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An Assessment of the Cod Stock in Subdivision 3Ps

by

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INTRODUCTION

Nominal catch and catch at age

Cod catches from Subdivision 3Ps since 1978 along with corresponding TACs are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
TAC('000t)	47.5	32.5	25	25	28	30	33	33	33	41
Catch('000t)	37	32	27	33	38	39	34	38[a]	36[a]	

[a] preliminary

Annual landings by country since 1959 are listed in Table 1, while those for 1984 by month and gear are shown in Table 2. Canadian landings for 1984 were obtained from the Statistics and Systems Branch of the Department of Fisheries and Oceans, Canada while those for EEC were obtained from NAFO Circular letters. Inshore catches (Fig. 1) have comprised the larger portion of the total since 1977 mainly because of restrictions on otter trawl allocations. Catches by the major inshore gears in the Canadian fishery over the period 1964-84 are shown in Fig. 2. The line trawl gear component continues to be dominant although catches have declined in recent years. Gillnet catches have shown an increasing trend since 1978.

Sampling data (Table 3) used to obtain catch at age for the commercial catch in 1984 was obtained by the Commercial Sampling Research Unit of the Department of Fisheries and Oceans. Catches by EEC were adjusted to numbers at age using Canadian offshore sampling. Age frequencies for the major gear components in the Canadian fishery in 1984 along with estimated total catch at age, with associated variances, are shown in Table 4. Average weights at age were obtained by applying a length-weight relationship (log wt = 3.0879 log length - 5.2106) to the length frequencies and age length keys. The calculated total catch weight was approximately 3% lower than that reported. The 1978 year class was the most abundant in the total catch as it had been in the 1983 fishery.

Survey Data

The estimates of biomass obtained from stratified random research surveys are shown in Table 5. The problem of inconsistent sampling of all strata was addressed in a recent assessment (Bishop, et. al. NAFO SCR Doc. 84/VI/53). A method was presented which provided estimates of abundance for the non sampled strata using analysis of variance of the ln catch per tow. This method was once again used in the present analysis after inclusion of the 1985 survey data. Table 6 indicates the estimated values along with those from surveyed strata.

Research survey data showed a decline in abundance in recent years but both abundance and biomass increased substantially in 1985 over the 1984 level. Age distribution from the 1985 survey in terms of mean number per tow (Table 7) indicated that the 1980 and 81 year classes were most abundant.

Catch-effort data

Catch rate data for Canada, France (STPM), Spain, and Portugal were analysed using a multiplicative model (Gavaris, 1980). Data for 1959-82 were obtained from ICNAF/NAFO Statistical Bulletins while that for 1983-84 was from Canada only and was provided by the Statistics and Systems Branch of the Department of Fisheries and Oceans, Canada. Plots of the residuals indicated that the data were less variable when values of catch and effort were higher. Estimated weights (log catch X effort) calculated according to Judge et. al. (1980, p. 132), were applied in a weighted regression of the multiplicative model. This procedure was effective in giving weight to data valued with large catch and effort. Data with less than 10 t catch or 10 hr. effort were excluded from the analysis to reduce the possible effect of truncation and rounding errors.

The strong seasonal trend observed in previous analysis was once again observed (Table 8) with catch rates being highest in the winter months. The annual catch rate indices (Table 9; Fig. 3) show an increasing trend since the late 1970s with the values for 1983 and 84 being the highest in the recorded series. As stated previously the data available to determine these latter two years was that from Canadian otter trawlers only. Catch rates from the country-gear category have shown an increasing trend in recent years along with some large fluctuations. The amount of directed catch in this fishery during 1983 and 84 was between 5 and 8% of the total. The confidence limits associated with the catch rates were wide when compared with other years in this series. The reliability of catch rate data from a gear category which has a restricted (quota) fishery might be questionable. A tendency to fish an allocation when catch rates are traditionally best might introduce bias in a particular year.

Partial Recruitment

Historical partial recruitment values are shown in Table 14. An estimate of partial recruitment in 1984 was initially obtained by iteration using cohort selectivity coefficients obtained by dividing fishing mortality by fully recruited fishing mortality for ages 7-11. Input values of partial recruitment (Table 1) and F on the oldest age group (14) were those used in the most recent assessment (Bishop et. al. NAFO SCR Doc. 84/VI/53). In that assessment final estimates of partial recruitment were those which had been adjusted so that cohort numbers at age 3 and surveys numbers at age 3 showed some correspondence.

In the present assessment cohort and survey abundance were once again compared at age 3. For this purpose survey data for Canada and France were once again combined after adjusting Canadian survey data for seasonality using parameters obtained from the commercial catch rate standardization (Table 8). The survey data for both countries with adjustment factors and an average estimate of survey abundance at age 3 are shown in Table 10. Based on the relationship of cohort and survey abundance (Table 11, Fig. 4) an estimate of partial recruitment was determined (Table 1) as appropriate to the 1984 commercial fishery.

Cohort analysis

Catch and weight-at-age data from the 1984 commercial fishery (Table 4) were added to previously used matrices (Table 12) and these were used in cohort analyses. Partial recruitment estimates used were those obtained by comparing survey to cohort population at age 3 and the fishing mortality on the last age group (14) was estimated as the fully recruited mortality for ages 7-11.

The relationship between catch rate index and exploitable biomass (mid-year biomass X partial selection matrix) was used to estimate a fully recruited F appropriate to the fishery in 1984. As in previous assessments the 1959 and 60 data points were excluded.

The best 'fit' of catch rate index to exploitable biomass was with F_t of approximately 0.20 (Table 13, Fig. 5) based on the residual pattern from 1982-84. The large predicted exploitable biomass values for 1983 and 84 result from the high catch rate values for those years. The reliability of these catch rate indices has been discussed earlier. Tables 15-17 show the results of a cohort analysis in terms of population numbers, mid year population biomass, and fishing mortalities for a cohort analyses at F_t= 0.20.

In the most recent assessment for this stock the relationship of survey mean number per tow (age 4-14) with cohort population numbers (age 4-14) was used in an attempt to determine fully recruited F in 1983. This analysis was repeated in the present assessment using survey populations, number estimates, and cohort population numbers (F_t= 0.20). The catch per tow abundance estimates from Canadian and French surveys in 1984 differed substantially (9.54 and 82.63) and as a result their average was not considered appropriate for cohort tuning. Consequently, results presented (Table 18, Fig. 6) used data similar to that presented previously and the results of a relationship of survey numbers at age 4-14 with cohort numbers at age 4-14 are presented for illustration. The 1985 estimate from Canadian surveys showed an increase over that for 1984 to the levels shown in 1982 and 1983.

REFERENCES

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Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci., 37: 2272-2275.

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Table 1. Cod catches (MT) from Subdivision 3Ps, 1959-83.

Year	Can(N) Offshore	Can(N) Inshore	Can(M)	France STPM	France M	Spain	Portugal	Other	Total
1959	2,726	32,718	4,784	3,078	4,952	7,794	3,647	471	60,170
1960	1,780	40,059	5,095	3,634	2,460	17,223	262	2,123	72,636
1961	2,167	32,506	3,883	4,140	11,490	21,017	4,985	3,434	83,622
1962	1,176	29,888	1,474	2,241	4,138	10,289	1,873	1,560	52,639
1963	1,099	30,447	331	1,757	324	10,826	209	5,058	50,051
1964	2,161	23,887	370	2,097	2,777	15,217	169	7,268	53,956
1965	2,459	25,902	1,203	2,570	1,781	13,404	-	4,081	51,400
1966	5,473	23,785	583	3,207	4,607	23,678	519	3,897	65,749
1967	3,861	26,331	1,258	2,244	3,204	20,852	980	3,663	62,393
1968	6,536	22,940	585	1,880	1,126	26,868	8	18,274	77,217
1969	4,269	20,009	849	2,477	15	28,141	57	7,286	63,103
1970	4,649	23,411	2,166	1,970	35	35,750	143	8,037	76,161
1971	8,657	26,651	731	1,651	2,730	19,169	81	4,297	63,967
1972	3,323	19,276	252	1,436	-	18,550	109	1,379	44,325
1973	3,107	21,349	181	1,165	-	19,952	1,180	5,707	52,641
1974	3,770	15,999	657	948	5,366	14,937	1,246	3,783	46,706
1975	741	14,332	122	775	3,549	12,234	1,350	2,270	35,373
1976	2,013	20,978	317	904	1,501	9,236	177	2,007	37,133
1977	3,333	23,755	2,171	1,252	1,734				32,245
1978	2,082	19,560	700	1,974	2,860			45	27,221
1979	2,381	23,413	863	4,289	2,060				33,006
1980	2,809	29,427	715	1,936	2,681				37,568
1981	2,690	26,075	2,321	4,101	3,706				38,905
1982	2,648	21,342	2,948	4,780	2,184				33,902
1983	2,141	23,726	2,580	4,478	5,372				38,297
1984	891	22,699	1,967	10,770					36,327

Table 2. Canadian cod landings in 1984(t) from NAFO Subdivision 3Ps, by month and gear.

Month	Can(N) OT[a]	Trap	GN	LL	HL	Can-M OT	LL	EEC	Total
Jan.	60		41	569	8			877	
Feb.	281		37	1 423	5	14		892	
Mar.	19		55	1 082	8	1	1	1 095	
Apr.	9	8	111	773	35		10	1 449	
May	33	309	344	541	279		74	1 396	
June	57	1 454	1 767	947	338		76	227	
July	3	1 385	3 149	382	328	3		390	
Aug.	10	84	849	775	948	2		13	
Sept.		3	240	935	608	1	9	68	
Oct.	7		88	891	190	63	31	755	
Nov.	215	3	143	627	171	667		1 200	
Dec.	197		346	417	3	1 012	3	2 409	
	891	3 246	7 170	9 362	2 921	1 763	204	10 770	36 327

[a]Includes pair trawl (86 t).

Table 3. Commercial sampling for NAFO Subdivision 3Ps cod in 1984.

Qtr.	Gear	Country	No. Aged	Month	No. Measured	Landings(t) Country/Month	Total
1+2	OT	CAN(N)	227	Feb.	915	281	474
	"	France					5 976
			227		915		6 450
3+4	OT	Can(N)	301	Nov.	1 515	215	2 180
	"	France					3 356
			301		1 515		5 536
1	LL	Can(N)	426	Feb.	7 170	1 423	2 005[a]
2	LL	Can(N)		Mar.	6 319	1 082	1 091
	"	"		Apr.	489	773	818
	"	"	-841	May	2 992	541	894
	Trap	"		May	2 564	309	317
	GN	"		May	3 083	344	588
			841		15 447		3 708
3	Trap	Can(N)		June	4 440	1 454	1 454
				July	2 521	1 385	1 475
	GN	"		June	2 420	1 767	
	"	"	-725	July	505	3 149	6 582
	"	"		Aug.	290	849	
	HL	"		Aug.	1 092	948	1 614
	LL	"		June	2 272	947	2 180
	"	"		Aug.	3 182	775	
			725		16 722		13 305
4	HL	Can(N)		Sept.	670	608	608
	"	"		Oct.	332	190	364
	LL	"	-979	Sept.	4 481	935	944
	"	"		Oct.	4 847	891	922
	"	"		Nov.	4 879	627	1 047
			979		15 209		3 885
Totals			3 499		56 978		34 885

[a]Includes 13 t HL.

Table 4. Cod catch at age, by gear, from the Canadian fishery in Subdivision 3Ps during 1984, along with an estimate of catch at age for the total fishery.

Age	OT	LL	GN	Trap	HL	Total Can.
2	1					1
3	44	53		28	28	153
4	463	1 072	26	926	478	2 965
5	331	1 058	300	793	559	3 041
6	201	2 159	1 533	625	468	4 986
7	72	668	337	77	79	1 233
8	28	171	123	12	22	356
9	29	140	104	7	18	298
10	27	91	108	5	11	242
11	5	34	47	2	6	94
12	3	10	9		2	24
13	1	3	2		1	7
14		3	4		1	8
15	1	1				2
16		1				1
17						
18						
19		1				1
20						

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
2	0.508	38.980	2	1.86	0.87
3	0.660	42.346	220	28.91	0.13
4	1.045	48.814	3694	156.77	0.04
5	1.401	53.754	3755	197.84	0.05
6	1.972	60.146	6038	192.96	0.03
7	2.644	66.034	1754	118.17	0.07
8	3.771	73.806	544	58.09	0.11
9	4.750	79.292	470	42.98	0.09
10	5.564	83.411	408	40.78	0.10
11	6.012	84.862	128	20.53	0.16
12	9.044	98.471	40	8.34	0.21
13	11.197	104.750	7	2.37	0.32
14	10.405	101.596	10	4.03	0.39
15	12.068	107.528	7	4.00	0.57
16	15.641	117.449	1	0.51	0.48
17	16.628	121.000		0.22	0.66
18	18.521	125.158		0.34	0.68
19	24.685	135.708	1	0.29	0.51
20	13.505	111.848	1	0.43	0.62
21	13.097	112.000		0.32	1.07

Table 5. Cod biomass (MT) from stratified random cruises in Subdivision 3Ps.

Depth Range (Fm.)	Strata	Area	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0-30	314	974	0	-	1328	-	2357	249	0	-	432	369	2028	13103	567	25
	320	1320	-	729	-	-	1335	-	-	-	2946	23087	1920	5618	5456	5259
TOTAL			0	729	1328	-	3692	249	0	-	3378	23456	3948	18721	6023	5284
31-50	308	112	-	181	279	205	193	311	38	125	240	305	490	766	681	1024
	312	272	210	-	243	355	456	1047	343	151	-	165	766	524	674	1016
	315	827	1480	0	592		1747	1550	-	1836	235	0	528	2451	1894	329
	321	1189	1917	0	-	-	1742	-	2037	-	1880	1419	2845	2419	1183	89
	325	944	-	-	-	-	2	-	180	820	28	1109	85	294	449	0
	326	166	-	-	-	-	-	-	0	2	3	0	54	326	0	-
TOTAL			3607	181	1114	540	4140	2908	2598	2934	2386	2998	4768	6780	4881	2458
51-100	307	395	2918	6133	3919	884	1127	2097	3222	4105	1763	13723	3028	892	771	5189
	311	317	3885	590	2432	763	627	411	154	1106	3792	761	1943	3256	863	4870
	317	193	101	286	589	164	551	491	-	368	536	268	1582	3685	30	14064
	319	984	4604	662	478	481	3102	2493	-	10637	1652	15068	3548	3799	3995	1282
	322	1567	-	-	-	-	5183	-	491	14	2599	26	3705	4932	2597	1073
	323	696	736	-	-	-	368	63	1652	-	775	491	1215	858	2247	1263
	324	494	-	-	-	-	8	-	-	29	0	-	430	618	136	10756
TOTAL			12244	7671	7418	2292	10966	5555	5519	16259	11117	30337	15451	18040	10639	38497
101-151	306	419	-	-	376	719	214	161	416	710	457	2652	1211	1250	236	590
	309	296	662	975	479	311	178	192	103	1558	863	2983	838	926	156	1611
	310	170	1008	191	377	2183	-	0	154	119	0	817	608	134	134	268
	313	165	371	29	144	242	142	41	50	1036	127	446	283	74	130	250
	316	189	271	937	63	58	77	17	-	65	61	25	-	207	170	85
	318	123	173	11	4	0	0	6	-	36	790	-	136	11	0	-
TOTAL			2485	2143	1443	3513	611	417	723	3524	2298	6923	3076	2602	826	2804
151-200	705	195	-	-	66	0	0	60	1	91	674	1310	22	27	0	542
	706	476	-	-	23	-	-	76	-	356	827	304	30	32	0	2068
	707	93	-	-	5	0	0	228	-	326	190	-	-	7	0	-
	715	132	-	-	-	1	1	31	142	352	499	168	154	338	54	-
	716	539	-	-	-	-	-	92	781	303	248	1608	168	147	15	344
TOTAL					94	1	1	487	924	1428	2438	3390	374	551	69	2954
201-300	708	117	-	-	-	0	-	11	-	177	4633	-	-	0	0	-
	711	961	-	-	-	-	-	-	-	-	1113	0	0	7	87	109
	712	973	-	-	-	-	-	-	-	9077	282	259	353	0	-	993
	713	950	-	-	-	0	-	-	-	-	0	850	0	36	-	87
	714	1195	-	-	-	-	-	-	-	-	0	161	0	163	-	-
TOTAL			-	-	-	0	-	11	-	9254	6028	1270	353	206	87	1189

	Total Area per Depth Range							
0-30	2294	-	3378	23456	3948	18721	6023	5284
31-50	3510	2934	2386	2998	4768	6780	4881	2458
51-100	4646	16259	11117	30337	15451	18040	10639	38497
101-150	1362	3524	2298	6923	3076	2602	826	2804
151-200	1435	1428	2438	3390	374	551	69	2954
201-300	4196	9254	6028	1270	353	206	87	1189
TOTAL		33399	27645	68374	27970	46900	22520	53184
Confidence Interval								
Upper		126620	51812	182436	35732	75157	30681	109276
Lower		-59817	3481	-45684	20204	18640	14359	-2908

Table 6. Cod abundance (000's) from stratified-random cruises in Subdivision 3Ps. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0-30	314	974	0	(163)	1,170	(317)	1,060	73	0	(531)	279	307	2,237	1,859	91	21
	320	1,320	(1,217)	545	(960)	(765)	867	(754)	(908)	(1,285)	528	10,354	1,362	1,589	1,870	476
31-50	308	112	134	29	122	65	34	166	21	74	59	46	235	238	395	563
	312	272	337	(106)	225	221	257	597	378	157	(385)	92	296	347	153	1,644
	315	827	186	0	62	(469)	745	1,273	(557)	621	171	0	145	489	410	177
	321	1,189	223	0	(255)	(203)	312	(200)	179	(341)	196	402	1,227	785	342	76
	325	944	(164)	(53)	(129)	(103)	35	(102)	567	850	35	190	76	111	63	0
	326	166	(41)	(13)	(32)	(26)	(34)	(25)	0	12	6	0	69	63	0	(38)
51-100	307	395	1,621	2,627	2,609	423	756	1,090	1,186	2,090	949	5,505	2,372	569	193	2,006
	311	317	2,261	820	2,847	433	670	119	309	1,124	3,105	690	1,888	1,348	381	3,692
	317	193	275	354	742	127	974	196	(584)	309	1,391	623	913	2,062	14	1,427
	319	984	1,717	842	1,182	638	4,136	2,958	(1,301)	15,068	2,733	13,000	3,176	2,058	1,637	111
	322	1,567	(693)	(225)	(547)	(436)	2,235	(429)	706	118	2,641	471	2,632	1,882	509	860
	323	696	418	(75)	(182)	(145)	78	111	1,097	(244)	261	78	392	383	901	871
	324	494	(364)	(118)	(287)	(229)	37	(225)	(271)	93	0	(915)	352	593	321	10,476
101-150	306	419	(375)	(122)	145	309	110	65	115	440	204	2,810	692	763	47	267
	309	296	678	141	86	152	89	63	67	870	289	1,811	700	496	56	933
	310	170	264	51	70	2,038	(174)	0	183	121	0	651	434	72	57	102
	313	165	121	56	89	215	54	26	17	1,018	81	266	217	37	12	111
	316	189	60	528	76	43	103	14	(52)	85	35	21	(135)	128	78	38
	318	123	32	9	5	0	0	5	(43)	503	379	(145)	92	3	0	(53)
151-200	705	195	(415)	(135)	55	0	0	48	7	66	432	988	15	5	0	285
	706	476	(180)	(59)	5	(114)	(148)	46	(135)	202	518	250	9	7	0	697
	707	93	(25)	(8)	3	0	0	171	(18)	91	122	(65)	(48)	2	0	(23)
	715	132	(93)	(30)	(73)	10	30	20	149	221	248	84	45	106	25	(85)
	716	539	(163)	(58)	(129)	(102)	(134)	20	587	334	223	1,123	81	91	13	170
Total		13,247	12,057	7,163	12,088	7,582	13,073	8,795	9,437	26,869	15,270	40,908	19,848	16,101	7,366	25,203
Estimated mean no. per tow			12.13	7.20	12.16	7.63	13.15	8.84	9.49	27.02	15.36	41.14	19.96	16.19	7.41	25.35

Table 7. Mean number of cod per tow from research trips in Subdivision 3Ps (depths to 200 fath).

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	0.04	0.03	1.08	0.66	0.22	0.01	0.0	1.47	0.21	0.04	0.68	0.33	0.01	.02
2	1.04	1.40	3.31	1.33	3.14	0.30	0.47	0.61	6.09	0.73	2.60	0.62	0.25	.36
3	1.83	1.64	3.27	3.75	2.05	3.82	0.70	0.89	1.79	4.20	1.33	1.35	0.39	2.26
4	3.77	2.50	2.34	3.41	3.77	3.35	2.63	8.24	0.89	6.90	6.53	0.74	0.71	5.77
5	2.52	2.79	3.16	2.10	2.35	2.56	1.15	19.77	2.36	7.53	3.01	4.03	0.54	7.44
6	1.69	0.78	2.92	1.94	1.07	1.32	0.83	3.12	2.11	9.70	1.41	2.06	2.30	3.34
7	2.24	1.56	0.81	1.74	0.65	0.41	0.60	1.04	0.53	9.09	1.89	0.72	0.92	3.05
8	1.32	0.61	0.65	0.65	0.60	0.20	0.42	0.55	0.61	1.80	1.95	1.41	0.47	.96
9	0.56	0.82	0.52	0.43	0.14	0.32	0.25	0.22	0.19	1.77	0.53	2.63	0.59	.57
10	0.33	0.19	0.26	0.26	0.11	0.12	0.23	0.19	0.17	0.41	0.14	1.22	0.92	.56
11	0.14	0.05	0.08	0.09	0.08	0.02	0.08	0.04	0.13	0.07	0.10	0.59	0.22	.58
12	0.08	0.05	0.06	0.04	0.08	0.05	0.03	0.02	0.15	0.11	0.04	0.22	0.17	.64
13	0.05		0.04	0.05		0.05	0.03	0.02	0.06	0.11	0.02	0.09	0.07	.27
14	0.09	0.02	0.04			0.01		0.03		0.06	0.02	0.08	0.03	.15
15	0.05	0.01	0.01	0.02	0.03	0.01	0.03		0.03	0.02	0.04	0.06		.04
16	0.15	0.03	0.02	0.0					0.03	0.02	0.02	0.05	0.04	.04
17	0.11	0.05	0.01	0.02	0.01		0.02		0.02	0.01		0.01	0.0	.06
18	0.07	0.04	0.01			0.01						0.02	0.03	.03
19	0.01		0.01		0.04		0.02					0.02		
20	0.01			0.01		0.02				0.01		0.02		
20+	0.01	0.01	0.01				0.05					0.03	0.01	.03
NK		0.01									0.03			
Total	16.09	12.60	18.62	16.50	14.34	12.57	7.53	36.21	15.40	42.58	20.35	16.30	7.67	26.16
Confidence limits														
Upper	25.10	21.58	24.37	23.38	21.20	17.40	11.01	319.07	20.45	115.88	26.63	22.08	10.88	172.68
Lower	7.09	3.62	12.87	9.61	7.48	7.74	4.06	-246.66	10.34	-30.71	14.07	10.52	4.46	-120.36
Sets	44	55	81	56	69	98	44	76	71	53	79	132	84	87
Survey dates	Mar. 20-30	Mar. 16-23	Apr. 19-30	June 2-13	May 11-21	Apr. 14-26	Feb. 21-28	Feb. 16-Mar. 5	Mar. 19-Apr. 2	Mar. 7-26	May 28-June 9	Apr. 22-May 8	Apr. 9-18	March 7-26

Table 8. Regression coefficients for grouped categories and the analysis of variance from the regression on ln catch rate for cod in Subdivision 3Ps from 1959 to 1984.

Country / Gear		Ln Power	Month	ln Power
Can-N	OT-4	-0.372	May	
Can-N	OT-5		June	
			July	-0.418
Can-M	OT-4	0.000	Aug.	
			Sept.	
Spain	OT-5	0.083	Oct.	
Can-M	OT-5		Apr.	-0.240
FRA-STPM	OT-5		Nov.	
Port	OT-6	0.432		
Spain	PT-4		Jan.	
Spain	PT-6		Feb.	0.000
			March	
Spain	PT-5	0.796	Dec.	

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.676
MULTIPLE R SQUARED.....0.456

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.627E1	2.627E1	
REGRESSION	31	1.537E2	4.957E0	19.144
TYPE 1	4	9.746E1	2.437E1	94.109
TYPE 2	2	2.252E1	1.126E1	43.485
TYPE 3	25	5.451E1	2.180E0	8.422
RESIDUALS	707	1.831E2	2.589E-1	
TOTAL	739	3.630E2		

Table 9. Mean catch rate indices of cod in Subdivision 3Ps for the years 1959-84.

YEAR	TOTAL CATCH	CATCH RATE MEAN	S.E.	EFFORT
1959	60170	1.087	0.112	55364
1960	72636	0.954	0.101	76178
1961	83620	1.406	0.138	59486
1962	52639	1.127	0.120	46709
1963	50051	1.360	0.147	36798
1964	53956	1.234	0.134	43720
1965	51400	1.315	0.147	39099
1966	65749	1.477	0.150	44505
1967	62393	1.239	0.144	50374
1968	77217	1.528	0.161	50544
1969	63103	1.505	0.163	41922
1970	76161	1.264	0.132	60275
1971	63967	1.249	0.124	51219
1972	44323	0.997	0.095	44460
1973	52641	0.874	0.081	60251
1974	46712	0.681	0.068	68562
1975	35373	0.689	0.082	51377
1976	37133	0.682	0.079	54476
1977	32245	0.641	0.079	50300
1978	27221	1.136	0.156	23953
1979	33006	0.905	0.106	36467
1980	37568	0.661	0.092	56821
1981	38905	1.048	0.132	37126
1982	33902	1.172	0.136	28938
1983	38297	1.848	0.264	20721
1984	34889	2.191	0.480	15924

AVERAGE C.V. FOR THE MEAN:0.116

Table 10. Survey abundance estimates (mean numbers per tow) from research vessel surveys by Canada and France along with an age 3 abundance estimate from the combined survey data for cod in Subdivision 3Ps.

Year	Canadian survey Age 2	Canadian survey Age 3	Total all ages	Adj. factor for seasonality	Adjusted total	Adjusted nos. Age 2	Adjusted nos. Age 3
1972	1.04	1.83	12.13	1.00	12.13	0.78	1.38
1973	1.40	1.64	7.20	1.00	7.20	0.80	.94
1974	3.31	3.27	12.16	.79	15.45	2.75	2.71
1975	1.33	3.75	7.63	.66	11.60	0.94	2.64
1976	3.14	2.05	13.15	.66	19.98	4.38	2.86
1977	.30	3.82	8.84	.79	11.23	.27	3.41
1978	.47	.70	9.49	1.00	9.49	.59	.88
1979	.61	.89	27.02	1.00	27.02	.46	.66
1980	6.09	1.79	15.36	1.00	15.36	6.07	1.79
1981	.73	4.20	41.14	1.00	41.14	.71	4.06
1982	2.60	1.33	19.96	0.66	30.33	3.88	1.98
1983	.62	1.35	16.19	0.72	22.42	.85	1.86
1984	.25	.39	7.41	0.79	9.42	.31	.48
1985	.36	2.26	25.35	1.00	25.35	.35	2.19

	French survey	
	Age 2	Age 3
1977	4.75	13.94
1978	.76	1.49
1979	.46	.42
1980	8.14	1.91
1981	.20	5.64
1982	12.07	1.91
1983	11.09	5.64
1984	12.50	8.24

	Age 3 survey no's.		
Year	Canada	France	Average
1972	1.38		1.38
73	.94		.94
74	2.71		2.71
75	2.64		2.64
76	2.86		2.86
77	3.41		3.41
78	.88	1.49	1.18
79	.66	.42	.54
80	1.79	1.91	1.85
81	4.06	5.64	4.85
82	1.98	1.91	1.94
83	1.86	5.64	3.75
84	.48	8.24	4.36
85	2.19		

Table 11. Data used in estimating partial recruitment in 1984 for cod in Subdivision 3Ps.

Age	PR from 1984 assessment	PR calculated from preliminary cohort	PR from tuning cohort age 3 to survey age 3 numbers
3	0.02	0.01	0.01
4	0.30	0.16	0.20
5	0.65	0.47	0.50
6	0.74	0.70	0.70
7	1.00	1.00	1.00
•			
•			
•			
14	1.00	1.00	1.00

Year	Mean number per tow age 3	Cohort numbers age 3-5 - F_t = 0.25 ($\times 10^{-3}$)
1972	1.38	39
1973	0.94	31
1974	2.71	42
1975	2.64	56
1976	2.86	59
1977	3.41	74
1978	1.18	38
1979	.54	23
1980	1.85	38
1981	4.85	98
1982	1.94	56
1983	3.75	103
1984	4.36	97
1985		

(1972-83)

r^2 = 0.85

slope = 18.41

intercept = 11.71

Table 12. Catch and average weight at age of cod from the commercial fishery in Subdivision 3Ps.

CATCH AT AGE

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	1001	567	450	1245	961	1906	2314	949	2871	1143	774	756	2884	731	945	1887
4	13940	5496	5586	6749	4499	5785	9636	13662	10913	12602	7098	8114	6444	4944	4707	6042
5	7525	23704	10357	9003	7091	5635	5799	13065	12900	13135	11585	12916	8574	4591	11386	9987
6	7265	6714	15960	4533	5275	5179	3609	4621	6392	5853	7178	9763	7266	3552	4010	6365
7	4875	3476	3616	5715	2527	2945	3254	5119	2349	3572	4554	6374	8218	4603	4022	2540
8	942	3484	4680	1367	3030	1881	2055	1586	1364	1308	1757	2456	3131	2636	2201	1857
9	1252	1020	1849	791	898	1891	1218	1833	604	549	792	730	1275	833	2019	1149
10	1260	827	1376	571	292	652	1033	1039	316	425	717	214	541	463	515	538
11	631	406	446	187	143	339	327	517	380	222	61	178	85	205	172	249
12	545	407	265	140	99	329	68	389	95	111	120	77	125	117	110	80
13	44	283	560	135	107	54	122	32	149	5	67	121	62	48	14	32
14	0	27	58	241	92	27	36	22	3	107	110	14	57	45	29	17
3+	39280	46411	45203	30677	25014	26623	29471	42834	38336	39032	34813	41713	38662	22768	30130	30743
4+	38279	45844	44753	29432	24053	24717	27157	41885	35465	37889	34039	40957	35778	22037	29185	28856
5+	24339	40348	39167	22683	19554	18932	17521	28223	24552	25287	26941	32843	29334	17093	24478	22814
6+	16814	16644	28810	13680	12463	13297	11722	15158	11652	12152	15356	19927	20760	12502	13092	12827

AGE	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	1840	4110	935	218	149	298	1000	110	783	220
4	7329	12139	9156	4308	2370	1644	2765	5079	2623	3694
5	5397	7923	8326	5391	9777	5096	2864	4114	9106	3755
6	4541	2875	3209	4203	5235	8335	4220	1979	3984	6038
7	5867	1305	920	1791	2588	4387	5187	2806	1705	1754
8	723	495	395	730	884	1420	1573	3101	1140	544
9	1196	140	265	243	284	349	571	725	1029	470
10	105	53	117	189	82	104	204	297	237	408
11	174	17	57	76	48	54	89	102	90	128
12	52	21	43	26	19	42	37	34	35	40
13	6	4	31	19	11	19	24	15	18	7
14	2	3	11	10	10	25	6	10	8	10
3+	27232	29085	23465	17204	21457	21773	18540	18372	20758	17068
4+	25392	24975	22530	16986	21308	21475	17540	18262	19975	16848
5+	18063	12836	13374	12678	18938	19831	14775	13183	17352	13154
6+	12666	4913	5048	7287	9161	14735	11911	9069	8246	9399

AVERAGE WEIGHT AT AGE

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
3	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.55
4	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.68
5	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.30
6	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.86
7	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.67
8	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.42
9	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.19
10	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	4.94
11	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	5.92
12	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	6.76
13	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.78
14	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	10.90

AGE	1978	1979	1980	1981	1982	1983	1984
3	0.45	0.41	0.52	0.48	0.45	0.58	0.66
4	0.70	0.65	0.72	0.79	0.77	0.84	1.04
5	1.08	1.01	1.13	1.32	1.17	1.33	1.40
6	1.75	1.65	1.66	1.80	1.78	1.99	1.97
7	2.45	2.55	2.48	2.30	2.36	2.58	2.64
8	2.99	3.68	3.60	3.27	2.88	3.26	3.77
9	4.10	4.30	5.40	4.36	3.91	3.77	4.75
10	5.16	6.49	6.95	5.68	5.28	5.04	5.56
11	5.17	7.00	7.29	7.41	6.18	6.56	6.01
12	7.20	8.20	8.64	9.04	8.62	8.45	9.04
13	7.75	9.53	9.33	8.39	8.64	10.06	11.20
14	8.72	10.84	9.58	9.56	11.41	11.82	10.40

Table 13. Relationship of standard CPUE indices with exploitable biomass for Subdivision 3Ps cod from cohort analysis at a range of fully recruited fishing mortalities. Residuals (observed-calculated) are indicated for recent years.

Year	CPUE	0.15		0.20		0.25	
		Observed	Residuals	O.	R.	O.	R.
1961	1.406	138	20.7				
1962	1.127	135	42.2				
1963	1.360	132	17.9				
1964	1.234	120	17.5				
1965	1.315	103	-6.5				
1966	1.477	99	-25.4				
1967	1.239	117	14.5				
1968	1.528	112	-16.8				
1969	1.505	100	-27.1				
1970	1.264	109	4.3				
1971	1.249	91	-12.4				
1972	.997	71	-10.6				
1973	.874	69	-0.8				
1974	.681	54	0.8				
1975	.689	34	-19.6				
1976	.682	55	2.4				
1977	.641	70	20.9	70	13.9	69	9.7
1978	1.136	47	-47.9	46	-43.4	46	-41.3
1979	.905	67	-6.4	65	-9.2	64	-10.8
1980	.661	74	23.3	70	13.0	68	6.8
1981	1.048	87	1.2	79	-5.0	74	-8.8
1982	1.172	84	-13.0	72	-20.8	64	-25.5
1983	1.848	141	-16.0	113	-25.9	96	-31.9
1984	2.191	224	35.8	168	5.9	135	-12.0
Intercept			-8.16		11.89		23.94
Slope			89.60		68.59		55.97
R^2			0.73		0.63		0.49

Table 14. Historical partial recruitment for NAFO Subdivision 3Ps cod. Average values for 1978-82 were used as cohort input in 1984.

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
3	0.05	0.03	0.01	0.07	0.07	0.08	0.07	0.02	0.08	0.04	0.03	0.04	0.07	0.03	0.05	0.06	0.03	0.15	0.03	0.01	0.01	0.01	0.02
4	0.42	0.32	0.21	0.51	0.41	0.56	0.44	0.38	0.45	0.39	0.26	0.37	0.39	0.21	0.24	0.36	0.22	0.69	0.64	0.14	0.16	0.16	0.20
5	0.71	1.00	0.62	0.88	0.99	0.69	0.68	0.69	1.00	0.76	0.49	0.71	0.54	0.57	0.63	0.81	0.40	1.00	1.00	0.42	0.52	0.43	0.53
6	1.00	0.95	0.89	0.81	1.00	1.00	0.54	0.68	1.00	0.73	0.64	0.65	0.65	0.48	0.78	0.59	0.67	1.00	1.00	0.76	0.73	0.64	0.78
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
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
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
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
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
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
13	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
14	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	1982	1983	1984
3	0.00	0.02	0.01
4	0.13	0.16	0.20
5	0.41	0.45	0.50
6	0.57	0.88	0.70
7	1.00	1.00	1.00
8	1.00	1.00	1.00
9	1.00	1.00	1.00
10	1.00	1.00	1.00
11	1.00	1.00	1.00
12	1.00	1.00	1.00
13	1.00	1.00	1.00
14	1.00	1.00	1.00

Table 15. Population numbers (x 10^{-3}) of Subdivision 3Ps cod from a cohort analysis at F_t = 0.20.

POPULATION NUMBERS

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
3	59386	59260	50943	48671	42957	70839	80985	84415	98472	70170	54301	35488	60169	39336
4	107064	47715	48005	41302	38722	34300	56274	64211	68254	78024	56416	43758	28371	46653
5	35820	75043	34093	34249	27708	27632	22848	37354	40210	46007	52478	39767	28484	17397
6	24206	22518	39992	18541	19894	16269	17524	13459	18761	21249	25783	32483	20872	15563
7	16270	13245	12361	18302	11079	11515	8634	11082	6838	9577	12101	14614	17761	10514
8	5812	8910	7699	6849	9813	6784	6763	4125	4441	3473	4609	5787	6198	7105
9	4041	3906	4142	2068	4370	5292	3852	3678	1942	2402	1660	2183	2516	2241
10	3449	2175	2275	1718	978	2766	2622	2052	1352	1043	1470	643	1127	906
11	3661	1683	1033	618	890	536	1674	1212	740	821	470	555	333	433
12	1180	2426	1011	442	337	599	132	1075	525	262	472	329	293	195
13	154	473	1618	588	235	186	193	47	528	344	114	278	200	127
14	0	86	131	818	359	96	103	48	9	298	277	33	118	108
3+	261043	237442	203304	174166	157342	176816	201606	222757	242074	233670	210150	175917	166441	140578
4+	201657	178182	152360	125495	114385	105976	120621	138343	143601	163500	155849	140429	106271	101242
5+	94592	130466	104355	84193	75664	71676	64347	74131	75347	85476	99432	96671	77900	54589
6+	58772	55423	70262	49944	47955	44044	41499	36777	35137	39468	46954	56904	49416	37192

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	31162	41865	56629	59416	75639	40133	24255	42548	115675	68502	127738	121484
4	31544	24658	32569	44699	44927	61082	32661	19724	34566	93802	55986	103875
5	33723	21567	14721	20034	25612	28498	46112	24596	14661	25798	72203	43464
6	10090	17307	8621	7169	9233	13436	18455	28907	15526	9412	17399	50875
7	9528	4632	8411	2949	3268	4656	7197	10372	16125	8894	5915	10641
8	4443	4161	1494	1577	1234	1843	2191	3551	4523	8509	4742	3300
9	3432	1646	1727	569	844	653	849	994	1623	2280	4160	2851
10	1081	983	308	332	339	451	315	438	498	812	1210	2475
11	323	419	318	157	224	172	198	183	264	223	396	777
12	169	109	118	103	113	131	72	119	101	136	91	243
13	54	39	17	49	65	54	84	42	59	49	81	42
14	60	32	3	8	37	25	27	59	17	27	27	50
3+	125609	117419	124936	137064	161536	151135	132416	131533	203639	218444	289948	340076
4+	94447	75554	68307	77647	85897	111003	108161	88985	87964	149941	162210	218592
5+	62903	50896	35738	32949	40970	49920	75500	69261	53398	56139	106224	114717
6+	29180	29329	21016	12915	15358	21422	29388	44665	38737	30341	34022	71254

Table 16. Mid-year (average) population biomass (t x 10^{-3}) of Subdivision 3Ps cod from a cohort analysis at F_t = 0.20.

POPULATION BIOMASS (AVERAGE)

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
3	14935	14962	12867	12182	10771	17718	20237	21294	24599	17652	13675	8903	14875	9883
4	62174	27961	28111	23497	22677	19450	31857	35382	38917	44442	32849	24548	15483	27489
5	30949	60147	27575	28539	23202	23972	19161	29159	32106	37718	45019	31656	23087	14486
6	30539	28451	46617	24345	25746	20246	23618	16427	22945	27296	33050	40968	25377	20663
7	29334	24533	22405	32686	21016	21436	14650	17431	11922	16302	20542	23547	27914	16915
8	15396	19981	13752	17710	23502	16630	16258	9301	10651	7885	10421	12604	12486	16204
9	12351	12372	11294	5968	14379	15589	11719	9530	5930	7782	4396	6549	6462	6524
10	12504	7792	6458	6396	3734	11047	9283	6534	5410	3651	4771	2391	3686	2870
11	18097	7952	4197	2792	4433	1741	8156	4950	2775	3801	2384	2473	1555	1693
12	5412	13964	5463	2294	1777	2511	576	5386	2994	1245	2562	1815	1390	770
13	941	2144	9442	3737	1249	1132	837	188	3235	2487	524	1500	1200	721
14	0	589	805	5660	2554	668	687	288	64	1960	1768	204	696	676
3+	232632	220847	188986	165807	155040	152133	157038	155869	161548	172222	171961	157159	134210	118895
4+	217697	205885	176119	153625	144269	134416	136801	134575	136949	154570	158286	148256	119335	109012
5+	155523	177924	148008	130128	121592	114966	104944	99193	98032	110127	125437	123708	103852	81523
6+	124574	117778	120433	101589	98390	90995	85783	70035	65926	72409	80418	92052	80766	67037

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	7779	10366	14120	14514	37456	16321	8984	19978	50091	27915	66929	72600
4	18106	13292	17799	23649	24542	37273	18485	12289	23675	63549	41547	96044
5	26578	15248	11336	15059	24536	24963	37211	22278	15633	24949	81021	52570
6	11778	20712	8883	8343	12435	17490	23145	36350	21426	13401	27351	84963
7	15548	6657	9799	4725	6644	8012	13161	17478	27402	15580	11562	23153
8	9042	8885	3077	3764	3122	3835	5574	8864	10706	17503	12117	10254
9	8032	3273	3467	1822	2627	1900	2670	3877	5104	6604	12234	11163
10	3549	2995	1139	1392	1217	1586	1578	2390	1946	3058	4926	11342
11	1185	1432	1151	808	1027	594	1086	1008	1431	909	2053	3846
12	621	342	551	580	540	763	456	740	654	913	537	1808
13	337	113	95	345	372	301	674	257	343	320	643	392
14	359	177	14	53	303	156	208	384	118	218	240	426
3+	102914	83492	71431	75053	114820	113193	113231	125893	158530	174919	261160	368562
4+	95134	73126	57311	60540	77364	96872	104248	105915	108439	147004	194231	295962
5+	77029	59833	39512	36890	52822	59600	85763	93626	84763	83454	152684	199918
6+	50451	44585	28176	21832	28285	34637	48552	71349	69130	58505	71663	147348

Table 17. Fishing mortalities for Subdivision 3Ps cod from a cohort analysis at F_t = 0.20.

FISHING MORTALITY

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
3	0.019	0.011	0.010	0.029	0.025	0.030	0.032	0.013	0.033	0.018	0.016	0.024	0.054	0.021	0.034	0.051	0.037
4	0.155	0.136	0.138	0.199	0.137	0.206	0.210	0.268	0.194	0.197	0.150	0.229	0.289	0.125	0.180	0.316	0.286
5	0.264	0.429	0.409	0.343	0.332	0.255	0.329	0.489	0.438	0.379	0.280	0.445	0.404	0.345	0.467	0.717	0.519
6	0.403	0.400	0.582	0.315	0.347	0.434	0.258	0.477	0.472	0.363	0.368	0.404	0.486	0.291	0.578	0.522	0.873
7	0.402	0.343	0.391	0.423	0.290	0.332	0.539	0.714	0.477	0.531	0.538	0.658	0.716	0.661	0.628	0.931	1.474
8	0.197	0.566	1.114	0.249	0.417	0.366	0.409	0.553	0.415	0.538	0.547	0.633	0.817	0.528	0.793	0.680	0.765
9	0.419	0.341	0.680	0.549	0.258	0.502	0.430	0.800	0.421	0.291	0.749	0.461	0.821	0.529	1.050	1.476	1.450
10	0.517	0.545	1.104	0.458	0.401	0.302	0.572	0.820	0.299	0.598	0.774	0.459	0.756	0.832	0.748	0.928	0.473
11	0.211	0.310	0.649	0.407	0.195	1.199	0.243	0.638	0.838	0.355	0.155	0.438	0.332	0.740	0.889	1.069	0.927
12	0.714	0.205	0.342	0.431	0.393	0.933	0.839	0.511	0.223	0.632	0.330	0.299	0.637	1.085	1.268	1.683	0.669
13	0.379	1.083	0.482	0.293	0.699	0.387	1.199	1.406	0.374	0.016	1.049	0.657	0.419	0.541	0.337	2.375	0.513
14	0.370	0.420	0.660	0.390	0.330	0.370	0.480	0.700	0.430	0.500	0.570	0.630	0.750	0.610	0.740	0.880	1.300

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	0.080	0.014	0.006	0.007	0.008	0.010	0.002	0.007	0.002
4	0.357	0.255	0.081	0.084	0.097	0.093	0.062	0.053	0.040
5	0.575	0.445	0.235	0.267	0.260	0.243	0.194	0.150	0.100
6	0.586	0.485	0.424	0.376	0.384	0.357	0.264	0.292	0.140
7	0.671	0.373	0.554	0.506	0.630	0.439	0.429	0.384	0.200
8	0.426	0.437	0.576	0.590	0.583	0.485	0.515	0.309	0.200
9	0.317	0.426	0.530	0.462	0.491	0.493	0.433	0.319	0.200
10	0.194	0.480	0.622	0.340	0.304	0.602	0.518	0.244	0.200
11	0.127	0.331	0.670	0.312	0.394	0.465	0.703	0.289	0.200
12	0.255	0.544	0.247	0.344	0.495	0.517	0.323	0.557	0.200
13	0.094	0.742	0.494	0.156	0.698	0.593	0.408	0.284	0.200
14	0.520	0.396	0.560	0.522	0.623	0.487	0.524	0.394	0.200

Table 18. Estimation of research survey population abundance (ages 4-14) from Canadian, French, and both countries combined for cod in Subdivision 3Ps.

Year	Seas. adj. Total	Prop. age 4-14	4+ nos.	4+ (France)	Ave.	Cohort 4+ F_t = 0.20
1972	12.13	.79	9.58		9.58	101
1973	7.20	.74	5.33		5.33	94
1974	15.45	.58	8.96		8.96	76
1975	11.60	.65	7.54		7.54	68
1976	19.98	.62	12.39		12.39	78
1977	11.23	.67	7.52	(12.51)	7.52	86
1978	9.49	.83	7.88	8.49	8.18	111
1979	27.02	.92	24.86	17.35	21.10	108
1980	15.36	.47	7.22	12.15	9.68	89
1981	41.14	.88	36.20	30.58	33.39	88
1982	30.33	.77	23.35	32.18	27.76	150
1983	22.42	.85	19.06	28.84	23.95	162
1984	9.42	.90	8.48	61.29		219
1985	25.35	.89	22.56	24.12	23.34	

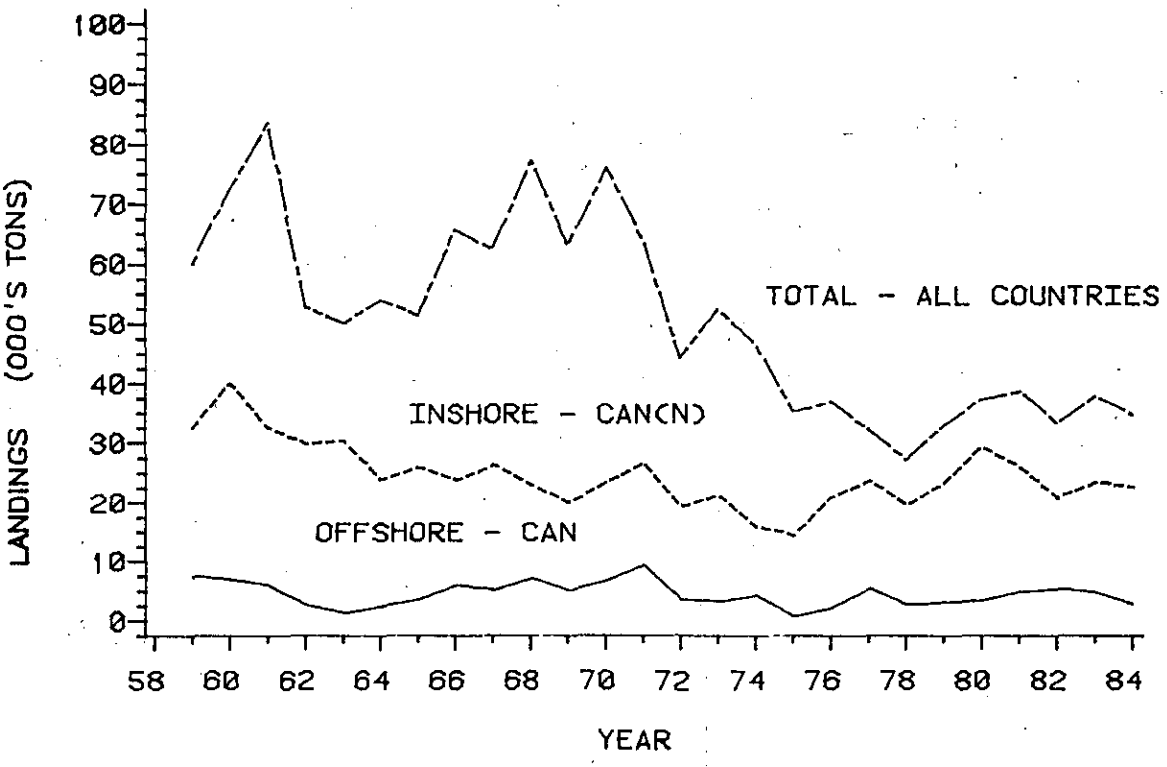

FIG. 1. TOTAL CATCH OF 3PS COD BY ALL COUNTRIES ALONG WITH CANADIAN CATCHES FOR 1959-1984.

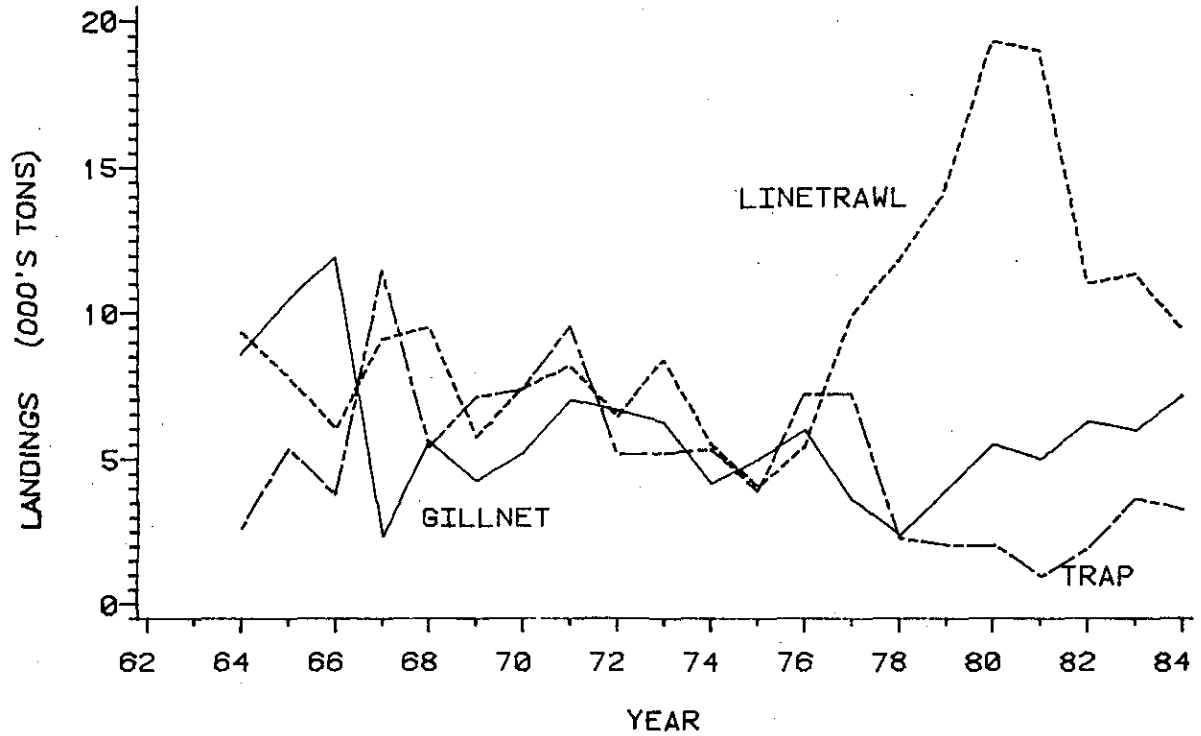

FIG. 2. INSHORE CAN(N) COD CATCHES BY GEAR IN SUBDIVISION 3PS FOR THE PERIOD 1964-1984.

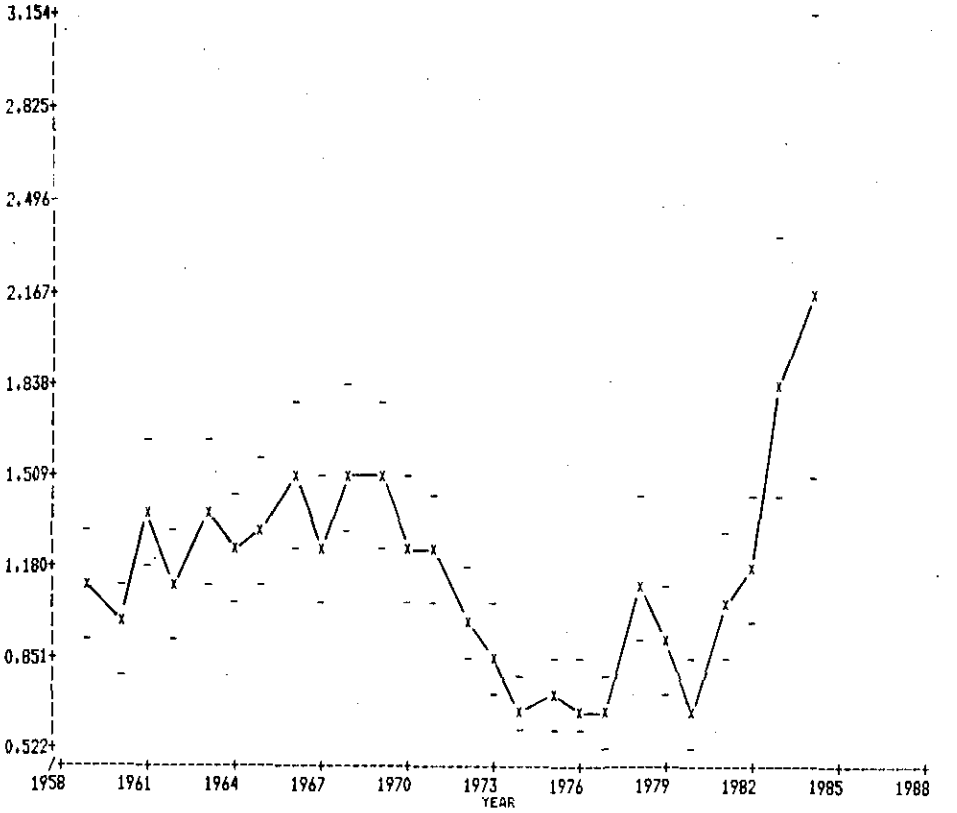

Fig. 3. Historical catch rate indices for cod in Subdivision 3Ps with approximate 90% confidence limits.

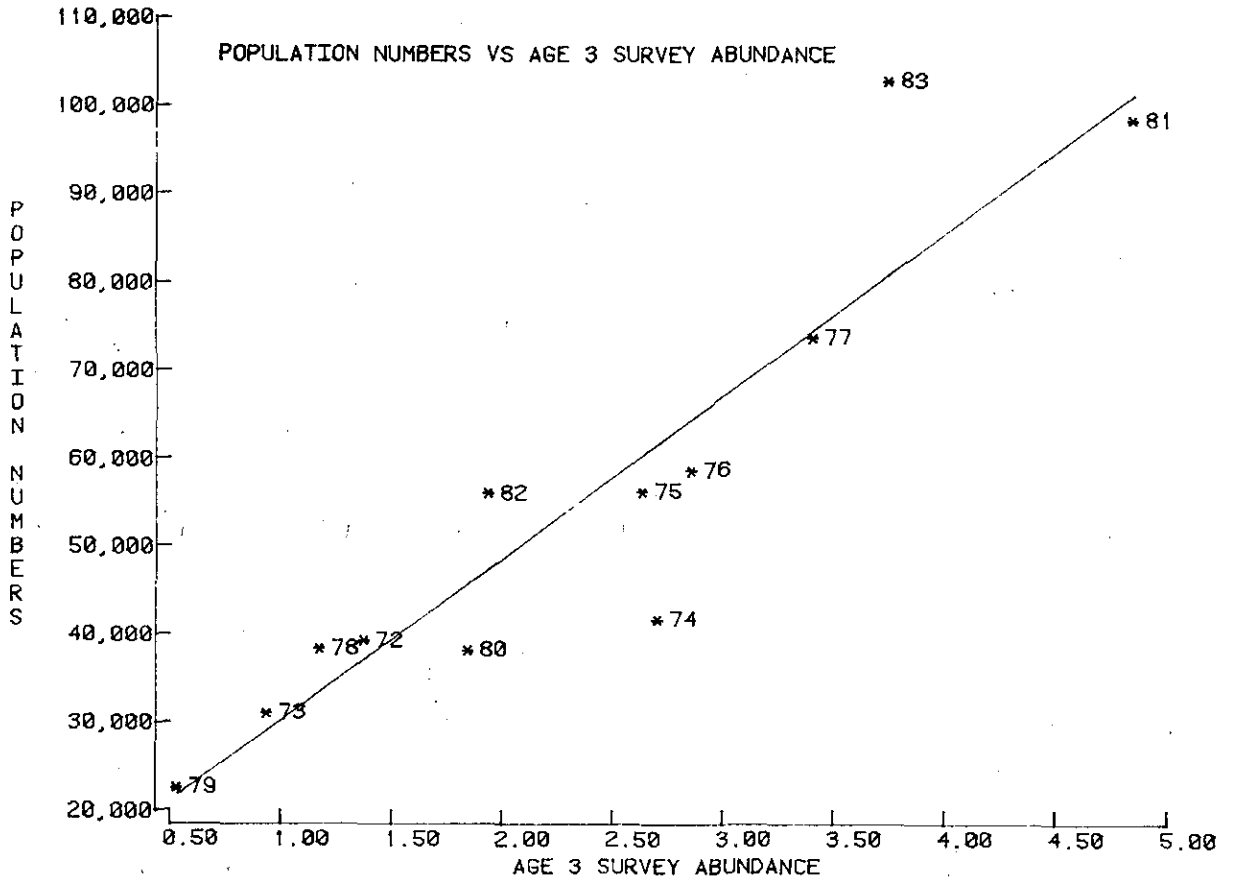

Fig. 4. Cohort age 3 abundance vs survey age 3 abundance for the period 1972-83 (F_t = 0.25).

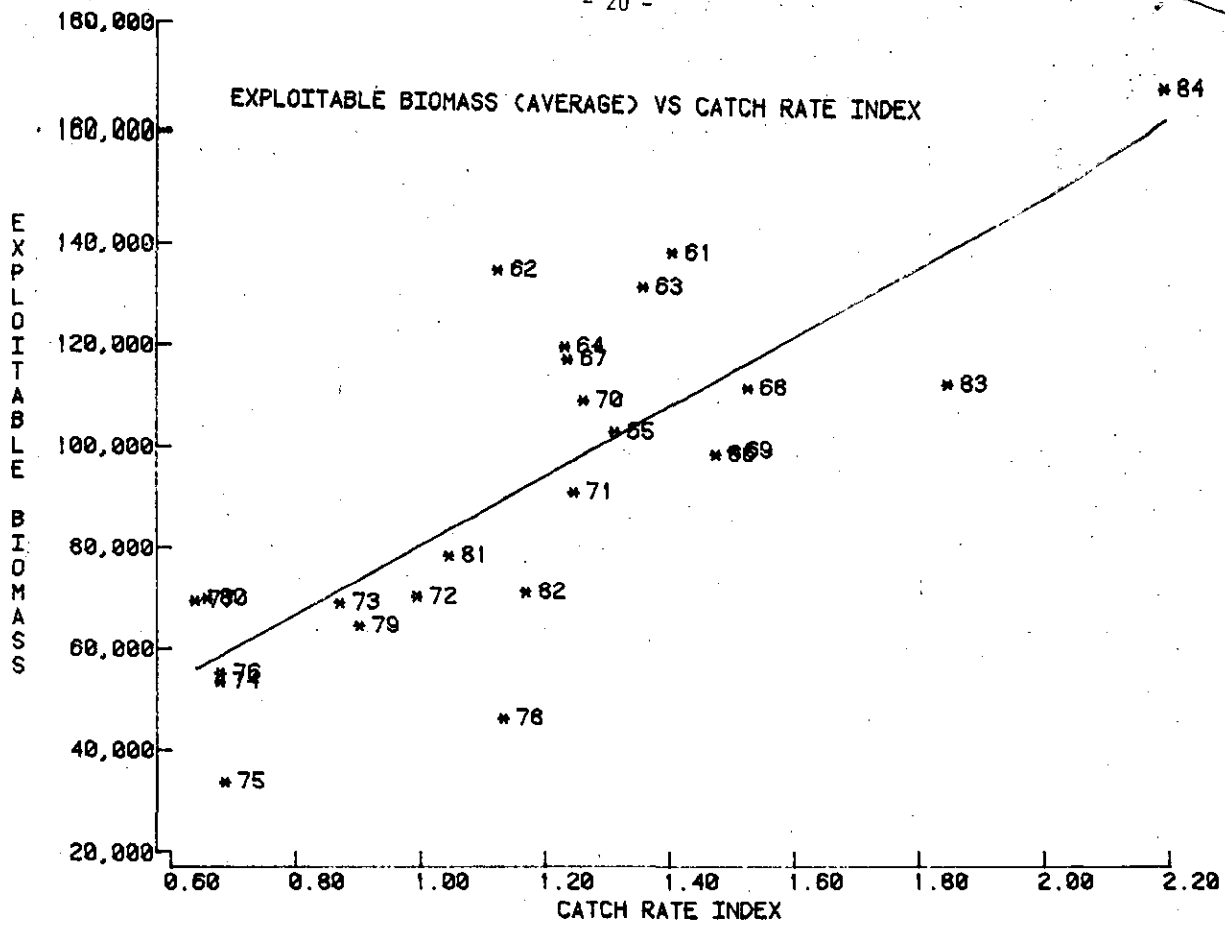

Fig. 5. Relationship of cohort exploitable biomass (F_t = 0.20) with standard CPUE for the period 1961-84 for Subdivision 3Ps cod.

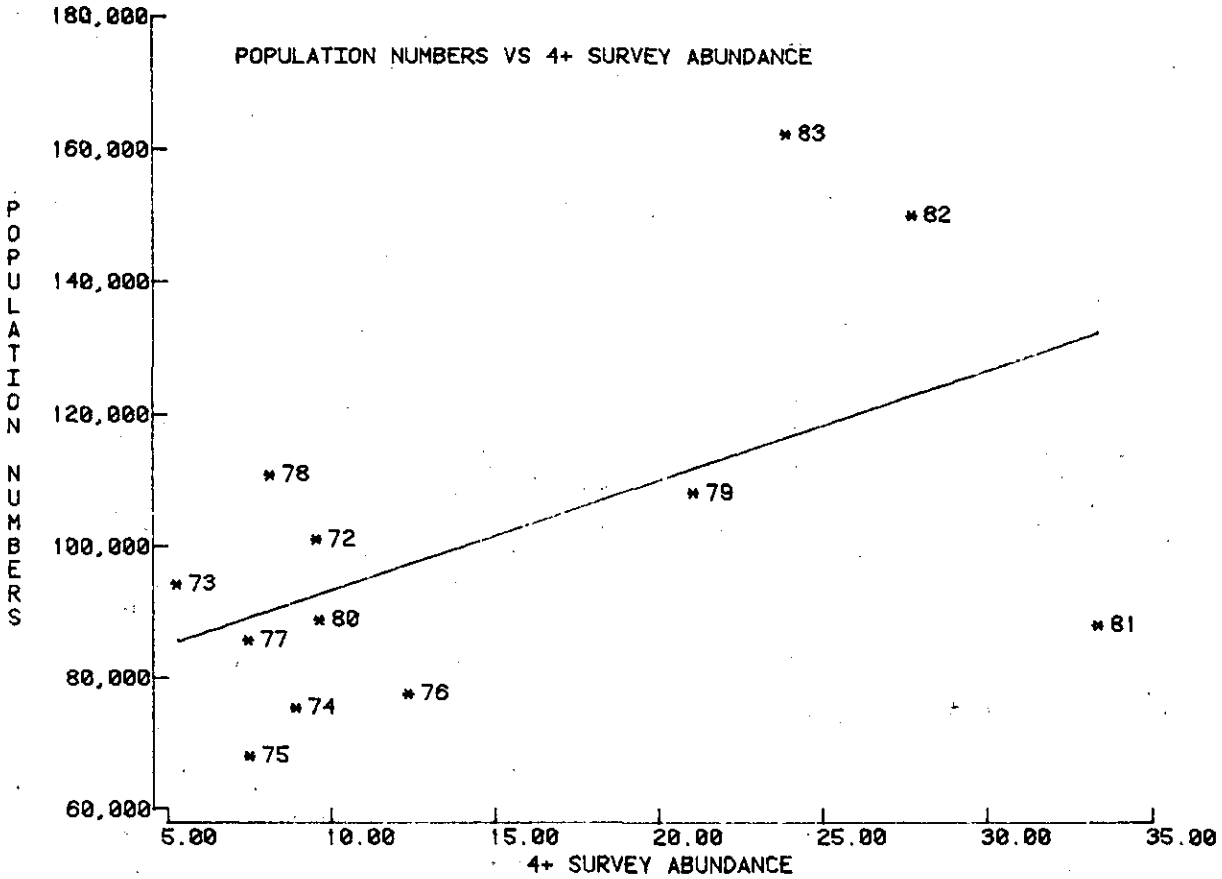

Fig. 6. Cohort 4+ abundance vs survey 4+ abundance for the period 1972-83 (F_t = 0.20).

Appendix

Further Assessment of the Cod Stock in Subdivision 3Ps

Catch at age for the period 1959-84 including French sampling information for 1984 is shown in Table 1.

Results of the regression using 3+ abundance from French surveys versus cohort population numbers are shown in Table 2 and Figure 1. Results of regressions using 6+ abundance from French surveys, 3+ and 6+ abundance from Canadian surveys were not significant.

Table 3 shows the mean number of cod per tow from Canadian research vessel surveys adjusted for seasonality and missing strata using the same proceedure described earlier in the text.

Results of cohort analyses using fully recruited fishing mortalities in 1984 of 0.20 and 0.40 are given in Tables 4 and 5 respectively.

Table 1. Catch at age including sampling by France in 1984 for cod in Subdivision 3Ps.

CATCH AT AGE

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	1001	567	450	1245	961	1906	2314	949	2871	1143	774	756	2884	731	945
4	13940	5496	5586	6749	4499	5785	9636	13662	10913	12602	7098	8114	6444	4944	4707
5	7535	23704	10357	9003	7091	5635	5799	13065	12909	13135	11585	12916	8574	4591	11396
6	7265	6714	15960	4533	5275	5179	3609	4621	6393	5853	7178	9763	7266	3552	4010
7	4875	3476	3616	5715	2527	2945	3254	3119	2349	3572	4554	6374	8218	4603	4022
8	942	3484	4680	1367	3030	1881	2035	1586	1364	1308	1757	2456	3131	2636	2201
9	1252	1020	1849	791	898	1891	1218	1833	604	549	792	730	1275	833	2019
10	1260	827	1376	571	292	652	1033	1039	316	425	717	214	541	463	515
11	631	406	446	187	143	339	327	517	380	222	61	178	88	205	172
12	545	407	265	140	99	329	68	389	95	111	120	77	125	117	110
13	44	283	560	135	107	54	122	32	149	5	57	121	62	48	14
14	0	27	58	241	92	27	36	22	3	107	110	14	57	45	29
3+	39280	46411	45203	30677	25014	26623	29471	42834	38336	39032	34813	41713	38662	22768	30130
4+	38279	45844	44753	29432	24053	24717	27157	41885	35465	37889	34039	40957	35778	22037	29185
5+	24339	40348	39167	22683	19554	18932	17521	28223	24552	25287	26941	32843	29334	17093	24478
6+	16814	16644	28810	13680	12463	13297	11722	15158	11652	12152	15356	19927	20760	12502	13092

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	1887	1840	4110	935	218	149	298	1000	110	783	204
4	6042	7329	12139	9156	4308	2370	1644	2765	5079	2623	4287
5	9987	5397	7923	8326	5391	9777	5096	2864	4114	9106	4106
6	6365	4541	2875	3209	4203	5235	8335	4220	1979	3984	6848
7	2540	5867	1305	920	1791	2588	4387	5187	2806	1705	2067
8	1857	723	495	395	730	884	1420	1573	3101	1140	596
9	1149	1196	140	265	243	284	349	521	725	1029	535
10	538	105	53	117	189	82	104	204	297	237	353
11	249	174	17	57	76	48	54	89	102	90	126
12	80	52	21	43	26	19	42	37	34	35	33
13	32	6	4	31	19	11	19	24	15	18	9
14	17	2	3	11	10	10	25	6	10	8	8
3+	30743	27232	29085	23465	17204	21457	21773	18548	18372	20758	19170
4+	28856	25392	24975	22530	16988	21308	21475	17548	18262	19975	18966
5+	22814	18063	12836	13374	12678	18938	19831	14775	13183	17352	14679
6+	12827	12666	4913	5048	7287	9161	14735	11911	9069	8246	10573

Table 2. Results of regressions using 3+ survey abundance from French surveys versus cohort population numbers.

Year	Research Biomass Index	F=0.2 Observ.	F=0.2 Residual	F=0.25 Observ.	F=0.25 Residual	F=0.30 Observ.	F=0.30 Residual
1978	9.98	151163	11142	147309	12878	144793	14031
1979	17.77	133296	-39077	128360	-28822	125113	-22002
1980	14.06	136450	-20485	127382	-18965	121357	-7969
1981	36.22	220094	-28903	193019	-18048	175010	-10838
1982	34.09	237977	-2175	202306	-8540	178561	-2816
1983	34.48	326308	84536	268221	62236	229523	47327
1984	69.53	361009	-26328	290944	-17407	244250	-11529
1985	42.65	296992	21290	240514	10668	203145	3797
intercept		98573		105284		109810	
slope		4153.08		2921.57		2099.37	
r^2		0.798				.762	

Table 3. Mean number of cod per tow from research vessel surveys in Subdivision 3Ps (depths to 200 fath) adjusted for seasonality and missing strata.

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	0.03	0.02	0.90	0.46	0.31	0.01	-	1.10	0.21	0.04	1.01	0.45	0.01	0.02
2	0.78	0.80	2.75	0.94	4.38	0.27	0.59	0.46	6.07	0.71	3.88	0.85	0.31	0.35
3	1.38	0.94	2.71	2.64	2.86	3.41	0.88	0.66	1.79	4.06	1.98	1.86	0.48	2.19
4	2.84	1.43	1.94	2.41	5.25	2.99	3.31	6.15	0.89	6.67	9.73	1.02	0.87	5.59
5	1.90	1.59	2.62	1.48	3.27	2.29	1.45	14.75	2.35	7.28	4.49	5.54	0.66	7.21
6	1.27	0.45	2.42	1.36	1.49	1.18	1.05	2.33	2.10	9.37	2.10	2.83	2.82	3.24
7	1.69	0.89	0.67	1.22	0.91	0.37	0.76	0.78	0.53	8.78	2.82	0.99	1.13	2.96
8	1.00	0.35	0.54	0.46	0.84	0.18	0.53	0.41	0.61	1.74	2.91	1.94	0.58	0.93
9	.42	0.47	0.43	0.30	0.20	0.29	0.32	0.16	0.19	1.71	0.79	3.62	0.72	0.55
10	.25	0.11	0.22	0.18	0.15	0.11	0.29	0.14	0.17	0.40	0.21	1.68	1.13	0.54
11	.11	0.03	0.07	0.06	0.11	0.02	0.10	0.03	0.13	0.07	0.15	0.81	0.27	0.56
12	.07	0.03	0.05	0.03	0.11	0.04	0.04	0.01	0.15	0.11	0.06	0.30	0.21	0.62
13	.04	-	0.03	0.04	-	0.04	0.04	0.01	0.06	0.11	0.03	0.12	0.09	0.26
14	.10	0.01	0.03	-	-	0.01	-	0.02	-	0.06	0.03	0.11	0.04	0.15
15	.04	0.01	0.01	0.01	0.04	0.01	0.04	-	0.03	0.02	0.06	0.08	-	0.04
16	.13	0.02	0.02	-	-	-	-	-	0.03	0.02	0.03	0.07	0.05	0.04
17	.09	0.03	0.01	0.01	0.01	-	0.03	-	0.02	0.01	-	0.01	-	0.06
18	.06	0.02	0.01	-	-	0.01	-	-	-	-	-	0.03	0.04	0.03
19	.01	-	0.01	-	0.06	-	0.03	-	-	-	-	0.03	-	-
20	.01	-	-	0.01	-	0.02	-	-	-	0.01	-	0.03	-	-
20+	.01	0.01	0.01	-	-	-	0.06	-	-	-	-	0.04	0.01	0.03
Total	12.13	7.20	15.45	11.60	19.98	11.23	9.49	27.02	15.36	41.14	30.33	22.42	9.42	25.35

Table 4. Population numbers, population biomass, and fishing mortality from a cohort analysis using fully recruited fishing mortality in 1984=0.20.

POPULATION NUMBERS

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	59386	59260	50943	48671	42957	70839	80985	94415	98472	70170	54301	35498	60169
4	107064	47715	48005	41302	38722	34309	56274	64211	68254	78024	56416	43758	28371
5	35820	75043	34093	34249	27708	27633	22848	37354	40210	46007	52478	39767	28484
6	24206	22518	39992	18541	19894	16269	17524	13459	18761	21249	25783	32483	20872
7	16270	13245	12361	18302	11079	11515	8634	11082	6838	9577	12101	14614	17761
8	5812	9919	7699	6849	9913	6784	6763	4125	4441	3473	4609	5787	6198
9	4041	3906	4142	2068	4370	5292	3852	3678	1942	2402	1660	2183	2515
10	3449	2175	2275	1719	978	3766	2622	2052	1352	1043	1470	643	1127
11	3661	1683	1033	618	890	536	1674	1212	740	821	470	555	333
12	1180	2426	1011	442	337	599	132	1075	525	262	472	339	292
13	154	473	1618	588	235	186	193	47	528	344	114	278	200
14	0	86	131	818	359	96	103	48	9	298	277	33	118
3+	261043	237442	203304	174166	157342	176816	201606	222757	242074	233670	210150	175917	166441
4+	201657	178182	152360	125495	114385	105976	120621	128343	143601	153500	155849	140429	106271
5+	94592	130466	104355	84193	75664	71676	64347	74131	75347	85476	99432	96671	77900
6+	58772	55423	70262	49944	47955	44044	41499	36777	35137	39468	46954	56904	49416

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	39336	31072	41955	56372	59356	74286	41442	25113	46774	128080	74563	148105	112649
4	46653	31544	24585	32642	44488	44878	59975	33733	20426	38026	103958	60948	120550
5	17397	33723	21567	14661	20094	25440	28458	45205	25473	15236	29631	80518	47526
6	15563	10090	17307	8621	7120	9282	13295	18422	28164	16245	9883	19719	52683
7	10514	9528	4632	8411	2949	3228	4696	7092	10345	15517	9482	6300	12539
8	7105	4443	4161	1494	1577	1234	1810	2224	3457	4501	8011	5224	3616
9	2241	3432	1646	1727	569	844	653	822	1021	1545	2261	3753	3246
10	906	1081	983	308	332	339	451	315	416	520	748	1196	2141
11	433	323	419	318	157	224	172	198	183	246	241	344	764
12	195	169	109	118	103	113	131	72	119	101	121	105	206
13	127	54	39	17	49	65	54	84	42	59	49	68	55
14	108	60	32	3	8	37	25	27	59	17	27	27	40
3+	140578	125519	117435	124692	136804	159971	151163	133296	136480	220094	237977	326308	361009
4+	101242	94447	75480	68320	77448	85685	109721	108183	89705	92014	163413	178202	248361
5+	54589	62903	50896	35678	32959	40807	49746	74450	69280	53988	59455	117254	127811
6+	37192	29180	29329	21016	12866	15367	21288	29245	43806	38752	30824	36736	80284

POPULATION BIOMASS (AVERAGE)

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	14935	14962	12867	12182	10771	17718	20237	21294	24599	17652	13675	8903	14875
4	62174	27961	28111	23497	22677	19450	31857	35382	38917	44442	32849	24548	15483
5	30949	60147	27575	28539	23202	23972	19161	29159	32106	37718	45019	31656	23087
6	30539	28451	46617	24345	25746	20246	23618	16427	22945	27396	33050	40968	25377
7	29334	24533	22405	32686	21016	21430	14850	17431	11922	16302	20542	23547	27914
8	15396	19981	13752	17710	23502	16630	16258	9301	10651	7885	10421	12604	12486
9	12351	12372	11294	5968	14379	15589	11719	9530	5930	7782	4396	6549	6462
10	12504	7792	6458	6396	3734	11047	9283	6534	5410	3651	4771	2391	3686
11	18097	7952	4197	2792	4433	1741	8156	4950	2775	3801	2384	2473	1555
12	5412	13964	5463	2294	1777	2511	576	5386	2994	1245	2562	1815	1390
13	941	2144	9442	3737	1249	1132	837	198	3235	2487	524	1500	1200
14	0	589	805	5660	2554	668	687	288	64	1960	1768	204	696
3+	232632	220847	188986	165807	155040	152133	157038	155869	161548	172222	171961	157159	134210
4+	217697	205885	176119	153625	144269	134416	136801	134575	136949	154570	158286	148256	119335
5+	155523	177924	148008	130128	121592	114966	104944	99193	98032	110127	125437	123708	103852
6+	124574	117778	120433	101589	98390	90995	85783	70035	65926	72409	80418	92052	80766

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	9883	7757	10389	14055	14498	36781	16855	9302	21970	55488	30387	77636	67320
4	27489	18106	13246	17845	23516	24512	36570	19117	12747	26154	70639	45326	111462
5	14486	26578	15248	11276	15119	24130	24923	36375	23181	16324	27961	91061	57484
6	20663	11778	20712	8883	8266	12519	17263	23896	35219	22610	14184	31560	96333
7	16915	15548	6657	7799	4725	6545	9104	12889	17415	26113	16857	12473	27284
8	16204	9042	8885	3077	3764	3122	3743	5687	8546	10639	16172	13551	11235
9	6524	8032	3273	3467	1822	2627	1900	2562	4011	4792	6539	10828	12706
10	2870	3549	2995	1139	1392	1217	1586	1578	2250	2063	2747	4858	9813
11	1693	1185	1432	1151	808	1027	594	1086	1068	1307	1014	1743	3786
12	770	621	342	551	580	540	763	456	740	654	796	653	1492
13	721	337	113	95	345	372	301	674	257	343	320	531	504
14	676	359	177	14	53	303	156	208	384	118	218	240	341
3+	118895	102891	83469	71352	74888	113895	112757	113030	127729	166606	187814	290459	399760
4+	109012	95134	73079	57297	60390	77113	95902	103727	105759	111118	157427	212823	332440
5+	81523	77029	59833	39452	36874	52601	59333	84611	93012	84963	86789	167497	220978
6+	67037	50451	44585	28176	21755	28271	34409	48236	69831	68639	58826	76436	163494

FISHING MORTALITY

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.019	0.011	0.010	0.029	0.025	0.030	0.032	0.013	0.033	0.018	0.016	0.024	0.054	0.021	0.034	0.051
4	0.155	0.136	0.138	0.199	0.137	0.206	0.210	0.268	0.194	0.197	0.150	0.229	0.289	0.125	0.180	0.317
5	0.264	0.429	0.409	0.343	0.332	0.255	0.329	0.489	0.438	0.379	0.280	0.445	0.404	0.345	0.467	0.717
6	0.403	0.400	0.582	0.315	0.347	0.434	0.258	0.477	0.472	0.363	0.368	0.404	0.486	0.291	0.578	0.522
7	0.402	0.343	0.391	0.423	0.290	0.332	0.539	0.714	0.477	0.531	0.538	0.658	0.716	0.661	0.628	0.931
8	0.197	0.566	1.114	0.249	0.417	0.366	0.409	0.553	0.415	0.538	0.547	0.633	0.817	0.528	0.793	0.680
9	0.419	0.341	0.680	0.549	0.258	0.502	0.430	0.800	0.421	0.291	0.749	0.461	0.821	0.529	1.050	1.476
10	0.517	0.545	1.104	0.458	0.401	0.302	0.572	0.820	0.299	0.598	0.774	0.459	0.756	0.832	0.748	0.928
11	0.211	0.310	0.649	0.407	0.195	1.199	0.243	0.638	0.838	0.355	0.155	0.438	0.322	0.740	0.837	1.069
12	0.714	0.205	0.342	0.431	0.393	0.933	0.839	0.511	0.223	0.632	0.330	0.299	0.637	1.085	1.268	1.683
13	0.379	1.083	0.482	0.293	0.699	0.387	1.199	1.406	0.374	0.016	1.049	0.657	0.419	0.541	0.337	2.375
14	0.370	0.420	0.660	0.390	0.330	0.370	0.480	0.700	0.430	0.500	0.570	0.630	0.750	0.610	0.740	0.880

AGE	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	0.037	0.008	0.014	0.006	0.007	0.007	0.009	0.002	0.006	0.002
4	0.285	0.359	0.256	0.083	0.081	0.093	0.084	0.056	0.049	0.040
5	0.522	0.572	0.449	0.235	0.273	0.250	0.233	0.173	0.134	0.100
6	0.873	0.591	0.491	0.430	0.377	0.396	0.338	0.250	0.253	0.140
7	1.474	0.671	0.378	0.547	0.517	0.632	0.461	0.396	0.355	0.200
8	0.765	0.426	0.437	0.590	0.578	0.605	0.488	0.558	0.276	0.200
9	1.450	0.317	0.426	0.530	0.481	0.474	0.525	0.437	0.361	0.200
10	0.473	0.194	0.480	0.622	0.340	0.324	0.568	0.577	0.247	0.200
11	0.927	0.127	0.331	0.670	0.312	0.394	0.510	0.629	0.341	0.200
12	0.669	0.255	0.544	0.247	0.344	0.495	0.517	0.371	0.457	0.200
13	0.513	0.094	0.742	0.494	0.156	0.698	0.593	0.408	0.343	0.200
14	1.300	0.520	0.396	0.560	0.522	0.623	0.487	0.524	0.394	0.200

Table 5. Population numbers, population biomass, and fishing mortality from a cohort analysis using fully recruited fishing mortality in 1984=0.40.

POPULATION NUMBERS

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	59386	59260	50943	48671	42957	70839	98985	84419	98486	70186	54345	35514	60221	39399	31072
4	107064	47715	48005	41302	38722	34300	56274	64211	68258	78035	56430	43794	28392	46696	31596
5	35820	75043	34073	34249	27708	27632	22848	37354	40210	46010	52487	39778	28514	17415	33758
6	24206	22518	39992	18541	19894	16269	17524	13459	18761	21249	25785	30035	20881	15587	10104
7	16270	12245	12361	18302	11079	11515	8634	11082	6838	9577	12101	14616	17767	10521	9547
8	5812	8910	7699	6849	9813	6784	6763	4125	4441	3473	4609	5767	6199	7110	4449
9	4041	3906	4142	2068	4370	5292	3852	3678	1942	2402	1660	2183	2516	2242	3436
10	3449	2175	2275	1718	978	2766	2622	2052	1352	1043	1470	643	1127	906	1082
11	3661	1683	1033	618	890	536	1674	1212	740	821	470	555	333	433	323
12	1180	2426	1011	442	337	599	132	1075	525	262	472	329	293	195	169
13	154	473	1618	588	235	186	193	47	528	344	114	278	200	127	54
14	0	86	131	818	359	96	103	48	9	298	277	33	118	108	60
3+	261043	237442	203304	174166	157342	176816	201606	222762	242090	233700	210219	175999	166560	140739	125651
4+	201657	178182	152360	125495	114385	105976	120621	138343	143605	163514	155873	140485	106339	101340	94579
5+	94592	130466	104355	84193	75664	71676	64347	74131	75347	85479	99444	96691	77946	54645	62983
6+	58772	55423	70282	49944	47955	44044	41499	36777	35137	39468	46957	56913	49433	37230	29225

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	41773	55824	57645	70361	36572	20671	34161	79069	40822	75908	56379
4	24585	32493	44040	43477	56761	29745	16789	27699	63832	33323	61439
5	21609	14661	19972	25073	27311	42574	22209	12258	20176	47665	24909
6	17336	8655	7120	9182	12995	17482	26010	13572	7445	12796	30786
7	4644	8434	2978	3228	4614	6836	9577	13753	7293	4304	6872
8	4178	1504	1597	1257	1810	2157	3255	3871	6567	3432	1981
9	1651	1740	577	859	672	822	966	1380	1746	2571	1779
10	987	312	342	346	464	330	416	475	613	774	1174
11	420	321	160	232	177	209	196	246	205	233	419
12	109	119	105	116	139	76	127	112	121	75	110
13	39	17	56	67	56	90	45	66	58	68	30
14	32	3	8	37	27	29	64	20	33	34	40
3+	117361	124083	134595	154237	141598	121021	113815	152523	148911	181184	185917
4+	75588	68259	76950	83876	105026	100350	79654	73453	108089	105276	129538
5+	51003	35766	32909	40399	48265	70605	62865	45754	44257	71954	68098
6+	29394	21105	12938	15326	20954	28031	40656	33496	24081	24288	43189

POPULATION BIOMASS (AVERAGE)

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	14935	14962	12867	12182	10771	17719	20237	21295	24602	17656	13686	8910	14888	9899	7757
4	62174	27961	28111	23497	22677	19450	31857	35382	38919	44449	32858	24570	15496	27515	18138
5	30949	60147	27575	28539	23202	23979	19161	29159	32106	37721	45028	31667	23116	14504	26613
6	30539	28451	46617	24345	25746	20246	23618	16427	22945	27296	33054	40979	25391	20700	11800
7	29334	24533	22405	32586	21016	21430	14650	17431	11922	16302	20542	23552	27928	16932	15592
8	15396	19981	13752	17710	23502	16630	16258	9301	10651	7885	10421	12604	12490	16219	9060
9	12351	12372	11294	5968	14379	15589	11719	9530	5930	7782	4396	6549	6462	6529	8048
10	12504	7792	6458	6396	3734	11047	9283	6534	5410	3651	4771	2391	3688	2870	3554
11	18097	7952	4197	2792	4433	1741	8156	4950	2775	3801	2384	2473	1555	1693	1185
12	5412	13964	5463	2294	1777	2511	576	5386	2994	1245	2562	1815	1390	770	621
13	941	2144	9442	3737	1249	1132	837	188	3235	2487	524	1500	1298	721	337
14	0	589	805	5660	2554	668	687	288	64	1960	1768	204	696	676	359
3+	232632	220847	188986	165807	155640	152133	157038	155870	161554	172236	171993	157215	134298	119028	103065
4+	217697	205885	176119	153625	144269	134416	136801	134575	136952	154579	158307	148305	119410	109129	95308
5+	155523	177924	148008	130128	121592	114966	104944	99193	98032	110130	125449	123735	103914	81614	77170
6+	124574	117778	120433	101589	98390	90995	85783	70035	65926	72409	80421	92068	80798	67110	50557

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	10343	13916	14064	34825	14868	7652	16025	34166	16626	39683	33660
4	13246	17751	23233	23643	34530	16766	10372	18754	42624	24286	55731
5	15291	11276	14996	23890	23795	33951	19817	12741	18962	51355	28742
6	20757	8939	8266	12347	16779	21673	31930	18198	10203	18963	48166
7	6684	9859	4789	6545	7917	12307	15621	22359	12089	7725	13642
8	8934	3196	3820	3195	3743	5457	7867	8728	12271	8201	5617
9	3295	3525	1852	2687	1972	2562	3737	4123	4671	6717	6353
10	3011	1158	1442	1246	1648	1670	2250	1824	2077	2914	4907
11	1437	1167	826	1074	620	1153	1093	1307	799	1075	1893
12	342	556	594	557	811	488	808	741	796	415	746
13	113	95	349	387	317	725	289	398	388	531	252
14	177	14	53	307	168	226	428	143	278	315	311
3+	83629	71343	74284	110705	107167	104631	110237	123482	121783	162180	200021
4+	73287	57447	60220	75880	92298	96979	94212	89316	105158	122497	166361
5+	60040	39695	36987	52237	57769	80213	83841	70562	62534	98211	110630
6+	44750	28420	21991	28346	33973	46262	64024	57821	43571	46856	81888

FISHING MORTALITY

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	0.019	0.011	0.010	0.029	0.025	0.030	0.032	0.013	0.033	0.018	0.016	0.024	0.054	0.021	0.034	0.051	0.037	0.082
4	0.155	0.136	0.138	0.199	0.137	0.206	0.210	0.268	0.194	0.197	0.150	0.229	0.289	0.124	0.180	0.317	0.287	0.363
5	0.264	0.429	0.409	0.343	0.332	0.255	0.329	0.489	0.438	0.379	0.280	0.444	0.404	0.344	0.466	0.715	0.522	0.577
6	0.403	0.400	0.582	0.315	0.347	0.434	0.258	0.477	0.472	0.363	0.368	0.404	0.485	0.290	0.577	0.520	0.867	0.591
7	0.402	0.343	0.391	0.423	0.290	0.332	0.539	0.714	0.477	0.531	0.538	0.658	0.716	0.661	0.627	0.927	1.464	0.662
8	0.197	0.566	1.114	0.249	0.417	0.366	0.409	0.553	0.415	0.538	0.547	0.633	0.817	0.527	0.791	0.676	0.758	0.420
9	0.419	0.341	0.680	0.549	0.258	0.502	0.430	0.809	0.421	0.291	0.749	0.461	0.821	0.529	1.048	1.466	1.426	0.312
10	0.517	0.545	1.104	0.458	0.401	0.302	0.572	0.820	0.299	0.598	0.774	0.459	0.756	0.832	0.746	0.923	0.465	0.188
11	0.211	0.310	0.649	0.407	0.195	1.199	0.243	0.638	0.838	0.355	0.155	0.438	0.332	0.740	0.889	1.065	0.914	0.125
12	0.714	0.205	0.342	0.431	0.393	0.933	0.839	0.511	0.223	0.632	0.330	0.299	0.637	1.085	1.268	1.683	0.663	0.249
13	0.379	1.083	0.482	0.293	0.699	0.387	1.199	1.406	0.374	0.016	1.049	0.657	0.419	0.541	0.337	2.375	0.513	0.093
14	0.370	0.420	0.660	0.390	0.330	0.370	0.480	0.700	0.430	0.500	0.570	0.630	0.750	0.610	0.740	0.880	1.300	0.520

AGE	1977	1978	1979	1980	1981	1982	1983	1984
3	0.015	0.007	0.008	0.010	0.014	0.003	0.011	0.004
4	0.265	0.088	0.092	0.115	0.117	0.092	0.091	0.080
5	0.457	0.246	0.293	0.292	0.299	0.255	0.237	0.200
6	0.488	0.442	0.402	0.437	0.421	0.348	0.422	0.280
7	0.378	0.560	0.542	0.706	0.539	0.554	0.576	0.400
8	0.427	0.590	0.603	0.658	0.596	0.738	0.457	0.400
9	0.417	0.510	0.481	0.509	0.611	0.614	0.584	0.400
10	0.468	0.599	0.321	0.324	0.643	0.766	0.413	0.400
11	0.316	0.642	0.293	0.363	0.510	0.801	0.555	0.400
12	0.527	0.232	0.321	0.453	0.456	0.371	0.722	0.400
13	0.713	0.469	0.145	0.622	0.511	0.337	0.343	0.400
14	0.390	0.520	0.480	0.560	0.400	0.410	0.300	0.400

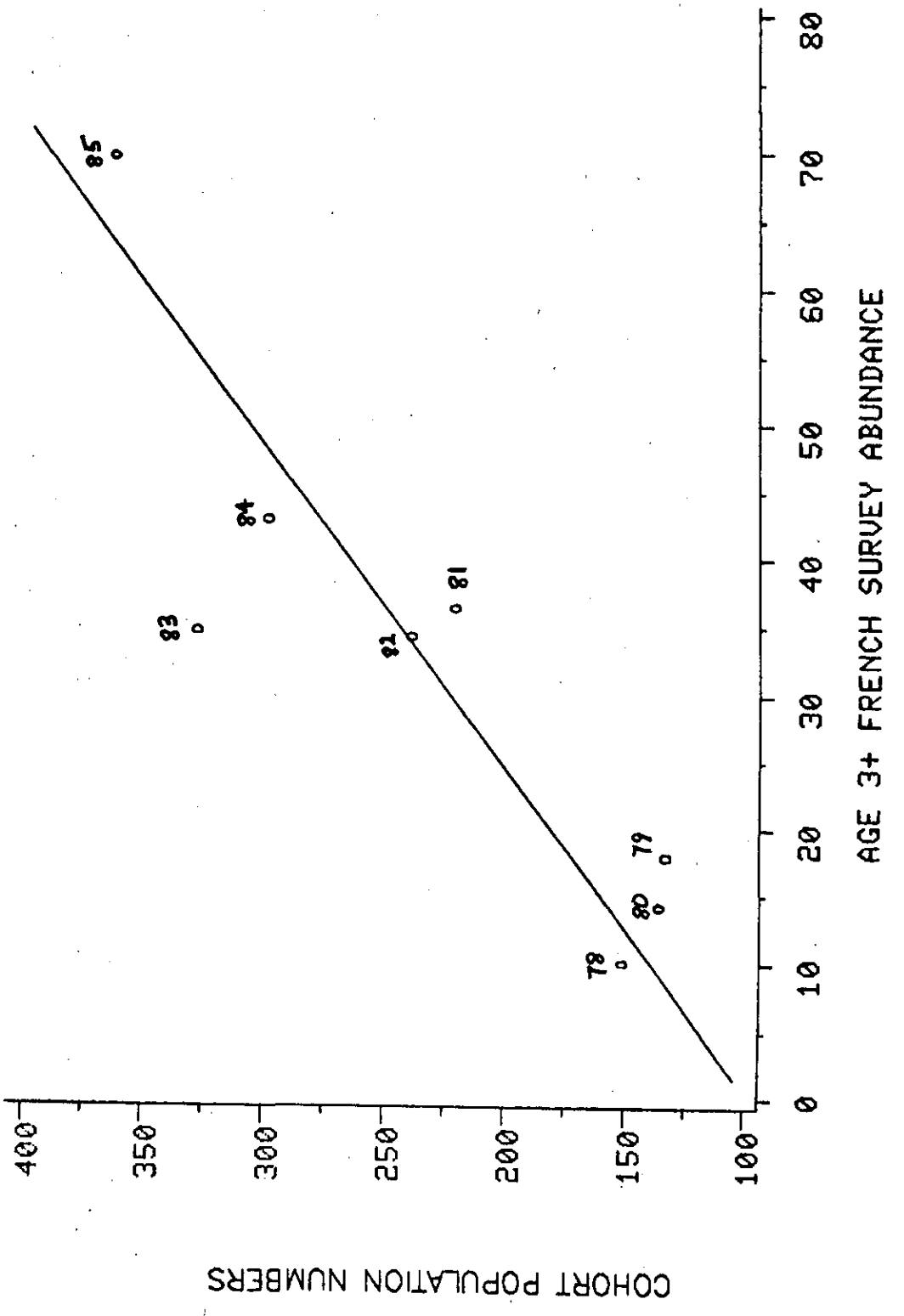

Fig. 1. Results of regression of 3+ survey abundance from French surveys versus cohort population numbers using fully recruited F = 0.20 in 1984.