUE INDEX ESTIMATED BY AVERAGING CANADIAN OT AND SPANISH PT CATCH RATES.

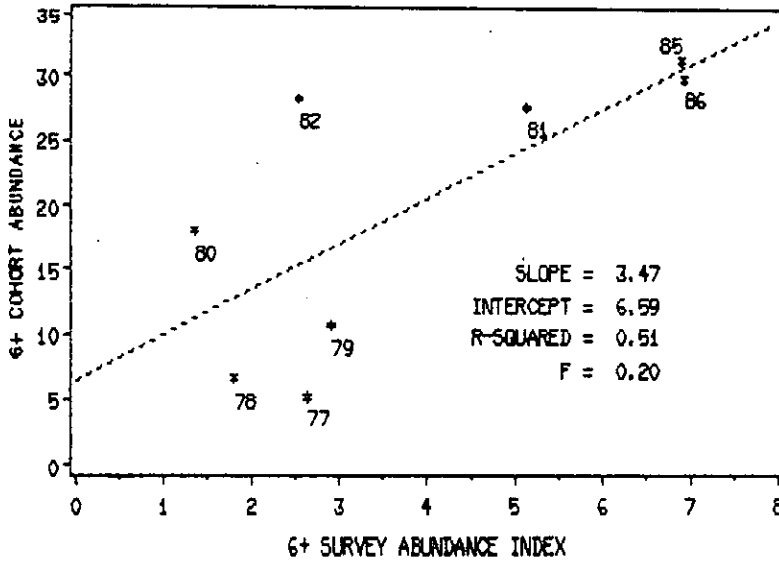


FIG 4. THE RELATIONSHIP OF CANADIAN SURVEY ABUNDANCE AND COHORT NUMBERS (MILLIONS) FOR AGES 6+.

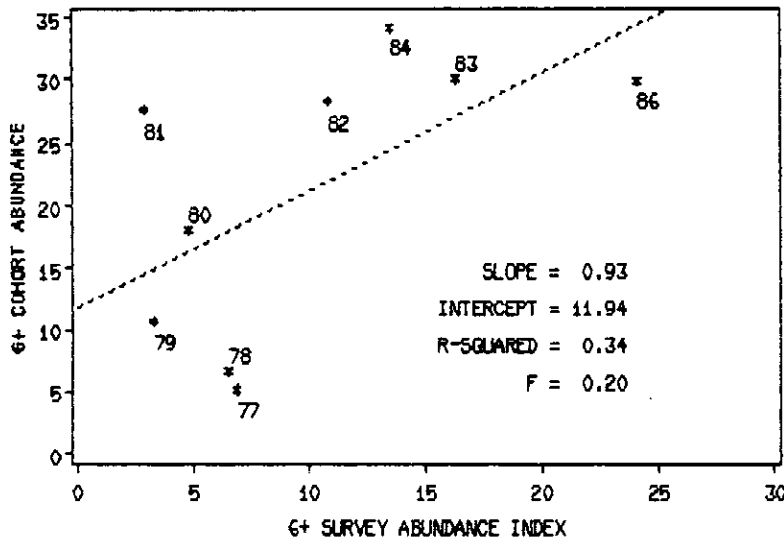


FIG 5. THE RELATIONSHIP OF USSR SURVEY ABUNDANCE AND COHORT NUMBERS (MILLIONS) FOR AGES 6+.

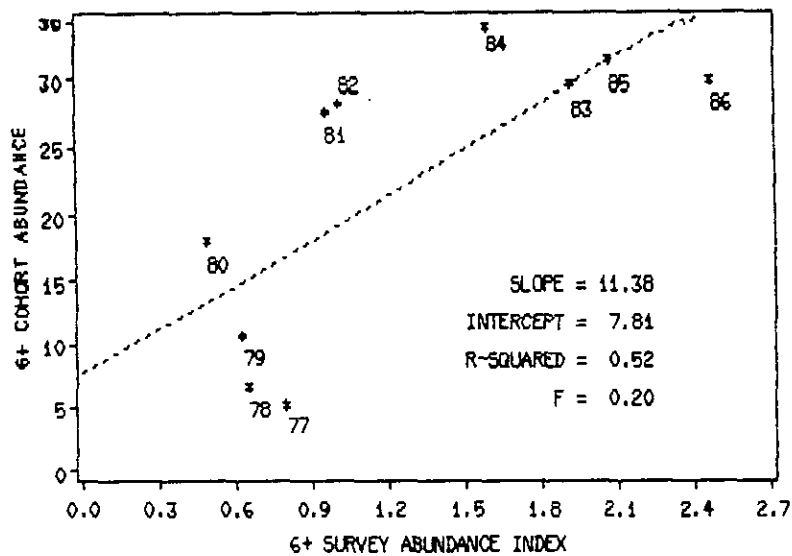


FIG 6. THE RELATIONSHIP OF COMBINED USSR/CANADA SURVEY ABUNDANCE WITH COHORT NUMBERS (MILLIONS) FOR AGES 6+.

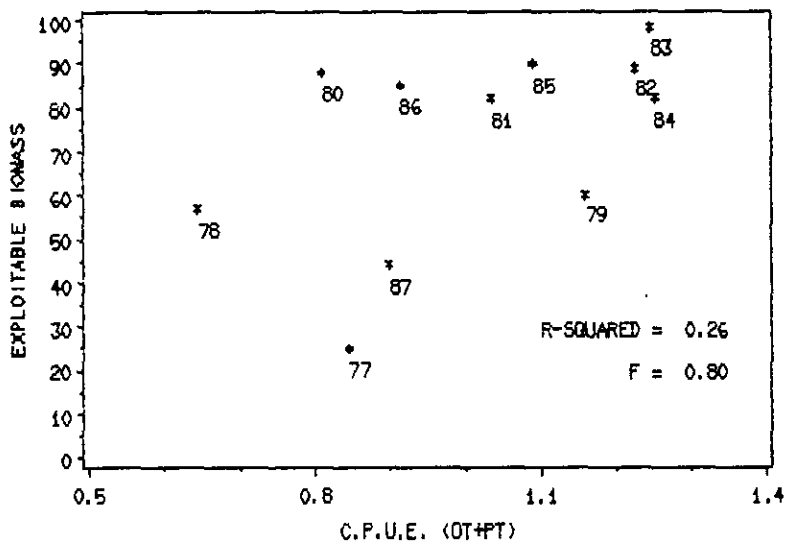


FIG 7. THE RELATIONSHIP OF COMMERCIAL C.P.U.E. (OT+PT) WITH COHORT EXPLOITABLE BIOMASS (X 1000 T).