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Assessment of 4VsW Cod in 1992

by

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Abstract

The 1992 fishery for 4VsW cod landed 29,802 t, a shortfall of about 5000 t from the TAC and about 3000 t less than in 1991. This is the smallest catch since 1978. The proportion of the catch taken in Subdiv. 4Vs steadily declined from 88% in 1988 to 72% in 1991 perhaps indicating a return to the more equal division of catches seen prior to the mid-1980's. Foreign landings are reported to be very low, approximately 78 t.

The 1991 winter fishery (Jan - Apr.) took an estimated 8800 t of migrant 4TVn fish, the largest amount estimated for which we have the necessary data - since 1986 (M. Hanson. pers. comm.). The 1992 winter fishery caught an estimated 4400 t of 4TVn fish and anecdotal information from the fishermen reports that the strong migration of fish seen in 1991 was not present in 1992.

The sequential population analysis (SPA) was calibrated using both July and March RV indices in ADAPT. The 1992 data points for both surveys were quite depressed which in turn produced low estimates from the SPA. The 1992 March survey point was the smallest ever seen and may indeed be unreliable as it was less than one tenth the 1991 or one fifth the 1993 values.

The principal biological indices of the resource, research survey and commercial, suggest that the stock is seriously depleted. The surveys show a depressed stock similar in magnitude to what was seen in the 70's. However the pattern is different from the 70's in that now there are relatively fewer of the larger fish,which suggests that the stock is still reproductively viable but that survivorship is reduced as fish enter the fishery. Results of the SPA indicate that fishing mortality has been above F_{Max} since 1988 and that the spawning stock biomass is the lowest since 1970. Effort must be reduced on this stock and small fish protected to allow a replenishment of the spawning stock.

Résumé

En 1992, les prises de morue de 4VsW se sont établies à 29 802 t, soit environ 5 000 t de moins que le TPA et 3 000 t de moins qu'en 1991. Ce sont là les prises les plus basses depuis 1978. La proportion des captures provenant de la subdivision 4Vs est en régression constante, étant passée de 88 p. 100 en 1988 à 72 p. 100 en 1991, ce qui pourrait être le signe d'un retour à la division plus équitable des prises qui existait avant le milieu des années 80. Selon les indications, les débarquements des navires étrangers sont très faibles, se chiffrant à environ 78 t.

Durant la pêche d'hiver de 1991 (janvier-avril), on a pêché environ 8 800 t de poisson ayant migré du stock de 4TVn, ce qui représente, d'après les données dont on dispose à ce sujet, les estimations les plus élevées depuis 1986 (Communication personnelle de M. Hanson). Durant la pêche d'hiver de 1992 on a capturé environ 4 400 t de poisson de 4TVn; selon les dires des pêcheurs, la forte migration observée en 1991 ne s'est pas renouvelée en 1992.

L'analyse séquentielle de population (ASP) a été étalonnée au moyen des données des relevés de recherche de juillet et mars, en suivant la méthode ADAPT. Les points de données des deux relevés de 1992 étaient assez bas, ce qui explique que les estimations étaient elles aussi basses par rapport à l'ASP. Le point de données du relevé de mars, le plus bas enregistré à ce jour, représentait seulement un dixième et un cinquième respectivement des valeurs de 1991 et de 1993, ce qui le rend sujet à caution.

Les principaux indices biologiques sur l'état de la ressource, les données des relevés de recherche et les résultats de la pêche commerciale révèlent que les stocks sont extrêmement bas. Selon les résultats des relevés de recherche, l'effondrement du stock est est comparable à celui des années 70, du point de l'ampleur, quoiqu'il se manifeste différemment; en effet, il y a maintenant relativement moins de gros poisson, ce qui semble indiquer que le stock est encore capable de se reproduire, mais que le taux de survie diminue au fur et à mesure que le poisson est recruté à la pêche. Les résultats de l'ASP indiquent que la mortalité est supérieure à F_{Max} depuis 1988 et que la biomasse du stock de reproducteurs est à son plus bas depuis 1970. Il convient de réduire l'effort de pêche dans ce stock et de protéger le petit poisson pour permettre à la biomasse de reproducteurs de se reconstituer.

Description of the fishery

Landings of 4VsW cod ranged from 40,000 t to 80,000 t in the years 1958 to 1974 and then declined rapidly to a low of 10,000 t in 1977 (Table 1, Figure 1). Subsequent to extension of jurisdiction the landings quickly climbed again and were at or above 50,000 t from 1980 to 1986. Under quota restrictions, the TAC's have been reduced and consequently the catches have declined in recent years to 29800 t in 1992, the lowest catch since 1978. Since 1977 the foreign catch has only exceeded 1000 t once and in 1992 was approximately 78 t, primarily bycatch in the silver hake fishery. Anecdotal information suggests that there was a strong 'river' of fish from the Gulf in 1991, which was estimated to have contributed 8761 t (M. Hanson, DFO, Moncton. pers. comm.) to the January to April fishery in 4Vsb. However, during the same period in 1992 the 'edge' fishery was not nearly as strong and the estimated contribution is 4358. Prior to 1980, the total catch was dominated by the Div. 4W component. However, since 1980 the percentage of the catch coming from Subdiv. 4Vs climbed from 60% to a high of 87% in 1988 (Table 2). The percentage has declined for the last three years and was 70% in 1992, the lowest since 1983. The proportion of the catch taken by each gear type is essentially unchanged from 1989 with over 70% of the catch taken by otter trawls, 25% taken by longline and handline and the remainder taken primarily by seines and gillnets (Table 3). In some cases (Mobile gear sectors > 65' and fixed gear < 45 and fixed gear 65-100') the catches were close to the final allocations (Table 3) . This was not the case for FG 45-64 ' (caught about 1/3 of their allocation), MG <65' (caught about two-thirds) and the vessels >100' which were about 2500 t short of their final allocation (4000 t short of their initial allocation). See Figure 2 for a comparison of catch histories for 1990-1992 from the three dominant gear sectors. In 1992 some gear sectors were complaining about the difficulty in getting legal size catch. "Wharftalk" also alleged that many tons were being discarded in order that a few might be landed. The CAFSAC advice, TAC and nominal catches (kt) are:

Year	1987	1988	1989	1990	1991	1992	1993
Advice	44	38	33.2[b]	35[b]	35.2[c]	35.2[c]	20.[b]
TAC	44	38	35.2	35.2	35.2	35.2	11.
Catch	45.5	38.4	36.8[a]	34.3[a]	32.9[a]	29.8[a]	
Catch[d]	43.5	35.9	34.2[a]	29.7[a]	24.1	25.4[a]	

[a] Preliminary
[b] 50% rule
[c] Advised that constant catch would not be detrimental
[d] with nominal 4T component removed

Data

Catch and weight at age

The 1992 catch at age was constructed by using seven separate keys, mobile gears (trawlers and seines) for Quarters 1-4, and fixed gears (longline and handline) for first half-year and Quarters 3+4. The parameters of the length/weight relationships were estimated from the 1992 March and July RV surveys and applied to the keys for the appropriate time periods. The keyed catch accounted for more than 98% of the total catch and was pro-rated to the total. The catch at age for 1990 and 1991 was re-calculated because analytical software (SURVSYS) had erroneously been parameterized for fish greater than 20 cm instead of all fish. The details of the sampling and age-length keys used to form the 1990-

92 catch at age are given in Tables 4-6 respectively. The resultant catch at age for 1970-92 is given in Table 7.

The mean size at age in southern Gulf (4TVn) cod is substantially smaller than in 4VsW cod and they are known to migrate into 4Vn in the winter to the degree that catches from the 4Vn (Jan.- Apr.) fishery are considered part of the 4TVn spawning group for management purposes. There have also been industry reports in the past that indicate parts of the 4TVn migration may extend southward into 4Vb and perhaps even 4Vc, however, as this usually involves small quantities of catch, the impact has been assumed negligible. However in recent years, the catch has been considerable Corrections for the proportion of the catch that are slower growing, and presumably to a large degree from 4T, were estimated for 1986-1992 (Table 8.). The "4T" corrected catch is used in all analyses.

The commercial mean weights at age (Table 9) in 1992 continue the recent trend to smaller weights at age. The mean weights at age peaked in the early eighties and have slowly fallen since that time.

Commercial catch rates

The data for the years 1968-1988 were extracted from the NAFO data base and 1989-1992 were extracted from the Interzonal (ZIFF) database and aggregated into the same the gear/area/month categories previously defined by Sinclair and Smith (1987). See Table 10 for the details of the statistical analysis. Selection criteria removed catch or landings of less than 10 units. Throughout the 1980's the C/E remained higher than the 1970's and relatively stable, with the exception of 1985-86 which were the highest observed (Figure 3). The 1992 value rose slightly from the 1991 value.

The Canadian OTB (TC 4-5) catch rates from the IOP were calculated for the years 1982-1991. See Table 11 for the details of the statistical analysis. The observed catch has varied between 7% and 17% of the total OTB catch during 1982-89, however, in 1990 the IOP observed 34% of the OTB catch. When standardized to the same basis, the C/E based on the IOP was significantly higher than that based on the commercial statistics in 1984-89 but nearly equal in 1982, 83 and 90 and 1991, but lower in 1992 (Figure 3). A possible explanation for this pattern is discussed in Fanning& MacEachern (1991) and is attributed to changes induced by the introduction of the IQ program. Until the poor agreement in the two CPUE series is resolved they will not be included in tuning SPA's.

Catch and catch rates from a single longliner, who kept detailed daily records over a number of years, are shown in Figure 4. It is interesting to note that the peak in the catch rate is 1985-86 which matches the pattern of the surveys well. These data were only used as a reference and not in the analysis.

Research vessel surveys

The July stratified random trawl survey of 4VsW has been conducted annually since 1970. Table 12 contains the mean catch at age in numbers and Table 13 is the coefficients of variation of the means. The research vessel conducting the survey was changed in 1982 and 1983 due to the retirement of the A.T. Cameron, the temporary use of the Lady Hammond (in 1982) and the advent of the Alfred Needler in 1983. The catches from the A.T. Cameron and the Lady Hammond were adjusted by a cod conversion factor of 0.8, which is applied to the latter vessel, to account for the change in the survey vessel. Because of differences in age composition, the stratified estimates of mean catch per tow and coefficients of variation were calculated for 4Vs and 4W separately, and combined by weighting by strata areas. Due to vessel failure of the Needler, the 1991 July survey was

completed by the Lady Hammond. The conversion factor was applied on a set by set basis in the construction of the survey estimates.

A second survey has been conducted in March from 1979 to 1992 with the exception of 1985. Table 14 contains the mean catch at age in numbers and Table 15 is the coefficients of variation of the means. The same conversion factor was applied to the March surveys for the years 1979-83 when the Lady Hammond was the survey vessel. From time to time the estimation of abundance from the March survey has been complicated by missing strata due to the presence of ice in the survey area. The CAFSAC Groundfish subcommittee had previously recommended that methods of adjusting for the effect of missing strata be investigated, however this has not been completed and the March survey index assumes that missing strata would have been equal to the overall mean of the sampled strata. In 1991 and 1992 there were no missing strata although a number of strata contained only 1 set. In 1993 one strata had only 1 set and 4 new strata were added in deeper water in the Laurentian Channel. The new strata are not included in the results in Table 14 nor in subsequent analysis. The CV's associated with the March survey estimates are generally larger than in the July survey, probably reflecting the more aggregated distribution of fish in the winter. See Smith and Gavaris (1993) for a discussion of these surveys. Also, parameters related to this survey have lower levels of significance when fit to SPA's.

The July survey mean catch per tow in recent years, 1987-90, was higher than all years prior to 1982 except for 1973, but well below the peak of 1982-84. See Figure 5 or Table 12. The 1992 point was beneath the long term average but about 30 % higher than the 1991 1+ value. The general trend in the March surveys was similar although 1986 and 1990 seemed to be extremely high and low, respectively, relative to the July estimates. The March survey estimate for ages 4+ was very low in 1990 and 1992. However, in 1991 the estimate, which includes the strong 1987 yearclass, is comparable to the early 1980's. The March 1992 numbers are the lowest on record and the 1992 point is probably anomalous. The recovery from 1992 to the 1993 survey is still beneath the long term mean but is similar to the 1991 March survey and the 1992 July survey (Figure 5). For this reason the 1993 point is not suspect.

Both surveys series have indicated that the 1986 and 1987 yearclasses are above average. The 1987 yearclass has constituted 44% to 49% of the mean catch per tow (in numbers) in 4 of the 5 surveys available for 1989 to 1991, and it was 30% of the total numbers in the fifth survey (July 1989).

Analysis

Estimation of parameters

The traditional aged population analysis was performed for this stock using ADAPT to fit the model which is described as:

Parameters:

Terminal F estimates --	$F_{i,1992}$, i=3 to 8
Calibration coefficients --	$K_{1,i}$, i=3 to 8 for July RV survey
--	$K_{2,i}$, i=3 to 9 for March RV survey

Structure Imposed:

Error in catch assumed negligible
Partial recruitment fixed for ages 1, 2, and 9+
F on oldest age (15) set to 95% of the average F ages 7-9
No intercept was fitted
M=0.2 for all ages

Input:

$C_{i,t}$, i=1 to 15; t=1970 to 1992 - Full year catch at age
$J_{i,t}$, i=3 to 9; t=1970 to 1992 - July RV index
$M_{i,t}$, i=3 to 9; t=1979 to 1992 - March RV index (excluding 1985)

Objective function: Minimize:

$$\Sigma\,\Sigma\,\{\ln J_{i,t} - K_{1,i}\,N_{i,t}\}^2 - \Sigma\,\Sigma\,\{\ln M_{i,t} - K_{2,i}\,N_{i,t}\}^2$$

Summary:

Number of observations: 138 from July RV
91 from March RV

Number of parameters: 19

Results

The SPA results (Tables 16-18, Figures 6-9) indicate that the average F(ages 7-9) has increased in recent years and is well above $F_{0.1}$ or F_{Max} and is indeed the highest seen. Moreover, the results show that the 6+ biomass is extremely low, at levels comparable to the late 70's. This year's SPA results indicate much lower recent recruitments than last years with levels well beneath the long term GM average of 61 million animals. The 1987 yearclass is the strongest in recent years but still well below the GM level, 48 versus 61 million (Figure 7).

Figure 9 is the stock-recruit relationship estimated from the population analysis. The spawning biomass is approximated by the 6+ fish and the recruits are the numbers at age 1 in the following year. The points since 1982 aare all lower on this graph than the earlier points which shows that even though the biomass was strong recruitment was weak.

The diagnostic statistics from ADAPT are given in Table 19. The coefficient of variation on the terminal F range from 42 to 57%. As seen in previous years the CVs are higher for the March survey than the summer survey. The bias estimates for F_{1992} are negative and range from 9 to 16% . The q's have small (< 3%) negative biases. Because they are small, the estimates of stock status were not corrected for bias.

Figure 10 shows the VPA numbers totaled from age 3 to 8. The VPA numbers are compared to the estimates from the surveys after correction for the efficiency of the survey gear (the q's estimated in Table 19). This is done to allow a direct comparison of the results to the numbers age 3-8 from the surveys. The SPA numbers show a steady decline since the early 80's. On this scale the summer surveys show a slow, steady decline (excepting 1990). In the last 4 years the estimates from the spring survey are seen to be quite erratic.

Retrospective Analysis

All the ADAPT formulations investigated continue to show the retrospective pattern that has been of concern in this assessment for the last few years. Table 20 shows the estimates for average F for ages 7-9 using increasing data sets for the last 5 years. Reading down each column shows the retrospective pattern as more data are added. Thus the average for 1992, which is well above 1, may be even higher but if so it would not change the nature of our understanding of this resource.

Prognosis

Projections

The 1992 numbers are projected ahead from base run of ADAPT with a GM recruitment of 28 million (GM average 1984-1990) for ages 1-3. The recent time period was chosen as an appropriate range because of the lower recruitment seen in recent years (Figure 9). The weights are the average commercial weights for the years 1990 - 1992 and represent mid-year values, and the selectivity is the smoothed average from last year's assessment. The resultant values used in stock projections are:

Age	N_{1993}	Weight	Selectivity
1	28000	.05	.000
2	22900	.33	.000
3	18770	.72	.014
4	5801	.89	.156
5	7501	1.27	.480
6	8048	1.39	.740
7	1484	1.67	.951
8	288	2.02	1.000
9	241	2.17	1.000
10	38	2.39	1.000
11	59	3.25	1.000
12	17	4.11	1.000
13	22	6.10	1.000
14	6	12.95	1.000
15	1	10.80	1.000

Projections with these data were done assuming a catch at the 11000 t TAC for 1993 and $F_{0.1}$ (0.22) for 1994 and 1995.

Year	1993	1994	1995
Yield	11	3.0	4.3
Biomass 3+	36.2	37.7	47.8
Biomass 6+	14.5	12.0	13.6
F7-9	0.88	0.22	0.22

The severe depletion of the fishable biomass as estimated by the above VPA is reflected by very low $F_{0.1}$ yields for 1994 and 1995. The projection for 1994 for a range of fishing mortality up to 1.0 is shown in Fig. 11. One observes that the 6+ biomass is of the same magnitude as the yield in the region of F_{Max} which suggests that this is a "recruitment" fishery.

The spawning stock biomass and fishable biomass are at the lowest levels seen since 1970. However, small fish are still seen in the surveys. If fishing is stopped now, the chances for recovery are improved. If the fishery continues, even at the present 11 kt TAC and without restrictions on small fish removal, the reduction to the spawning stock biomass may lead to recruitment failure and will retard recovery.

Discussion

Current status

Compared to last year's assessment (Mohn & MacEachern, 1992) the current VPA indicates a much more depleted stock. Although the 1987 year-class is relatively strong

compared to others in recent years it is still below the long term average. Similarly, the summer survey estimates that the 1987 year-class is the strongest in recent years but below the long term average. The spring survey suggests that it is a bit stronger (as 4 year olds in 1991) and near average recruitment for neighbouring year-classes as 3 year olds.

The current size distribution seen in the 1992 summer survey when compared to the long term average sizes indicates a depressed fishable biomass. Similarly, the size distribution of the 1993 spring survey shows very few animals above the legal size. The size frequencies seen in commercial sampling for 1991-92 show that the fish are increasingly being caught nearer the legal size with fewer large fish seen.

A number of factors contributed to the change in perception in this assessment compared to last years. Probably the most important is the 1992 survey estimates. The summer survey is the lowest since 1978 and the spring 1992 point is the lowest on record. Minor changes were also made in re-calculating the catch at age for 1990-91. Based on a review of the hydrographic conditions during the spring survey it was not possible to exclude the 1992 point from the series. Because the 1992 survey results over all ages are so much lower than the 1991 or 1993 results it is probable that the availability of the fish was reduced not the stock itself. To assess the sensitivity of the SPA results to the 1992 spring survey it was increased by 700% to match the 1993 spring 3+ numbers and ADAPT was re-run with the adjusted data. A summary of the original (Unadj.) and adjusted (Adj.) results is:

	F(7-9)		Biomass6+ (kt)		Recruits (Mill. age 1)	
Year	Unadj.	Adj.	Unadj.	Adj.	Unadj.	Adj.
1986	.44	.44	100	100	33	38
1987	.53	.53	84	85	43	56
1988	.66	.64	71	72	49	73
1989	.55	.52	52	54	22	38
1990	1.31	1.13	33	36	12	35
1991	.73	.53	19	24		
1992	1.56	.67	18	28		

Although the differences are large they do not change the perception of a seriously depleted resource, fished well above Fmax. For example, the 1993 TAC of 11 kt represents a large fraction of the spawning (6+) biomass with or without the upward adjustment of the 1992 spring survey.

Discussion of Factors Contributing to Current Status

To provide a view of the future of this resource, it is first necessary to understand the processes that brought the population to its current depressed state. As well as overfishing a number of alternate hypotheses are available:

(1) - catchability has increased due to reduced stock size;

(2) - the population has experienced recruitment failure;

(3) - production has been reduced by changes in the ecosystem which have in turn been prompted by environmental fluctuations; and

(4) - grey seal predation on small cod has been a significant cause of reduced recruitment to the population.

The system may be showing non-linear or positive feedback dynamics which could cause rapid transitions. For example, as the geographic extent of the stock decreases the same effort would produce a higher exploitation. This in turn would decrease survivorship and further reduce the stock, etc. Similarly, as the size distribution shrinks towards the legal minimum, the tonnage removed would represent more fish and a higher F. This would decrease survivorship into larger sizes shifting the size distribution further exacerbating the problem, etc. Hypothesis (1) addresses this sort of problem. The 2nd hypothesis is suggested by the recent years in the stock-recruit relationship (Figure 9). They show poor recruitment in recent years but the cause is not known. Hypothesis (3) addresses both recruitment and growth - both of which are depressed. Hypothesis (4) has been suggested by fishermen for a number of years. We do not have the data to eliminate any of these hypotheses and of course two or more may be acting in concert which could magnify the effects. Research has been initiated to investigate the hypothesized factors in order to determine the mechanisms which control the health of this resource.

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Table 1. TAC and total catch of 4VsW cod by gear and (Sub)Division from NAFO.

	4Vs					4W					4VsW					
YEAR	TRAWLS	LL	SDN	MIS	TOTAL	TRAWLS	LL	SDN	MIS	TOTAL	TRAWLS	LL	SDN	MIS	TOTAL	TAC
1964	25452	42	2	0	25496	32855	708	88	4110	37761	58307	750	90	4110	63257	-
1965	36607	84	22	0	36713	28931	1416	159	3767	34273	65538	1500	181	3767	70986	-
1966	27006	143	14	14	27177	36460	1474	38	3376	41348	63466	1617	52	3390	68525	-
1967	26481	99	27	0	26607	22407	2405	71	2668	27551	48888	2504	98	2668	54158	-
1968	48715	48	18	0	48781	24686	2970	89	3902	31647	73401	3018	107	3902	80428	-
1969	22265	43	7	1	22316	21946	3567	13	2323	27849	44211	3610	20	2324	50165	-
1970	28617	21	1	0	28639	23655	3817	62	1261	28795	52272	3838	63	1261	57434	-
1971	24088	40	0	0	24128	22006	4819	26	1584	28435	46094	4859	26	1584	52563	-
1972	33570	595	4	2364	36533	15888	3793	7	5424	25112	49458	4388	11	7788	61645	-
1973	21654	82	3	1662	23401	25144	3748	20	1780	30692	46798	3830	23	3442	54093	60500
1974	19105	337	0	169	19611	18931	2969	5	2225	24130	38036	3306	5	2394	43741	60000
1975	10522	444	0	728	11694	16336	3185	11	1291	20823	26858	3629	11	2019	32517	60000
1976	10068	68	0	1417	11553	8021	2913	14	1906	12854	18089	2981	14	3323	24407	30000
1977	2819	50	4	0	2873	2305	3487	68	1657	7517	5124	3537	72	1657	10390	7000
1978	10044	294	19	0	10357	8277	4552	839	1380	15048	18321	4846	858	1380	25405	7000
1979	14869	438	86	0	15393	14579	5825	3245	988	24637	29448	6263	3331	988	40030	30000
1980	28941	2116	321	0	31378	6729	6588	3440	1117	17874	35670	8704	3761	1117	49252	45000
1981	27662	4274	171	0	32107	9813	8229	2433	1136	21611	37475	12503	2604	1136	53718	50000
1982	32247	7069	794	0	40110	6431	6655	1943	615	15644	38678	13724	2737	615	55754	55600
1983	28024	4475	671	0	33170	11555	5052	1936	667	19210	39579	9527	2607	667	52380	64000
1984	37576	4123	879	0	42578	3839	3512	2144	473	9968	41415	7635	3023	473	52546	55000
1985	39978	7449	718	44	48189	3768	3386	1229	883	9266	43746	10835	1947	927	57455	55000
1986	35514	8277	237	0	44028	2758	3075	600	1068	7501	38272	11352	837	1068	51529	48000
1987	33157	6276	311	11	39755	1803	2666	538	741	5748	34960	8942	849	752	45503	44000
1988	26964	6097	612	56	33729	1240	2163	382	842	4627	28204	8260	994	898	38356	38000
1989	22614	6324	400	40	29378	3450	2983	323	609	7365	26064	9307	723	649	36743	35200
1990[1]	22272	3840	224	4	26340	2997	4027	532	438	7994	25269	7867	756	442	34334	35200
1991[1]	20371	3827	253	0	24451	3956	3511	429	568	8464	24327	7338	682	568	32915	35200
1992[1]	17941	3203	170	0	21314	3674	4098	506	210	8488	21615	7301	676	210	29802	35200
1993																11000

[1] Preliminary Interzonal and International Observer Program data.

Table 2. Canadian catch of 4VsW cod by gear and (sub) Division (from NAFO).

	4Vs					4W					4VsW				
YEAR	TRAWLS	LL	SDN	MIS	TOTAL	TRAWLS	LL	SDN	MIS	TOTAL	TRAWLS	LL	SDN	MIS	TOTAL
1964	2056	42	2	-	2100	7324	708	88	4110	12230	9380	750	90	4110	14330
1965	7366	84	22	-	7472	10290	1416	159	3767	15632	17656	1500	181	3767	23104
1966	6374	143	14	-	6531	6614	1472	38	3035	11159	12988	1615	52	3035	17690
1967	6735	99	27	-	6861	6460	2405	71	2667	11603	13195	2504	98	2667	18464
1968	9501	48	18	-	9567	8360	2970	89	3902	15321	17861	3018	107	3902	24888
1969	3540	43	7	-	3590	4695	3567	13	2323	10598	8235	3610	20	2323	14188
1970	3054	21	1	-	3076	3602	3817	62	1261	8742	6656	3838	63	1261	11818
1971	5827	40	-	-	5867	4768	4819	26	1584	11197	10595	4859	26	1584	17064
1972	9856	115	4	-	9975	4732	3793	7	1480	10012	14588	3908	11	1480	19987
1973	6392	82	3	-	6477	4723	3748	20	961	9452	11115	3830	23	961	15929
1974	4644	56	-	-	4700	1335	2969	5	1691	6000	5979	3025	5	1691	10700
1975	1824	63	-	-	1887	3566	3185	11	1290	8052	5390	3248	11	1290	9939
1976	3755	42	-	-	3797	937	2913	14	1906	5770	4692	2955	14	1906	9567
1977	2751	50	4	-	2805	1873	3487	68	1657	7085	4624	3537	72	1657	9890
1978	9561	294	19	-	9874	7997	4552	839	1380	14768	17558	4846	858	1380	24642
1979	14853	438	86	-	15377	13742	5825	3245	988	23842	28637	6263	3331	988	39219
1980	28941	2116	321	-	31378	6298	6588	3440	1117	17443	35239	8704	3761	1117	48821
1981	27662	4274	171	-	32107	9148	8229	2433	1136	20946	36810	12503	2604	1136	53053
1982	32247	7069	794	-	40110	6352	6655	1943	615	15565	38599	13724	2737	615	55675
1983	26817	4475	671	-	31963	11280	5052	1936	667	18935	38097	9527	2607	667	50898
1984	37290	4123	879	-	42292	3683	3512	2144	473	9812	40973	7635	3023	473	52104
1985	39098	7449	718	44	47309	3746	3386	1229	883	9244	42844	10835	1947	927	56553
1986	35482	8277	237	-	43996	2728	3075	600	1068	7471	38210	11352	837	1068	51467
1987	33139	6276	311	11	39737	1748	2666	538	741	5693	34887	8942	849	752	45430
1988	26959	6077	612	56	33704	1124	2163	382	842	4453	28083	8240	994	898	38215
1989	22608	6324	400	40	29372	3332	2983	323	609	7247	25940	9307	723	649	36619
1990[1]	22272	3840	224	4	26340	2799	4027	532	438	7796	25071	7867	756	442	34136
1991[1]	20371	3827	253	-	24451	3739	3511	429	568	8247	24110	7338	682	568	32698
1992[1]	17941	3203	170	-	21314	3596	4098	506	210	8410	21537	7301	676	210	29724

[1] Preliminary Interzonal data.

Table 3. Domestic quotas and catches from monthly Quota Reports.

	FG <45		FG 45-64		MG 45-64 4T, 3Pn		MG <65 ITQ		FG 65-100		MG 65-100		Vessels >100		Total	
Date	Quota	Catch	Quota	Catch	Quota	Catch	Quota	Catch	Quota	Catch	Quota	Catch	Quota	Catch	Quota	Catch
Jan. 1	4860	0	1985	0	40	0	4010	0	520	0	625	0	23160	0	35200	0
Feb. 5	4860	81	1985	53	40	0	4010	155	520	211	625	248	23160	3065	35200	3813
Mar. 4	4860	201	1985	151	40	0	4010	397	520	393	422	318	23363	6013	35200	7473
Apr. 1	4860	296	1985	165	40	0	4010	500	882	547	537	332	22886	9193	35200	11033
May 6	4860	501	1985	196	40	0	4010	699	902	711	744	490	22659	12783	35200	15380
June 2	4860	627	1985	326	40	0	4010	943	944	948	718	598	22643	13829	35200	17271
June 30	4860	1401	1985	457	40	0	4010	1039	1194	1166	762	599	22349	14192	35200	18854
Aug. 12	4860	1910	1985	501	40	0	4010	1294	1544	1448	762	608	22149	15193	35350	20954
Sept. 9	4860	3011	1985	601	40	0	4010	1384	1656	1500	762	608	21887	15306	35200	22410
Oct. 7	4860	3225	1985	641	40	0	4010	1882	1656	1518	762	615	21887	15587	35200	23468
Nov. 4	4860	3423	1985	676	40	5	4010	2460	1656	1588	762	653	21887	16106	35200	24911
Dec. 2	4860	4201	1985	715	40	0	4010	2714	1856	1755	782	659	21667	17546	35200	27590
Dec. 31	4860	4431	1985	727	40	0	4010	2951	1856	1805	797	697	21652	19130	35200	29741

Table 4(a). Data used to recalculate 1990 4VsW cod commercial catch at age.

Key	Gear	Period	Length/weight coefficients a	b	Source	Lengths	Aged	Catch
1	OTB, PTB, SNU*	Q1	.0054	3.1062	March 4Vs	11753	1218	15532
2	OTB, PTB, SNU	Q2	.0089	3.0049	July 4VsW	3134	285	3564
3	OTB, PTB, SNU	H2	.0074	3.0427	July 4Vs	4780	489	6730
4	LL, LHP	H1	.0089	3.0049	July 4VsW	6948	923	2833
5	LL, LHP	H2	.0089	3.0049	July 4VsW	4939	586	5034

*OTB - Otter trawl
PTB - Pair trawl
SNU - Seine
LL - Longline
LHP - Handline

Table 4(b). Recalculated 4VsW cod catch at age ('000) by key for 1990.

	OTB, PTB, SNU			LL, LHP		
Age	Q1	Q2	H2	H1	H2	Total
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	14	8	238	2	24	286
4	464	81	1285	55	401	2286
5	1583	264	1172	181	709	3909
6	2252	232	552	179	376	3591
7	1433	155	304	98	177	2167
8	2054	330	247	147	374	3152
9	1074	116	149	83	148	1570
10	1383	123	135	85	118	1844
11	183	44	28	41	26	322
12	60	24	17	20	11	132
13	19	7	6	17	5	54
14	1	1	6	4	3	15
15	3	1	4	4	2	14
16	5	1	2	3	2	13
Total	10528	1387	4145	919	2376	19355

Table 5(a). Data used to recalculate 1991 4VsW cod commercial catch at age.

Key	Gear	Period	Length/weight coefficients a	b	Source	Lengths	Aged	Catch
1	OTB, PTB, SNU*	Q1	.0063	3.0747	March 4Vs	6395	673	14661
2	OTB, PTB, SNU	Q2	.0095	2.9891	July 4Vs	3042	365	4075
3	OTB, PTB, SNU	H2	.0100	2.9763	July 4VsW	4975	473	6274
4	LL, LHP	H1	.0100	2.9763	July 4VsW	3240	367	3143
5	LL, LHP	H2	.0100	2.9763	July 4VsW	5421	567	4196
6	GN	FY	.0100	2.9770	July 4W	1003	134	566

*OTB - Otter trawl
PTB - Pair trawl
SNU - Seine
LL - Longline
LHP - Handline
GN - Gillnet

Table 5(b). Recalculated 4VsW cod catch at age ('000) by key for 1991.

	OTB, PTB, SNU			LL, LHP		GN	
Age	Q1	Q2	H2	H1	H2	FY	Total
1	0	0	0	0	0	0	0
2	0	0	0	1	0	0	1
3	13	11	193	29	31	0	277
4	694	326	1731	212	402	0	3365
5	2454	619	2058	658	989	12	6790
6	2236	517	733	383	587	30	4486
7	2257	334	261	199	266	31	3348
8	902	155	74	69	100	32	1332
9	939	143	96	75	77	26	1356
10	674	42	13	83	27	22	861
11	352	28	8	46	10	13	457
12	98	12	3	17	11	13	154
13	34	14	0	6	9	2	65
14	0	5	2	2	1	0	10
15	0	1	0	3	2	0	6
16	4	0	0	1	0	0	5
Total	10657	2207	5172	1784	2512	181	22513

Table 6(a). Data used to calculate 1992 4VsW cod commercial catch at age.

Key	Gear	Period	Length/weight coefficients a	b	Source	Lengths	Aged	Catch
1	OTB, PTB, SNU*	Q1	.0070	3.0389	March 4Vs	4844	517	9800
2	OTB, PTB, SNU	Q2	.0091	2.9912	July 4Vs	6335	683	5770
3	OTB, PTB, SNU	Q3	.0082	3.0208	July 4VsW	3422	251	1947
4	OTB, PTB, SNU	Q4	.0091	2.9912	July 4Vs	5065	523	4696
5	LL, LHP	H1	.0082	3.0208	July 4VsW	2654	290	3397
6	LL, LHP	Q3	.0082	3.0208	July 4VsW	6515	530	2482
7	LL, LHP	Q4	.0074	3.0534	July 4W	3167	267	1422

*OTB - Otter trawl
PTB - Pair trawl
SNU - Seine
LL - Longline
LHP - Handline

Table 6(b). 1992 4VsW cod catch at age ('000) by key.

	OTB, PTB, SNU				LL, LHP			
Age	Q1	Q2	Q3	Q4	H1	Q3	Q4	Total
1	0	0	0	0	0	0	0	0
2	0	2	0	0	0	0	0	2
3	8	173	95	107	17	92	73	565
4	151	843	454	457	137	216	258	2516
5	2372	2101	838	1823	804	634	588	9160
6	2379	1331	307	616	708	462	217	6020
7	976	378	53	221	262	139	76	2105
8	980	144	8	135	44	52	24	1387
9	341	72	2	64	22	13	2	516
10	300	56	8	41	28	26	7	466
11	164	17	0	24	5	15	4	229
12	123	5	0	29	9	10	0	176
13	11	9	0	6	5	1	1	33
14	0	1	0	1	4	1	0	7
15	0	1	0	3	1	0	1	6
16	2	1	0	2	3	0	0	7
Total	7807	5134	1765	3529	2049	1661	1251	23193

Table 7. Commercial 4VsW cod catch at age (000's). (4TVn component included.)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	1293	1984	2046	1218	1273	1538	513	1	34	12	31	3	3
2	8631	12824	15865	10221	7321	8571	2866	23	94	93	92	258	138
3	8886	9643	11801	8001	13324	7402	2860	532	1168	1762	1765	3200	2473
4	14802	5125	11989	5803	11695	3163	4707	1229	4078	6559	4873	9136	7667
5	13673	6612	7384	9634	6854	4788	3900	1591	4817	9525	6937	7281	10123
6	4539	5128	6527	3324	2247	3297	2085	845	2582	5056	6177	4651	3681
7	1942	3419	3308	3370	669	2943	1287	490	767	1210	3050	2957	2568
8	759	1963	1880	4732	1008	623	447	199	247	377	1121	1421	1315
9	236	704	347	1684	196	497	136	118	107	76	313	397	679
10	72	367	466	389	153	686	53	33	75	23	92	135	318
11	137	159	68	551	13	172	12	42	31	10	50	69	153
12	56	173	8	8	2	123	47	44	27	4	26	32	65
13	9	156	36	21	0	41	0	11	28	3	4	22	54
14	12	80	0	21	0	6	4	3	10	0	0	2	55
15	4	40	3	18	0	6	0	2	1	0	1	5	19
16	4	52	7	47	0	19	2	6	2	0	7	2	19
1+	55055	48429	61735	49042	44755	33875	18919	5169	14068	24710	24539	29571	29330
2+	53762	46445	59689	47824	43482	32337	18406	5168	14034	24698	24508	29568	29327
3+	45131	33621	43824	37603	36161	23766	15540	5145	13940	24605	24416	29310	29189
4+	36245	23978	32023	29602	22837	16364	12680	4613	12772	22843	22651	26110	26716
5+	21443	18853	20034	23799	11142	13201	7973	3384	8694	16284	17778	16974	19049
6+	7770	12241	12650	14165	4288	8413	4073	1793	3877	6759	10841	9693	8926

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	0	0	0	0	0	0	0	0	0	0
2	6	1	4	3	0	8	7	0	1	2
3	3507	430	156	124	38	185	671	291	277	571
4	8679	5778	2253	4210	877	1512	2544	2329	3365	2541
5	7484	9101	8151	7640	5694	2399	4111	3983	6790	9251
6	6278	5678	7523	9221	5885	4531	3334	3659	4486	6080
7	1905	3829	4284	3589	6049	4075	3669	2208	3348	2125
8	1012	1250	2430	1571	2733	3295	1796	3212	1332	1401
9	625	544	1063	1123	1105	1731	2018	1600	1356	521
10	224	290	452	447	604	626	590	1879	861	471
11	149	153	284	285	233	260	251	328	457	231
12	52	63	173	105	131	153	156	135	154	178
13	24	34	68	66	61	64	29	55	65	33
14	15	17	20	11	11	9	15	15	10	7
15	6	8	17	19	14	10	58	14	6	6
16	11	5	15	18	12	11	35	13	5	7
1+	29977	27181	26893	28432	23447	18869	19284	19721	22513	23425
2+	29977	27181	26893	28432	23447	18869	19284	19721	22513	23425
3+	29971	27180	26889	28429	23447	18861	19277	19721	22512	23423
4+	26464	26750	26733	28305	23409	18676	18606	19430	22235	22852
5+	17785	20972	24480	24095	22532	17164	16062	17101	18870	20311
6+	10301	11871	16329	16455	16838	14765	11951	13118	12080	11060

Table 8. Estimated contribution of 4TVn fish in the catch at age (000's).

	1986	1987	1988	1989	1990	1991	1992
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	8	0	0	0	3	3
4	121	62	5	0	65	128	137
5	542	294	391	45	94	495	1019
6	1637	518	611	201	1082	897	183
7	221	584	579	353	602	2740	435
8	213	97	513	552	276	703	749
9	201	177	277	664	709	1029	336
10	108	112	155	106	828	800	186
11	96	13	0	49	5	25	147
12	24	9	1	118	0	85	70
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
3+	3163	1874	2532	2088	3661	6905	3265
4+	3163	1866	2532	2088	3661	6902	3262
5+	3042	1804	2527	2088	3596	6774	3125
6+	2500	1510	2136	2043	3502	6279	2106
Total Weight in mt.	3469	2029	2496	2574	4606	8761	4358

Table 9. 4VsW cod weights at age from commercial landings.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.53	.79	.49	.43	.00	.00	.00	.61	.57	.59	.60	.55	.47
3	.76	1.01	.96	.79	.71	.79	.80	.96	.69	.81	.81	.77	.78
4	1.08	1.15	.94	1.19	.85	1.05	1.11	1.21	.96	1.16	1.12	1.04	1.04
5	1.45	1.39	1.17	1.74	1.36	1.50	1.72	1.63	1.57	1.60	1.68	1.53	1.53
6	1.80	1.84	1.64	2.17	1.88	2.26	2.40	2.33	2.30	2.22	2.12	2.33	2.13
7	2.28	2.29	2.29	2.59	2.34	3.33	3.15	3.39	3.08	3.10	2.96	2.73	3.09
8	3.50	2.88	2.28	2.47	2.94	4.37	4.47	4.76	3.72	4.26	3.90	3.99	3.55
9	4.87	4.82	2.64	3.24	3.69	4.85	4.04	5.34	4.90	5.38	5.69	5.34	4.38
10	5.70	4.56	4.27	3.62	3.72	5.57	5.29	6.19	6.39	6.96	7.02	6.84	5.79
11	5.70	7.57	3.85	4.87	4.79	7.39	4.73	7.91	7.25	7.42	7.68	8.53	6.84
12	8.74	11.56	9.48	9.58	5.46	3.38	4.92	8.57	10.11	10.01	9.45	8.88	9.16
13	6.77	6.31	7.05	.00	8.24	14.23	6.57	9.61	13.95	8.75	12.05	10.90	10.64
14	5.92	.00	9.06	.00	12.10	11.54	8.85	10.30	10.26	10.53	8.48	10.43	11.73
15	9.27	14.49	10.98	.00	12.78	22.97	10.52	8.37	11.97	13.97	9.80	13.34	14.07
16	6.03	8.73	9.61	.00	8.13	15.50	12.27	12.04	12.89	17.80	17.77	14.92	13.55

	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.54	.68	.27	.00	.35	.29	.00	.46	.19
3	.74	.71	.68	.48	.63	.77	.76	.77	.63
4	1.06	1.03	.95	.93	.97	1.01	1.00	.88	.79
5	1.50	1.45	1.26	1.28	1.26	1.28	1.23	1.14	1.01
6	2.06	1.97	1.65	1.54	1.73	1.56	1.40	1.46	1.31
7	2.69	2.38	2.38	1.87	1.92	2.19	1.68	1.57	1.76
8	3.64	3.10	2.74	2.61	2.37	2.21	2.27	1.96	1.84
9	4.03	3.84	3.67	3.58	2.79	2.50	2.18	2.37	1.96
10	5.19	5.03	4.99	4.31	3.67	3.93	2.17	2.29	2.72
11	7.09	6.32	5.30	6.49	4.92	5.10	4.38	2.89	2.49
12	8.44	6.13	6.87	6.32	7.06	5.16	6.19	3.53	2.60
13	9.28	9.88	10.18	7.23	7.65	8.55	8.49	4.14	5.67
14	10.58	11.12	9.57	11.68	11.17	12.28	12.33	12.98	13.53
15	12.63	11.12	11.89	12.69	12.16	7.87	10.38	9.18	12.83
16	13.21	14.49	14.52	13.19	14.76	15.38	11.41	10.75	12.97

Table 10. Standardized catch and effort for 4VsW cod from NAFO and Ziff data.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... .581
MULTIPLE R SQUARED..... .337

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.875E0002	1.875E0002	
REGRESSION	46	3.571E0002	7.762E0000	20.793
TYPE 1	10	1.690E0002	1.690E0001	45.271
TYPE 2	1	1.034E0001	1.034E0001	27.708
TYPE 3	11	9.673E0001	8.794E0000	23.555
TYPE 4	24	1.776E0002	7.399E0000	19.820
RESIDUALS	1881	7.022E0002	3.733E2001	
TOTAL	1928	1.247E0003		

PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 5 1 1

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	CATCH RATE S.E.	EFFORT
68	80428	0.779	1.073	0.098	74929
69	50165	0.731	1.076	0.108	46640
70	57434	0.803	1.093	0.104	52548
71	52563	0.715	0.784	0.073	67044
72	61645	0.652	0.856	0.075	71982
73	54093	0.741	0.885	0.076	61133
74	43741	0.728	0.730	0.066	59881
75	32517	0.603	0.523	0.050	62196
76	24407	0.588	0.693	0.065	35236
77	10390	0.292	0.725	0.082	14333
78	25405	0.597	1.412	0.131	17992
79	40030	0.653	1.784	0.166	22440
80	49252	0.605	1.308	0.116	37646
81	53718	0.591	1.378	0.117	38978
82	55754	0.645	1.693	0.142	32938
83	52380	0.657	1.627	0.140	32197
84	52546	0.722	1.792	0.158	29328
85	57455	0.614	2.209	0.193	26010
86	51529	0.581	2.299	0.201	22409
87	45503	0.599	1.599	0.145	28453
88	38356	0.592	1.477	0.133	25970
89	36743	0.555	1.523	0.141	24131
90	34334	0.540	1.894	0.177	18125
91	32915	0.639	1.375	0.124	23946
92	29802	0.644	1.437	0.134	20734

AVERAGE C.V. FOR THE MEAN: .092

Table 10. (continued).

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	5	INTERCEPT	0.343	0.084	1928
2	1				
3	1				
4	82				
1	0	1	[2]0.090	0.060	153
	1	2	[2]0.213	0.049	284
	2	3	[2]0.830	0.067	116
	3	4	[2]0.426	0.055	202
	4	5	[2]0.200	0.051	232
	6	6	[2]0.334	0.079	74
	7	7	[2]0.088	0.095	48
	8	8	[2]0.050	0.062	139
	9	9	0.544	0.061	191
	10	10	0.825	0.080	93
2	2	11	[2]0.162	0.031	770
3	2	12	0.179	0.067	196
	3	13	0.037	0.065	242
	4	14	[2]0.250	0.065	232
	5	15	[2]0.435	0.068	202
	6	16	[2]0.524	0.074	134
	7	17	[2]0.579	0.079	110
	8	18	[2]0.414	0.077	121
	9	19	[2]0.408	0.075	129
	10	20	[2]0.387	0.073	144
	11	21	[2]0.104	0.073	141
	12	22	[2]0.163	0.074	132
4	68	23	[2]0.455	0.096	71
	69	24	[2]0.452	0.106	55
	70	25	[2]0.436	0.100	64
	71	26	[2]0.769	0.097	69
	72	27	[2]0.681	0.093	86
	73	28	[2]0.648	0.091	98
	74	29	[2]0.840	0.095	83
	75	30	[2]1.174	0.101	67
	76	31	[2]0.893	0.097	76
	77	32	[2]0.845	0.117	38
	78	33	[2]0.181	0.095	71
	79	34	0.053	0.093	74
	80	35	[2]0.257	0.090	83
	81	36	[2]0.205	0.085	103
	83	37	[2]0.039	0.087	94
	84	38	0.057	0.089	85
	85	39	0.267	0.088	88
	86	40	0.307	0.089	87
	87	41	[2]0.056	0.092	77
	88	42	[2]0.136	0.093	75
	89	43	[2]0.105	0.096	67
	90	44	0.113	0.096	66
	91	45	[2]0.208	0.092	76
	92	46	[2]0.163	0.096	68

Table 11. Standardized catch and effort for 4VsW cod from IOP data.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... .661
MULTIPLE R SQUARED..... .437

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.003E²001	2.003E²001	
REGRESSION	22	7.469E0001	3.395E0000	6.482
TYPE 1	10	2.143E0001	2.143E0000	4.092
TYPE 2	11	5.286E0001	4.806E0000	9.176
TYPE 3	1	2.546E0000	2.546E0000	4.861
RESIDUALS	184	9.637E0001	5.237E²001	
TOTAL	207	1.713E0002		

PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 1 5

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	S.E.	EFFORT
82	55754	0.075	1.731	0.400	32203
83	52930	0.080	1.555	0.344	34028
84	52546	0.125	2.920	0.653	17993
85	57455	0.102	3.280	0.733	17519
86	51529	0.053	2.790	0.653	18472
87	45503	0.073	2.593	0.602	17545
88	38356	0.133	2.165	0.481	17718
89	36791	0.114	2.883	0.672	12763
90	34334	0.241	1.863	0.419	18428
91	32915	0.153	1.445	0.346	22778
92	29802	0.079	1.101	0.261	27059

AVERAGE C.V. FOR THE MEAN: .229

Table 11. (continued).

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	82	INTERCEPT	0.313	0.234	207
2	1				
3	5				
1	83	1	[2]0.109	0.226	23
	84	2	0.521	0.228	22
	85	3	0.637	0.231	21
	86	4	0.478	0.249	16
	87	5	0.404	0.245	17
	88	6	0.221	0.228	22
	89	7	0.510	0.250	16
	90	8	0.072	0.234	20
	91	9	[2]0.179	0.249	16
	92	10	[2]0.451	0.254	15
2	2	11	0.396	0.221	22
	3	12	0.387	0.221	22
	4	13	[2]0.526	0.230	19
	5	14	[2]0.746	0.237	17
	6	15	[2]0.885	0.252	14
	7	16	[2]0.905	0.252	14
	8	17	[2]0.704	0.257	13
	9	18	[2]0.844	0.251	14
	10	19	[2]1.104	0.230	19
	11	20	[2]0.299	0.233	18
	12	21	[2]0.212	0.252	14
3	4	22	[2]0.235	0.106	82

Table 12. 4VsW cod July survey mean catch at age per tow.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	.03	.01	.00	.00	.25	.02	.00	.00	.05	.29	.01	.02	.00
1	.42	.44	1.78	1.84	1.48	.95	.67	.21	.88	.35	.20	1.33	.73
2	4.73	2.20	2.77	12.59	9.45	2.43	3.70	2.75	3.75	3.04	2.01	3.65	62.94
3	1.66	10.22	3.41	19.79	5.53	3.76	4.22	6.97	8.96	4.60	5.31	5.53	52.60
4	2.58	2.30	9.04	16.07	1.62	1.76	2.60	4.53	9.80	4.76	2.94	8.44	18.37
5	1.28	4.53	1.67	6.44	.58	.86	1.65	2.82	2.71	5.18	4.98	3.22	4.12
6	.42	1.66	1.72	.53	.64	.19	.32	1.24	1.00	2.59	3.47	2.31	2.23
7	.50	.99	.46	.83	.11	.23	.15	.27	.25	.77	1.37	1.19	1.20
8	.16	.42	.16	.26	.13	.06	.26	.18	.05	.29	.37	.44	.51
9	.03	.18	.14	.12	.06	.12	.00	.04	.03	.12	.10	.14	.11
10	.07	.02	.04	.15	.05	.01	.18	.00	.02	.02	.08	.16	.12
11	.08	.04	.00	.05	.02	.00	.02	.03	.00	.01	.03	.04	.06
12	.03	.02	.00	.00	.02	.02	.00	.02	.00	.00	.00	.01	.00
13	.05	.06	.00	.00	.00	.00	.04	.00	.00	.01	.00	.01	.00
14	.00	.00	.00	.06	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.01	.02	.00	.00	.00	.00	.00	.00	.01	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00	.00
0+	12.04	23.09	21.19	58.74	19.95	10.40	13.82	19.05	27.51	22.04	20.87	26.50	143.01
1+	12.01	23.08	21.19	58.74	19.70	10.38	13.82	19.05	27.46	21.74	20.85	26.47	143.00
2+	11.59	22.64	19.41	56.90	18.22	9.44	13.15	18.84	26.59	21.40	20.66	25.15	142.27
3+	6.86	20.44	16.63	44.31	8.77	7.01	9.45	16.09	22.84	18.35	18.64	21.49	79.33
4+	5.20	10.22	13.23	24.53	3.24	3.24	5.22	9.12	13.89	13.76	13.33	15.96	26.74

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	.02	.07	.00	.03	.04	.07	.03	.00	.00	.00
1	13.72	.41	1.29	.36	.64	.06	.25	.13	.47	1.69
2	13.31	7.27	1.68	1.32	1.51	4.70	8.86	5.06	1.44	5.51
3	44.47	12.82	7.88	1.53	4.97	7.29	7.38	18.22	2.73	6.58
4	19.25	19.09	9.56	6.16	4.83	5.89	5.01	8.64	5.58	3.83
5	9.88	12.94	9.32	3.89	8.86	3.27	3.47	3.83	3.90	2.43
6	4.42	6.01	5.12	3.26	3.61	3.41	1.35	1.41	1.32	.81
7	.99	4.13	2.56	1.15	2.71	1.95	2.00	.60	.39	.15
8	.55	.41	1.01	.55	1.47	.98	.47	.29	.20	.08
9	.14	.33	.48	.24	.34	.22	.32	.11	.18	.03
10	.08	.10	.11	.15	.02	.05	.01	.07	.05	.02
11	.04	.23	.11	.04	.08	.12	.00	.00	.05	.00
12	.02	.01	.07	.00	.04	.02	.02	.00	.00	.00
13	.02	.01	.00	.02	.01	.00	.01	.00	.00	.00
14	.00	.01	.00	.00	.00	.02	.00	.00	.00	.01
15	.00	.00	.01	.00	.03	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
0+	106.91	63.82	39.21	18.69	29.17	28.04	29.19	38.35	16.31	21.14
1+	106.89	63.75	39.21	18.67	29.13	27.97	29.17	38.35	16.31	21.14
2+	93.16	63.35	37.92	18.31	28.48	27.92	28.92	38.22	15.84	19.45
3+	79.86	56.08	36.24	16.99	26.98	23.21	20.06	33.16	14.40	13.94
4+	35.39	43.26	28.36	15.45	22.00	15.92	12.68	14.94	11.67	7.36

Table 13. 4VsW cod July survey coefficients of variation.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	.51	1.00	.00	.00	.00	1.00	.00	.00	.47	.55	.64	.76	1.00	1.00	.53	.00	.70	1.00
1	.28	.36	.75	.65	.13	.34	.37	.28	.15	.23	.29	.40	.30	.91	.56	.67	.37	.35
2	.06	.30	.29	.77	.03	.27	.16	.17	.43	.26	.40	.32	.85	.40	.28	.33	.49	.29
3	.21	.59	.66	.62	.07	.35	.12	.20	.40	.26	.37	.38	.82	.50	.57	.17	.29	.38
4	.10	.47	.84	.78	.08	.25	.25	.25	.23	.22	.24	.29	.74	.42	.48	.26	.34	.27
5	.08	.58	.68	.71	.31	.19	.23	.40	.29	.19	.23	.26	.36	.39	.49	.34	.35	.24
6	.10	.55	.82	.77	.38	.24	.22	.50	.17	.16	.27	.22	.08	.22	.48	.34	.31	.29
7	.25	.52	.81	.68	.27	.33	.20	.51	.10	.17	.26	.27	.05	.13	.54	.26	.29	.30
8	.29	.34	.62	.33	.46	.40	.00	.49	.32	.18	.34	.27	.03	.18	.36	.21	.29	.28
9	.76	.69	.63	.78	.35	.46	.00	.42	.26	.19	.48	.45	.10	.21	.53	.20	.30	.26
10	.54	.73	.78	.52	.19	1.00	.00	.00	.67	.52	.61	.52	.00	.00	.31	.24	.29	.39
11	.00	.60	.00	.44	1.00	.00	1.00	.47	.00	.40	.69	.66	.00	.00	.71	.47	.54	.40
12	1.00	1.00	.00	.00	.00	1.00	.00	.54	.00	1.00	.00	1.00	.00	.00	1.00	.29	.00	.53
13	.00	.72	.00	.00	.00	.00	.00	.00	.00	.88	.00	1.00	.00	.00	.74	.00	1.00	1.00
14	.00	.00	.00	.68	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.74	.00	.00	.00
15	.00	.00	.00	.71	1.00	.00	.00	.00	.00	.00	.00	1.00	.00	.00	.00	1.00	.00	.58
16	.00	.00	.00	.00	.00	.00	.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	1988	1989	1990	1991	1992
0	.59	1.00	1.00	1.00	.00
1	.45	.23	.55	.42	.94
2	.46	.62	.51	.18	.77
3	.51	.48	.37	.16	.64
4	.32	.33	.30	.15	.59
5	.31	.24	.35	.13	.34
6	.48	.23	.31	.13	.22
7	.44	.27	.30	.13	.20
8	.39	.25	.31	.12	.25
9	.27	.28	.39	.13	.33
10	.35	.68	.35	.24	.50
11	.36	1.00	.00	.22	.00
12	.42	.63	.00	.00	.00
13	.00	.73	.00	.00	.00
14	.64	.00	.00	.00	1.00
15	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00

Table 14. 4VsW cod Spring survey mean catch at age per tow.

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1	.26	.86	8.25	2.65	.85	.22	.00	.19	.35	.60	.58	.12	.02
2	2.12	2.71	3.80	22.22	3.17	1.49	.00	10.88	.92	7.96	17.96	1.60	3.50
3	.89	2.04	5.29	17.91	42.14	1.85	.00	19.44	2.87	9.49	10.40	5.08	12.15
4	.60	1.67	7.79	11.84	25.52	9.37	.00	23.58	4.50	4.26	4.23	2.56	21.92
5	1.37	2.52	4.87	7.24	4.96	6.21	.00	11.67	10.14	4.32	4.80	.86	5.09
6	1.02	2.90	5.76	1.99	5.85	2.92	.00	13.13	4.82	4.88	1.68	.31	1.49
7	.47	1.43	3.20	1.36	1.32	2.53	.00	6.27	3.32	1.43	.70	.19	.35
8	.29	.30	1.53	1.08	.62	.77	.00	1.34	1.20	1.87	.22	.36	.02
9	.07	.06	.18	.28	.29	.50	.00	.73	.24	.46	.25	.13	.10
10	.10	.03	.14	.14	.10	.20	.00	.28	.10	.19	.05	.12	.00
11	.08	.01	.03	.06	.04	.02	.00	.04	.04	.18	.03	.04	.01
12	.02	.00	.02	.03	.04	.09	.00	.05	.03	.04	.02	.03	.00
13	.03	.01	.00	.01	.01	.00	.00	.01	.03	.02	.00	.01	.02
14	.01	.00	.00	.00	.04	.01	.00	.01	.01	.00	.01	.00	.01
15	.01	.00	.00	.01	.00	.00	.00	.00	.00	.03	.02	.00	.00
16	.00	.00	.00	.01	.00	.02	.00	.01	.00	.00	.00	.00	.00
0+	7.33	14.55	40.86	66.83	84.94	26.19	.00	87.62	28.56	35.75	40.94	11.42	44.69
1+	7.33	14.55	40.86	66.83	84.94	26.19	.00	87.62	28.56	35.75	40.94	11.42	44.69
2+	7.07	13.68	32.62	64.18	84.09	25.97	.00	87.43	28.22	35.15	40.37	11.29	44.66
3+	4.95	10.98	28.81	41.96	80.92	24.48	.00	76.55	27.30	27.18	22.41	9.69	41.16
4+	4.06	8.93	23.52	24.05	38.78	22.63	.00	57.11	24.43	17.69	12.01	4.62	29.02

	1992	1993
0	.00	.00
1	.07	.03
2	.52	2.86
3	.25	5.62
4	.25	3.83
5	.49	2.43
6	.31	1.08
7	.11	.16
8	.05	.08
9	.02	.01
10	.00	.00
11	.01	.00
12	.03	.00
13	.01	.00
14	.00	.00
15	.00	.00
16	.00	.00
0+	2.14	16.10
1+	2.14	16.10
2+	2.07	16.07
3+	1.55	13.21
4+	1.30	7.59

Table 15. 4VsW cod Spring survey coefficients of variation.

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1	.29	.31	.00	.00	.40	.21	.00	.00	.20	.15	.58	.38	.54	.43	1.00
2	.14	.46	.53	.00	.58	.17	.00	.00	.08	.70	.76	.41	.67	.23	.57
3	.18	.40	.20	.00	.71	.14	.00	.00	.04	.80	.49	.44	.92	.44	.51
4	.25	.31	.20	.00	.52	.26	.00	.00	.01	.51	.48	.47	.89	.44	.47
5	.17	.38	.27	.00	.37	.39	.00	.00	.01	.54	.44	.34	.74	.43	.51
6	.17	.48	.25	.00	.31	.45	.00	.00	.02	.43	.38	.31	.57	.42	.53
7	.38	.55	.19	.00	.30	.38	.00	.00	.10	.37	.34	.33	.52	.45	.50
8	.31	.64	.22	.00	.30	.37	.00	.00	.13	.39	.58	.65	.45	.40	.38
9	.09	.34	.17	.00	.36	.55	.00	.00	.17	.43	.38	.47	.48	.50	.00
10	.27	.77	.33	.00	.64	.40	.00	.00	.09	.35	.29	.52	1.00	1.00	.00
11	.28	.40	.63	.00	.89	.53	.00	.00	.00	.05	.44	.53	.41	1.00	.00
12	.21	1.00	.45	.00	.49	.32	.00	.00	.00	.43	.65	.00	1.00	.67	.00
13	.70	.83	.00	.00	.77	.00	.00	.00	.00	.00	1.00	.41	.60	.00	.00
14	.00	1.00	.00	.00	.56	1.00	.00	.00	.00	.00	.86	.00	.03	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.27	.86	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table 16. Numbers at age from VPA.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	84967	84749	67000	61756	74329	84679	70860	66551	101958	90265
2	80063	68395	67592	53004	49459	59704	67937	57551	54487	83445
3	40548	57741	44393	40984	34147	33869	41126	53029	47098	44525
4	47459	25157	38548	25668	26315	15901	21032	31083	42935	37504
5	39970	25462	15960	20713	15764	10963	10157	12961	24337	31462
6	17291	20353	14864	6385	8241	6705	4643	4787	9171	15566
7	6582	10050	12024	6264	2220	4714	2506	1915	3154	5173
8	3843	3632	5134	6851	2079	1212	1196	887	1124	1889
9	902	2459	1197	2502	1327	790	429	575	546	697
10	375	525	1376	666	525	909	197	228	364	350
11	486	241	98	705	193	291	124	113	157	230
12	320	274	54	18	79	146	83	90	54	100
13	126	211	68	37	8	62	8	25	34	20
14	114	95	32	23	11	6	14	7	11	2
15	9	82	5	26	0	9	0	8	3	0
1+	323060	299433	268351	225608	214704	219968	220319	229817	285439	311234

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	106098	112221	63351	62957	26131	27119	32961	43353	48884	21959
2	73892	86838	91876	51865	51545	21394	22203	26986	35494	40023
3	68235	60414	70863	75097	42458	42200	17512	18176	22095	29053
4	34859	54269	46567	55780	58311	34372	34410	14226	14854	17922
5	24770	24131	36165	31189	37816	42512	26103	24472	10909	10798
6	17140	14003	13169	20450	18763	22726	27431	14949	15150	7115
7	8170	8444	7257	7451	11062	10224	11799	15596	7383	8857
8	3140	3929	4238	3617	4376	5592	4495	6613	7824	2881
9	1205	1556	1931	2280	2046	2452	2380	2451	3029	3888
10	502	703	915	966	1301	1183	1046	1114	1167	1164
11	266	327	454	461	588	803	559	549	467	529
12	179	172	206	233	243	343	400	287	250	147
13	78	123	112	109	143	142	124	254	124	67
14	14	60	81	43	68	87	54	42	153	44
15	2	11	47	16	21	40	53	34	24	117
1+	338557	367210	337238	312521	254879	211197	181537	169109	167814	144571

	1990	1991	1992
1	11506		
2	17979	9420	
3	32762	14720	7711
4	23179	26559	11803
5	12371	16929	18816
6	5161	6610	8164
7	2990	1894	2164
8	4251	995	1000
9	1233	823	245
10	1958	203	378
11	515	652	111
12	250	129	143
13	86	83	43
14	29	20	9
15	22	10	7
1+	114299	87200	57272

Table 17. Fishing mortality at age from VPA.

	1970	1971	1972	1973	1974	1975	1976	1977
1	0.01	0.02	0.03	0.02	0.01	0.02	0.00	0.00
2	0.12	0.23	0.30	0.23	0.17	0.17	0.04	0.00
3	0.27	0.20	0.34	0.24	0.56	0.27	0.07	0.01
4	0.42	0.25	0.42	0.28	0.67	0.24	0.28	0.04
5	0.47	0.33	0.71	0.72	0.65	0.65	0.55	0.14
6	0.34	0.32	0.66	0.85	0.35	0.78	0.68	0.21
7	0.39	0.47	0.36	0.90	0.40	1.17	0.83	0.33
8	0.24	0.90	0.51	1.44	0.76	0.83	0.53	0.28
9	0.34	0.38	0.38	1.36	0.17	1.18	0.43	0.25
10	0.23	1.47	0.46	1.03	0.38	1.79	0.35	0.17
11	0.37	1.29	1.45	1.98	0.07	1.05	0.11	0.52
12	0.21	1.19	0.17	0.63	0.02	2.59	0.97	0.76
13	0.08	1.68	0.87	0.98	0.00	1.27	0.00	0.64
14	0.12	2.65	0.00	5.24	0.00	3.99	0.36	0.60
15	0.64	0.74	0.90	1.33	1.02	1.19	0.88	0.30
7-9	0.32	0.58	0.42	1.23	0.45	1.06	0.60	0.29
3-13	0.30	0.77	0.58	0.95	0.37	1.07	0.44	0.30

	1978	1979	1980	1981	1982	1983	1984	1985
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.02	0.04	0.02	0.06	0.03	0.05	0.01	0.00
4	0.11	0.21	0.16	0.20	0.20	0.18	0.11	0.07
5	0.24	0.40	0.37	0.40	0.37	0.30	0.30	0.23
6	0.37	0.44	0.50	0.45	0.36	0.41	0.40	0.45
7	0.31	0.29	0.53	0.48	0.49	0.33	0.48	0.62
8	0.27	0.24	0.50	0.51	0.41	0.36	0.37	0.65
9	0.24	0.12	0.33	0.33	0.49	0.36	0.34	0.65
10	0.25	0.07	0.22	0.23	0.48	0.29	0.28	0.54
11	0.24	0.04	0.23	0.26	0.46	0.44	0.33	0.49
12	0.78	0.04	0.17	0.22	0.42	0.28	0.33	0.81
13	2.29	0.17	0.05	0.21	0.75	0.27	0.30	0.75
14	4.50	0.00	0.00	0.03	1.38	0.48	0.32	0.29
15	0.40	0.49	0.63	0.63	0.56	0.49	0.51	0.61
7-9	0.27	0.22	0.45	0.44	0.46	0.35	0.40	0.64
3-13	0.47	0.19	0.28	0.31	0.41	0.30	0.30	0.48

	1986	1987	1988	1989	1990	1991	1992
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.02	0.00	0.02	0.08
4	0.14	0.06	0.11	0.17	0.11	0.14	0.25
5	0.35	0.27	0.22	0.53	0.42	0.52	0.64
6	0.36	0.50	0.33	0.66	0.80	0.91	1.50
7	0.37	0.48	0.74	0.53	0.90	0.43	1.81
8	0.40	0.58	0.49	0.64	1.44	1.19	1.22
9	0.55	0.54	0.75	0.48	1.60	0.57	1.65
10	0.44	0.66	0.59	0.61	0.89	0.40	1.65
11	0.46	0.58	0.95	0.54	1.17	1.31	1.65
12	0.25	0.63	1.10	0.33	0.90	0.88	1.65
13	0.87	0.30	0.83	0.63	1.22	1.99	1.65
14	0.25	0.33	0.06	0.46	0.83	0.75	1.65
15	0.49	0.57	0.57	0.77	1.10	0.97	1.65
7-9	0.44	0.53	0.66	0.55	1.31	0.73	1.56
3-13	0.38	0.42	0.56	0.47	0.86	0.76	1.25

Table 18. VPA biomass at age in thousands of tons.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	3.6	3.6	2.3	2.7	3.5	5.7	4.7	4.4	4.1	3.7
2	35.4	15.7	18.9	11.7	10.2	8.8	10.0	8.5	13.4	19.9
3	25.8	36.6	32.4	35.6	21.2	18.7	17.1	22.2	21.6	28.8
4	44.2	22.7	36.0	25.0	28.1	13.0	18.1	29.1	42.2	36.0
5	52.0	31.8	19.5	24.0	20.1	13.9	11.4	17.4	32.7	43.3
6	27.6	32.8	24.2	9.6	13.1	12.1	8.1	9.0	18.3	30.1
7	12.1	20.3	24.4	12.8	4.5	10.6	6.2	5.1	8.9	13.8
8	11.4	10.2	13.1	15.6	4.9	3.3	3.8	3.4	4.3	6.7
9	4.0	10.1	4.9	6.9	3.6	2.3	1.6	2.4	2.6	3.3
10	2.1	2.7	6.4	3.0	1.6	3.1	0.8	1.1	1.8	2.0
11	2.2	1.3	0.6	2.9	0.8	1.2	0.6	0.5	1.0	1.5
12	3.1	1.9	0.4	0.1	0.4	0.7	0.3	0.5	0.3	0.8
13	0.9	1.6	0.5	0.3	0.0	0.5	0.0	0.1	0.2	0.2
14	0.5	0.6	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
15	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1+	225.5	193.3	184.3	150.9	112.6	94.4	83.5	104.4	152.1	190.7
6+	64.3	82.5	74.8	51.7	29.2	34.1	21.9	22.6	37.9	58.8

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	4.3	4.5	2.7	2.9	1.1	1.0	2.0	2.9	2.6	1.2
2	17.9	21.2	21.5	11.2	11.9	5.5	3.6	4.0	6.6	6.8
3	46.3	41.7	48.1	49.1	25.0	26.1	11.9	6.5	8.2	15.0
4	31.1	51.6	42.7	49.9	53.0	30.0	28.2	11.3	10.1	14.2
5	30.6	33.6	47.3	39.3	47.2	52.7	29.7	26.9	11.8	12.0
6	32.0	25.7	26.0	36.9	33.3	39.0	42.4	20.8	22.5	9.9
7	21.8	21.6	17.4	19.9	26.4	22.6	25.5	27.3	12.6	17.2
8	11.3	13.6	14.5	11.2	14.6	16.1	11.4	16.4	16.4	5.9
9	5.3	7.6	8.8	9.5	7.7	9.1	8.0	7.6	8.1	9.4
10	2.9	4.3	5.7	5.3	6.2	5.3	4.5	4.4	4.2	3.8
11	1.8	2.3	3.5	3.1	3.7	4.5	2.8	3.1	2.1	2.2
12	1.5	1.4	1.7	2.0	1.8	2.2	2.6	1.6	1.6	0.7
13	0.7	1.3	1.1	1.0	1.3	1.2	0.9	1.7	0.8	0.5
14	0.1	0.5	0.9	0.4	0.7	0.8	0.5	0.4	1.3	0.4
15	0.0	0.1	0.5	0.2	0.2	0.4	0.6	0.3	0.2	1.1
1+	208.3	231.9	242.8	242.6	234.7	217.3	175.2	136.0	109.9	101.0
6+	77.8	78.9	80.3	90.0	96.3	101.8	99.7	84.2	70.5	51.5

	1990	1991	1992
1	0.7	0.3	0.0
2	2.6	2.0	0.9
3	15.3	6.0	4.1
4	20.3	21.7	9.2
5	13.7	18.0	17.7
6	6.9	8.8	9.9
7	4.8	2.8	3.4
8	9.4	1.8	1.7
9	2.7	1.9	0.4
10	4.5	0.4	0.9
11	2.1	1.6	0.2
12	1.4	0.5	0.3
13	0.5	0.4	0.1
14	0.3	0.2	0.0
15	0.2	0.1	0.1
1+	86.1	66.9	49.6
6+	33.1	18.7	17.6

Table 19. Diagnmostics from ADAPT.

Relative change in phi parameter < 0.0001
Mean Square of the Residuals = 0.59237

#	Est. Param	SE	CV	Bias %	Name
Terminal F					
1	0.0846319	0.048083	0.57	-15.7	F3
2	0.253295	0.1086	0.43	-9.2	F4
3	0.649235	0.271695	0.42	-9.6	F5
4	1.50505	0.69504	0.46	-9.2	F6
5	1.81565	0.835906	0.46	-7.1	F7
6	1.22021	0.590427	0.48	-11.7	F8
Summer survey					
7	0.231091	0.0380904	0.16	-1.0	q3
8	0.252605	0.0412224	0.16	-1.0	q4
9	0.239892	0.0390831	0.16	-1.1	q5
10	0.20736	0.034015	0.16	-1.2	q6
11	0.196571	0.0324023	0.16	-1.3	q7
12	0.165862	0.0273343	0.16	-1.7	q8
Spring survey					
13	0.165625	0.0368327	0.22	-1.8	q3
14	0.177394	0.0387294	0.22	-1.8	q4
15	0.193596	0.0420113	0.22	-1.8	q5
16	0.213437	0.0463538	0.22	-1.9	q6
17	0.193351	0.0421159	0.22	-2.0	q7
18	0.168769	0.0368204	0.22	-2.5	q8
19	0.145839	0.0317586	0.22	-3.0	q9

Table 20. Retrospective analysis in terms of average F for ages 7-9. Each row of the table represents an additonals year's data.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1988	0.32	0.58	0.42	1.23	0.44	1.06	0.59	0.28	0.27	0.22	0.45	0.45	0.47
1989	0.32	0.58	0.42	1.23	0.44	1.06	0.59	0.29	0.27	0.22	0.45	0.42	0.45
1990	0.32	0.58	0.42	1.23	0.44	1.06	0.59	0.29	0.27	0.22	0.45	0.43	0.46
1991	0.32	0.58	0.42	1.23	0.45	1.06	0.60	0.29	0.27	0.22	0.45	0.44	0.46
1992	0.32	0.58	0.42	1.23	0.45	1.06	0.60	0.29	0.27	0.22	0.45	0.44	0.46

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1988	0.35	0.35	0.54	0.35	0.40	0.41				
1989	0.33	0.39	0.62	0.42	0.46	0.49	0.32			
1990	0.34	0.39	0.63	0.42	0.50	0.56	0.43	0.67		
1991	0.35	0.40	0.63	0.43	0.50	0.64	0.53	1.36	0.55	
1992	0.35	0.40	0.64	0.44	0.53	0.66	0.55	1.31	0.73	1.56

Figure 1. Catch and TAC history for 4VsW cod.

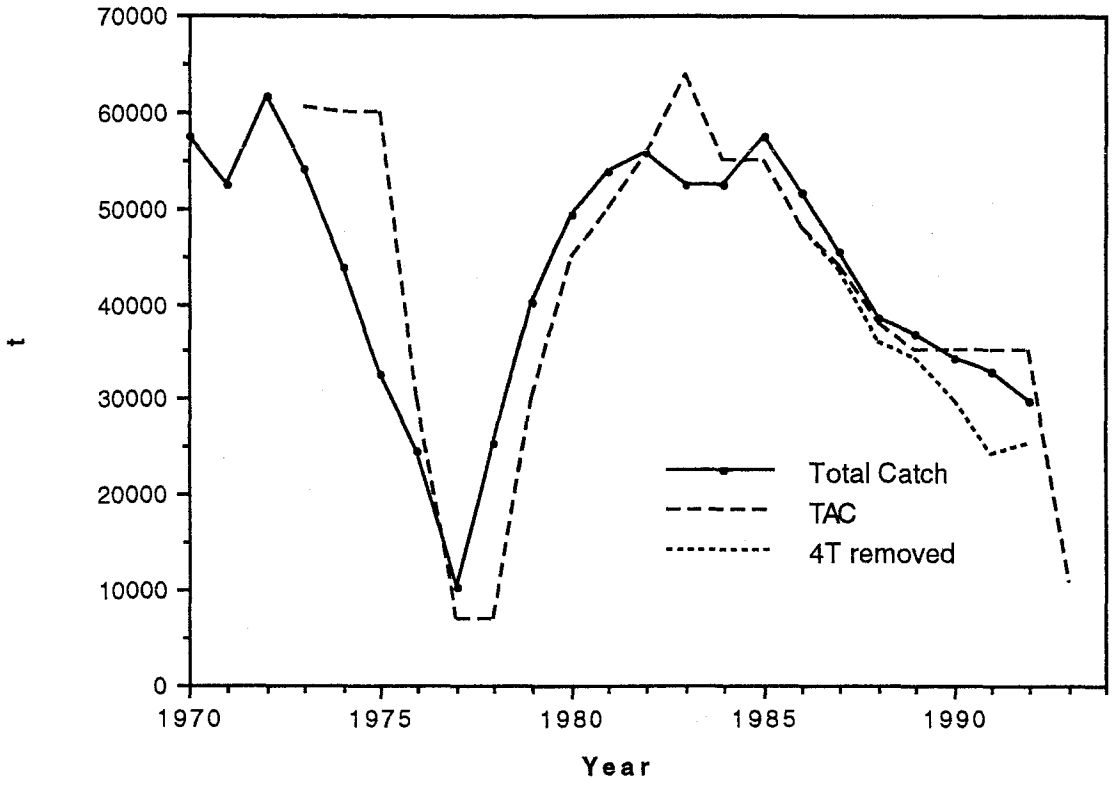


Figure 2. Comparative catch for 3 gear sectors for 1990-92.

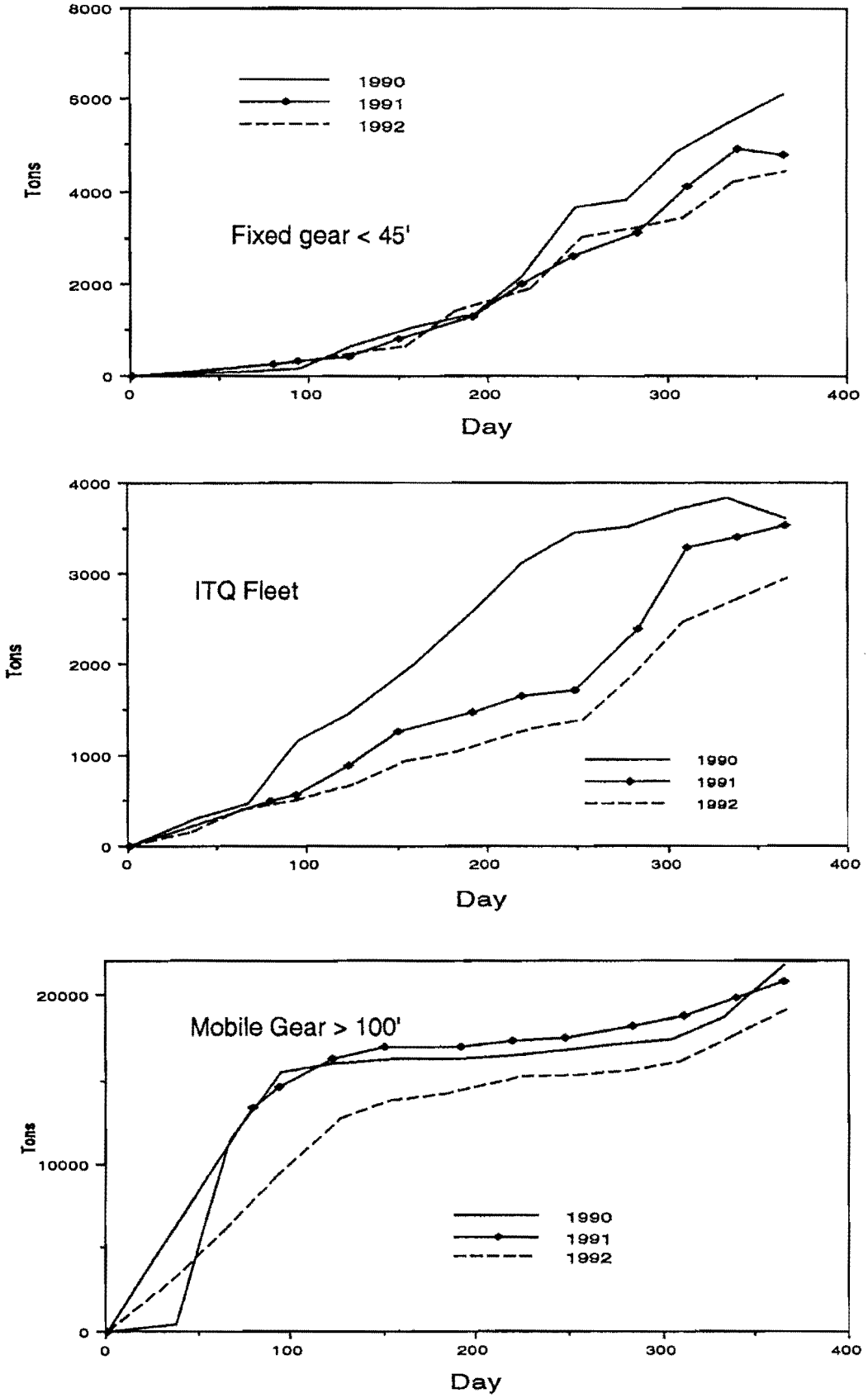


Figure 3. Catch rates from landings statistics and IOP data for 4VsW cod.

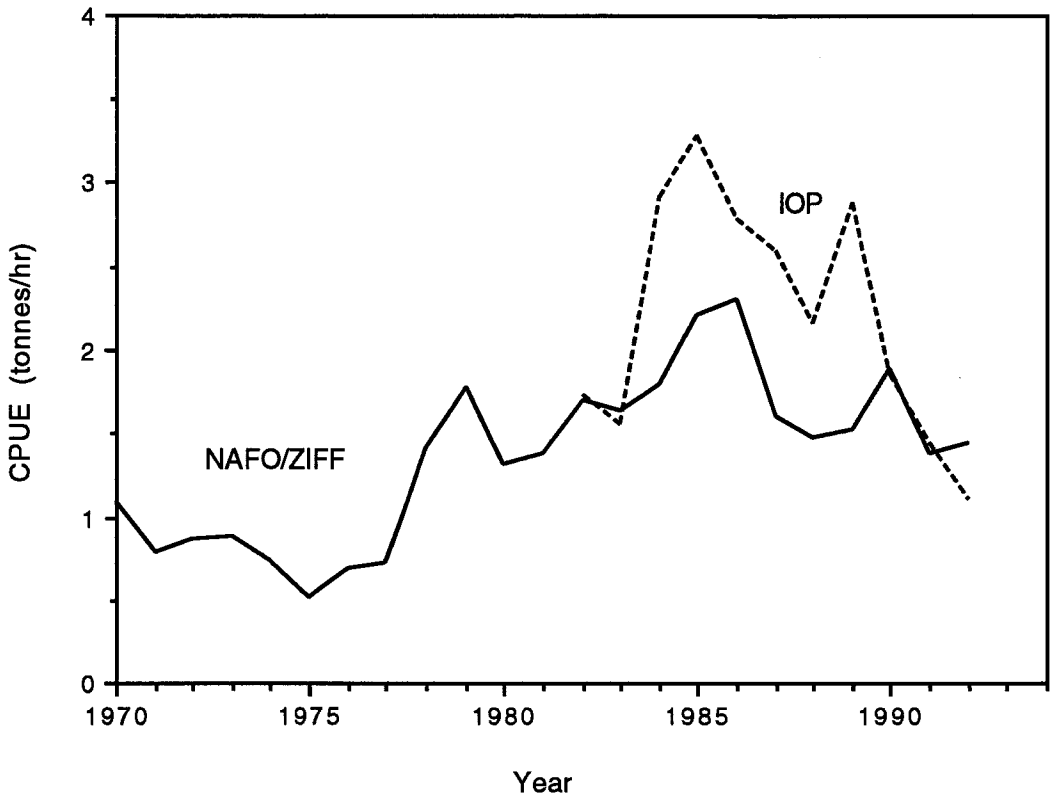
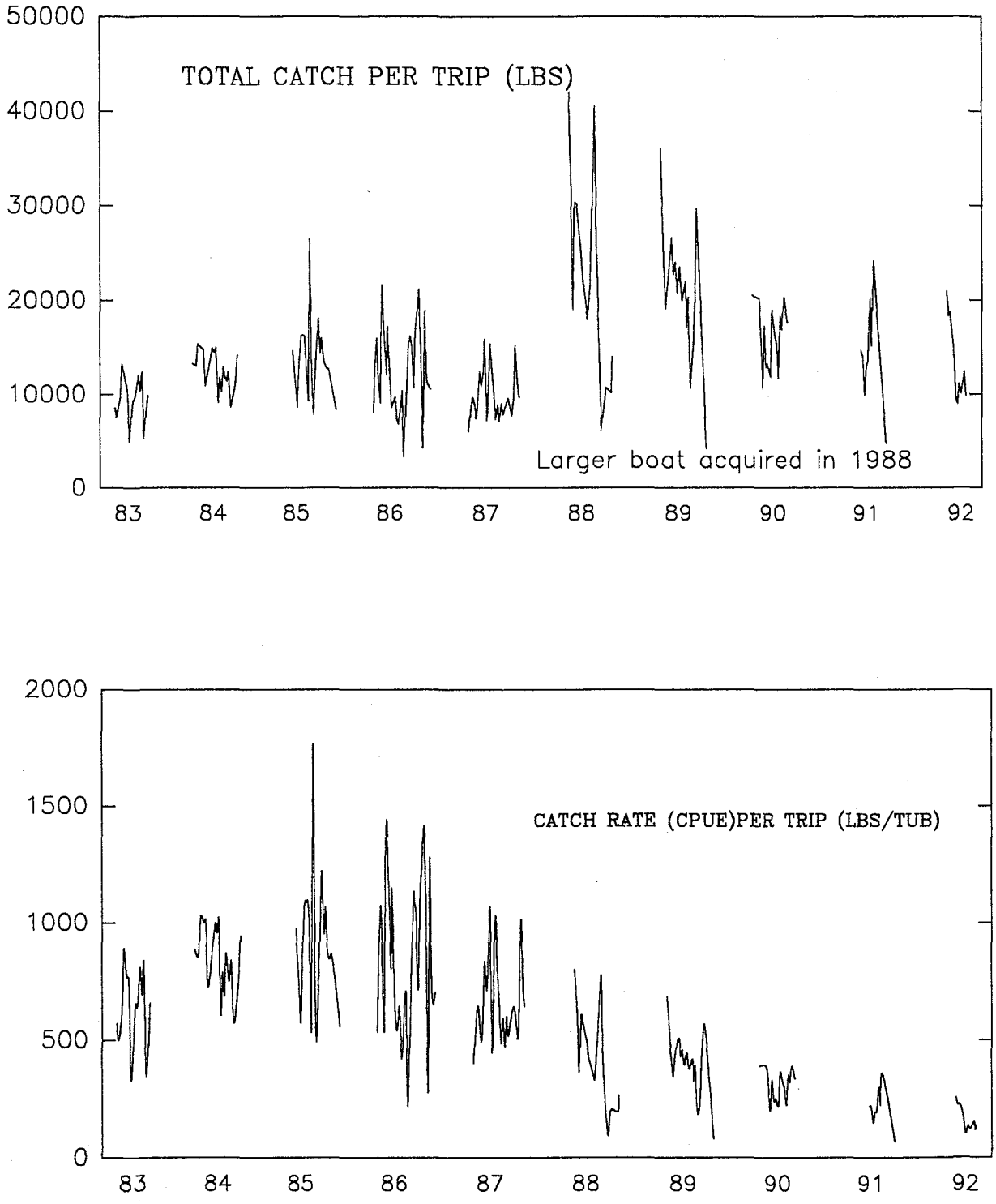


Figure 4. Catch and catch rate from longline vessel.



COD CATCH HISTORY, 1983 – 1992

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Figure 5. Survey numbers (3+) for 4VsW cod.

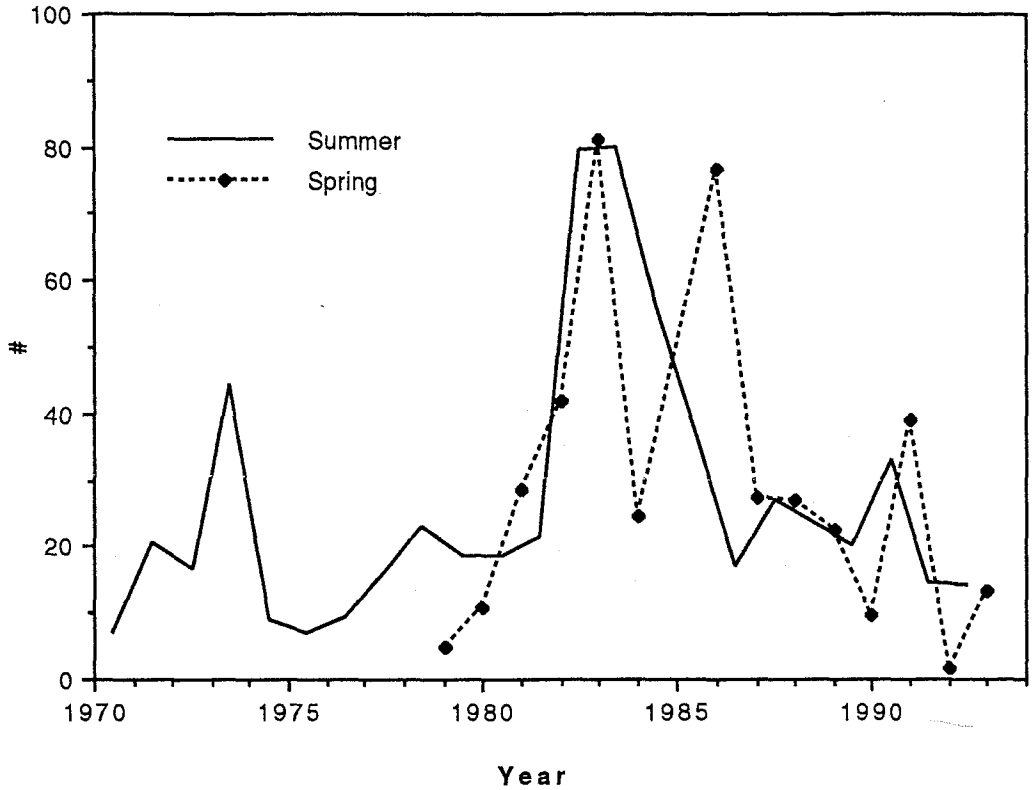

Figure 6. Biomass estimates for 4VsW cod from VPA.

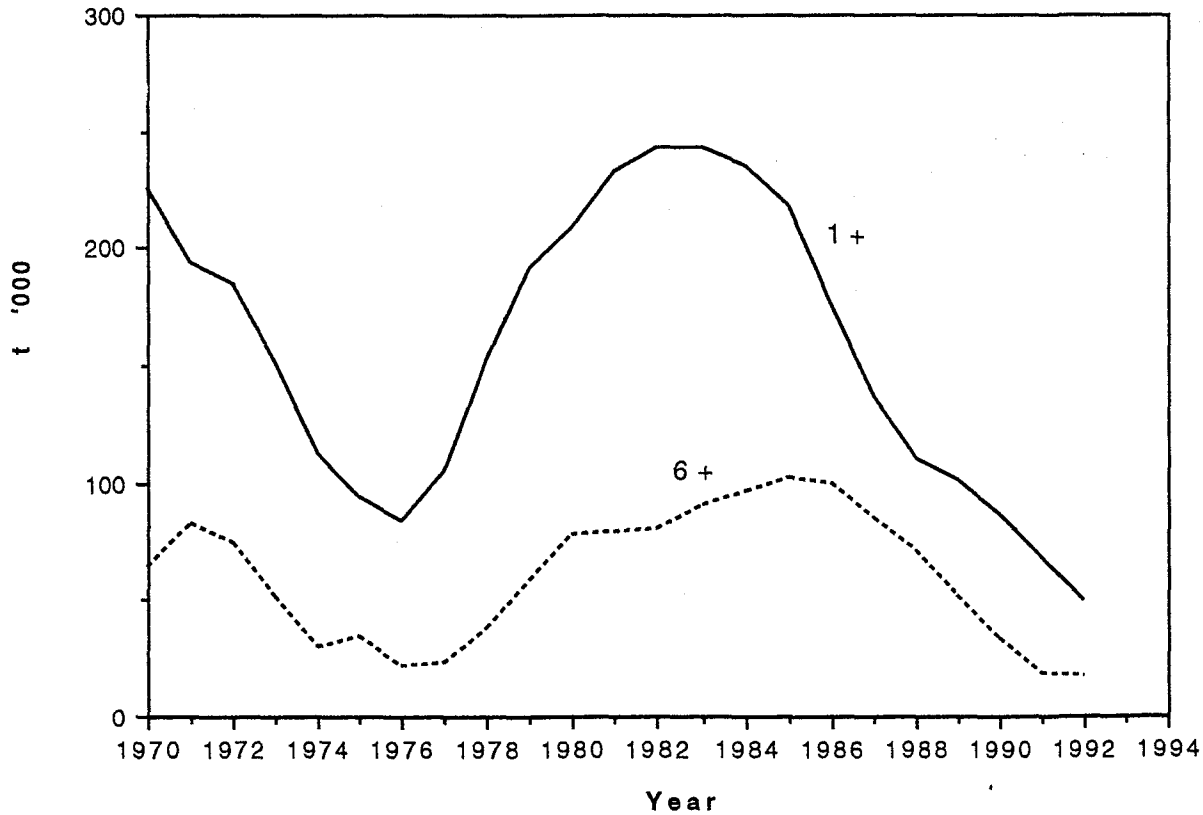

Figure 7. Recruitment series for 4VsW cod from VPA.

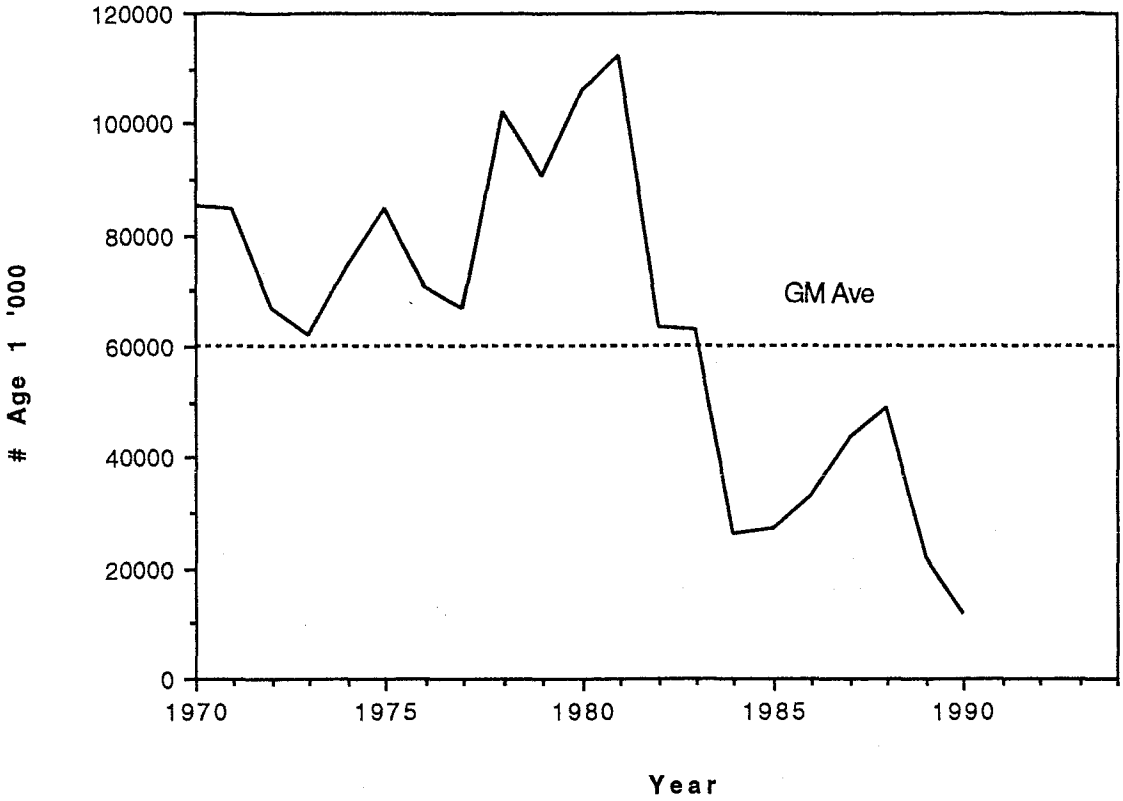

Figure 8. Estimates of average fishing mortality for 4VsW cod.

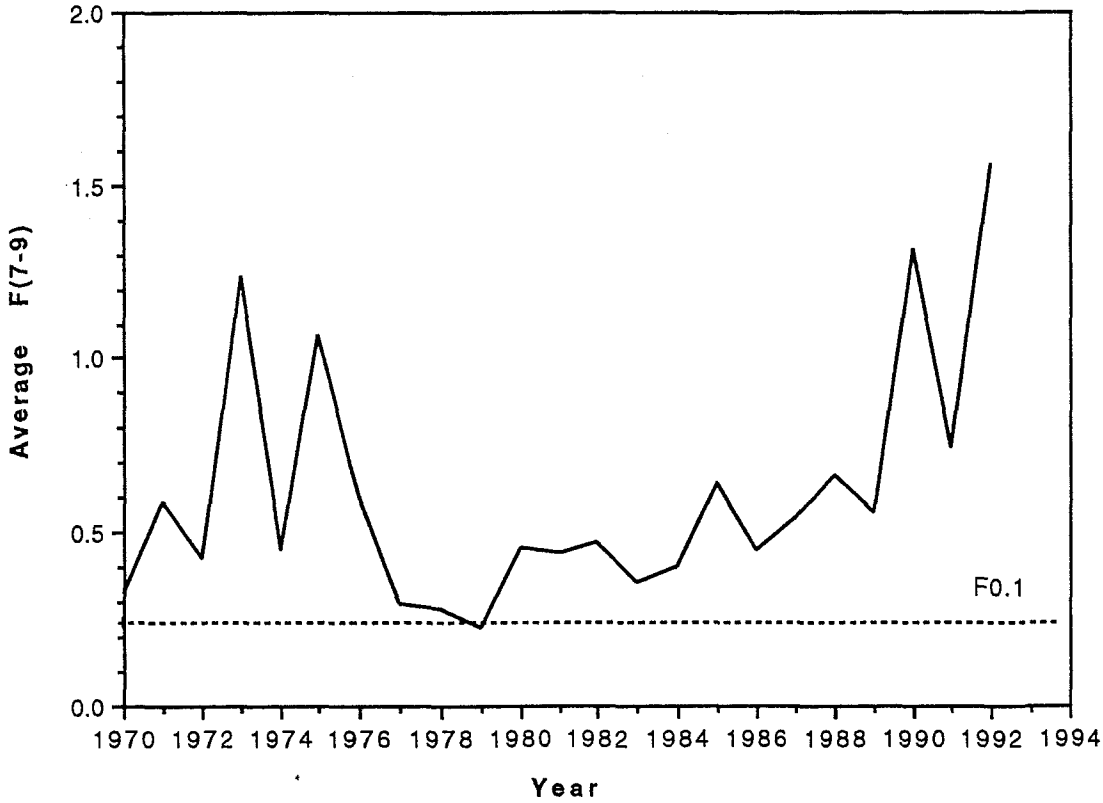

Figure 9. 4VsW cod recruit numbers vs 6+ biomass.

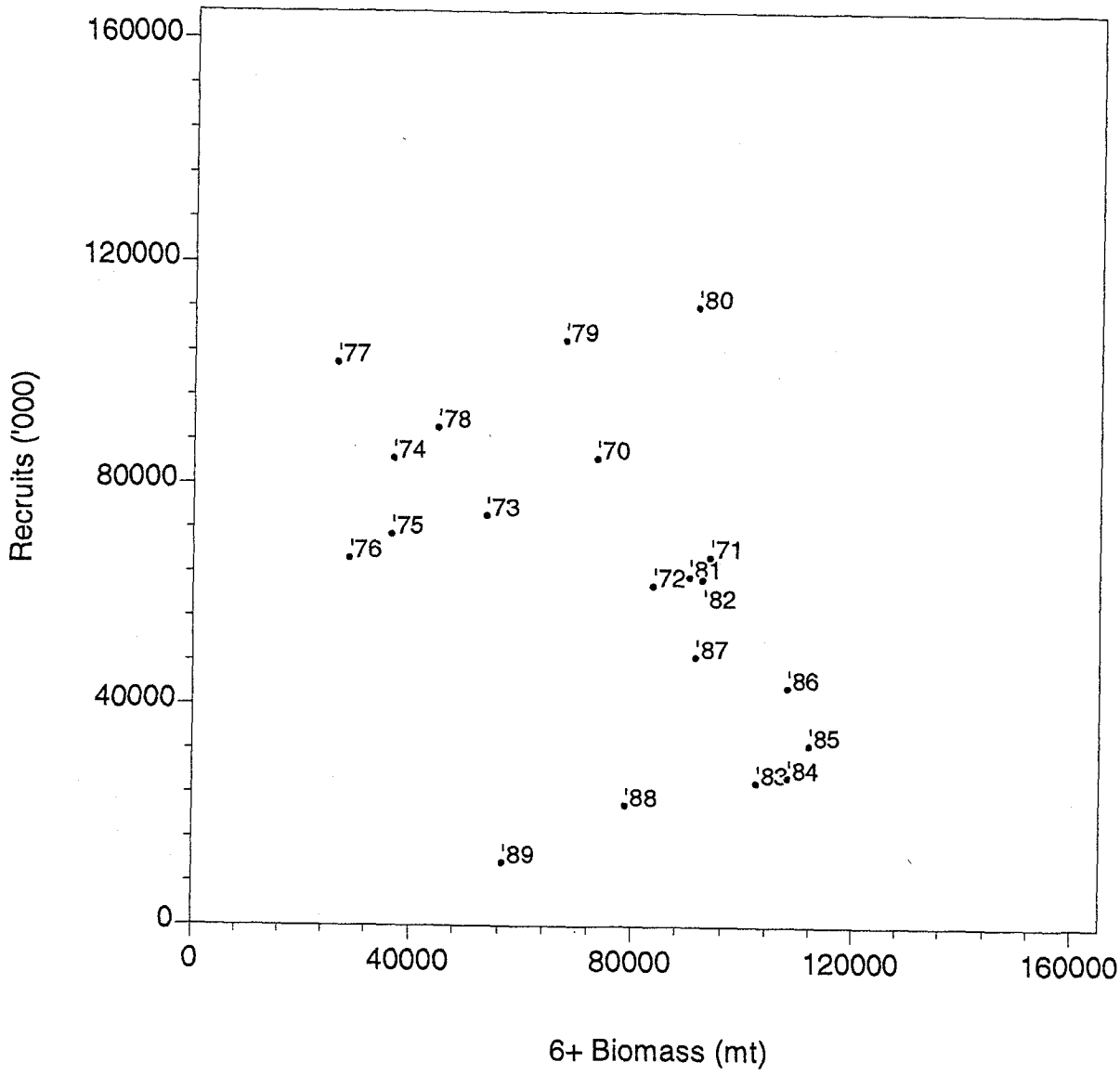

Figure 10. 4VsW cod numbers 3-8 from SPA and surveys.

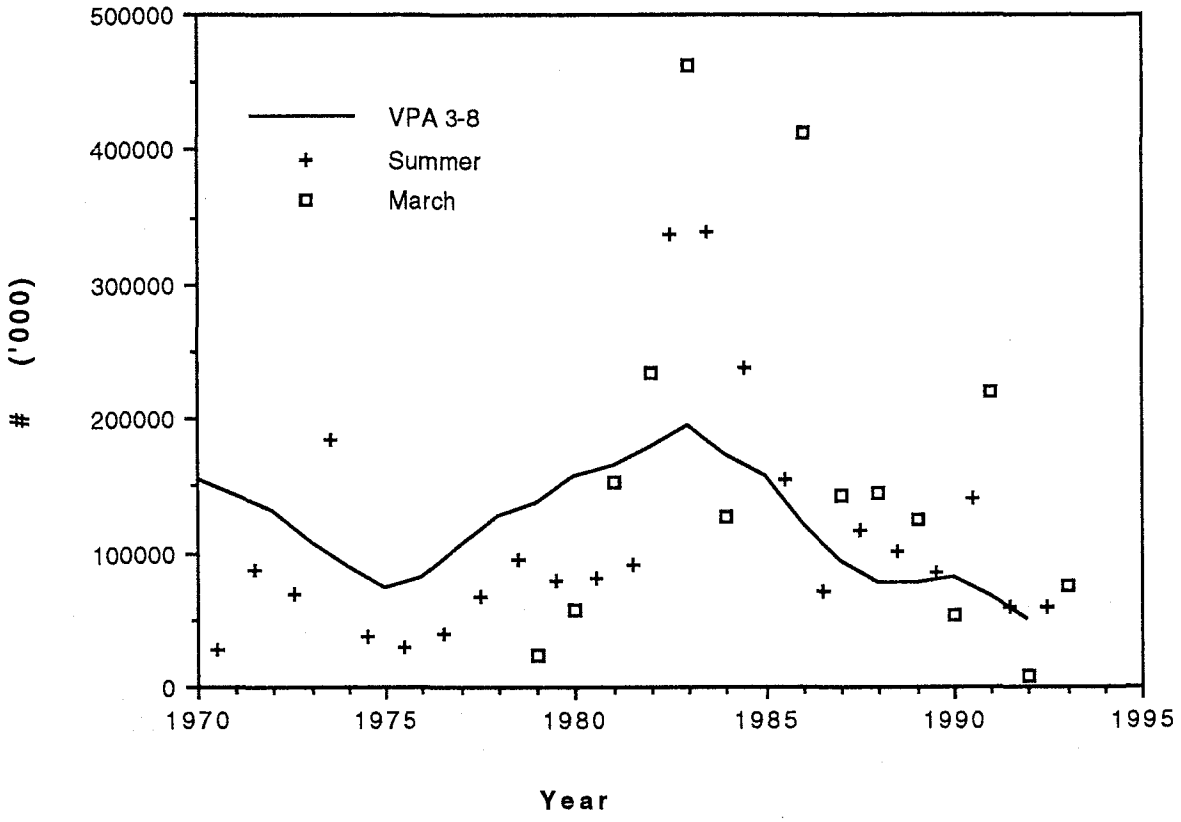

Figure 11. Yield in 1994 and biomass remaining at end of 1993 over a range of fishing mortalities.