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An Assessment of the Cod Stock in NAFO Subdivision 3Ps*

by

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Nominal catch at age

Cod catches from Subdivision 3Ps since 1977 along with corresponding TAC's are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC ('000 t)	32.5	25	25	28	30	33	33	33	41	41
Catch ('000 t)	32	27	33	38	39	34	38	37[a]	44[a]	

[a]Preliminary.

Annual landings by country since 1959 are listed in Table 1 while those for 1985 by month and major gear categories are shown in Table 2. Canadian landings for 1985 were obtained from the Statistics and Systems Branch of the Department of Fisheries and Oceans, Canada. Landings in 1985 by EEC were available from NAFO circular letters and only from the first quarter. These were higher than from the same period in 1984 and as such total landings for 1985 were estimated at 12,000 t, slightly higher than that for 1984.

Inshore catches (Fig. 1) in 1985 still make up the largest proportion of the total catch but as a result of increased allocations, Canadian otter trawlers obtained substantially higher landings over those for 1984. Catches by the major inshore gears in the Canadian fishery over the period 1964-85 are shown in Fig. 2. The line trawl component continues to be dominant although .

Sampling data (Table 3) used to obtain catch at age for the commercial catch in 1985 was obtained by the Commercial Sampling Research Unit of the Department of Fisheries and Oceans. Estimated 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 1985 along with estimated total catch at age, with associated variances, are shown in Table 4. Average weights 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 equal to that reported. The 1980 year-class was the most abundant in the total catch and more than 94% of the total numbers caught were from ages 4-7.

Survey data

Estimates of biomass and abundance from stratified-random research surveys are shown in Tables 5 and 6 respectively. Estimates of abundance for nonsampled strata were once again obtained after inclusion of the 1986 survey data (Table 6). The method used was described in a previous assessment (NAFO SCR Doc. 84/VI/53) and basically involves the analysis of variance of ln catch per tow data, an approach similar to that using the multiplicative model for catch rates.

Estimates of biomass showed a slight increase in 1986 over that for 1985 with the increase being seen in strata in depth ranges from 151 to 300 fath. For the same period total

* Further assessment of this stock is given in the Appendix

abundance declined slightly (Table 6). Estimates of mean number per tow at age (Tables 7 and 8) after adjustment for missing strata, indicated a higher proportion of older fish in 1986 than 85. As in 1985 the 1980 and 81 year-classes were most abundant with an indication of a moderately strong 1982 year-class. Subsequent year-classes, especially that for 1983, appear to be weak. Table 9 shows a comparison of French and Canadian survey data for ages 2 and 3 with a combined index for numbers per tow at age 3.

Catch-effort data

Catch rate data for Canada, France (STPM), Spain, and Portugal were analyzed using a multiplicative model (Gavaris, 1980). Data for 1959-82 were obtained from ICNAF/NAFO Statistical Bulletins while that for 1983-85 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 values 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.

A strong seasonal trend was apparent once again (Table 10) with catch rates being highest in the winter months. The annual catch rate indices (Table 11, Fig. 3) show a substantial increase since 1983. The data from this period was obtained only from Canadian otter trawlers. The confidence limits associated with the catch rates were wide when compared with other years in the series. The catches from this gear category have been under quota restrictions in recent years although there was a substantial increase in 1985. The reliability of catch rates from a fishery which tends to fish its allocation at a time of year when catch rates have traditionally been highest, might be questionable. Data from the French otter trawl fishery have not been available since 1982.

During the 1985 assessment it was suggested that an attempt be made to obtain effort data from the Canadian inshore fishery. The only data that could be obtained to date was that from 'purchase slips' for 1984 and 1985 which are essentially records of a day's fishing by gears such as line trawl, gillnet, and handline or an individual haul of a codtrap. These slips are provided to fishermen by fish buyers as well as to the Department of Fisheries and Oceans. Although little can be concluded from two data points (Table 12), they would indicate an increase in catch per unit effort for trap, a decrease for linetrawl, with handline and gillnet showing little change. For all inshore gears there was essentially no change in catch per slip from 1984 to 1985.

Partial recruitment

For preliminary analysis partial recruitment values obtained in the 1985 assessment were used in a cohort analysis. No adjustments with respect to survey and cohort numbers at age 3 were attempted at this stage until all data were available and tuning procedures determined.

These partial recruitment values were as follows:

Age	3	4	5	6	7	. . . . .	14
PR	0.01	0.20	0.50	0.70	1.00	. . . . .	1.00

Cohort analysis

Catch and weight-at-age data from the 1985 commercial fishery (Table 4) were combined with previously used matrices (Table 13) and these were used for a preliminary cohort analysis. Table 14 also shows the results of a sum of products analysis. Partial recruitments were those used in the 1985 assessment and the fishing mortality on the oldest age group (14) was similarly estimated as the fully recruited mortality for ages 7-11.

No tuning was attempted at this stage until all data were available and parameters accepted. The results of a cohort at $F_t = 0.25$ are presented for illustration (Tables 15-17).

Table 1. Cod catches (MT) from Subdivision 3Ps, 1959-85.

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	5,618	4,238				38,303
1984	891	22,863	1,969	11,221					36,944
1985	4,143	23,370	4,516	18,508					50,537

Table 2. Cod landings (t) in 1985 from NAFO Subdivision 3Ps by month and gear.

Month	Can (N) OT	Can (N) LL	Can (N) GN	Can (N) Trap	Can (N) HL	Can(M) OT	EEC	Total
J		735	94		2	389	1505	1505
F	1023	860	48		2	189	1904	1904
M	1092	1361	64		1	97	2565	2565
A	1155	728	146		6	215	1253	
M	10	420	540	163	56	65	2785	
J	21	617	1312	2015	225	55	863	
J	14	515	3349	2891	232	203	344	
A	2	1328	812	112	509	407	52	
S	2	1531	264		469	470	277	
O	1	692	162		96	247	1975	
N	35	405	92	7	19	374	4555	
D	788	366	123		1	1808	430	
	4143	9558	7006	5188	1618	4516	18508	55037

Table 3. Commercial sampling for NAFO Subdivision 3Ps cod in 1985.

Qtr.	Gear	Country	No. aged	Month	No. meas.	Landings (t) country/mo.	Total
1-2	OT	Can(N)	418	Feb.	1417	1023	1601
	"	"		Mar.	1758	1092	1189
	"	France	28				
	"	Can(N)		Apr.	577	1155	1521
			446		3752		4311
3-4	OT	Can(N)	230	Dec.	1151	788	4348
1	LL	Can(N)	500	Jan.	4181	735	735
	"	"		Feb.	3179	860	860
	HL	"					4
			500		7360		1599
2	Trap	Can(N)	815	May	2499	163	163
	GN	"		May	3595	540	892
	LL	"		May	420	420	2509
	HL	"					63
			815		9624		3627
3	Trap	Can(N)	479	June	7509	2015	2015
	"	"		July	1946	2891	2891
	"	"		Aug.	949	112	112
	GN	"		June	2302	1312	1312
	"	"		July	2748	3349	3349
	"	"		Aug.	679	812	1453
	HL	"		July	817	232	457
	"	"		Aug.	182	509	509
	LL	"		Aug.	1728	1328	2460
			479		18860		14588
4	HL	Can(N)	759	Sept.	1509	469	585
	LL	"		"	5708	1531	1531
	"	"		Oct.	245	692	692
	"	"		Nov.	858	405	771
	Trap	"					7
			759		8320		3586
Total			3229		49067		32029
Total (Including 12,000 t estimated for France)							44029

Table 4. Cod catch at age by gear along with average weights and lengths from the Canadian fishery in NAFO Subdivision 3Ps during 1985.

Age	OT	LL	GN	Trap	HL	Total Can.
3		79		21	2	102
4	148	696	16	1026	186	2072
5	749	1963	400	2548	563	6223
6	627	1142	792	920	264	3745
7	791	1186	1149	230	114	3470
8	206	347	280	121	47	1001
9	137	89	63	4	4	297
10	110	72	74	4	6	266
11	58	44	97	3	9	211
12	13	18	40	1	5	77
13	1	7	8	-	1	17
14	-	2	3	-	1	6
15	1	2	1	-	-	4
16	1	-	-	-	-	1
#	2842	5647	2923	4878	1202	17492
Wt.	8659	9558	7006	5188	1618	32029

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
3	0.611	40.992	103	17.13	0.17
4	0.804	44.830	2072	165.31	0.08
5	1.149	50.223	6223	228.21	0.04
6	1.681	56.914	3746	190.89	0.05
7	2.582	65.413	3471	120.10	0.03
8	2.969	67.525	1001	90.53	0.09
9	4.654	78.960	296	29.33	0.10
10	5.452	82.547	266	25.72	0.10
11	5.830	84.912	211	19.07	0.09
12	6.697	88.179	78	11.80	0.15
13	9.324	98.788	17	2.84	0.16
14	10.212	101.757	5	1.74	0.33
15	16.145	117.168	3	0.87	0.25
16	11.277	105.555	1	1.06	0.73
17	14.211	115.000		0.17	1.15
18	19.845	127.940	1	0.32	0.58
19	16.628	121.000		0.27	0.99

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	1986
0-30	314	974	0	-	1328	-	2357	249	0	-	432	369	2028	13103	567	25	0
	320	1320	-	729	-	-	1335	-	-	-	2946	23087	1920	5618	5456	5259	284
TOTAL			0	729	1328	-	3692	249	0	-	3378	23456	3948	18721	6023	5284	284
31-50	308	112	-	181	279	205	193	311	38	125	240	305	490	766	681	1024	0
	312	272	210	-	243	355	456	1047	343	151	-	165	766	524	674	1016	61
	315	827	1480	0	592		1747	1550	-	1836	235	0	528	2451	1894	329	2762
	321	1189	1917	0	-	-	1742	-	2037	-	1880	1419	2845	2419	1183	89	335
	325	944	-	-	-	-	2	-	180	820	28	1109	85	294	449	0	35
	326	166	-	-	-	-	-	-	0	2	3	0	54	326	0	-	0
TOTAL			3607	181	1114	540	4140	2908	2598	2934	2386	2998	4768	6780	4881	2458	3193
51-100	307	395	2918	6133	3919	884	1127	2097	3222	4105	1763	13723	3028	892	771	5189	12339
	311	317	3885	590	2432	763	627	411	154	1106	3792	761	1943	3256	863	4870	399
	317	193	101	286	589	164	551	491	-	368	536	268	1582	3685	30	14064	2180
	319	984	4604	662	478	481	3102	2493	-	10637	1652	15068	3548	3799	3995	1282	10189
	322	1567	-	-	-	-	5183	-	491	14	2599	26	3705	4932	2597	1073	2004
	323	696	736	-	-	-	368	63	1652	-	775	491	1215	858	2247	1263	2881
	324	494	-	-	-	-	8	-	-	29	0	-	430	618	136	10756	230
TOTAL			12244	7671	7418	2292	10966	5555	5519	16259	11117	30337	15451	18040	10639	38497	30222
101-151	306	419	-	-	376	719	214	161	416	710	457	2652	1211	1250	236	590	755
	309	296	662	975	479	311	178	192	103	1558	863	2983	838	926	156	1611	3216
	310	170	1008	191	377	2183	-	0	154	119	0	817	608	134	134	268	332
	313	165	371	29	144	242	142	41	50	1036	127	446	283	74	130	250	0
	316	189	271	937	63	58	77	17	-	65	61	25	-	207	170	85	71
	318	123	173	11	4	0	0	6	-	36	790	-	136	11	0	-	81
TOTAL			2485	2143	1443	3513	611	417	723	3524	2298	6923	3076	2602	826	2804	4455
151-200	705	195	-	-	66	0	0	60	1	91	674	1310	22	27	0	542	611
	706	476	-	-	23	-	-	76	-	356	827	304	30	32	0	2068	447
	707	93	-	-	5	0	0	228	-	326	190	-	-	7	0	-	3124
	715	132	-	-	-	1	1	31	142	352	499	168	154	338	54	-	1523
	716	539	-	-	-	-	-	92	781	303	248	1608	168	147	15	344	3464
TOTAL					94	1	1	487	924	1428	2438	3390	374	551	69	2954	9169
201-300	708	117	-	-	-	0	-	11	-	177	4633	-	-	0	0	-	527
	711	961	-	-	-	-	-	-	-	-	1113	0	0	7	87	109	6949
	712	973	-	-	-	-	-	-	-	9077	282	259	353	0	-	993	300
	713	950	-	-	-	0	-	-	-	-	0	850	0	36	-	87	271
	714	1195	-	-	-	-	-	-	-	-	0	161	0	163	-	-	1857
TOTAL			-	-	-	0	-	11	-	9254	6028	1270	353	206	87	1189	9704

	Total Area per Depth Range											
0-30	2294	-	3378	23456	3948	18721	6023	5284	284
31-50	3510	2934	2386	2998	4768	6780	4881	2458	3193
51-100	4646	16259	11117	30337	15451	18040	10639	38497	30222
101-150	1362	3524	2298	6923	3076	2602	826	2804	4455
151-200	1435	1428	2438	3390	374	551	69	2954	9169
201-300	4196	9254	6028	1270	353	206	87	1189	9704
TOTAL		33399	27645	68374	27970	46900	22520	53184	57028
Confidence Interval									
Upper		126620	51812	182436	35732	75157	30681	109276	85724
Lower		-59817	3481	-45684	20204	18640	14359	-2908	28332

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	1986
0-30	314	974	0	(166)	1,170	(317)	1,060	73	0	(529)	279	307	2,237	1,859	91	21	1
	320	1,320	(1,030)	545	(822)	(638)	867	(619)	(745)	(1,065)	528	10,354	1,362	1,589	1,870	476	99
31-50	308	112	(138)	29	122	65	34	166	21	74	59	46	235	238	395	563	0
	312	272	337	(107)	225	221	257	597	378	157	(377)	92	296	347	153	1,644	31
	315	827	186	0	62	(468)	745	1,273	(547)	621	171	0	145	489	410	177	787
	321	1,189	223	0	(255)	(198)	312	(192)	179	(330)	196	402	1,227	785	342	76	27
	325	944	(159)	(52)	(126)	(98)	35	(95)	567	850	35	213	76	111	63	0	27
	326	166	(42)	(14)	(55)	(26)	(35)	(25)	0	12	6	0	69	63	0	(38)	0
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	5,802
	311	317	2,261	820	2,847	433	670	119	309	1,124	3,105	690	1,888	1,348	381	3,692	127
	317	193	275	354	742	127	974	196	(575)	309	1,391	623	913	2,062	14	1,427	420
	319	984	1,717	842	1,182	638	4,136	2,958	(1,341)	15,068	2,733	13,000	3,176	2,058	1,637	111	3,241
	322	1,567	(729)	(237)	(581)	(451)	2,235	(438)	706	118	2,641	471	2,632	1,882	509	860	1,382
	323	696	418	(81)	(198)	(154)	78	111	1,097	(257)	261	78	392	383	901	871	2,069
	324	494	(338)	(110)	(270)	(209)	37	(203)	(244)	93	0	(838)	352	593	321	10,476	178
101-150	306	419	(397)	(129)	145	309	110	65	115	440	204	2,810	692	763	47	267	577
	309	296	678	141	86	152	89	63	67	870	289	1,811	700	496	56	933	1,700
	310	170	264	51	70	2,038	(182)	0	183	121	0	651	434	72	57	102	179
	313	165	121	56	89	215	54	26	17	1,018	81	266	217	37	12	111	0
	316	189	60	528	76	43	103	14	(47)	85	35	21	(122)	128	78	38	14
	318	123	32	9	5	0	0	5	(40)	503	379	(137)	92	3	0	(50)	14
151-200	705	195	(427)	(139)	55	0	0	48	7	66	432	988	15	5	0	285	366
	706	476	(190)	(62)	5	(118)	(158)	46	(137)	202	518	250	9	7	0	697	241
	707	93	(45)	(15)	3	0	0	171	(32)	91	122	(111)	(85)	2	0	(41)	565
	715	132	(122)	(40)	(97)	10	30	20	149	221	248	84	45	106	25	(110)	817
	716	539	(194)	(63)	(155)	(120)	(162)	20	587	334	223	1,123	81	91	13	170	3,004
Total		13,247	12,005	7,217	12,031	7,471	13,120	8,631	9,276	26,649	15,261	40,872	19,872	16,101	7,366	25,244	21,667
Estimated mean no. per tow			12.07	7.25	12.09	7.51	13.19	8.68	9.33	26.80	15.34	41.10	19.98	16.19	7.41	25.39	21.79

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	1986
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	.01
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	.34
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	.71
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	3.04
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	5.44
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	5.52
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	2.22
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	1.84
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	1.08
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	.38
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	.32
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	.37
13	0.05		0.04	0.05		0.05	0.03	0.02	0.06	0.11	0.02	0.09	0.07	.27	.20
14	0.09	0.02	0.04			0.01		0.03		0.06	0.02	0.08	0.03	.15	.13
15	0.05	0.01	0.01	0.02	0.03	0.01	0.03		0.03	0.02	0.04	0.06		.04	.09
16	0.15	0.03	0.02	0.0					0.03	0.02	0.02	0.05	0.04	.04	.05
17	0.11	0.05	0.01	0.02	0.01		0.02		0.02	0.01		0.01	0.0	.06	.03
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			.01
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	21.79
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	35.87
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	7.71
Sets	44	55	81	56	69	98	44	76	71	53	79	132	84	87	112
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	March 6-23

Table 8. Mean no of cod per tow from research vessel surveys in NAFO Subdivision 3Ps (depth to 200 fath) after adjustment for non-sample strata.

Ratio/ Age	1972 12.07/ 16.09	1973 7.25/ 12.60	1974 14.39/ 18.62	1975 12.31/ 16.50	1976 19.69/ 14.34	1977 10.33/ 12.57	1978 9.33/ 7.53	1979 26.80/ 36.21	1980 15.34/ 15.40	1981 41.10/ 42.58	1982 32.75/ 20.35	1983 21.30/ 16.30	1984 8.82/ 7.67	1985 25.39/ 26.16	1986 21.79/ 21.79
1	0.03	0.02	0.83	0.50	0.30	0.01	-	1.09	0.21	0.04	1.09	0.43	0.01	0.02	0.01
2	0.78	0.81	2.56	0.99	4.31	0.24	0.58	0.45	6.07	0.70	4.19	0.81	0.29	0.35	0.34
3	1.37	0.95	2.52	2.80	2.81	3.14	0.87	0.66	1.78	4.05	2.14	1.76	0.45	2.19	0.71
4	2.83	1.44	1.81	2.54	5.17	2.75	3.26	6.23	0.88	6.66	10.51	0.96	0.81	5.60	3.04
5	1.89	1.60	2.44	1.57	3.22	2.11	1.42	14.63	2.35	7.27	4.85	5.26	0.62	7.22	5.44
6	1.27	0.45	2.26	1.45	1.47	1.09	1.03	2.31	2.10	9.36	2.27	2.69	2.64	3.24	5.52
7	1.68	0.90	0.62	1.29	0.89	0.34	0.74	0.77	0.53	8.77	3.04	0.94	1.06	2.96	2.22
8	0.99	0.35	0.51	0.49	0.82	0.16	0.52	0.41	0.61	1.74	3.14	1.84	0.54	0.93	1.84
9	0.42	0.47	0.40	0.32	0.19	0.26	0.31	0.16	0.19	1.71	0.85	3.44	0.68	0.56	1.08
10	0.25	0.11	0.20	0.19	0.15	0.10	0.28	0.14	0.17	0.39	0.23	1.60	1.06	0.55	0.38
11	0.11	0.03	0.06	0.06	0.11	0.02	0.10	0.03	0.13	0.06	0.17	0.77	0.25	0.56	0.32
12	0.06	0.03	0.05	0.03	0.11	0.05	0.04	0.01	0.15	0.11	0.06	0.29	0.20	0.62	0.37
13	0.04	-	0.03	0.04	-	0.05	0.04	0.01	0.06	0.11	0.04	0.12	0.08	0.26	0.20
14	0.06	0.01	0.03	-	-	0.01	-	0.02	-	0.06	0.04	0.10	0.04	0.15	0.13
15	0.04	0.01	0.01	0.02	0.05	0.01	0.04	-	0.03	0.02	0.06	0.08	-	0.04	0.09
16	0.11	0.02	0.03	-	-	-	-	-	0.03	0.02	0.04	0.07	0.05	0.04	0.05
17	0.08	0.03	0.01	0.02	0.02	-	0.02	-	0.02	0.01	-	0.02	-	0.06	0.03
18	0.05	0.03	0.01	-	-	0.01	-	-	-	-	-	0.03	0.04	0.03	-
19	0.01	-	0.01	-	0.05	-	0.02	-	-	-	-	0.03	-	-	-
20	0.01	-	-	0.01	-	0.02	-	-	-	-	-	0.03	-	-	0.01
20+	0.01	0.01	0.01	-	-	-	0.06	-	-	0.01	-	0.04	0.01	0.03	-
NK	-	0.01	-	-	-	-	-	-	-	-	0.05	-	-	-	-
Total:	12.07	7.25	14.39	12.31	19.69	10.33	9.33	26.80	15.34	41.10	32.75	21.30	8.82	25.39	21.79

Table 9. 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 (including estimated strata)	Adj. factor for seasonality	Adjusted total	Adjusted nos. Age 2	Adjusted nos. Age 3
1972	1.04	1.83	12.07	.91	13.26	.86	1.51
1973	1.40	1.64	7.25	.91	7.97	.89	1.04
1974	3.31	3.27	12.09	.76	15.91	2.83	2.79
1975	1.33	3.75	7.51	.56	13.41	1.08	3.05
1976	3.14	2.05	13.19	.61	21.62	4.73	3.09
1977	.30	3.82	8.68	.76	11.42	.27	3.47
1978	.47	.70	9.33	1.00	9.33	.58	.87
1979	.61	.89	26.80	1.00	26.80	.45	.66
1980	6.09	1.79	15.34	.91	16.86	6.67	1.96
1981	.73	4.20	41.10	.91	45.16	.77	4.45
1982	2.60	1.33	19.98	.56	35.68	4.56	2.33
1983	.62	1.35	16.19	.66	24.53	.93	2.03
1984	.25	.39	7.41	.76	9.75	.32	.50
1985	.36	2.26	25.39	.91	27.90	.38	2.41
1986	.34	.71	21.79	.91	23.95	.31	.65

Year	French survey Age 2	French survey 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
1985	5.79	18.53

Year	Age 3 survey no's. Canada	France	Average
1972	1.51		1.38
1973	1.04		.94
1974	2.79		2.71
1975	3.05		2.64
1976	3.09		2.86
1977	3.47		3.41
1978	.87	1.49	1.18
1979	.66	.42	.54
1980	1.96	1.91	1.85
1981	4.45	5.64	4.85
1982	2.33	1.91	1.94
1983	2.03	5.64	3.75
1984	.50	8.24	4.36
1985	2.41	18.53	
1986	.65		

Table 10. 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
CanN	OT 4	-0.359	June	
			July	-0.587
CanN	OT 5	-0.250	Aug.	
CanM	OT 4	0.000	May	
			Oct.	-0.493
Spain	OT 5	0.150	Nov.	
CanM	OT 5	0.366	Nov.	-0.387
Fra (STPM)	OT 5		Apr.	-0.272
Port.	OT 6	0.520	Dec.	
Spain	PT 4			
	PT 6		Feb.	-0.099
			Mar.	
Spain	PT 5	0.885		
			Jan.	0.000

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.688
MULTIPLE R SQUARED.....0.473

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.006E1	2.006E1	
REGRESSION	37	1.696E2	4.583E0	17.476
TYPE 1	6	9.814E1	1.636E1	62.372
TYPE 2	5	2.493E1	4.987E0	19.015
TYPE 3	26	7.261E1	2.793E0	10.649
RESIDUALS	719	1.886E2	2.622E-1	
TOTAL	757	3.782E2		

Table 11. Mean catch rate indices for cod in Subdivision 3Ps for the years 1959-85.

YEAR	TOTAL CATCH	CATCH RATE MEAN	S.E.	EFFORT
1959	60170	0.825	0.107	72945
1960	72636	0.704	0.091	103205
1961	83620	1.044	0.125	80077
1962	52639	0.835	0.105	63030
1963	50051	1.012	0.130	49457
1964	53956	0.929	0.119	58107
1965	51400	0.970	0.123	53014
1966	65749	1.091	0.128	60259
1967	62393	0.906	0.114	68865
1968	77217	1.113	0.125	69403
1969	63103	1.102	0.130	57245
1970	76161	0.930	0.108	81909
1971	63967	0.905	0.101	70684
1972	44323	0.727	0.080	60968
1973	52641	0.644	0.069	81720
1974	46712	0.498	0.056	93773
1975	35373	0.516	0.069	68542
1976	37133	0.515	0.064	72100
1977	32245	0.515	0.068	62628
1978	27221	0.896	0.130	30367
1979	33006	0.727	0.095	45396
1980	37568	0.532	0.078	70591
1981	38905	0.831	0.110	46790
1982	33902	0.934	0.012	36290
1983	38297	1.376	0.197	27823
1984	36944	2.244	0.477	16464
1985	44029	2.537	0.385	17352

AVERAGE C.V. FOR THE MEAN:0.125

Table 12. Estimates of catch (t), effort (purchase slips) and catch per slip for the Canadian inshore fishery in NAFO Subdivision 3Ps in 1984 and 1985.

	Inshore gears				
	Trap	GN	HL	LT	Total
		1984			
No. of purchase slips	1494	11055	3489	14271	30309
Catch by gear	3241	7133	2822	9513	22709
Catch per slip	2.17	0.65	0.83	0.67	0.75
		1985			
No. of purchase slips	1664	11134	1658	16138	30594
Catch by gear	5188	7009	1499	9541	23237
Catch per slip	3.12	0.63	0.90	0.59	0.76

Table 13. 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	1985
3	1840	4110	935	218	149	298	1000	110	783	209	191
4	7329	12139	9156	4308	2370	1644	2765	5079	2623	4373	3001
5	5397	7923	8326	5391	9777	5096	2864	4114	9106	4172	8536
6	4541	2875	3209	4203	5235	8335	4220	1979	3984	6931	5062
7	5867	1305	920	1791	2558	4387	5187	2806	1705	2107	4740
8	723	495	395	730	884	1420	1573	3101	1140	607	1356
9	1196	140	265	243	284	349	571	725	1029	547	408
10	105	53	117	189	82	104	204	297	237	360	365
11	174	17	57	76	48	54	89	102	90	128	286
12	52	21	43	26	19	42	37	34	35	33	105
13	6	4	31	19	11	19	24	15	18	8	24
14	2	3	11	10	10	25	6	10	8	8	7
3+	27232	29085	23465	17204	21457	21773	18540	18372	20758	19483	24081
4+	25392	24975	22530	16986	21308	21475	17540	18262	19975	19274	23890
5+	18063	12836	13374	12678	18938	19831	14775	13183	17352	14901	20889
6+	12666	4913	5048	7287	9161	14735	11911	9069	8246	10729	12353

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	1985
3	0.45	0.41	0.52	0.48	0.45	0.58	0.66	0.63
4	0.70	0.65	0.72	0.79	0.77	0.84	1.04	0.81
5	1.08	1.01	1.13	1.32	1.17	1.33	1.40	1.16
6	1.75	1.65	1.66	1.80	1.73	1.99	1.97	1.69
7	2.45	2.55	2.48	2.30	2.36	2.58	2.64	2.58
8	2.99	3.68	3.60	3.27	2.88	3.26	3.77	3.00
9	4.10	4.30	5.40	4.36	3.91	3.77	4.75	4.66
10	5.16	6.49	6.95	5.68	5.28	5.04	5.56	5.47
11	5.17	7.00	7.29	7.41	6.18	6.56	6.01	5.84
12	7.20	8.20	8.64	9.04	8.62	8.45	9.04	6.65
13	7.75	9.53	9.33	8.39	8.64	10.06	11.20	9.39
14	8.72	10.84	9.58	9.56	11.41	11.82	10.40	10.03

Table 14. Summary of products analysis for cod in Subdivision 3Ps

Year	Reported Catch	Sum of products	% Difference
1959	60,170	64,463	+7.1
1960	72,636	76,563	+5.4
1961	83,622	89,835	+7.4
1962	52,639	51,994	-1.2
1963	50,051	44,109	-11.9
1964	53,956	48,512	-10.1
1965	51,400	48,030	-6.6
1966	65,749	68,036	+3.5
1967	62,393	51,285	-17.8
1968	77,217	53,352	-30.9
1969	63,103	55,899	-11.4
1970	76,161	66,138	-13.2
1971	63,967	66,879	+4.6
1972	44,325	42,672	-3.7
1973	52,641	52,344	-0.6
1974	46,706	48,152	+3.1
1975	35,373	42,348	+19.7
1976	37,133	28,787	-22.5
1977	32,245	30,049	-6.8
1978	27,221	25,648	-5.8
1979	33,006	32,425	-1.8
1980	37,568	40,706	+8.4
1981	38,905	36,016	-7.4
1982	33,902	33,419	-1.4
1983	38,297	37,048	-3.3
1984	36,944	37,872	+2.5
1985	44,029	43,867	-0.4

Table 15. Population numbers (X 10^{-3}) of Subdivision 3Ps cod from a cohort analysis at F_t=0.25.

POPULATION NUMBERS

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967
3	59386	59260	50943	48671	42957	70839	80985	84419	98486
4	107064	47715	48005	41302	38722	34300	56274	64211	68258
5	35820	75043	34093	34249	27708	27632	22848	37354	40210
6	24206	22518	39992	18541	19894	16269	17524	13459	18761
7	16270	13245	12361	18302	11079	11515	8634	11082	6838
8	5812	8910	7699	6849	9813	6784	6763	4125	4441
9	4041	3906	4142	2068	4370	5292	3852	3678	1942
10	3449	2175	2275	1718	978	2766	2622	2052	1352
11	3661	1683	1033	618	890	536	1674	1212	740
12	1180	2426	1011	442	337	599	132	1075	525
13	154	473	1618	588	235	186	193	47	528
14	0	86	131	818	359	96	103	48	9
3+	261043	237442	203304	174166	157342	176816	201606	222762	242090
4+	201657	178182	152360	125495	114385	105976	120621	138343	143605
5+	94592	130466	104355	84193	75664	71676	64347	74131	75347
6+	58772	55423	70262	49944	47955	44044	41499	36777	35137

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	70186	54345	35514	60221	39399	31019	41931	56262	59426
4	78035	56430	43794	28392	46696	31596	24541	32623	44399
5	46010	52487	39778	28514	17415	33758	21609	14626	20078
6	21249	25785	32490	20881	15587	10104	17336	8655	7091
7	9577	12101	14616	17767	10521	9547	4644	8434	2978
8	3473	4609	5787	6199	7110	4449	4178	1504	1597
9	2402	1660	2183	2516	2242	3436	1651	1740	577
10	1043	1470	643	1127	906	1082	987	312	342
11	821	470	555	333	433	323	420	321	160
12	262	472	329	293	195	169	109	119	105
13	344	114	278	200	127	54	39	17	50
14	298	277	33	118	108	60	32	3	8
3+	233700	210219	175999	166560	140739	125598	117475	124615	136811
4+	163514	155873	140485	106339	101340	94579	75545	68353	77385
5+	85479	99444	96691	77946	54645	62983	51003	35730	32986
6+	39468	46957	56913	49433	37230	29225	29394	21105	12909

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	74252	40026	23837	42359	89332	73745	126092	83085	84396
4	44935	59947	32573	19381	34411	72234	60278	102527	67835
5	25367	26505	45182	24524	14380	25671	54544	46978	79985
6	9269	13235	18460	28145	15468	9182	17296	36418	34687
7	3204	4685	7033	10377	15502	8845	5727	10556	23545
8	1257	1791	2215	3416	4526	7998	4703	3146	6736
9	859	672	806	1014	1512	2283	3743	2819	2027
10	346	464	330	403	514	721	1213	2133	1813
11	232	177	209	196	236	237	322	779	1421
12	116	139	76	127	112	112	101	182	522
13	67	56	90	45	66	58	61	51	119
14	37	27	29	64	20	33	34	34	35
3+	159943	149723	130840	130052	176079	201120	274113	288707	303120
4+	85690	109697	107003	87693	86747	127375	148022	205622	218723
5+	40755	49751	74430	68312	52336	55141	87744	103095	150889
6+	15389	21246	29248	43788	37956	29469	33199	56117	70904

Table 16. Mid-year (average) population biomass (t X 10^{-3}) of subdivision 3Ps cod from a cohort analysis at F_t=0.25.

POPULATION BIOMASS (AVERAGE)

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967
3	14935	14962	12867	12182	10771	17718	20237	21295	24602
4	62174	27961	28111	23497	22677	19450	31857	35382	38919
5	30949	60147	27575	28539	23202	23972	19161	29159	32106
6	30539	28451	46617	24345	25746	20246	23618	16427	22945
7	29334	24533	22405	32686	21016	21430	14650	17431	11922
8	15396	19981	13752	17710	23502	16630	16258	9301	10651
9	12351	12372	11294	5968	14379	15589	11719	9530	5930
10	12504	7792	6458	6396	3734	11047	9283	6034	5410
11	18097	7952	4197	2792	4433	1741	8156	4950	2775
12	5412	13964	5463	2294	1777	2511	576	5386	2994
13	941	2144	9442	3737	1249	1132	837	188	3235
14	0	589	805	5660	2554	668	687	288	64
3+	232632	220847	188986	165807	155040	152133	157038	155870	161554
4+	217697	205885	176119	153625	144269	134416	136801	134575	136952
5+	155523	177924	148008	130128	121592	114966	104944	99193	98032
6+	124574	117778	120433	101589	98390	90995	85783	70035	65926

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	17656	13686	8910	14888	9899	7743	10383	14027	14516
4	44449	32858	24570	15496	27515	18138	13219	17833	23460
5	37721	45028	31667	23116	14504	26613	15291	11240	15103
6	27296	33054	40979	25391	20700	11800	20757	8939	8220
7	16302	20542	23552	27928	16932	15592	6684	9859	4789
8	7885	10421	12604	12490	16219	9060	8934	3106	3820
9	7782	4396	6549	6462	6529	8048	3295	3525	1852
10	3651	4771	2391	3686	2870	3554	3011	1158	1442
11	3801	2384	2473	1555	1693	1185	1437	1167	826
12	1245	2562	1815	1390	770	621	342	556	594
13	2487	524	1500	1200	721	337	113	95	349
14	1960	1768	204	696	676	359	177	14	53
3+	172236	171993	157215	134298	119028	103051	83642	71520	75024
4+	154579	158307	148305	119410	109129	95308	73259	57493	60508
5+	110130	125449	123735	103914	81614	77170	60040	39660	37048
6+	72409	80421	92068	80798	67110	50557	44750	28420	21945

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	36764	16277	8828	19889	38631	30054	66064	49633	48132
4	24547	36552	18433	12065	23564	48491	44816	94421	48616
5	24242	24969	36354	22204	15296	24814	59680	56732	79214
6	12496	17166	23154	35190	21329	13028	27162	58144	48884
7	6487	8079	12772	17488	26080	15476	11116	22448	48917
8	3195	3688	5657	8411	10717	16138	12000	9597	16272
9	2687	1972	2499	3975	4658	6614	10793	10826	7605
10	1246	1648	1670	2167	2031	2614	4937	9745	7986
11	1074	620	1153	1093	1234	986	1610	3855	6681
12	557	811	488	808	741	727	621	1342	2793
13	387	317	725	289	398	388	465	476	901
14	307	168	226	428	143	278	315	277	281
3+	113991	112267	111960	124006	144823	159607	239580	317497	316283
4+	77227	95990	103132	104117	106192	129554	173516	267864	268151
5+	52679	59438	84699	92052	82628	81063	128700	173443	219535
6+	28437	34468	48345	69848	67332	56249	69020	116711	140321

Table 17. Fishing mortalities for Subdivision 3Ps cod from a cohort analysis at F_t=0.25.

FISHING MORTALITY

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	0.019	0.011	0.010	0.029	0.025	0.030	0.032	0.013	0.033	0.018	0.016
4	0.155	0.136	0.138	0.199	0.137	0.206	0.210	0.268	0.194	0.197	0.150
5	0.264	0.429	0.409	0.343	0.332	0.255	0.329	0.489	0.438	0.379	0.280
6	0.403	0.400	0.582	0.315	0.347	0.434	0.258	0.477	0.472	0.363	0.368
7	0.402	0.343	0.391	0.423	0.290	0.332	0.539	0.714	0.477	0.531	0.538
8	0.197	0.566	1.114	0.249	0.417	0.366	0.409	0.553	0.415	0.538	0.547
9	0.419	0.341	0.680	0.549	0.258	0.502	0.430	0.800	0.421	0.291	0.749
10	0.517	0.545	1.104	0.458	0.401	0.302	0.572	0.820	0.299	0.598	0.774
11	0.211	0.310	0.649	0.407	0.195	1.199	0.243	0.638	0.838	0.355	0.155
12	0.714	0.205	0.342	0.431	0.393	0.933	0.839	0.511	0.223	0.632	0.330
13	0.379	1.083	0.482	0.293	0.699	0.387	1.199	1.406	0.374	0.016	1.049
14	0.370	0.420	0.660	0.390	0.330	0.370	0.480	0.700	0.430	0.500	0.570

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
3	0.024	0.054	0.021	0.034	0.051	0.037	0.080	0.014	0.006	0.007	0.008
4	0.229	0.289	0.124	0.180	0.318	0.285	0.360	0.235	0.083	0.084	0.098
5	0.444	0.404	0.344	0.466	0.715	0.524	0.573	0.451	0.234	0.273	0.261
6	0.404	0.485	0.290	0.577	0.520	0.867	0.594	0.462	0.432	0.376	0.396
7	0.658	0.716	0.661	0.627	0.927	1.464	0.662	0.382	0.549	0.522	0.630
8	0.633	0.817	0.527	0.791	0.676	0.758	0.420	0.427	0.599	0.582	0.615
9	0.461	0.821	0.529	1.048	1.466	1.426	0.312	0.417	0.510	0.493	0.479
10	0.459	0.756	0.832	0.746	0.923	0.465	0.188	0.468	0.599	0.321	0.336
11	0.438	0.332	0.740	0.889	1.065	0.914	0.125	0.316	0.642	0.293	0.363
12	0.299	0.637	1.085	1.268	1.683	0.663	0.249	0.527	0.232	0.321	0.453
13	0.657	0.419	0.541	0.337	2.375	0.513	0.093	0.713	0.469	0.145	0.622
14	0.630	0.750	0.610	0.740	0.880	1.300	0.520	0.390	0.520	0.480	0.560

AGE	1981	1982	1983	1984	1985
3	0.012	0.002	0.007	0.003	0.003
4	0.093	0.031	0.049	0.048	0.050
5	0.249	0.195	0.204	0.103	0.125
6	0.359	0.272	0.294	0.236	0.175
7	0.462	0.432	0.399	0.249	0.250
8	0.485	0.559	0.312	0.240	0.250
9	0.540	0.432	0.362	0.241	0.250
10	0.577	0.607	0.243	0.206	0.250
11	0.540	0.647	0.370	0.201	0.250
12	0.456	0.407	0.481	0.224	0.250
13	0.511	0.337	0.392	0.189	0.250
14	0.400	0.410	0.300	0.300	0.250

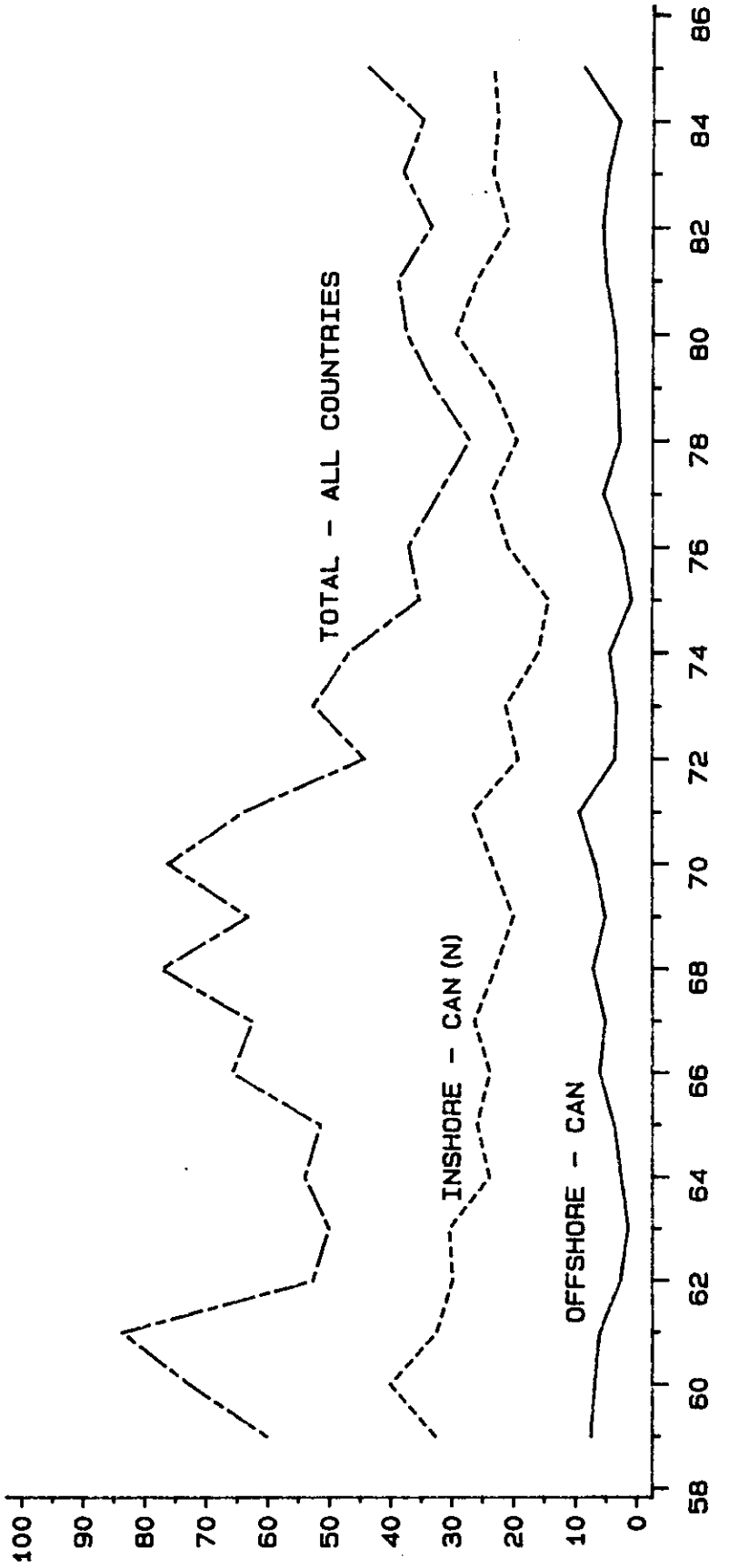

FIG. 1. TOTAL CATCH OF 3PS COD BY ALL COUNTRIES ALONG WITH CANADIAN CATCHES FOR 1959-1986.

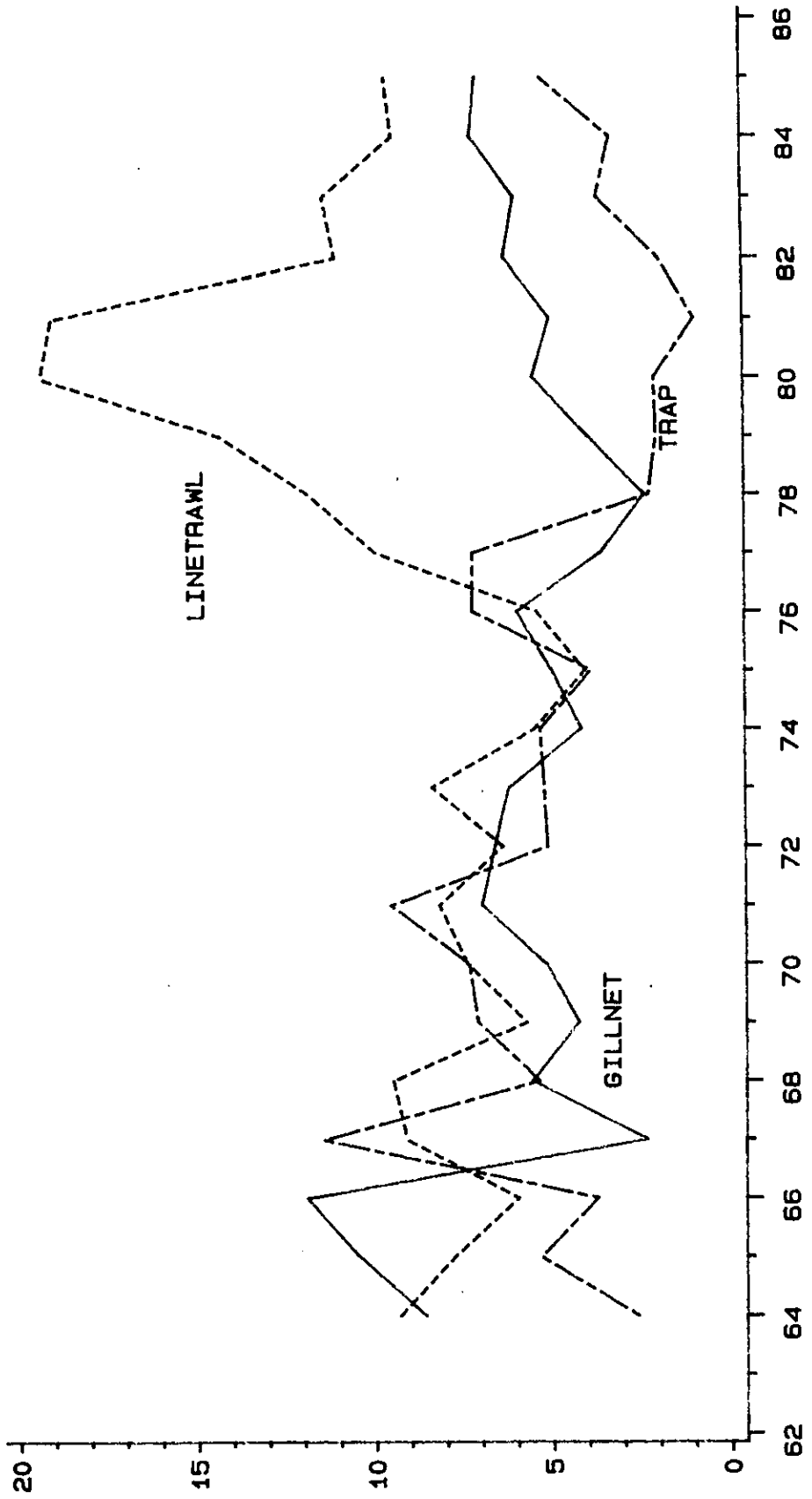

FIG. 2. INSHORE CAN(N) COD CATCHES BY GEAR IN SUBDIVISION 3PS FOR THE PERIOD 1964-1985.

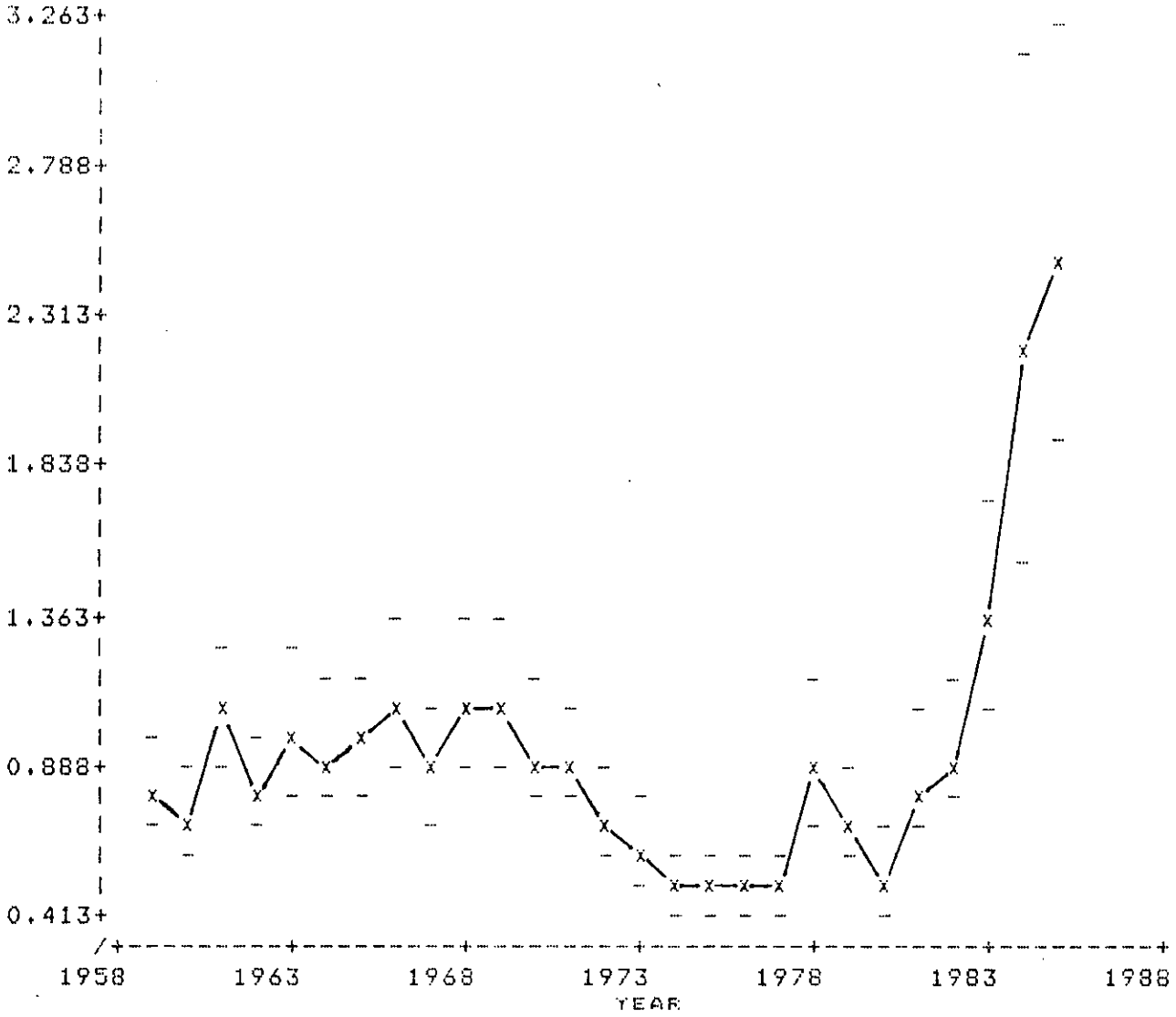

Fig. 3. Historical catch rate indices for cod in Subdivision 3Ps with approximate 90% confidence limits.

APPENDIX

Catch at age as reported by Canada and France were combined (Table 1) and the total appended to that previously used in cohort analyses.

Catch rate data from France (St. PM) for 1983-85 was combined with that previously used and was analyzed using a multiplicative model. The results of regression analysis and the catch rates obtained are shown in Tables 2, 3, and Fig. 1.

Because of possible intermixing of cod from the northern Gulf of St. Lawrence stock (4RS 3Pn) with the Subdiv. 3Ps stock in the Burgeo Bank area during winter, survey data was analyzed after excluding observations on Burgeo Bank (Table 4).

Survey numbers at age 3 obtained by combining Canadian and French survey data were used in the most recent assessment of this stock. A comparison of age 3 abundance from the two revised survey indices (Table 5) indicated that they were poorly related and as such were not combined as done previously.

The relationship between age 3+ numbers from the French survey and cohort analysis indicated that F_t in 1985 could be 0.45, based on the balance of residuals in the last 3 years (Table 6; Fig. 2). The relationship between exploitable biomass and catch rate index indicated that F_t in 1985 could be between 0.25 and 0.45 but that there was very little discriminating power. Figure 3 shows the results of this relationship at $F_t = 0.35$ in 1985.

Because of difficulties with determining an F_t appropriate for 1985, it was decided that a range of values (0.25 to 0.45) would encompass the actual value. Tables 7-9 show the results of a cohort analysis at 0.35 for illustrative purposes only.

Table 1. Cod catch-at-age by Canada and France in NAFO Subdivision 3Ps during 1985.

Age	Canada	France	Total
3	102	96	198
4	2072	2485	4557
5	6223	4844	11067
6	3745	2206	5951
7	3470	1525	4995
8	1001	465	1466
9	297	121	418
10	266	112	378
11	211	121	332
12	77	53	130
13	17	6	23
14	6	6	12
15	4		4
16	1		1
#	17492	12040	29532
wt.	32029	18508	50537

Table 2. Analysis of variance from the regression on ln catch rate for cod in Subdivision 3Ps from 1959 to 1985.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.689
MULTIPLE R SQUARED.....0.474

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.581E1	1.581E1	
REGRESSION	46	1.752E2	3.808E0	14.449
TYPE 1	9	9.330E1	1.037E1	39.334
TYPE 2	11	2.944E1	2.677E0	10.156
TYPE 3	26	6.811E1	2.619E0	9.939
RESIDUALS	737	1.942E2	2.635E-1	
TOTAL	784	3.852E2		

Table 3. Mean catch rate indices for cod in Subdivision 3Ps for the years 1959 to 1985.

YEAR	TOTAL CATCH	CATCH RATE MEAN	S.E.	EFFORT
1959	60170	0.726	0.089	82932
1960	72636	0.628	0.077	115613
1961	83620	0.945	0.105	88450
1962	52639	0.758	0.090	69418
1963	50051	0.925	0.112	54093
1964	53956	0.839	0.100	64288
1965	51400	0.871	0.106	59044
1966	65749	0.977	0.107	67283
1967	62393	0.815	0.099	76566
1968	77217	1.001	0.110	77172
1969	63103	0.993	0.116	63573
1970	76161	0.843	0.096	90365
1971	63967	0.813	0.089	78662
1972	44323	0.654	0.070	67758
1973	52641	0.579	0.060	90976
1974	46712	0.448	0.049	104167
1975	35373	0.455	0.060	77772
1976	37133	0.460	0.056	80728
1977	32245	0.459	0.063	70296
1978	27221	0.856	0.127	31793
1979	33006	0.712	0.093	46366
1980	37568	0.465	0.069	80775
1981	38905	0.814	0.108	47781
1982	33902	0.919	0.119	36906
1983	38297	1.164	0.151	32887
1984	36944	1.618	0.250	22833
1985	50537	1.712	0.221	29524

AVERAGE C.V. FOR THE MEAN:0.123

Table 4. Mean number of cod per tow from research trips in Subdivision 3Ps (depths to 200 fath and excluding Burgeo Bank).

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0.04	.04	1.32	.97	.21		0.0	1.68	.20	.05	.72	.36	0.01	.02	.01
2	1.10	1.59	3.78	1.74	3.05	.28	.54	.69	6.26	.76	2.61	.65	.27	.39	.30
3	1.79	1.83	3.37	5.07	2.17	4.07	.82	.92	1.88	3.40	1.12	1.36	.43	2.38	.69
4	3.40	2.45	1.43	4.23	3.96	3.60	2.77	8.84	.85	5.31	5.74	.67	.70	5.89	2.41
5	1.98	1.35	1.91	2.03	2.41	2.20	.95	20.15	2.33	6.57	2.26	3.54	.48	7.25	3.70
6	1.16	.21	1.91	1.77	1.08	.94	.59	2.26	1.87	8.22	1.08	1.82	2.23	2.93	3.27
7	1.54	.24	.58	1.47	.66	.29	.39	.48	.47	7.32	1.64	.66	.91	2.33	1.31
8	1.11	.08	.44	.52	0.60	.17	.26	.28	.59	1.37	1.74	1.38	0.47	.71	1.26
9	.50	.11	.39	.34	.13	.31	.16	.16	0.19	1.33	.49	2.62	.60	.44	.78
10	0.33	.04	.17	.17	0.11	.11	.16	.12	.16	.30	.11	1.24	.94	.45	.31
11	.15	.01	0.08	.05	.07	.01	.04	.03	.12	.05	.09	.62	.23	.55	.26
12	0.08	.01	.04	.01	.09	.03	.01	.01	.13	.07	0.04	.23	0.17	.62	.34
13	0.05	.01	0.04	0.05		.03	.02	.01	.04	.09	0.02	0.09	0.07	.26	.19
14	0.09		.02			0.01		.02		.04	0.02	0.08	0.03	.15	.10
15	0.05			.01	.04	.04	.01		.02		.03	.07		.03	.06
16	.16			0.0					.04		.03	.06	.03	.05	.04
17	0.11	.04		.03					0.02			0.01	0.0	.06	.02
18	0.07	.01										.03	.04	.03	
19	0.01				0.04							0.02			
20	0.01			0.01		.01						0.02			.01
20+	0.01						0.05					0.03	0.01	.03	
NK		0.01									0.03				
Total	13.73	8.01	15.50	18.48	14.59	12.09	6.77	35.65	15.17	34.87	17.77	15.55	7.63	24.57	15.05
Confidence limits															
Upper	23.54	14.71	22.40	28.29	22.10	17.73	10.94	358.79	20.73	266.97	24.60	21.80	11.09	186.28	23.67
Lower	3.92	1.31	8.61	8.67	7.08	6.45	2.61	-289.50	9.61	-197.24	10.94	9.29	4.17	-137.13	6.44
Sets	39	45	62	38	58	78	33	57	63	43	68	118	76	77	102
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	March 6-23

Table 5. Comparison of seasonally adjusted age 3 from Canadian surveys with age 3 from French surveys.

	Canada			France
Year	# age 3	Adj. factor	Adj. age 3	Age 3
1972	1.79	1.00	1.79	
1973	1.83	1.00	1.83	
1974	3.37	0.85	3.96	
1975	5.07	0.61	8.31	
1976	2.17	0.69	3.14	
1977	4.07	0.85	4.79	
1978	0.82	1.00	0.82	1.61
1979	0.92	1.00	0.92	0.44
1980	1.88	1.00	1.88	2.06
1981	3.40	1.00	3.40	5.30
1982	1.12	0.61	1.84	2.09
1983	1.36	0.76	1.79	5.98
1984	0.43	0.85	0.51	9.04
1985	2.38	1.00	2.38	16.36
1986	0.69	1.00	0.69	4.94

r^2 = 0.07
Slope = 1.34
Intercept = 3.20

Table 6. Results of calibrations using age 3+ French survey abundance versus age 3+ SPA abundance.

	F_T = 0.15	F_T = 0.25	F_T = 0.35	F_T = 0.45
83 Res.	139	75	49	32
84 Res.	-71	-34	-18	-9
85 Res.	167	79	35	20
r^2	0.62	0.61	0.53	0.54
Slope	6.12	3.06	1.49	1.02
Intercept	128	127	130	126

Table 7. Population numbers ($x10^{-3}$) of Subdivision 3Ps cod from a cohort analysis at F_t = 0.35.

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	84419	98408	70186	54345	35514	60221	39399
4	107064	47715	48005	41302	38722	34300	56274	64211	68258	78035	56430	43774	28392	46676
5	35820	75043	34073	34247	27708	27632	22848	37354	46210	46010	52487	39778	28514	17415
6	24206	22518	37992	18541	19894	16267	17524	13459	18761	21249	25785	32490	20881	15587
7	16270	13245	12361	18302	11079	11515	8634	11082	6838	9577	12101	14616	17767	10521
8	5812	8710	7692	6849	9813	6784	6763	4125	4441	3473	4609	5787	6199	7110
9	4041	3906	4142	2068	4370	5292	3652	3678	1942	2402	1660	2163	2516	2242
10	3449	2175	2275	1718	778	2766	2622	2052	1352	1043	1470	643	1127	706
11	3661	1685	1033	616	890	536	1674	1212	740	621	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	299	277	33	118	108
3+	261043	237442	203304	174166	157343	176816	201606	222762	242079	233700	210219	175999	166569	140739
4+	201657	178182	152360	125495	114385	105976	120621	138343	143605	163514	155873	140485	106339	101340
5+	94592	130466	104355	84193	75664	71676	64347	74131	75347	85479	77444	96671	77946	54645
6+	58772	55423	70262	49944	47955	44044	41499	36777	35137	39468	46957	56913	47433	37230

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	31019	41931	56040	58630	72478	38172	22140	37741	76116	55485	95665	74420	60312
4	31596	24541	32623	44217	44283	58494	31055	17992	30630	61414	45327	77615	60741
5	33756	21609	14626	20078	25218	27972	43992	23281	13243	22576	45686	34738	59589
6	10104	17336	8655	7691	9269	13113	15023	27171	14450	8251	14761	29165	24666
7	9547	4644	8434	2978	3204	4685	6933	10019	14704	8012	4965	8481	17607
8	4449	4178	1504	1577	1257	1791	2215	3335	4234	7345	4021	2522	5037
9	3436	1651	1740	577	859	672	866	1014	1445	2043	3208	2261	1516
10	1082	987	312	343	346	464	330	403	514	667	1017	1695	1356
11	323	420	321	160	232	177	209	196	236	237	277	618	1062
12	169	109	119	105	116	139	76	127	112	112	101	145	390
13	54	39	17	50	67	56	70	45	66	58	61	51	89
14	60	32	3	8	37	27	29	64	20	33	34	34	35
3+	125598	117475	124393	135833	157367	145761	125899	121389	155771	166232	215123	231745	232399
4+	94579	75545	68353	77203	84890	107589	103759	83648	79654	110748	119458	157324	172087
5+	62983	51003	35730	32986	40606	49095	72704	65656	49024	49334	74131	79709	111346
6+	29225	29394	21105	12909	15389	21124	28711	42375	35781	26757	28445	44972	51757

Table 8. Mid-year (average) population biomass ($tx10^{-3}$) of Subdivision 3Ps cod from a cohort analysis at F_t = 0.35.

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	21295	24682	17656	13686	8910	14888	9899
4	62174	27961	28111	23497	22677	19459	31857	35382	38919	44449	32858	24570	15496	27515
5	30949	60147	27575	28539	23202	23972	19161	29159	32106	37721	45028	31667	23116	14504
6	30539	28451	46817	24345	25746	20248	23618	16427	22945	27296	33054	40979	25391	20700
7	29334	24533	22405	32686	21016	21430	14650	17431	11922	16302	20542	23552	27928	16932
8	15396	19981	13752	17710	23502	16630	16258	9301	10651	7885	10421	12604	12490	16219
9	12351	12372	11294	5968	14379	15585	11717	9530	5930	7782	4396	6549	6462	6529
10	12504	7792	6458	6396	3734	11047	9283	6534	5410	3651	4771	2391	3686	2070
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	286	64	1960	1768	204	696	676
3+	232632	220847	189986	165607	155040	152133	157038	155870	161554	172236	171993	157215	134298	119028
4+	217697	205885	176119	153625	144269	134416	136801	134575	136952	154579	158307	148305	119410	109129
5+	155523	177924	148008	130128	121592	114966	104944	99193	98032	110130	125449	123735	103914	81614
6+	124574	117778	120433	101587	98370	90975	85783	70035	65926	72409	80421	92068	80798	67110

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	7743	10383	13971	14314	35880	15521	8198	17712	32081	22606	50067	44451	34300
4	18138	13219	17833	23345	24144	35629	17538	11187	20055	40935	33430	70934	43407
5	26613	15291	11240	15103	24064	24445	35258	20923	13927	21520	48957	41181	57736
6	11800	20757	8937	8220	12496	16770	22473	33704	19650	11515	22551	45117	33483
7	15592	6884	9859	4789	6487	8079	12536	16656	24386	13662	7305	17450	34941
8	9060	8934	3106	3820	3195	3688	5657	8135	9831	14304	7765	7450	11623
9	8048	3295	3525	1852	2687	1972	2499	3975	4387	5750	8942	6406	5432
10	3554	3011	1150	1442	1246	1640	1670	2167	2031	2342	4036	7530	5704
11	1185	1437	1167	826	1074	620	1153	1093	1234	986	1359	2776	4772
12	621	342	556	594	557	811	488	808	741	727	621	1039	1995
13	337	113	95	349	387	317	725	289	378	380	465	476	644
14	359	177	14	53	307	168	226	428	143	278	315	277	268
3+	103051	83642	71463	74707	112524	109867	108441	117048	130464	135092	187975	247288	234305
4+	95308	73259	57493	60393	76645	94346	100244	99336	97583	112486	137926	202837	200005
5+	77170	60040	39660	37048	52501	58717	82706	88178	76728	71551	106496	131703	156598
6+	50557	44750	28420	21945	28437	34272	47447	67255	62801	50031	57539	90723	98862

Table 9. Fishing mortalities for Subdivision 3Ps cod from a cohort analysis at F_t = 0.35.

FISHING MORTALITY

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
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
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
5	0.264	0.429	0.409	0.343	0.332	0.255	0.329	0.489	0.436	0.379	0.280	0.444	0.404	0.344
6	0.403	0.400	0.532	0.315	0.347	0.434	0.258	0.477	0.472	0.363	0.368	0.404	0.485	0.290
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
8	0.197	0.566	1.114	0.247	0.417	0.366	0.407	0.553	0.415	0.530	0.547	0.633	0.817	0.527
9	0.419	0.341	0.600	0.549	0.250	0.562	0.430	0.800	0.421	0.291	0.749	0.461	0.821	0.529
10	0.517	0.545	1.104	0.458	0.401	0.302	0.572	0.820	0.269	0.578	0.774	0.459	0.756	0.832
11	0.211	0.310	0.647	0.407	0.175	1.199	0.243	0.638	0.838	0.355	0.155	0.438	0.332	0.740
12	0.714	0.205	0.342	0.481	0.393	0.933	0.839	0.511	0.223	0.632	0.330	0.299	0.637	1.085
13	0.379	1.093	0.482	0.273	0.677	0.307	1.199	1.406	0.374	0.016	1.049	0.657	0.419	0.541
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

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	0.034	0.051	0.037	0.001	0.014	0.006	0.007	0.009	0.015	0.002	0.009	0.003	0.004
4	0.180	0.318	0.285	0.362	0.259	0.085	0.088	0.106	0.105	0.076	0.066	0.064	0.056
5	0.466	0.715	0.524	0.573	0.454	0.240	0.282	0.277	0.273	0.225	0.249	0.142	0.172
6	0.577	0.520	0.867	0.594	0.482	0.437	0.387	0.414	0.390	0.308	0.354	0.305	0.256
7	0.627	0.927	1.464	0.662	0.382	0.549	0.532	0.661	0.484	0.489	0.477	0.321	0.350
8	0.791	0.676	0.758	0.420	0.427	0.579	0.582	0.638	0.539	0.628	0.576	0.309	0.350
9	1.048	1.466	1.426	0.312	0.417	0.510	0.493	0.479	0.574	0.498	0.438	0.311	0.350
10	0.746	0.923	0.465	0.188	0.368	0.599	0.321	0.336	0.577	0.678	0.298	0.267	0.350
11	0.889	1.085	0.714	0.125	0.216	0.642	0.293	0.363	0.540	0.647	0.445	0.269	0.350
12	1.268	1.683	0.665	0.249	0.527	0.232	0.321	0.453	0.456	0.407	0.481	0.289	0.350
13	0.337	2.375	0.513	0.073	0.713	0.469	0.145	0.622	0.511	0.337	0.392	0.189	0.350
14	0.740	0.880	1.300	0.520	0.390	0.520	0.480	0.560	0.400	0.410	0.300	0.300	0.350

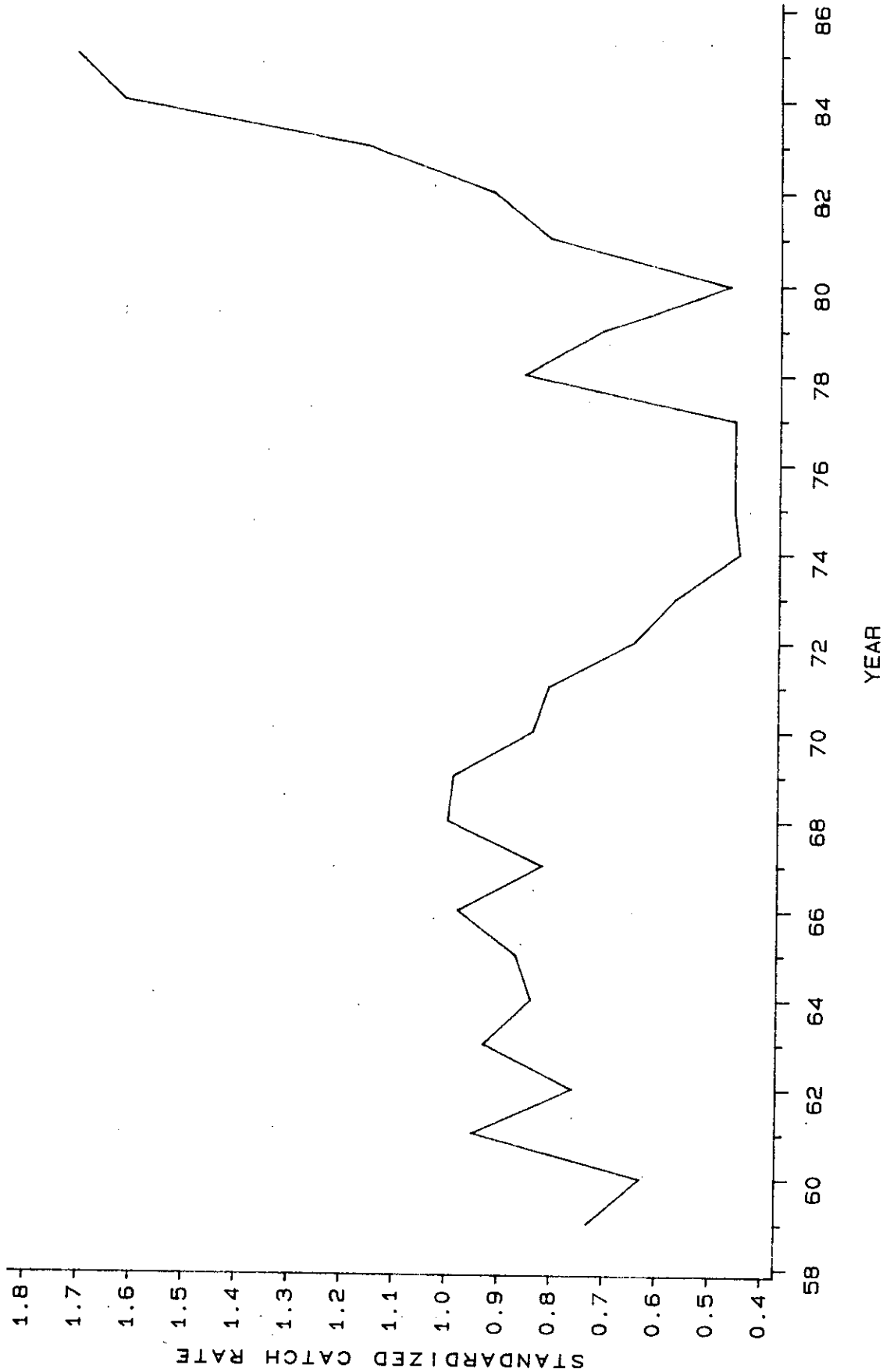

FIG 1. STANDARDIZED CATCH RATE FOR SUBDIVISION 3PS COD FOR THE PERIOD 1959-1985.

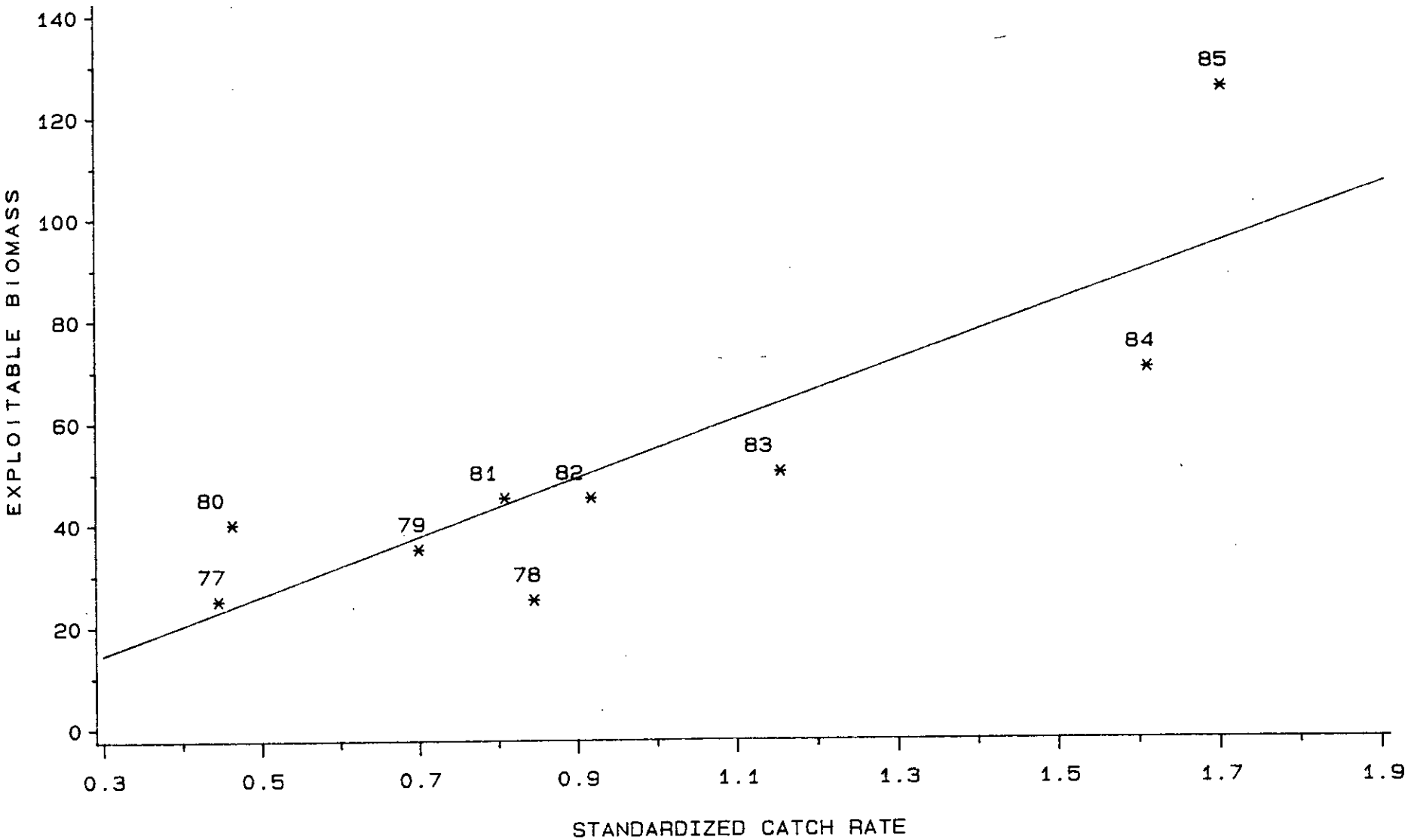

FIG 2. STANDARDIZED CATCH RATE VERSUS OFFSHORE AVERAGE EXPLOITABLE BIOMASS USING TERMINAL FISHING MORTALITY = 0.35 FOR THE PERIOD 1977-85.

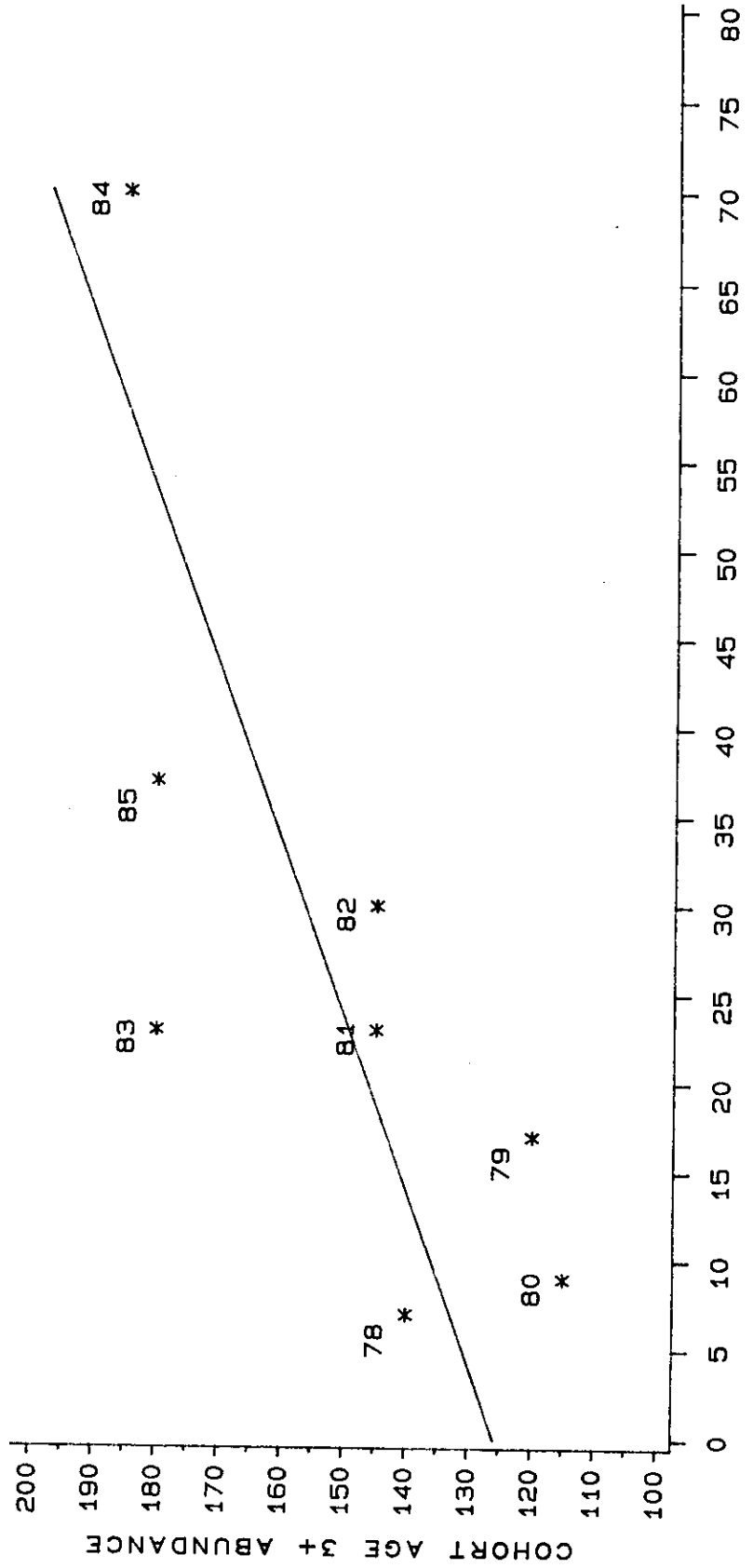

FIG 3. AGE 3+ ABUNDANCE FROM FRENCH SURVEYS VERSUS AGE 3+ ABUNDANCE FROM COHORT USING TERMINAL FISHING MORTALITY = 0.45 FOR THE PERIOD 1978-85.