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An Update of the Inshore Cod Stock in Subdivision 4Vn (May-Dec) for 1980

by

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Abstract

The status of the 4Vn (May-Dec) cod fishery for 1980 is studied here by considering the apparent trends in the stock size indices available (e.g. commercial CPUE and research survey estimates).

Previous studies on this stock have determined that this fishery is supported by three stock complexes - 4T cod stock, 4Vs cod stock and the 4Vn 'inshore' stock. The major proportion of the catch is assumed to be taken from the inshore stock. Recent changes in the behaviour of the major inshore gear, the longliners, from fishing inshore areas to the present situation of fishing out to the Laurentian Channel suggests that the offshore stocks of 4T and 4Vs are now contributing proportionally more to the fishery. The 1980 reported catch of 10,378 mt (a nine year high) seems therefore to be a result of increased effort toward the offshore components rather than an increase in population size of the inshore component.

Résumé

Ce document donne un aperçu de l'état de la pêcherie de morue dans 4Vn (mai-déc.) en 1980, fondé sur les tendances des indices de la taille du stock (p. ex. PUE commerciales et estimations des relevés par navire de recherche).

On a constaté dans des études antérieures que cette pêcherie exploitait trois complexes de stocks - stock de 4T, stock de 4Vs et stock "côtier" de 4Vn. On suppose que la majeure partie des prises provient du stock côtier. Les récents changements observés dans le déploiement des palangriers, l'élément principal de la flottille côtière, donnent à penser que les stocks de 4T et 4Vs contribuent maintenant proportionnellement plus aux captures. En effet, les palangriers pêchent maintenant beaucoup plus loin des côtes, se rendant jusqu'au chenal Laurentien. Les prises de 10 378 t signalées en 1980 (un sommet depuis neuf ans) semblent donc résulter d'un effort de pêche accru au large plutôt que d'une augmentation des effectifs du stocks côtier.

Introduction

This is the third CAFSAC Document devoted exclusively to this stock. Much of the historical information contained in this report is taken directly from Beacham et al. (1980) (after Gray et al. (1979)). Some changes have been made for the information presented in Tables 1, 2, and 3. The previous scientific documents cited above included catches by the Faroese (and a proportion of the Portuguese catch in 1972) for the years 1972 to 1976 inclusive which were listed as unknown in the ICNAF Statistical Bulletins with respect to the month in which the catch was taken. Knowledge of when the catch was taken is extremely important for this stock since it is defined to exist within a specific time period. These catches have been removed from these tables and are presented seperately in an appendix for historical interest.

For this analysis the catch of cod in 4Vn is divided between the inshore and offshore components according to gear type used. The offshore stock is assumed to be that which is fished by otter trawls only. This stock division was originally proposed by Halliday (1974) but recently this differentiation has become less marked with traditional inshore gear such as longliners now fishing out to the Laurentian Channel (Russel MacPherson personal communication). The Marine Fish Division is at present completing tagging studies in the area in order to improve our knowledge of the stock structure in 4Vn.

The general historical trends in this fishery have been reviewed in Beacham et al. and Gray et al. The 1980 data indicate a dramatic increase in catches taken by otter trawls and longliners and handlines. In fact the quota set for this stock was exceeded by a little over 100%.

Nominal catch

At present only Canada and France (St. Pierre-Miquelon) fish this stock with Canada taking greater than 99% of the reported catch. The historical breakdown by country along with this year's catches are contained in Table 1. This year saw a 64% increase in the total nominal catch over last year (total catch of 10,378 mt). Although the fishery is mainly prosecuted by "inshore" gear (see Fig. 1) all of the major gear types showed dramatic increases in catch (Table 2). The increase was also over all tonnage classes listed in Table 3 for otter trawls, longlines and handlines. A more detailed breakdown of catch by gear (for Canadian catches only) is given in Table 4. No significant seasonal pattern in the catches is readily evident in the monthly breakdowns presented in Table 5d. As reported for 1979 by Beacham et al. the landings from the major gears remain dispersed throughout the year.

According to the department's quota reports the major proportion of the quota set for 1980 was in the form of a fixed gear allowance (3,600 mt). This allowance was exceeded by mid-September and as of December 31 the reported landings for this category were well over double the set allowance (7,386 mt).

Research trawl survey abundance indices

In the reports previous to this one by Beacham et al. and Gray et al. general trend patterns in the research trawl survey abundance indices were found through the use of 3 year running means. Data from time trends can be considered to consist of two components the so-called 'smooth' and 'rough' (after Tukey 1977). The rough component is a reflection or a representation of the variability inherent in the data while the smooth is the pattern we are interested in extracting. Extraction of the smooth is generally referred to as filtering or smoothing the data. Define our observations as y_t (t = 1, 2, ...K). A three year running mean extracts the smooth by replacing each point y_t with an average of the y_{t-1}, y_t and y_{t+1} points. If there is an outlying data point, that is, outlying in the sense that the inherent variability or the rough is large in absolute value in comparison to the adjacent points then this point will dominate in the extracted smooth by contaminating the sequence it participates in (Velleman 1980). Tukey (1977) and others, have suggested that nonlinear smoothers based on medians would provide protection against these unsupported spikes in the data.

In Figure 2 we illustrate the behaviour of three year running means and the M3R when applied to the abundance indices for 4Vn for for ages 4 and up.

The M3R method smooths by replacing each value of y_t with the median of the y_{t-1}, y_t and y_{t+1} points. The 'span' or region of support is defined as the three points from which the median is taken. The difference between the two methods of smoothing can be best understood by considering the effect of the points for 1977 to 1980 inclusive. The 1978 point is much higher than the two adjacent years and pulls the running average point for 1978 up from the 1977 and 1979 points. In contrast the M3R point for 1978 treats the observed point as an outlier as it is not supported by the other points within its span. With the addition of the high 1980 point the 1979 point is now regarded as atypical within its span and the M3R point gives the 1978 point as the smoothed point while in the running average smooth the 1979 point contaminates the smoothed points for 1979 and 1980. Information provided by the 1981 survey will help us judge how atypical 1979 was.

We have used the M3R method throughout this paper not only for the survey data but for the catch per unit effort (CPUE) data as well so we feel that the explanation above albeit brief is necessary for this paper.

The smooths for the trends of the survey data for ages 4+, 5+, 6+, and 7+ are presented in Figure 3. The actual data are given in Table 6. Figure 3 indicates that increases exhibited by the smoothed trends are very much dependent upon the contribution made by the age 4 fish. Excluding the age 4's leaves the large 1980 points for ages 5, 6, and 7 unsupported in their spans and hence the trend is interpretated to be more or less flat for the recent years. With reference to Table 10 which contains the catches at age for longliners it seems that the age 4 signal picked up in the surveys has little effect in the 'inshore' fishery. This is not a totally unexpected result since the offshore stock, that is the stock available to otter trawls (such as used in the survey) has been postulated to the more related to the 4Vs cod stock at this time of year (Halliday 1974) than to the inshore stock. Research surveys are carried out in the two adjacent areas 4T (September) and 4Vs (with the 4Vn survey). In Figure 4 we plot the smoothed trends of the 4+ mean catch per tows from these surveys. From 1974 the 4Vn stock shows more relationships to the 4T stock than 4Vs. The aforementioned tagging studies will help to bring this observation into perspective.

Catch per unit effort

The available catch per unit effort for otter trawls and longliners is presented in Table 7. The breakdown according to groups of months was originally presented in Gray et al. in order to discern if the migrations of the 4T and 4Vs cod stocks were affecting the catch patterns. The groups identified as May + December (otter trawls) and November + December for (Longliners) were hypothesized as being part of the 4T stock and therefore the summer months as being part of the 4Vs stock.

Smoothed plots for the otter trawl CPUE's (May + Dec) in Figure 5 show that there is very little similarity between the trawler tonnage classes and only tonnage class 5 exhibits a persistent increase in recent years. From Figure 6 where seasonal differences are compared for tonnage class 4 it seems that there is a marked difference in CPUE patterns between the time periods considered.

Since longliners are the most important major gear type in this fishery (71% of the total inshore catch and 62% of the total Canadian catch) it is more relevant to look at the trends in Figure 7. The November + December CPUE's exhibit a stronger increase (since 1976) than the summer and fall CPUE's. This is in contradiction to Gray et al. who stated that the time periods do not show very much difference. Again changes noted in the areas now being fished by the longliners is probably contributing to this recent trend.

Although there has been an increase in catch by longliners in 1980 over that reported for 1979 a comparison of catch per unit effort calculated over the period May to December between the two years shows very little difference. Specifically for the major tonnage class (LL2) the 1979 and 1980 catch per unit efforts (t/1000 hks.) are 0.5475 and 0.5404 respectively.

Catch composition

Mean weight at age and catch at age obtained from commercial samples for longliners are contained in Tables 9 and 10 respectively. The sampling of the inshore gear has always been fairly sparse with the main attention directed to longliners (see Table 8). The 1980 results are based upon one sample taken in December. Given the differences noted in the CPUE's for longliners over time it is certain that the December sample is not representative of the year in general. Therefore because of this reason and also due to the changing importance of the longliner catch with respect to the total catch no cohort analysis was attempted on the information in Table 10.

Summary

The catch obtained in 1980 from the 4Vn (May-Dec) cod stock is the largest catch reported in nine years. This increase was evident for all of the major gear types and tonnage classes. The amount caught was over double the quota set for the stock with a major proportion being taken by the 'inshore' fishery.

Given the changes noted in the fishing patterns by the longliners it is possible that the 'offshore' component, which is thought to be part of the 4Vs stock, is contributing to the increase in the catch for the 'inshore' component. The catch per unit effort data for the longliners over the May to December period indicate that an increase may also be due to increased effort directed toward the offshore component.

Until the changes in areas being fished by the longliners have been studied fully and the seasonal interactions of the various stocks in the area have been understood it is felt that the available stock indices (i.e. survey indices and CPUE) are of dubious value in determining overall stock trends.

References

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Appendix

For historical interest the catches taken by Faroese[1] and Portuguese fleets which cannot be reliably considered to be strictly 4Vn (May-Dec) are listed below.

Year	Country	Catch (mt)
1972	Faroes	2442
	Portugal	67
1973	Faroes	1027
1974	Faroes	1491
1975	Faroes	1240
1976	Faroes	636

[1] Gear unknown as well

Table 1: Nominal Cod Catch (mt) by countries in Div. 4VN (May-Dec)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Canada	9136	9075	7292	6342	8373	8707	8469	6729	5245	4836	3363	5746	7780	5410	6243	10276
Spain	304	45	320	666	611	1141	2161	1171	241	852	89	-	-	-	-	-
Portugal	465	-	-	-	-	-	-	459	189	84	360	-	-	-	-	-
France	1679	210	-	44	85	34	1	745	-	-	-	211	135	53	95	102
Norway	-	-	-	-	-	-	-	-	-	142	186	-	-	-	-	-
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
U.K.	-	-	-	-	-	-	-	-	-	61	-	-	-	-	-	-
F.R.G.	-	-	-	-	-	-	-	-	73	14	-	-	-	-	-	-
U.S.A.	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Poland	-	-	-	-	71	7	-	-	-	-	-	-	-	-	-	-
Others	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-
USSR	415	543	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTALS	11999	9873	7627	7052	9140	9894	10631	9104	5748	5989	3998	5957	7915	5463	6338	10378
% Canadian	76	92	96	90	92	88	80	74	91	81	84	95	98	99	99	99
TAC	-	-	-	-	-	-	-	-	-	10000	10000	10000	3500	3500	3400	5000

Table 2. Nominal catch (mt) of cod in Subdiv. 4Vn (May - December) by gear type for all countries, 1971-80. (Note: numbers in brackets are percentages).

YEAR	OTTER TRAWLS	SEINES	GILLNETS	LONGLINES & HANDLINES	MISCELLANEOUS	TOTAL
1971	5304(50)	106(1)	41(0)	4421(42)	759(7)	10631
1972	4418(49)	121(1)	248(3)	3471(38)	846(9)	9104
1973	2099(37)	143(2)	649(11)	2386(42)	471(8)	5748
1974	2842(47)	139(2)	751(13)	2042(34)	215(4)	5989
1975	1851(46)	100(3)	604(15)	1235(31)	208(5)	3998
1976	4375(74)	83(1)	314(5)	930(16)	255(4)	5957
1977	4613(58)	554(7)	199(3)	2400(30)	155(2)	7921
1978	1600(29)	327(6)	7(0)	3501(64)	28(1)	5463
1979	536(8)	279(4)	5(0)	5122(81)	374(6)	6316
1980	1270(12)	560(5)	7(0)	8242(79)	299(3)	10378

Table 3. Nominal catch (mt) by all countries of cod in Subdiv. 4Vn (May - December) by vessel size by gear. Percentage of gear total catch for each size class is in parentheses.

TONNAGE CLASS (TONS)	OTTER TRAWLS	SEINES	GILLNETS	LONGLINES & HANDLINES	MISCELLANEOUS	TOTAL
1971						
0- 49.9		20(19)	41(100)	4256(96)	759	5076
50- 149.9	613(11)	86(11)		165(4)		864
150- 499.9	1543(29)					1543
500- 999.9	1154(22)					1154
1000-1999.9	1994(38)					1994
TOTAL	5304	106	41	4421	759	10631
1972						
0- 49.9		1(1)	165(67)	3394(98)	387(46)	3947
50- 149.9	138(3)	120(99)	83(33)	77(2)		418
150- 499.9	1548(35)					1548
500- 999.9	1521(34)				459(54)	1980
1000-1999.9	1211(28)					1211
TOTAL	4418	121	248	3471	846	9104

...continued

Table 3 (continued). page 2 of 4.

TONNAGE CLASS (TONS)	OTTER TRAWLS	SEINES	GILLNETS	LONGLINES & HANDLINES	MISCELLANEOUS	TOTAL
1973						
0- 49.9	2(0)	10(7)	336(52)	2345(98)	282(60)	2975
50- 149.9	83(4)	133(93)	313(48)	41(2)		570
150- 499.9	1389(66)					1389
500- 999.9	552(26)				68(14)	620
1000-1999.9					121(26)	121
>2000	73(4)					73
TOTAL	2099	143	649	2386	471	5748
1974						
0- 49.9	41(1)	24(17)	469(62)	1795(88)	131(61)	2460
50- 149.9	121(4)	115(83)	282(38)	183(9)		701
150- 499.9	1435(51)			64(3)		1499
500- 999.9	1170(41)				84(39)	1254
1000-1999.9	61(2)					61
>2000	14(1)					14
TOTAL	2842	139	751	2042	215	5989

...continued

Table 3 (continued). page 3 of 4.

TONNAGE CLASS (TONS)	OTTER TRAWLS	SEINES	GILLNETS	LONGLINES & HANDLINES	MISCELLANEOUS	TOTAL
1975						
0- 49.9	20(1)	29(20)	463(77)	1026(83)	208(100)	1746
50- 149.9	104(6)	71(71)	141(23)	23(2)		339
150- 499.9	598(32)			186(15)		784
500- 999.9	769(42)					769
1000-1999.9	168(9)					168
>2000	192(10)					192
TOTAL	1851	100	604	1235	208	3998
1976						
0- 49.9	41(1)	33(40)	314(100)	930(100)	255(100)	1573
50- 149.9	87(2)	50(60)				137
150- 499.9	2323(53)					2323
500- 999.9	1924(44)					1924
TOTAL	4375	83	314	930	255	5957
1977						
0- 49.9	73(2)	259(47)	154(77)	2318(97)	155(100)	2959
50- 149.9	291(6)	295(53)	45(23)	82(3)		713
150- 499.9	1539(33)					1539
500- 999.9	2710(59)					2710
TOTAL	4613	554	199	2400	155	7921

...continued

Table 3 (continued). page 4 of 4.

TONNAGE CLASS (TONS)	OTTER TRAWLS	SEINES	GILLNETS	LONGLINES & HANDLINES	MISCELLANEOUS	TOTAL
1978						
0- 49.9	110(7)	112(34)	7(100)	3420(98)	28(100)	3677
50- 149.9	104(6)	215(66)		81(2)		400
150- 499.9	778(49)					778
500- 999.9	608(38)					608
TOTAL	1600	327	7	3501	28	5463
1979						
0- 49.9	101(18)	177(63)	5(100)	5067(99)	346(93)	5696
50- 149.9	38(7)	102(37)			28(7)	168
150- 499.9	349(63)			55(1)		404
500- 999.9	70(12)					70
TOTAL	558	279	5	5122	374	6338
1980 (Maritimes and Newfoundland only.)						
0- 49.9	160(14)	527(94)	7(100)	8024(97)	211(71)	8929
50- 149.9	138(12)	33(6)		144(2)	88(29)	403
150- 499.9	502(43)			74(1)		576
500- 999.9	368(31)					368
TOTAL	1168	560	7	8242	299	10276

Table 4. 4Vn (May-Dec) Cod: Canadian Nominal Catch by Gear

Gear	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Longlines	1730	1313	2190	2733	2393	3798	3895	2124	2455	3300	3229	3725	3185	1982	1332	689	620	1805	3035	4482	6422
Handlines	617	912	960	945	-	-	-	1398	960	848	495	696	286	404	568	360	310	595	466	640	1820
Seines	78	229	108	88	910	154	134	207	184	107	83	106	121	143	269	100	83	554	327	279	560
Fixed nets & traps	385	41	29	388	-	1229	2030	44	163	6	99	2	4	-	-	-	-	-	9	4	7
Gill nets	-	199	373	110	-	209	130	139	110	115	75	41	248	649	751	604	314	199	7	5	7
Other	-	127	688	-	1135	-	-	1537	554	634	1054	770	390	282	1	208	255	155	19	370	292
TOTAL "INSHORE" (May - Dec.)	2810	2821	4348	4264	4438	5390	6189	5449	4426	5010	5035	5340	4234	3460	2921	1961	1582	3308	3863	5780	9108
Otter Trawls (May - Dec.)	1403	1096	3439	2981	4982	3737	2886	1843	1916	3363	3672	3129	2495	1785	1915	1402	4164	4478	1547	463	1168
TOTAL (May - Dec.)	4213	3917	7787	7245	9420	9127	9075	7292	6342	8373	8707	8469	6729	5245	4836	3363	5746	7786	5410	6243	1027

Table 5a: Nominal catches (mt) for cod fishery in 4VN (May - Dec) by month-gear 1977.

Catch	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Traps	-	-	-	-	-	-	-	-	-
Drift Nets	-	-	-	-	-	-	-	-	-
Fixed Gill Nets	-	21	33	118	25	2	-	-	199
Handlines	-	4	90	172	80	64	185	-	595
Misc	4	13	16	33	19	17	31	22	155
Unspec.	-	-	-	-	-	-	-	-	-
Shrimp Tr	-	-	-	-	-	-	-	-	-
Side OT	261	26	17	23	16	31	389	694	1457
Stern OT	198	16	-	257	4	23	290	2124	2912
Longlines	141	76	140	170	364	429	325	160	1805
Purse Seine	-	-	-	-	-	-	-	-	-
Danish Seine	166	54	21	5	1	1	54	157	459
Scottish Seine	-	29	35	31	-	-	-	-	95
Midwater	-	-	-	-	1	4	-	101	106
Pair Seine	-	-	-	-	-	-	-	-	-
OTB	-	1	-	1	1	-	-	-	3
TOTAL CAN	770	240	352	810	511	571	1274	3258	7786
				FOREIGN FISHERY					
FRANCE	2	-	-	-	-	-	-	133	135
TOTAL	772	240	352	810	511	571	1274	3391	7921

Table 5b. Nominal catch (mt) for Canadian cod fishery in Subdivision 4VN (May-Dec.) my month and gear (1978)

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	TOTAL
Gillnets	3	1	-	1	2	-	-	-	7
Hand	2	13	82	98	81	83	92	15	466
Long	373	243	310	375	401	473	534	326	3035
Traps			5	3	1	-	-	-	9
Miscellaneous			6	10	3	-	-	-	19
OT spec.	3	9	6	1	2	3	-	-	24
Side OT	664	23	9	12	15	7	4	10	744
Stern OT	451	38	4	-	57	5	9	54	618
Midwater Trawl	161	-	-	-	-	-	-	-	161
Purse seine	-	-	-	-	-	1	-	-	1
Danish seine	148	77	19	4	3	18	11	19	299
Scottish seine	27	-	-	-	-	-	-	-	27
TOTAL	1832	404	441	504	565	590	650	424	5410
				FOREIGN FISHERY					
FRANCE								53	53
(stern OT)									
TOTAL	1832	404	441	504	565	590	650	477	5463

Table 5c. Nominal catch (mt) for Canadian (Maritimes and Quebec) fishery in Division 4Vn (May-Dec) by month and gear (1979).

	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Fix gillnets			2						2
Drift gillnets	2		1						3
Handlines		2	84	119	119	140	121	55	640
Longlines	918	743	378	372	464	600	619	388	4482
Miscellaneous			7	11	4	25	263	24	334
Otter trawls (side)	35	44	12	39	44	12	30	19	235
Otter trawls (stern)	59	39	12	11	15	2	65	25	228
Danish seine	78	70	16	4	11	22	73	5	279
Traps		1	2				1		4
Not known	3					3			6
Shrimp trawl			2	3	21	2	2		30
Total	1095	899	516	559	678	806	1174	516	6243
				Foreign Fishery					
France (stern OT)	95								95
Overall totals	1190	899	516	559	678	806	1174	516	6338

Table 5d. Nominal catch (mt) for Canadian (Maritimes and Newfoundland) fishery in Division 4Vn (May-Dec) by month and gear (1980

	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Fixed gillnets		2	5						7
Handlines	1	28	64	180	246	462	487	352	1820
Longlines	1331	1080	536	652	594	845	589	795	6422
Miscellaneous	5		25	122					152
Otter trawls (side)	32	63	9	126	87	36	69	39	461
Otter trawls (stern)	115	55	43	15	18	24	225	212	707
Danish seine	250	86	27	18	12	38	55	62	548
Scottish seine	12								12
Traps	1	6							7
Scallop						1			1
Not known	1		5	17		2	26		51
Shrimp trawl	8	34	15	15	3	13			88
Total	1756	1354	729	1145	960	1421	1451	1460	10276
				Foreign Fishery					
France	102								
Overall totals	1858	1354	729	1145	960	1421	1451	1460	10378

Table 6. Div. 4Vn (M-D) cod: Research vessel population indices (numbers at age x 10^{-3}) (strata 40-42)

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	-	-	-	-	-	-	-	-	-	-	-
2	2120	391	174	-	-	204	2164	43	222	435	627
3	591	14146	95	970	203	2142	751	2377	3048	262	3509
4	1595	3368	784	1529	455	2863	494	1400	6442	1717	1325
5	3637	8846	100	7073	931	1550	643	968	1850	837	7866
6	3490	5390	538	870	1071	271	517	685	1462	197	5471
7	1502	3554	491	995	133	334	243	279	509	572	1719
8	864	1198	130	1028	168	192	597	64	392	186	387
9	280	657	89	154	87	71	549	93	147	98	149
10	-	180	85	49	74	109	469	48	145	49	123
11	96	-	62	-	36	-	81	64	-	-	123
12	46	-	-	-	-	38	78	85	-	55	-
13+	43	187	125	-	-	-	156	73	37	149	-
UK	70	135	125	72	-	55	-	23	42	-	-
TOTAL	14334	38052	2798	12740	3158	7829	6742	6202	14296	4557	21299
4+	11553	23380	2404	11698	2955	5428	3827	3759	10984	3860	17163
4+ (smoothed)	11553	11553	11553	5428	3827	3827	3827	3827	3860	10984	17163
5+	9958	20012	1620	10169	2500	2565	3333	2359	4542	2143	15838
5+ (smoothed)	9958	9958	9958	2565	2565	2565	2565	2565	2565	2359	2143
6+	6321	11166	1520	3096	1569	1015	2690	1391	2692	1306	7972
6+ (smoothed)	6321	6321	3096	1569	1569	1569	1569	1569	1391	1391	1306
7+	2831	5776	982	2226	498	744	2173	706	1230	1109	2501
7+ (smoothed)	2831	2831	2226	982	744	744	744	1109	1109	1109	1109

Table 7. 4Vn (M-D) cod: Catch per unit effort for Canadian (M & Q) Otter trawls (t/hr) and longlines (t/1000 hooks).

	OTTER TRAWL				LONGLINE		
YEAR	OTB3 May + Dec	OTB4 May + Dec	OTB4 Aug + Sept	OTB5 May + Dec	LL2 Nov + Dec	LL2 Aug + Sept + Oct	LL3 Nov + Dec
1967	0.3205	0.4581	0.8847	0.6833	0.6233	0.5978	0.6602
1968	0.2915	0.6054	-	0.4787	-	-	-
1969	0.2063	0.5720	0.7333	0.6296	0.7432	0.5586	-
1970	0.8062	0.4356	0.4400	0.4790	0.6245	0.5649	-
1971	0.2974	0.3680	0.3906	0.4874	0.6146	0.4242	-
1972	0.2110	0.5364	0.7679	0.9533	0.5419	0.3266	-
1973	0.2026	0.4121	0.5000	0.3587	0.3802	0.2918	0.3832
1974	0.2286	0.3477	0.1600	0.4564	0.1414	0.3197	0.2513
1975	0.3242	0.2821	-	0.5118	0.1938	0.2128	0.2167
1976	0.2065	0.5079	0.1500	0.6734	0.3786	0.2683	-
1977	0.4506	0.7538	0.1739	1.0111	-	-	-
1978	0.5932	0.9081	-	0.7897	0.6770	0.3815	0.7759
1979	0.1212	1.4595	0.1364	-	0.6170	0.3891	-
1980[1]	0.2930	0.5000	0.4000	1.4177	0.7306	0.4503	-

1. Maritimes and Nfld.

Table 8. 4Vn (May-Dec) cod inshore: available age length keys.

YEAR	LONGLINE	GILLNET	SEINE
1967	X		
1968	X		
1969	X		
1970	X		
1971	X		
1972	X		
1973	X		
1974	X		
1975	X		
1976	X	X	
1977			X
1978	X		
1979	X		
1980	X		

Table 9. 4Vn (May-Dec) inshore cod: mean weight-at-age for longline catch (kg).

AGES	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	0.28	-	-	-	-	-
3	0.44	0.54	0.46	0.60	0.48	-	0.40	0.49	0.53	-	-	0.56	-	-
4	0.96	0.87	0.94	0.79	0.77	0.82	0.72	0.81	0.84	-	-	0.99	0.93	0.73
5	1.49	1.38	1.26	1.09	1.04	0.91	1.17	1.28	1.29	1.82	-	1.40	1.63	1.22
6	2.03	2.00	1.86	1.67	1.45	1.72	1.75	1.72	1.79	2.46	-	2.14	2.54	2.03
7	2.45	2.87	2.38	2.14	2.01	1.66	1.78	2.65	2.29	3.08	-	3.27	3.78	2.49
8	2.93	2.38	3.14	3.11	4.33	2.10	2.14	2.40	2.00	4.18	-	4.14	3.92	3.14
9	4.51	3.29	4.44	4.38	3.60	9.29	2.79	2.50	3.18	4.23	-	4.97	4.99	4.55
10	4.07	4.97	4.19	4.39	5.24	6.91	5.33	3.14	3.50	6.19	-	5.27	6.95	6.21
11	4.10	6.70	4.67	5.15	6.29	3.46	5.98	7.72	4.41	6.07	-	6.27	7.78	6.99
12	5.13	5.97	4.63	8.07	8.55	9.29	5.68	4.15	7.72	7.50	-	6.45	9.78	7.65
13	7.44	4.58	6.96	8.79	4.84	15.23	7.24	11.06	11.06	-	-	7.98	10.72	8.36
14	7.04	7.55	8.01	9.49	13.45	-	10.15	10.26	8.79	-	-	8.93	6.88	-
15	13.42	11.06	9.39	12.02	12.03	11.06	13.03	11.37	-	-	-	9.16	-	-
16	8.55	-	9.37	-	10.71	15.23	7.01	6.08	8.48	9.39	-	14.09	-	-

Table 10. 4Vn (May-Dec) inshore cod: catch-at-age by longlines (thousands of fish).

AGES	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	1	-	-	-	-	-
3	5	5	2	3	10	-	7	15	44	-	-	35	-	-
4	122	96	42	62	43	676	133	179	177	-	-	277	17	8
5	336	393	240	322	236	39	437	181	127	5	-	265	208	105
6	266	382	346	314	492	604	87	184	73	10	-	197	480	532
7	67	102	370	181	600	444	193	54	36	25	-	120	305	747
8	112	122	184	208	63	209	230	66	17	27	-	76	185	386
9	24	68	41	56	152	2	51	82	13	17	-	49	91	219
10	23	10	55	40	48	21	17	26	11	15	-	54	17	127
11	33	12	24	82	14	50	9	-	4	10	-	20	39	32
12	11	10	24	21	7	2	5	4	-	10	-	18	8	8
13	4	10	17	17	28	1	6	1	-	-	-	13	4	8
14	3	2	8	11	1	-	1	1	1	-	-	3	4	-
15	1	1	2	1	7	1	-	1	-	-	-	8	-	-
16	2	-	1	-	5	1	2	1	-	10	-	4	-	-

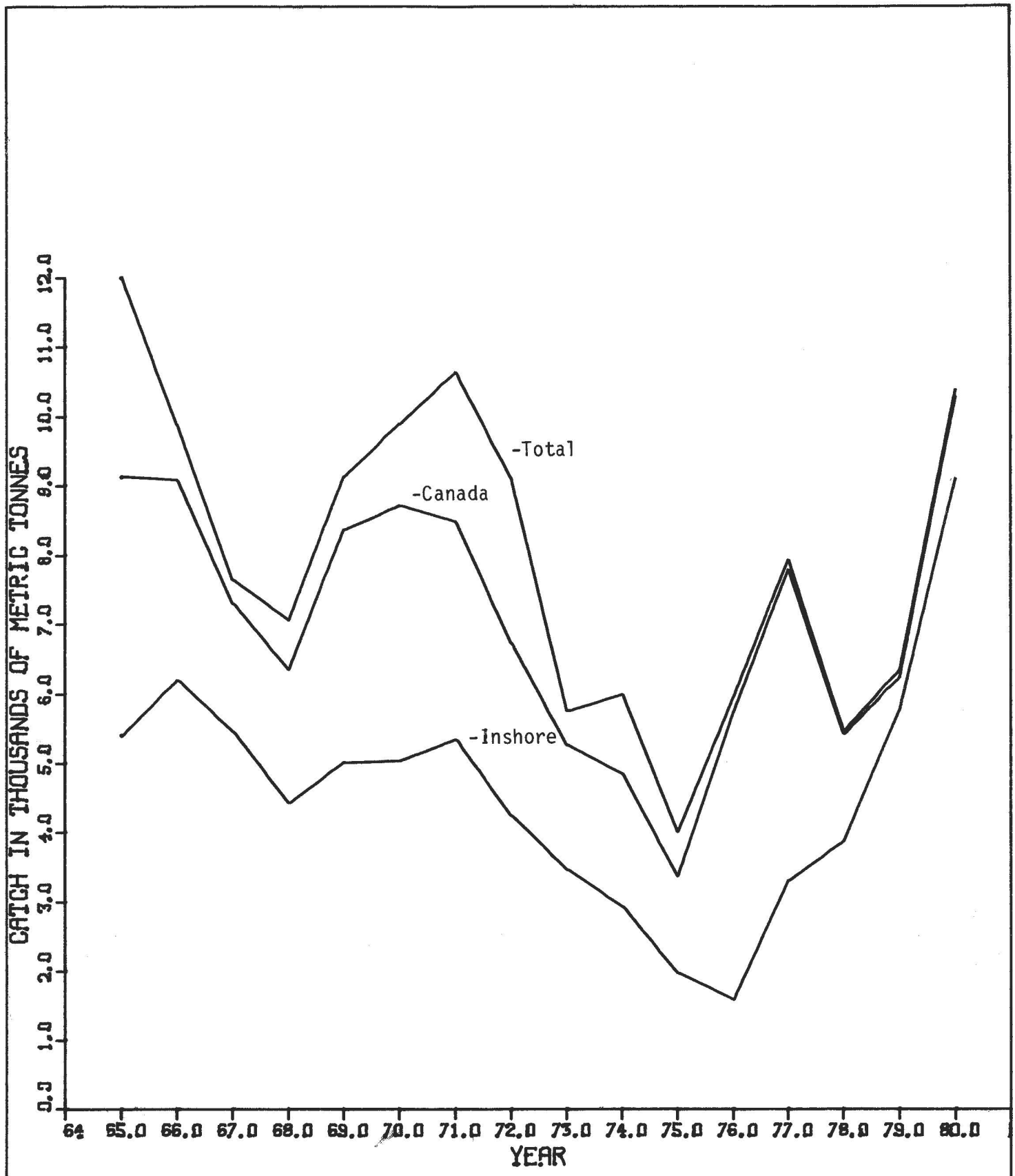

Figure 1. 4Vn (May-Dec) cod: nominal catch.

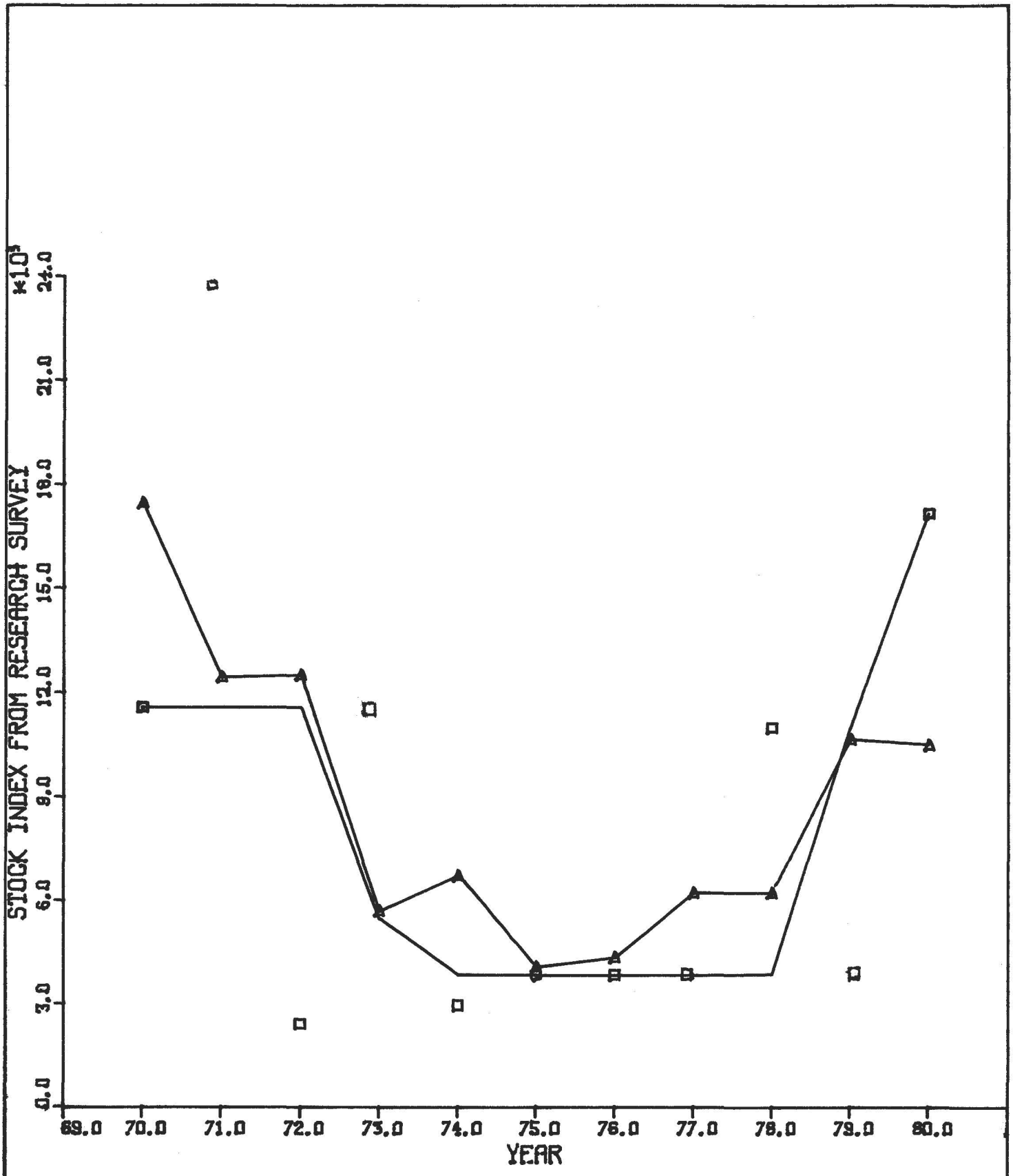

Figure 2. A comparison of methods for smoothing time trends (4Vn cod (M-D), 4+) for survey data (□ : observations, Δ: 3 year running means, —M3R.

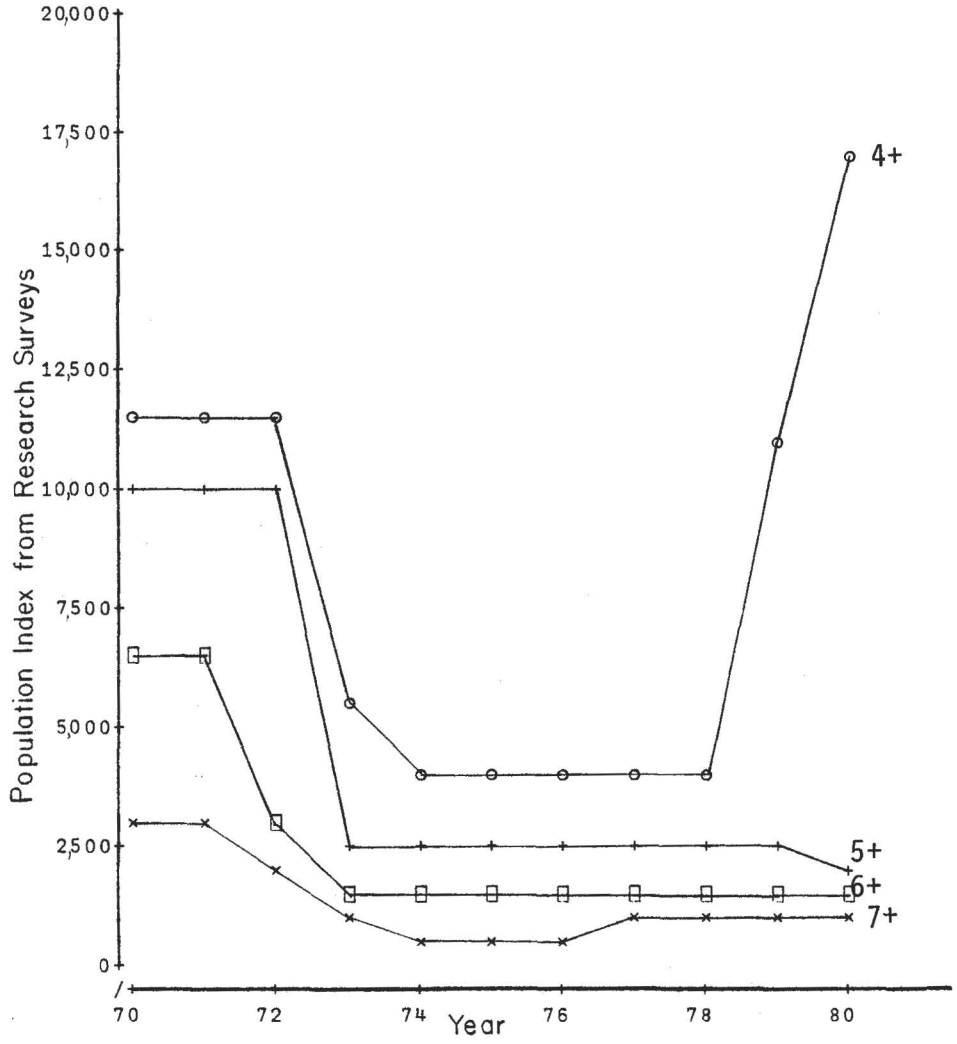

Figure 3. Research survey population indices (3 year median smooth). 4Vn (May-Dec) cod, numbers at age 4+, 5+, 6+, 7+.

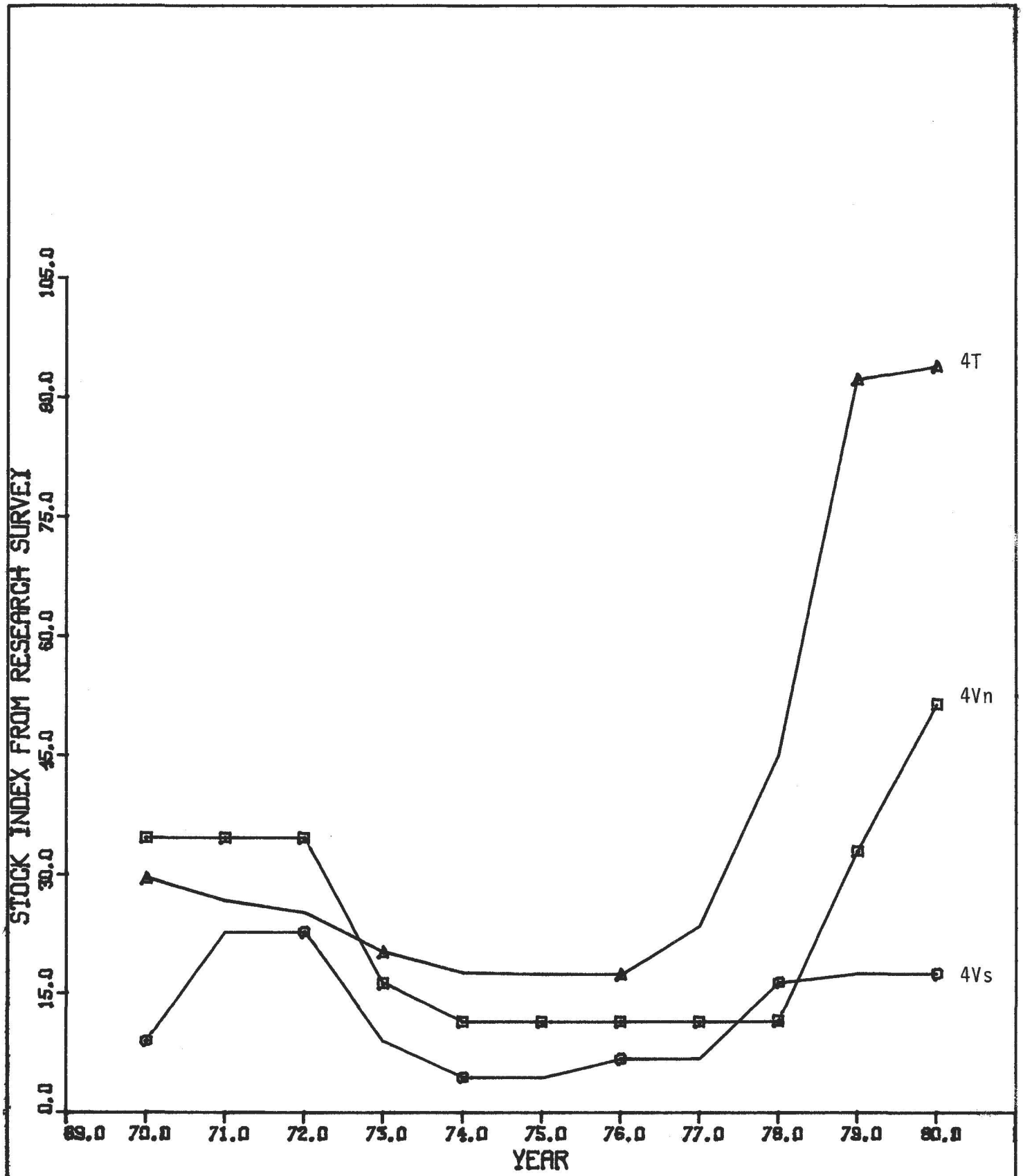

Figure 4. Comparison of smoothed time trends for research survey population indices (stratified mean number per tow) for NAFO area 4T, 4Vn, and 4Vs.

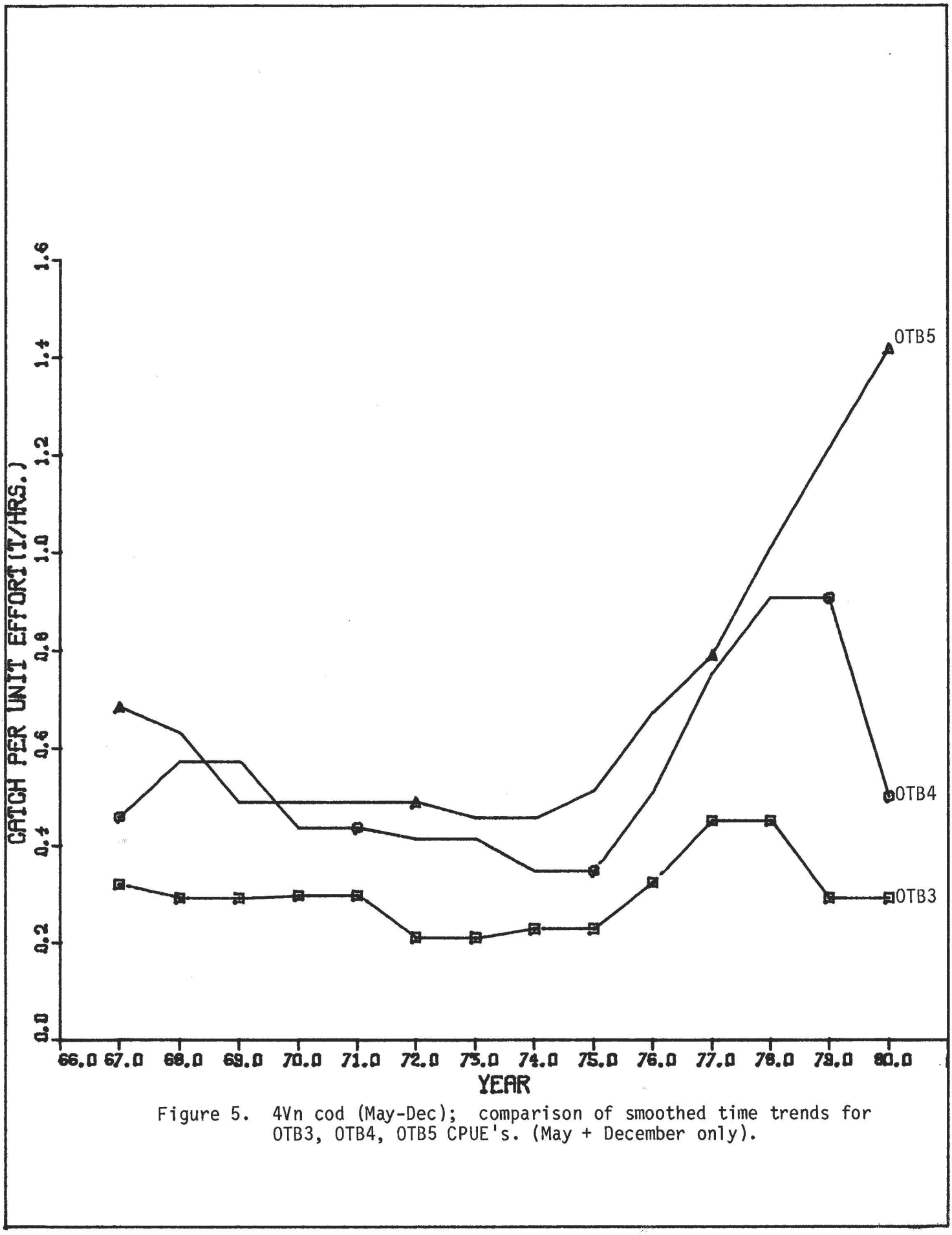

Figure 5. 4Vn cod (May-Dec); comparison of smoothed time trends for OTB3, OTB4, OTB5 CPUE's. (May + December only).

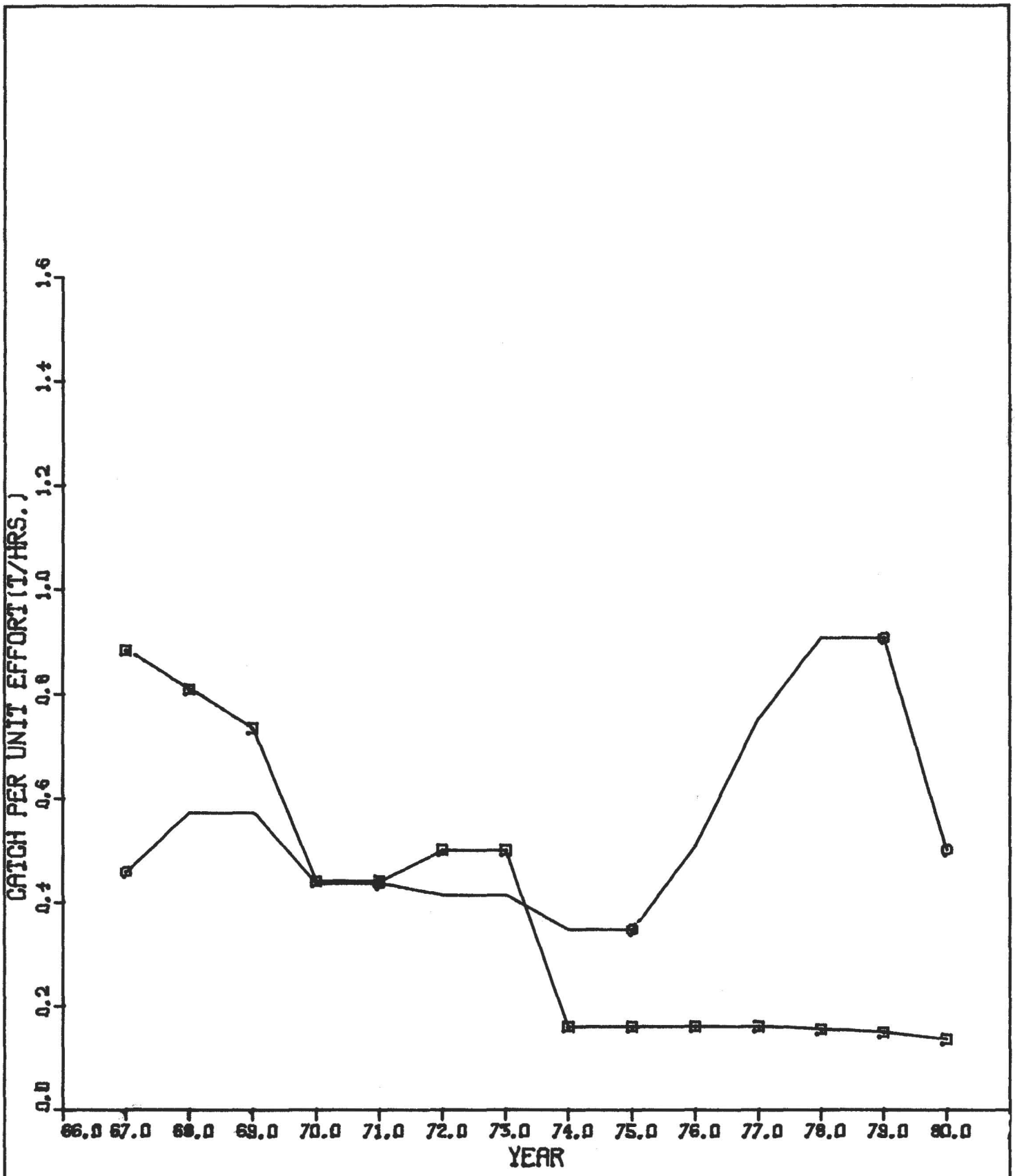

Figure 6. 4Vn cod (May-Dec); comparison of smoothed time trends for OTB4 seasonal trends in CPUE (May + December = -θ-, August + September = -⊟- .

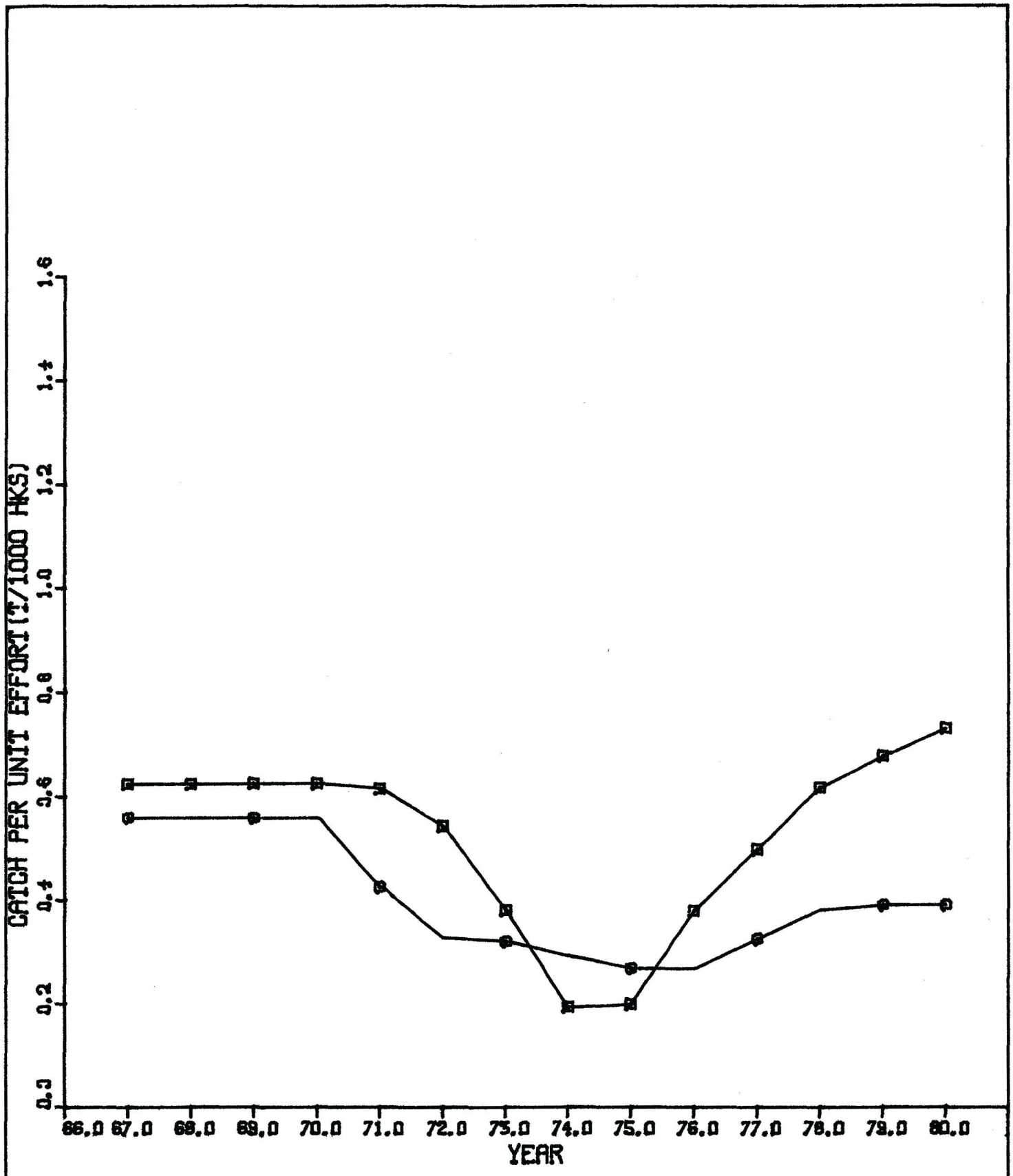

Figure 7. 4Vn cod (May-Dec); comparison of smoothed time trends for LL2 seasonal trends in CPUE (November + December = ⊟, August + September + October = ⊖).