Status of the 4T-Vn (Jan.-Apr.) cod stock - a mid-year look.

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ABSTRACT

Landings of 4T-Vn (Jan.-Apr.) cod from 1 January to 19 September 1991 were 28,212 t compared to 39,163 t for the same period in 1990. Some of the difference in landings between 1990 and 1991 (10,951 t) is due to 4,049 t less 4T cod being caught in the 4Vs winter fishery for 1991, a 2,721 t reduction in allocations to the 4Vn (Jan-Apr.) fishery for 1991, and a 1,033 t reduction in allocations to the 50-65 foot enterprise allocation (E.A.) fleet in the southern Gulf for 1991. Fixed gear catches for the same period did not differ between the two years. Overall, most of the perceived shortfall was in the landings by the 50-65 foot E.A. fleet. Factors that may have contributed to this shortfall include: severe ice-conditions during April and May; closures throughout the season due to excessive catches of small cod; and low catch rates. The autumn catch during 1990 was 18,000 t. There was no reason to presume similar catches would not be taken during 1991. If autumn catches in 1991 are as high as those recorded for 1990, the 1991 TAC would be taken. Catch rate analysis of the whole trawler fleet and an index fleet, restricted to the second quarter fishery, indicated that catch rates have declined since the mid-1980s. A preliminary analysis of the 1991 research survey also indicated a continued decline in numbers caught per tow. These results are consistent with the findings of the May 1991 stock assessment and the decrease in the TAC called for in the three year management plan (from 48,000 t in 1991 to 43,000 t in 1992) is, therefore, appropriate. As noted in the 1991 assessment, the reductions in the TAC will still result in fishing mortalities at the end of the multiyear plan that are higher than target levels of fishing mortality ($F_{0.1}$ = 0.20).

RÉSUMÉ

Du 1er janvier au 19 septembre 1991, les débarquements de morue de 4T-Vn (janvier-avril) s'élevaient à 28 212 t, comparativement à 39 169 t pour la même période en 1990. L'écart entre 1990 et 1991 (10 951 t) est dû en partie aux facteurs suivants: la pêche d'hiver de 1991 dans 4Vs a donné 404$ t de morue de 4T de moins; le contingent de la pêche de 1991 dans 4Vn (janvier-avril) a été réduit de 2721 t et la flottille des bateaux de 50 à 65 pieds du programme d'allocations par entreprise (AE), dans le sud du golfe, a essayé une baisse du contingent de 1991 de 1033 t. Par contre, il n'y avait pas de différence dans les prises du secteur à engins fixes d'une année à l'autre. Dans l'ensemble, c'est la flottille des bateaux de 50 à 65 pieds (AE) qui a subi la plus grosse baisse. Plusieurs facteurs ont pu contribuer à cette baisse, notamment l'importante quantité de glaces qui sont restées jusqu'en avril et mai; l'imposition de fermetures durant toute la saison de pêche à cause des prises excessives de petite morue et les taux de capture peu élevés. À l'automne 1990, les prises étaient de 18 000 t. On n'avait aucune raison de croire que la saison de 1991 ne donnerait pas les mêmes résultats. Si les prises de l'automne 1991 sont aussi élevées que celles de 1990, le TPA de 1991 aura été atteint. D'après une analyse des taux de capture de toute la flottille de chalutiers et d'une flottille de pêcheurs repères, qui visait seulement la pêche au deuxième trimestre, les taux de capture baissent depuis le milieu des années 1980. Une analyse préliminaire des résultats du relevé effectué en 1991 indique aussi une baisse continuelle des prises par trait de chalut. Ces résultats sont conformes aux conclusions de l'évaluation des stocks de mai 1991. Par conséquent, la

baisse du TPA que l'on demande dans le plan de gestion triennal (de 48 000 t en 1991 à 43 000 t en 1992) est appropriée. Comme on l'indiquait dans l'évaluation de 1991, malgré les réductions du TPA, à la fin de ce plan pluriannuel le taux de mortalité par pêche sera encore plus élevé que le taux de mortalité par pêche visé, qui est de $F_{0.1} = 0,20$.

(A) DESCRIPTION OF THE FISHERY

The winter fishery (Jan.-Apr.) for 4T cod in subdivision 4Vn landed slightly less than the allowed catch in 1991 (Table 1), similar to 1990. In 1991, the French fleet landed 1558 t of an allocation of 1600 t. Thus the total landings in 4Vn during 1991 were close to the quota allocation. Similar to 1990, there were severe ice-conditions during the winter in 4Vn and significant amounts (3600 t) of 4T cod were caught in 4Vs (Chouinard & Nielsen 1992). The landings from 1 January to 19 September 1991 were 28,212 t compared with 39,163 t for the same period in 1990. The differences in catches between 1990 and 1991 were partly due to:

    (1) 2,721 t lower quota allocation for the 4Vn (Jan.-Apr.) fishery;
    (2) 4,049 t less catch during the 4Vs winter fishery; and
    (3) 3,213 t less catch by the 50 to 65 foot enterprise allocation fleet in
    4T (note: the allocation was reduced by about 1,033 t).

Factors that likely contributed to the shortfall within 4T itself include: severe ice-conditions during April and early May; closure of the entire southern Gulf during late May and early June due to excessive catches of small cod; and closure of specific unit areas at various times due to excessive catches of small cod; and low catch rates. The fall catch of 4T cod was 18,000 t during 1990; there was no reason to presume that similar catches would not occur during the fall 1991 fishery. This would result in the 1991 TAC for the stock being caught.

Month-by-month comparisons of catches were made between 1991 and 1990 and between these two years and the 1986 to 1989 period. Cod catches in 4T have averaged about 4800 t in April from 1986 to 1989 but were only 1880 t in 1990 and 600 t in April 1991 (Table 2). Within the southern Gulf, severe ice-conditions occurred throughout April 1991 (similar to 1990) and the fishery was closed on 3 - 4 May due to ice-conditions near the Magdalen Islands. Catches in May averaged 13,000t from 1986 to 1989. Only 4800 t were caught in 1990 compared with 5000 t in 1991. This 5000 t catch in 1991 was remarkable because of closures early in the month due to the presence of ice and closure of the entire Gulf to mobile gears from the 23 May to 5 June due to excessive capture of small cod. Landings in June 1991 were relatively low compared to 1990, whereas catches in July and August were near average. The landings reported for the month of September were higher than those reported for 1990 but slightly below the average for 1986 to 1989. The overall pattern has been for a shift in landings from very high levels in spring (e.g., 1986 and 1987) to a greater fraction of landings occurring from October to December, beginning in 1988 and 1989. This change coincides with the introduction of individual allocations (Chouinard et al. 1990). The individual allocation permits fishermen more flexibility to decide when to fish (according to weather and market conditions) without being penalized

in terms of lost landings, as happens in a strictly competitive fishery.

There were many closures of the fishery in 4T during 1991. There was a two day closure early in May due to dangerous ice conditions. The entire mobile fishery was closed from 23 May to 01 June due to excessive catches of small cod. A test fishery was opened from 1 to 4 June but there were no participants. The small boat fleet (< 45') was placed on trip limits on 17 May. Because many small cod were present in the eastern part of the Gulf during 1990, areas 4Tg and 4Tf (comprising all areas east of the Magdalen Islands) were closed in June for all mobile gears (a 10% bycatch of cod was permitted) and remained closed until mid-September. It is also possible that cod distributions during the spring fishery were different from those normally observed (due to the ice-conditions) and such changes might result in reduced catch-per-unit-effort as the fleets attempted to find the areas of cod concentration.

The landings by various gear sectors were not affected similarly by the closures, ice-conditions, and changes in cod distribution. The total landings to the end of May were similar for 1990 and 1991 (Fig. 1). By the end of August to mid-September the total reported landings in Division 4T during 1991 were down by 4200 t compared to the same period in 1990. The 1991 fixed gear catches were the same as those reported during 1990 (Fig. 2). The mobile gear catches were down by 4700 t (Fig. 3) compared to the same period in 1990, despite being similar at the end of May. The 50 to 65' enterprise allocation fleet has more flexibility in choosing when to fish. The landings by this fleet began to diverge from those reported in 1990 at the end of May (Fig. 4). By mid-September the difference was over 3200 t, or most of the perceived shortfall in landings. Although catch rates were down, some of the shortfall was likely due to severe ice-conditions in 4T during 1991 (which were as bad or worse than those observed during 1990) and to part of the Gulf being closed to fishermen for a significant fraction of the season (to protect small cod). Nevertheless, there was no reason to suppose that the 1991 TAC would not be taken if October to mid-December catches followed the same pattern as seen in 1990.

(B) CATCH RATE INDEX

Otter trawl index - offshore and midshore fleet

Data from 1965 to 1991 were included in the analysis. Catch and effort data were only available to 30 June during 1991, therefore, the information used to calculate the otter trawl catch index was restricted to the second quarter for the entire period. The standardized catch rate was calculated with a multiplicative model (Gavaris 1980). The following categories were included: region/gear/tonnage class; NAFO division; month; and year. As usual, categories with fewer than 10 observations were eliminated from the analyses.

The analysis of variance and regression coefficients are presented in Table 3. The model explained 65% of the variation and coefficients for all categories except NAFO division were significantly different from 0.0. Residual plots are shown in Figure 5. The catch rate index showed an increase from the mid-1970s to a peak in 1983, decreases in 1984 and 1985, another peak in 1986 then a steady

decrease to 1991 (Table 4; Fig. 6). The standardized effort for the second quarter of 1991 was about 76% of that in 1990. The overall pattern was similar to that reported for the entire data set in Hanson et al. (1991) except that there was no decline in catch rates between 1989 and 1990 in the whole year analysis but there was a decline when only the second quarter was examined. We note, however, that in the month-by-month analysis, catches in April and May have decreased in recent years but have increased substantially during the fall months (Table 2). If the fall catch rates were higher than average, this might compensate for lower than average spring catch rates when calculating the annual average.

Index trawler catch rate

There is a concern that the otter trawl fleet has changed over time and that catchability has not been constant. Catch rate analyses (second quarter) were performed for a fleet of index boats comprised of 32 otter trawlers (10 gulf and 22 Quebec based) that have fished in 4T from 1985 to 1991 (Gulf based) or 1986 to 1991 (Quebec boats).

The number of hours fished was used as the measure of effort for the trawlers. Log book data were used for Gulf boats and ZIFF files for the Quebec based boats. Data were aggregated by boat, month, and year.

Results of the regression analyses are presented in Table 5. The model explains 75% of the variation and all estimates of coefficients except month were significantly different from zero. Residual plots are shown in Figure 7. The index trawl catch rate shows little change between 1990 and 1991. The mean catch rate between 1989 and 1991 was lower than that calculated for 1987 and 1988 (Table 6; Figure 8).

Summary of Catch Rates

Both indices showed the same pattern: catch rates for the second quarter of the last few years have been lower than historical levels. In 1990, the second quarter catch rates were noticeably lower than in previous years but the rates in the last half of the year were sufficiently high to produce a catch rate higher than that observed in 1989. For 1991, we do not have any indication of what the overall 1991 catch rate will be.

(C) RESEARCH SURVEY ANALYSES

The 1991 abundance survey was completed 22 September 1991, therefore, it is impossible to provide true mean numbers per tow for the various age groups in 1991. Instead, the 1990 size-at-age key was used to generate the 1991 results. The stratification scheme was the same as used in previous surveys (Fig. 9). The weather was not a factor during the 1991 survey and 188 sets were completed.

The mean number per tow for cod age 3 and older was 78.3, which is 82% of that observed in 1990 and about three times the numbers per tow observed for the period of low cod abundance during the mid- 1970s (Table 7). For ages 5+ the estimate was 78% of the 1990 estimate and for ages 8+ the estimates were 61% of

the 1990 estimate. Thus the small decline in mean number at age per tow appears to be primarily in the older age-groups. However, validation of these results will have to wait until age-determinations are completed. If sizes at age for 1991 are similar to those observed in 1990, the coefficients of variation around the estimated mean number per tow at age will vary between 10 and 29% (Table 8). Changes in average size-at-age could not be evaluated because age determinations were not completed.

Cod distributions have changed somewhat between 1988 and 1991 (Table 9). Between 12.6 and 17.4 % of the catch during the survey was collected in strata 416 and 417 during 1988 to 1990 but only 5.3% was caught there in 1991. Catches during 1991 were proportionately higher in strata 431 and 433 than in earlier years.

Acknowledgements

References

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Table 1. Total landings (t) from 1 January to 19 September 1991 of 4T cod compared with landings for the same period during 1990.

Area	1990 Original Quota	Catch	1991 Original Quota	Catch
France	1360	937	1600	1588
4Vn	8800	8636	6079	5243
4Vs	0	7656	0	3607
4T (to 19 Sept)	42840	21934	40321	17774
Subtotal		39163		28212
4T (rest of year)		18429		n/a
Total for stock	53000	57592	48000	n/a

Table 2. Monthly summaries of catches, expressed as total catch and percentage of TAC, of cod in Division 4T from 1986 to 1991.

Total Catch (tonnes)

Year	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	TAC
1986	5767	13416	6962	7173	2187	3946	2927	4038	22	60,000
1987	4864	15269	5853	3146	6534	1475	1675	2215	149	45,200
1988	4451	15800	1707	2091	2853	3794	4835	5702	1803	54,000
1989	3986	7368	7479	3711	3018	3575	5060	5571	1308	54,000
Mean	4767	12963	5500	4030	3648	3198	3624	4382	821	53,000
1990	1880	4791	7791	5056	3735	2367	3653	9773	952	53,000
1991	599	4980[a]	3342[b]	4044	3244	2695	?	?	?	48,000

Percentage of TAC

Year	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1986	9.6	22.4	11.6	12.0	3.6	6.6	4.9	6.7	0.04
1987	10.8	33.8	12.9	7.0	14.4	3.3	3.7	4.9	0.3
1988	8.2	29.3	3.2	3.9	5.3	7.0	9.0	10.6	3.3
1989	7.4	13.6	13.9	6.9	5.6	6.6	9.4	10.3	2.4
Mean	9.0	24.8	10.5	7.5	7.3	5.9	6.8	10.2	1.5
1990	3.5	9.0	14.7	9.5	7.0	4.4	6.9	18.4	1.8
1991	1.2	10.4[a]	7.0[b]	8.4	6.8	5.6	?	?	?

[a] last week closed due to catches of small cod
[b] first week closed due to catches of small cod

Table 3. Catch rate analysis for otter trawls from 1966 to 1991, second quarter only.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R............. .805
MULTIPLE R SQUARED..... .648

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.303E0002	3.303E0002	
REGRESSION	38	1.509E0002	3.971E0000	19.103
TYPE 1	10	6.158E0001	6.158E0000	29.626
TYPE 2	1	9.406E-001	9.406E-001	4.525
TYPE 3	2	8.156E0000	4.078E0000	19.619
TYPE 4	25	5.457E0001	2.183E0000	10.500
RESIDUALS	394	8.190E0001	2.079E-001	
TOTAL	433	5.631E0002		

Table 3. Continued.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	2114	INTERCEPT	-0.507	0.171	433
2	43				
3	4				
4	66				
1	2112	1	-1.097	0.088	61
	2113	2	-0.712	0.083	74
	2122	3	-0.579	0.115	27
	2123	4	-0.474	0.088	63
	2124	5	-0.134	0.092	45
	2125	6	0.304	0.102	33
	3113	7	0.038	0.184	8
	3114	8	-0.067	0.103	33
	3123	9	0.438	0.207	6
	3125	10	0.146	0.114	24
2	44	11	-0.142	0.067	106
3	5	12	-0.267	0.062	136
	6	13	-0.424	0.069	95
4	67	14	-0.015	0.201	14
	68	15	0.248	0.196	17
	69	16	0.156	0.192	16
	70	17	0.075	0.188	18
	71	18	-0.093	0.180	24
	72	19	0.260	0.179	25
	73	20	-0.033	0.183	22
	74	21	-0.448	0.182	23
	75	22	-0.349	0.187	19
	76	23	-0.489	0.188	18
	77	24	-0.120	0.206	12
	78	25	-0.094	0.204	13
	79	26	0.311	0.203	13
	80	27	0.401	0.194	17
	81	28	0.247	0.204	13
	82	29	0.495	0.191	18
	83	30	0.811	0.197	15
	84	31	0.719	0.199	14
	85	32	0.282	0.216	10
	86	33	0.907	0.187	20
	87	34	0.835	0.191	18
	88	35	0.582	0.191	19
	89	36	0.507	0.187	21
	90	37	0.278	0.196	16
	91	38	-0.023	0.222	9

Table 4. Predicted catch rates for otter trawl fleet, second quarter only.

PREDICTED CATCH RATE

STANDARDS USED   VARIABLE NUMBERS: 2114   43   4

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	CATCH RATE S.E.	EFFORT
1966	10820	0.305	0.658	0.112	16433
1967	7006	0.730	0.651	0.092	10756
1968	9792	0.728	0.849	0.115	11539
1969	7310	0.756	0.774	0.102	9447
1970	6973	0.810	0.714	0.091	9762
1971	10790	0.907	0.605	0.070	17840
1972	15929	0.944	0.861	0.098	18510
1973	6358	0.913	0.642	0.076	9909
1974	3427	0.861	0.424	0.050	8084
1975	5197	0.817	0.468	0.059	11113
1976	4497	0.660	0.406	0.052	11063
1977	2998	0.869	0.586	0.087	5114
1978	5514	0.848	0.602	0.085	9159
1979	7628	0.873	0.902	0.130	8455
1980	5610	0.845	0.989	0.129	5671
1981	7408	0.879	0.847	0.122	8747
1982	7006	0.892	1.088	0.138	6442
1983	9423	0.976	1.488	0.210	6333
1984	8122	0.736	1.357	0.195	5987
1985	8961	0.563	0.874	0.142	10252
1986	13388	0.723	1.642	0.209	8153
1987	15339	0.595	1.526	0.198	10049
1988	13105	0.633	1.185	0.158	11057
1989	11745	0.644	1.101	0.138	10670
1990	11404	0.481	0.874	0.121	13054
1991	8793	0.321	0.643	0.111	13668

AVERAGE C.V. FOR THE MEAN: .136

Table 5. Catch rate analysis for index fleet of trawlers, second quarter only.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.............. .863
MULTIPLE R SQUARED..... .746

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.720E0002	1.720E0002	
REGRESSION	39	1.834E0002	4.702E0000	18.332
TYPE 1	31	1.442E0002	4.652E0000	18.140
TYPE 2	2	2.392E0000	1.196E0000	4.664
TYPE 3	6	3.433E0001	5.722E0000	22.311
RESIDUALS	244	6.258E0001	2.565E-001	
TOTAL	284	4.180E0002		

Table 5. Continued.

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REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3	INTERCEPT	-0.211	0.272	284
2	4				
3	85				
1	4	1	0.050	0.311	6
	7	2	-0.384	0.300	7
	8	3	1.996	0.328	5
	10	4	-0.077	0.357	4
	11	5	-0.153	0.336	5
	13	6	0.725	0.389	3
	14	7	0.001	0.341	5
	15	8	1.063	0.303	9
	16	9	-0.216	0.328	6
	21	10	-1.270	0.309	8
	22	11	-1.203	0.293	11
	23	12	-0.876	0.325	6
	24	13	-1.239	0.303	9
	25	14	-1.745	0.302	9
	26	15	-1.333	0.287	13
	27	16	-1.707	0.294	11
	29	17	-1.926	0.315	7
	30	18	-1.550	0.290	12
	32	19	-0.872	0.309	8
	33	20	-1.438	0.287	13
	34	21	-1.287	0.284	14
	35	22	-1.116	0.284	14
	36	23	-1.136	0.290	12
	37	24	-1.336	0.286	13
	38	25	-1.099	0.301	9
	40	26	-1.469	0.297	10
	42	27	-1.344	0.295	11
	44	28	-1.356	0.299	10
	45	29	-1.562	0.305	9
	46	30	-1.512	0.300	10
	47	31	-1.406	0.300	10
2	5	32	0.200	0.089	138
	6	33	0.310	0.102	95
3	86	34	0.215	0.243	37
	87	35	0.721	0.243	56
	88	36	0.776	0.241	50
	89	37	0.002	0.241	50
	90	38	-0.130	0.248	48
	91	39	-0.166	0.252	36

Table 6. Predicted catch rates for index trawler fleet, second quarter only.

PREDICTED CATCH RATE

STANDARDS USED   VARIABLE NUMBERS: 3   4

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	S.E.	EFFORT
1985	8961	0.128	0.887	0.238	10100
1986	13388	0.234	1.105	0.278	12114
1987	15339	0.249	1.829	0.473	8385
1988	13105	0.390	1.934	0.497	6777
1989	11745	0.237	0.892	0.229	13167
1990	11404	0.238	0.780	0.206	14622
1991	8793	0.201	0.752	0.201	11700

AVERAGE C.V. FOR THE MEAN: .260

Table 7. Research survey mean numbers per tow at age (1971 to 1991) for the 4T-Vn (J.-A.) cod stock.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.14	0.24	0.19	0.21
1	0.06	0.73	0.07	0.08	0.40	2.96	0.55	1.24	0.17	0.98	4.72	3.04
2	0.57	2.07	4.69	2.31	5.42	7.33	10.19	5.11	21.67	4.61	20.50	25.17
3	6.18	4.54	9.29	10.10	4.08	31.73	15.12	23.11	21.99	31.99	19.02	16.10
4	7.48	12.13	4.31	7.08	6.18	7.97	12.75	24.90	46.63	24.02	56.74	20.63
5	7.10	5.02	6.86	2.74	5.18	5.34	4.99	14.07	28.46	41.82	47.01	23.93
6	5.52	4.18	3.23	3.31	1.82	2.25	2.65	4.28	11.60	20.53	45.88	38.13
7	3.49	2.85	2.29	1.43	1.30	0.60	1.51	2.42	3.03	7.40	19.31	19.67
8	0.85	1.65	1.72	1.01	0.87	0.44	0.65	0.83	1.24	1.23	10.40	9.34
9	0.16	0.31	1.09	1.01	0.40	0.25	0.48	0.33	0.62	0.60	1.38	2.89
10	0.19	0.23	0.31	0.44	0.30	0.23	0.31	0.41	0.17	0.25	0.57	0.32
11	0.11	0.20	0.07	0.18	0.35	0.21	0.25	0.48	0.18	0.60	0.25	0.12
12	0.09	0.06	0.21	0.09	0.08	0.06	0.20	0.60	0.15	0.01	0.10	0.10
13	0.00	0.03	0.03	0.19	0.05	0.06	0.24	0.00	0.05	0.01	0.06	0.05
14	0.08	0.02	0.05	0.00	0.00	0.02	0.00	0.13	0.04	0.05	0.05	0.02
15	0.07	0.03	0.01	0.04	0.00	0.02	0.04	0.03	0.04	0.01	0.06	0.00
16	0.00	0.00	0.00	0.04	0.00	0.02	0.02	0.00	0.02	0.01	0.00	0.03
17	0.09	0.00	0.02	0.03	0.00	0.00	0.03	0.00	0.00	0.00	0.06	0.00
18	0.06	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
19	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
20	0.00	0.00	0.03	0.03	0.00	0.00	0.03	0.00	0.00	0.00	0.19	0.00
3+	31.47	31.29	29.63	27.72	20.61	49.20	39.27	71.59	114.22	128.53	201.10	131.35
5+	17.81	14.62	16.03	10.54	10.35	9.50	11.40	23.58	45.60	72.52	125.34	94.62
8+	1.70	2.57	3.65	3.06	2.04	1.31	2.25	2.81	2.51	2.77	13.16	12.89

	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.01	0.00	1.30	2.08	0.29	0.64	0.23	0.14	0.48
1	5.94	2.18	3.92	6.42	0.33	2.70	8.78	1.50	2.81
2	19.66	11.06	12.65	21.42	8.34	7.17	18.33	4.99	6.49
3	42.38	15.05	33.07	38.15	20.05	35.92	22.30	27.79	20.70
4	36.49	33.85	43.43	51.48	17.73	46.88	22.29	21.14	21.09
5	19.46	42.08	78.63	50.97	24.43	42.62	22.01	15.66	15.07
6	14.04	15.67	88.81	54.87	19.18	31.39	24.16	11.24	8.69
7	12.16	8.08	21.12	35.31	26.19	15.99	13.60	7.87	5.35
8	8.36	8.54	8.31	9.28	9.95	19.41	8.68	4.45	2.81
9	3.98	3.41	5.93	1.85	2.17	11.65	8.74	2.65	1.60
10	2.62	1.56	3.06	2.64	1.61	1.91	5.82	3.07	1.81
11	0.56	0.54	2.00	0.91	0.60	0.55	1.15	1.44	0.84
12	0.11	0.01	0.68	0.58	0.49	0.36	0.38	0.29	0.18
13	0.31	0.04	0.03	0.20	0.20	0.34	0.19	0.06	0.03
14	0.04	0.01	0.00	0.10	0.09	0.12	0.16	0.11	0.10
15	0.06	0.02	0.00	0.00	0.01	0.18	0.05	0.02	0.01
16	0.00	0.02	0.07	0.10	0.01	0.00	0.03	0.01	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
3+	140.57	128.88	285.14	246.44	122.71	207.32	129.63	95.80	78.28
5+	61.70	79.98	208.64	156.81	84.93	124.52	85.04	46.87	36.49
8+	16.04	14.15	20.08	15.66	15.13	34.52	25.27	12.10	7.38

Table 8. Research survey (1971 to 1991) coefficients of variation for ages 1 to 12.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	73.9	82.4	47.4	50.9
2	53.2	31.9	46.7	44.1	66.2	36.6	30.5	43.5	41.2	36.0	33.6	26.4
3	24.9	46.5	21.8	24.4	46.8	24.9	16.5	19.7	25.2	19.1	42.9	29.9
4	10.9	19.7	18.6	12.9	52.0	18.9	17.8	21.1	15.6	26.5	18.4	31.6
5	14.5	15.3	18.5	9.1	29.4	13.5	17.2	35.7	13.4	19.5	20.0	23.1
6	15.7	21.0	17.5	8.9	26.2	22.2	22.2	37.4	12.2	21.3	20.5	22.8
7	16.0	20.4	16.4	7.0	31.7	27.5	28.5	27.8	9.7	22.2	19.3	23.1
8	15.8	18.0	16.2	7.8	28.3	31.4	34.0	23.6	8.5	20.5	17.7	19.6
9	15.5	17.9	15.0	7.4	27.2	28.4	31.7	25.4	10.2	21.9	16.1	17.3
10	23.3	16.7	16.2	7.1	26.2	33.2	30.8	44.0	13.3	25.2	13.0	15.5
11	25.9	22.1	20.9	12.9	29.6	29.3	36.3	39.3	36.2	29.5	14.3	21.3
12	35.5	24.4	21.3	18.4	31.0	31.7	33.5	71.8	23.4	33.5	14.2	33.3

	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	100.0	0.0	72.5	81.2	65.4	54.2	35.3	20.2	29.2
2	21.7	19.2	73.9	66.0	40.0	65.3	60.3	19.2	18.4
3	13.3	20.9	27.6	34.3	27.1	35.9	28.8	14.0	22.3
4	15.5	18.1	22.7	34.1	18.5	30.0	19.2	12.4	22.2
5	16.2	18.1	36.1	46.9	10.6	21.5	13.5	11.2	19.2
6	11.9	20.2	44.9	43.5	11.0	21.2	11.4	10.6	14.7
7	9.2	13.2	46.6	36.6	14.7	17.9	11.3	10.6	12.0
8	9.8	9.6	45.7	26.5	20.6	17.3	11.2	10.3	10.9
9	10.1	9.3	36.3	21.1	26.3	16.7	11.2	10.8	10.4
10	13.1	8.9	37.1	10.5	29.1	17.8	11.3	10.7	10.6
11	11.6	8.7	33.4	21.0	33.5	19.7	12.2	10.9	10.7
12	15.4	8.9	33.1	17.2	33.3	28.4	12.1	12.8	16.2

Table 9. Distribution of biomass (as percentages) between strata, based on research surveys from 1988 to 1991.

stratum	1991	1990	1989	1988
415	0.4	0.0	0.0	0.1
416	3.6	10.4	6.1	10.5
417	1.7	2.2	11.3	3.0
418	1.1	4.0	1.3	0.5
419	2.0	1.3	1.3	0.5
420	0.6	3.1	4.2	0.7
421	0.5	0.8	0.7	0.0
422	14.7	12.9	12.5	14.3
423	24.7	28.7	15.3	16.4
424	2.0	3.7	6.0	2.4
425	0.0	0.0	0.0	0.0
426	1.9	1.1	4.6	4.5
427	1.2	1.0	0.7	2.9
428	0.6	0.5	4.0	2.4
429	13.6	7.5	9.4	16.0
431	17.3	9.1	8.1	11.3
432	0.0	0.0	0.0	0.0
433	4.6	0.9	1.5	1.6
434	3.6	4.7	7.5	3.3
435	1.8	2.1	3.2	0.5
436	2.1	1.8	1.8	6.9
437	0.9	2.5	0.9	0.9
438	0.6	0.6	0.4	1.0
439	0.3	1.0	0.0	0.4

Summary of catches 1991 vs 1990

Total catch

1990

1991

(Thousands)

22 20 18 16 14 12 10 8 6 4 2 0

april 03   may 01   may 29   june 26   july 24   august 21   sept. 19
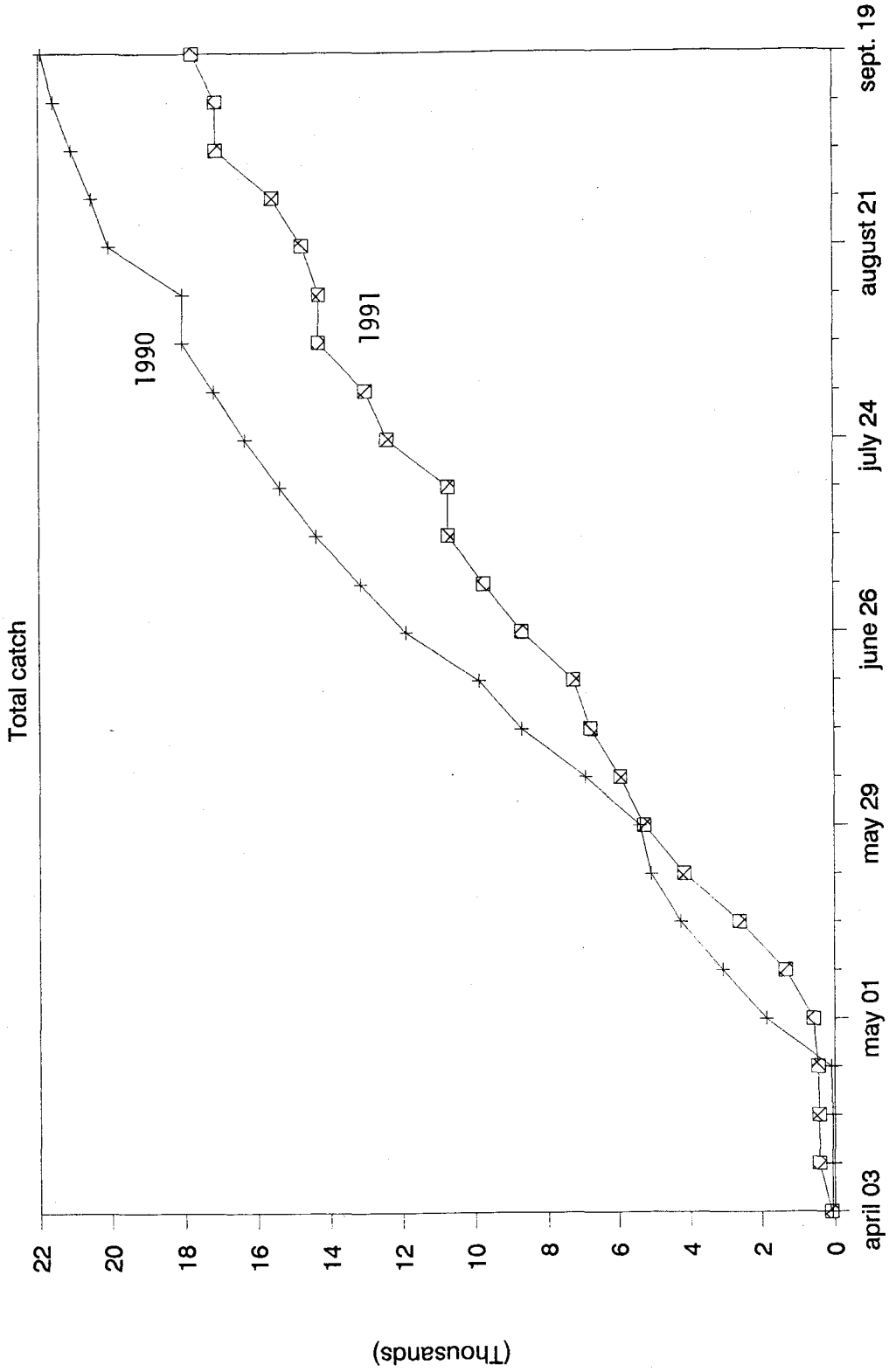
Figure 1. Cummulative catches of cod in 4T-Vn (J.-A.): all gears, area 4T only.
Boxes represent 1991, crosses 1990.
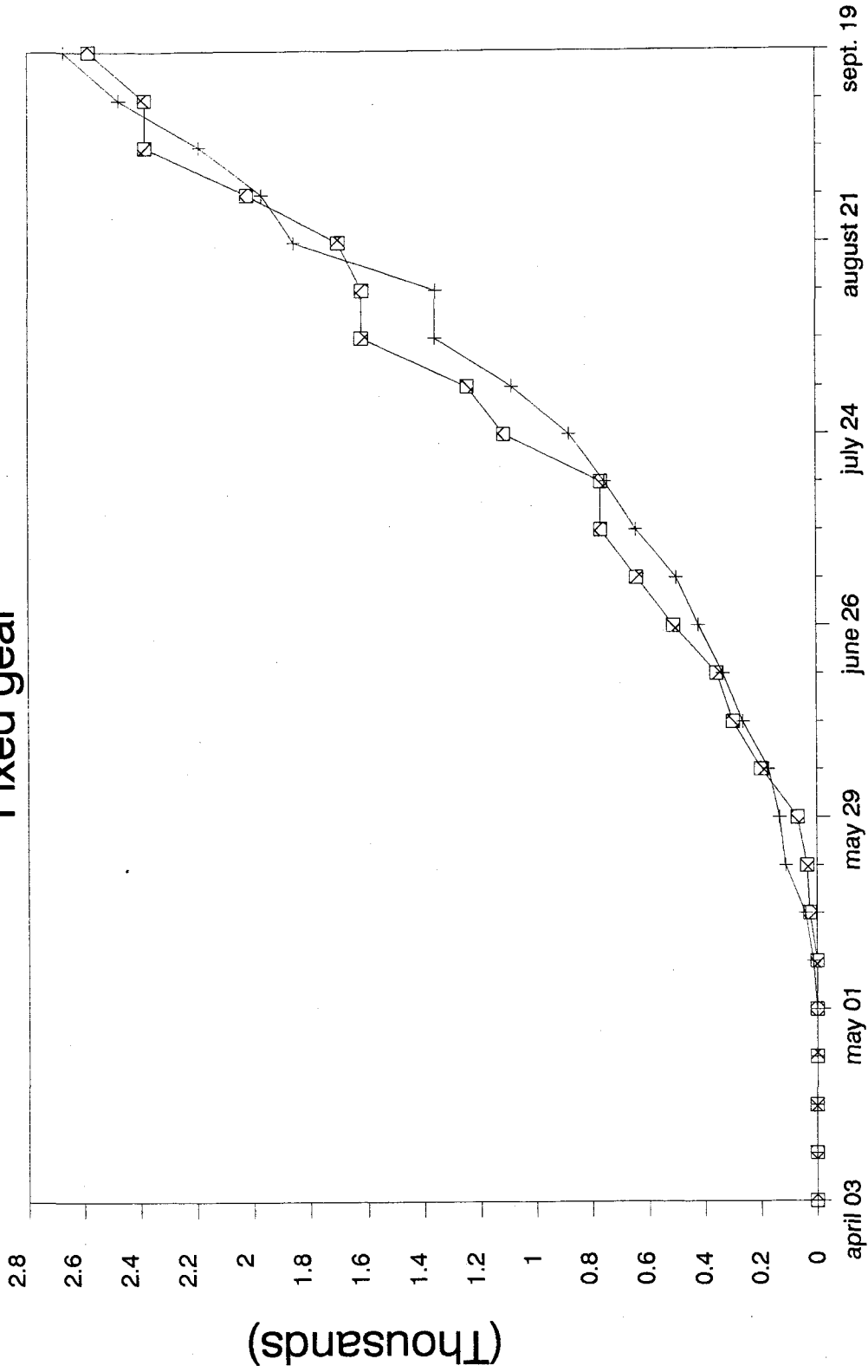
Figure 2. Cummulative catches of 4T-Vn (J.-A.) cod: fixed gear only (boxes represent 1991, crosses 1990). Area 4T only.
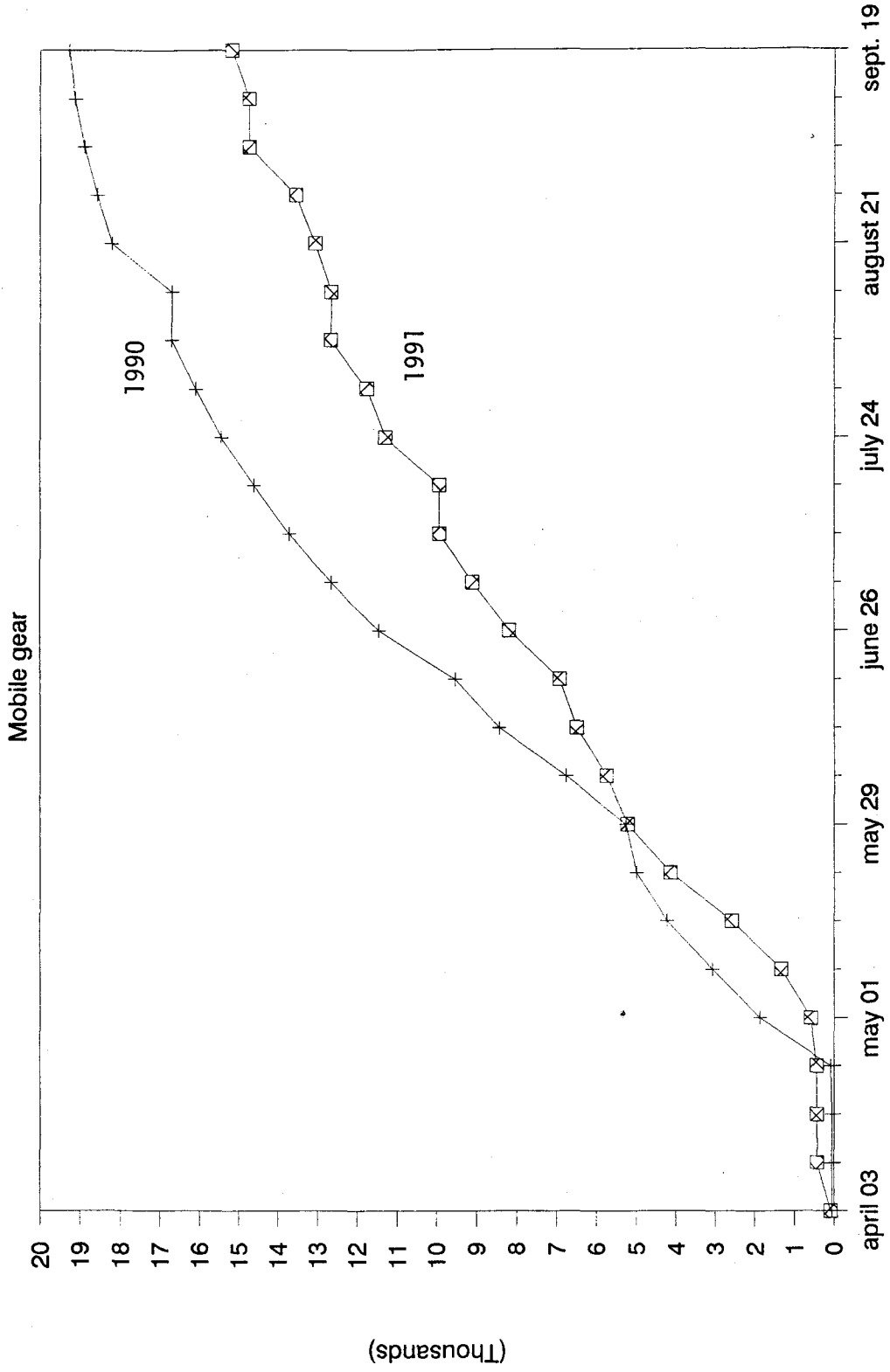
Figure 3. Cummulative catches of 4T-Vn (J.-A.) cod: all mobile gears. Symbols the same as Fig. 2.

Summary of catches 1991 vs 1990

EA-fleet (50 to 65 foot)

1990

1991

(Thousands)

12
11
10
9
8
7
6
5
4
3
2
1
0

april 03   may 01   may 29   june 26   july 24   august 21   sept. 19
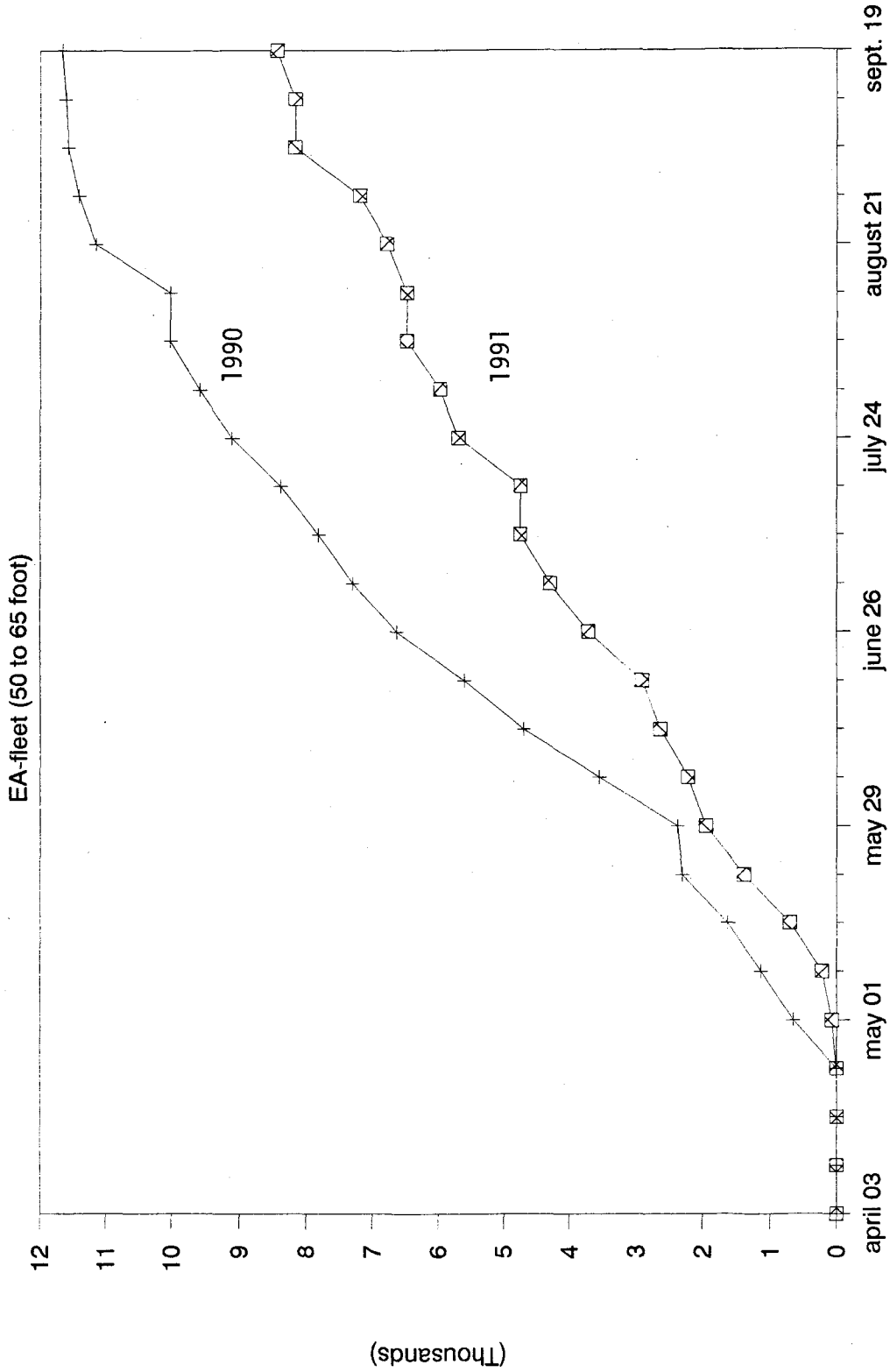
Figure 4. Cummulative catches of 4T-Vn (J.-A.) cod in 4T: 50 - 60 foot enterprise allocation fleet only. Symbols the same as Fig. 2.
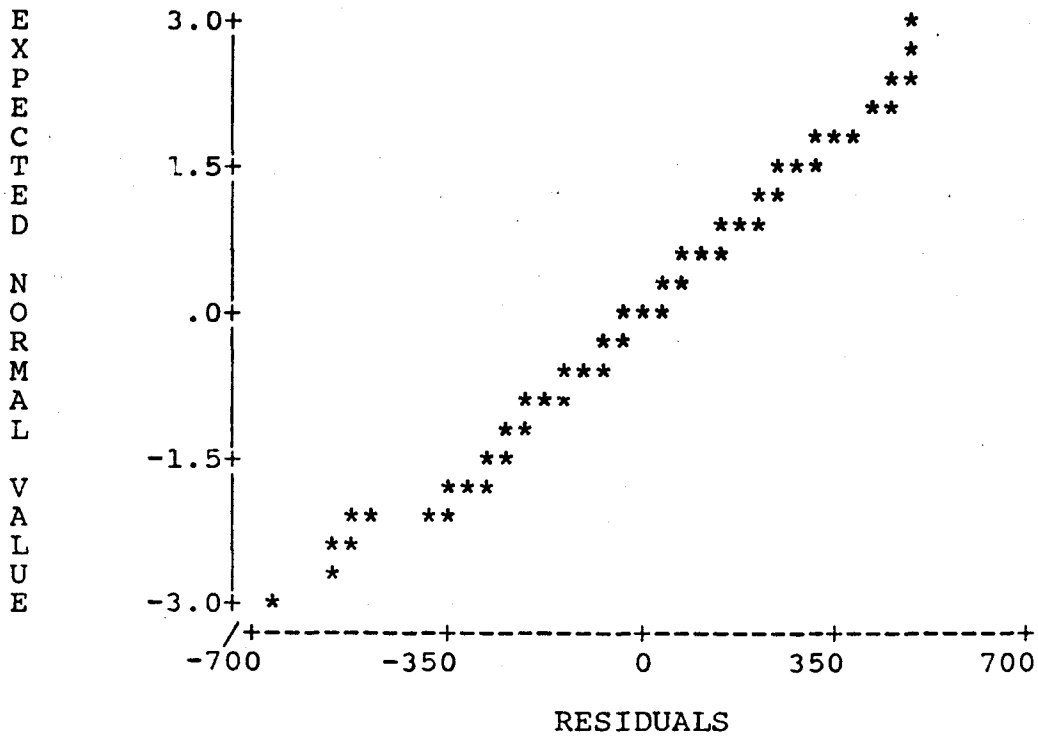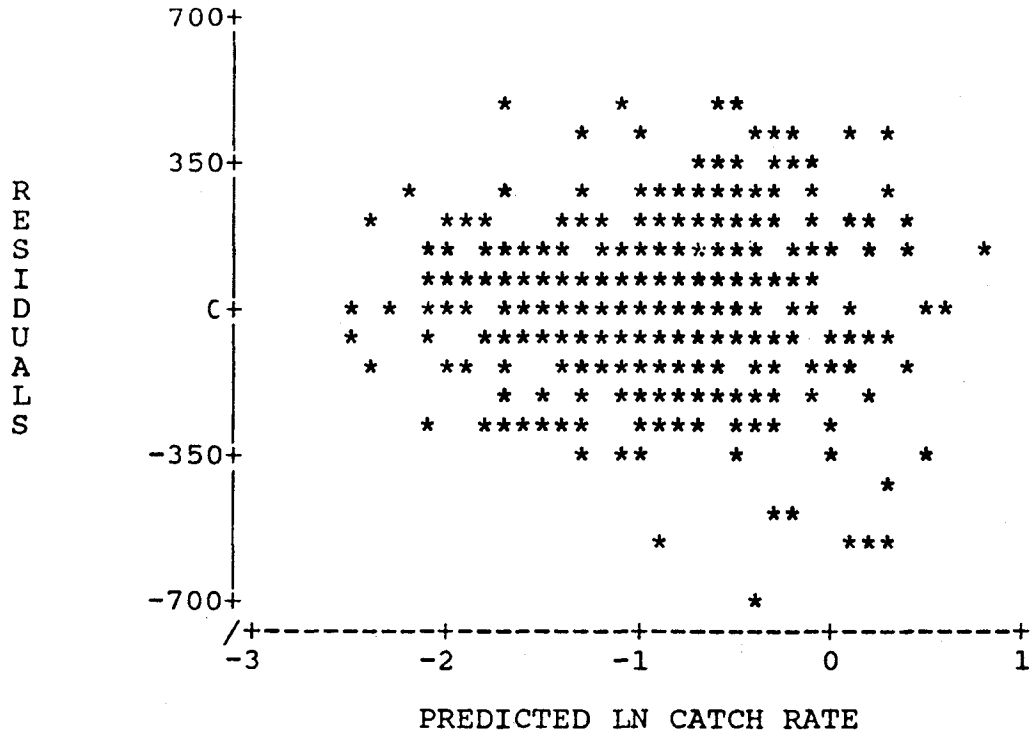
Figure 5. Residual plots for trawl catch rate index for second quarter fishery in 4T: all trawlers.
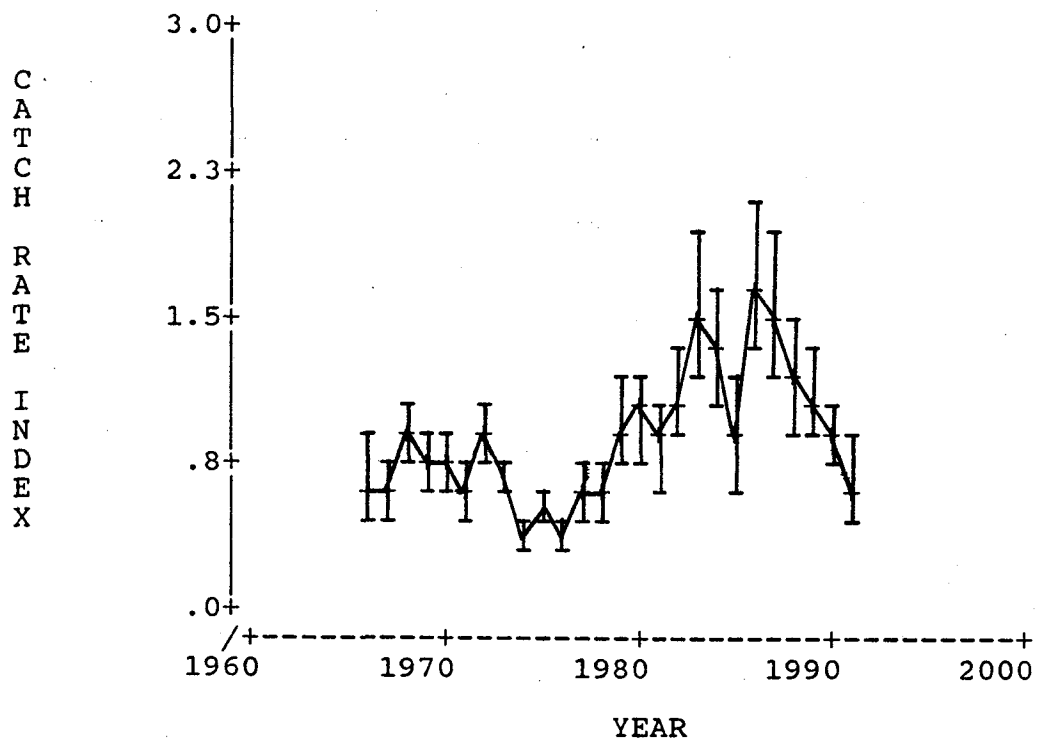
Figure 6. Standardized otter trawl catch rates (and S.E.s) for 4T-Vn (J.-A.)
cod during the second quarter fishery.
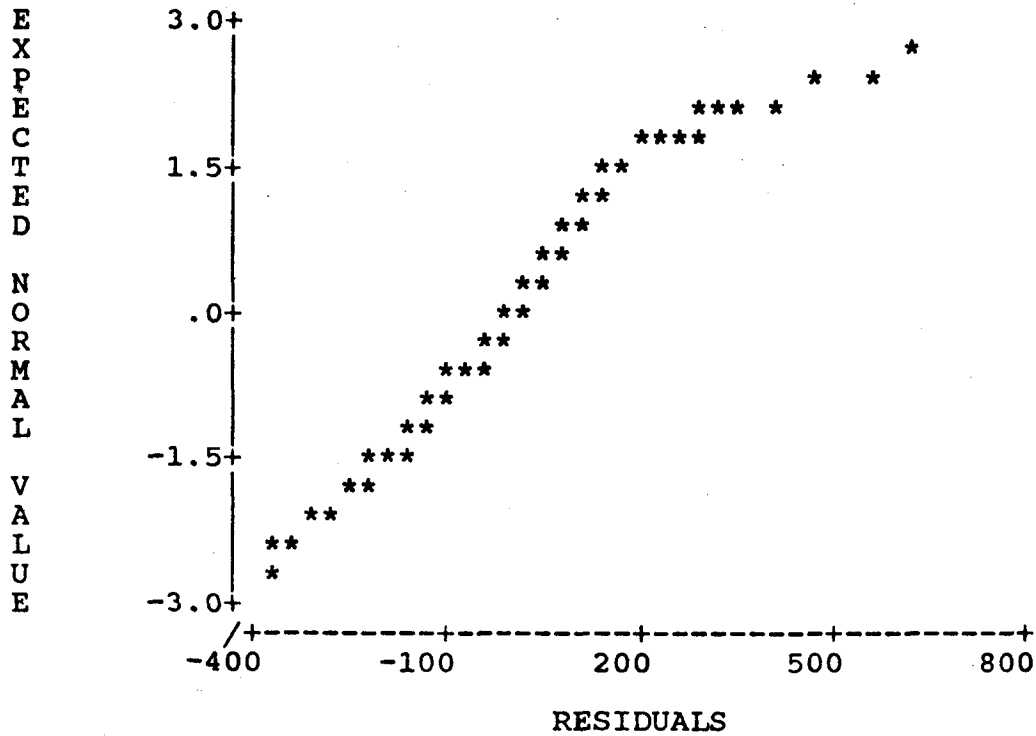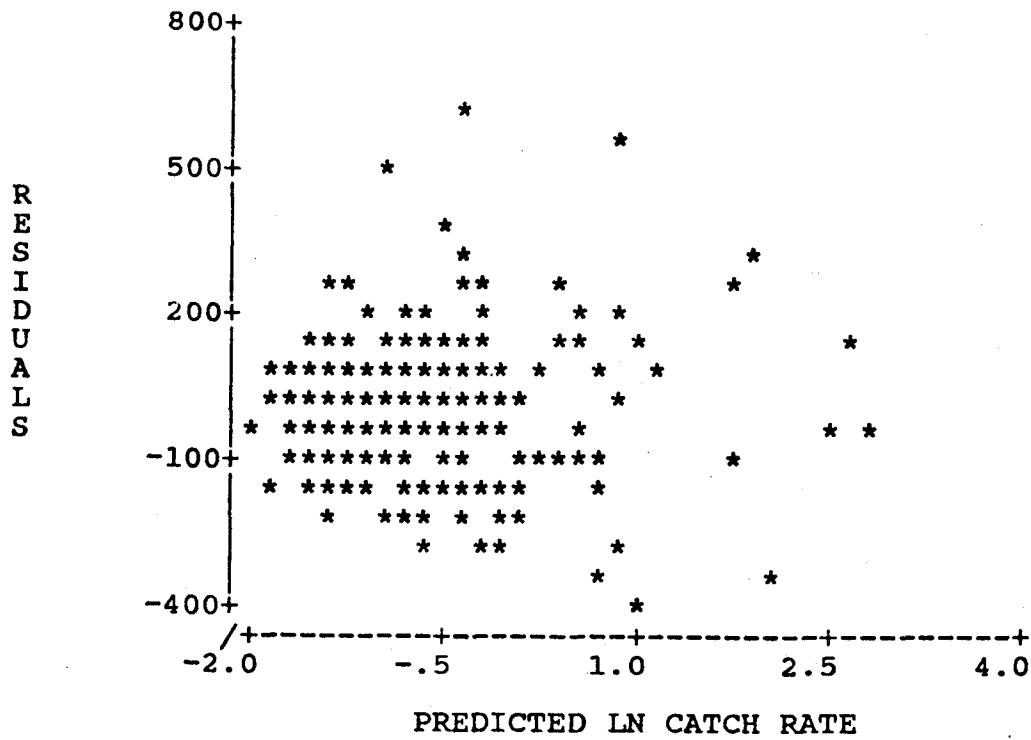
Figure 7. Residual plots for otter trawl catch rates for an index fleet. Analysis only includes data for the second quarter of the fishery.
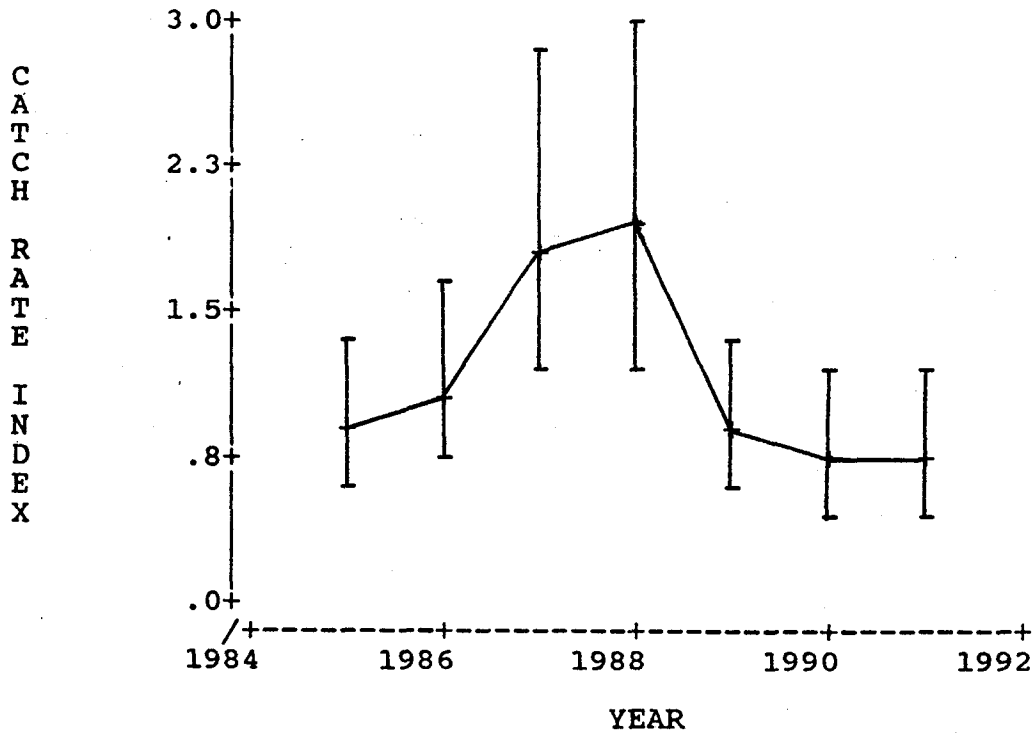
Figure 8. Standardized catch rates for an index fleet of otter trawlers fishing for cod in Division 4T during the second quarter of the fishery.
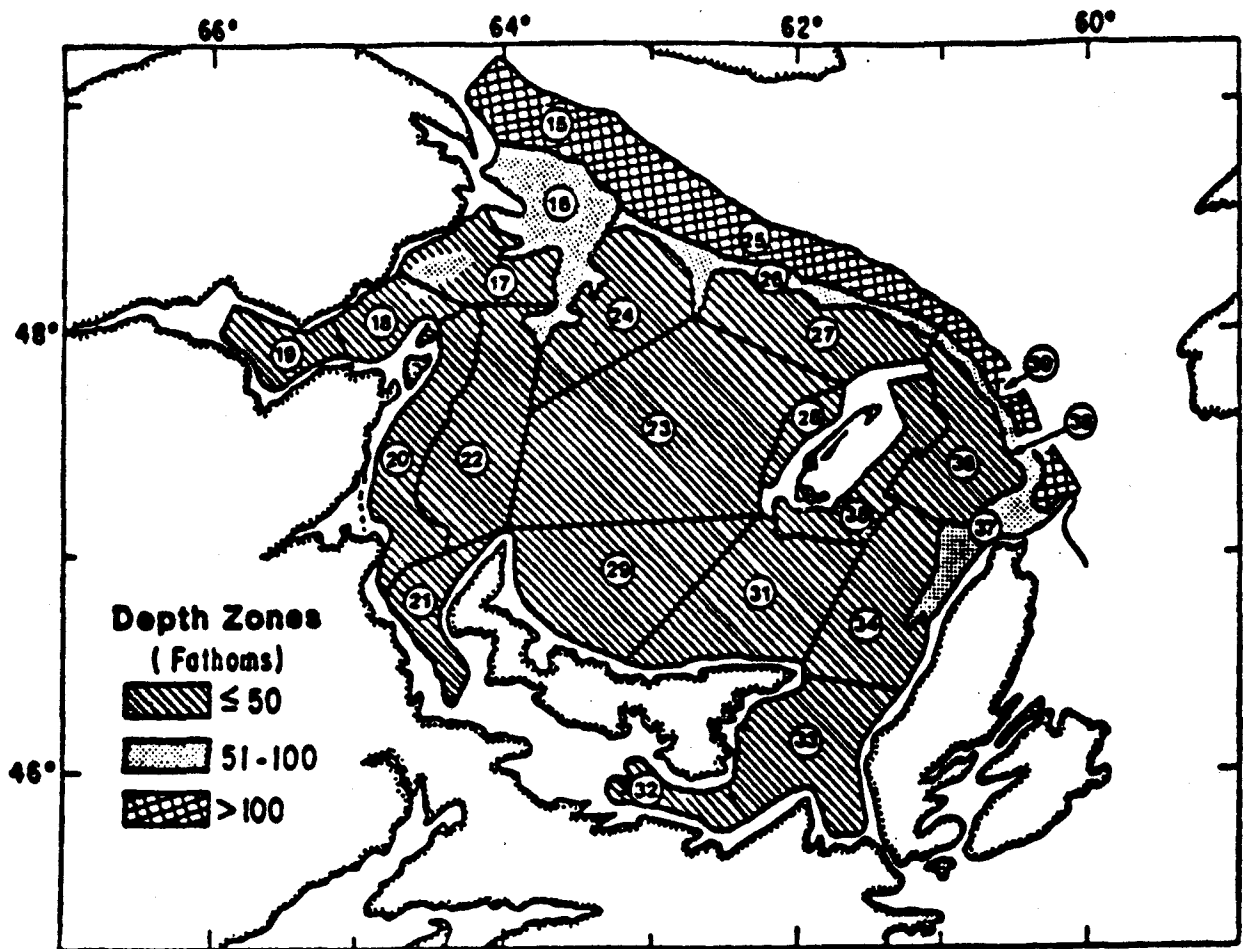
Figure 9. Stratification scheme for the southern Gulf of St. Lawrence groundfish surveys.