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Subdivision 4Vn Cod (May-December): Status Review for the 1987 Fishing Year

by

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Abstract

The nominal catch of cod in Subdivision 4Vn (May-Dec.) for 1987 was 10,248 t. All of the major gear components with the exception of TC-1 longliners experienced decreases in their catch from that reported for 1986. The fishery was under management restrictions as soon as it opened and it appears that the regulations were restrictive for all but the TC-1 longliners.

This report summarizes the available information for this fishery in 1987. Fishing mortality continues to be estimated in excess of $F_{0.1}$, but the exact level of exploitation could not be precisely determined.

Résumé

Les prises nominales de morue dans la Sous-division 4Vn (Mai-déc.) pour 1987 se sont élevées à 10 248 t. Tous les principaux engins de pêche, à l'exception des palangriers TC-1, accusent une baisse par rapport aux prises consignées pour 1986. La pêche a été soumise à des restrictions de gestion dès son ouverture et il semble que les règlements aient été restrictifs pour tous les engins, à l'exception des palangriers TC-1.

Ce rapport résume les informations accessibles pour cette pêche en 1987. La mortalité due à la pêche demeure, d'après les estimations, supérieure à $F_{0,1}$, mais il a été impossible de déterminer avec précision le taux exact d'exploitation.

Introduction

The management of the cod fishery in NAFO Subdivision 4Vn has undergone a number of changes in the last 10 years. The TAC's set for this fishery from 1978-1980 consisted of quota regulation for the mobile gear sector an allowance for the fixed gear component. Beginning in 1981 TAC's were set for all gear components of this fishery in response to a rapid rise in landings, the bulk of which were experienced by the longline component. Over the next 4 years the fixed gears did not catch their allocation by the end of the fishing year and the unused portions of their quota were transferred to the mobile fleet at the end of the year. This transfer remained in place for the mobile fleet in the following fishing year. Thus the fixed gear component experienced both an absolute and proportional decrease in its allocation over the 4 years. The Assistant Deputy Minister (AFS) request that CAFSAC look into the possible implications of this trend (Smith and Sinclair, MS 1986) and subsequently a study by Sinclair (MS 1986) showed the negative effects this practise would have on future yields. A moratorium was declared on such transfers in 1986.

Starting in 1986, the allocation scheme was changed from one amount for each gear for the whole season to sub-allocations of portions of the quotas over the year. This resulted in the fixed gear (<65') fishery being closed in August and vessels being restricted to trip limits for the rest of the year. The mobile gear (<65') was essentially closed the first of May and the fleet operated on a variety of trip limits or bycatch restrictions for the remainder of 1986.

The allocation system in 1987 was even more complicated and all the major gear components were essentially under trip limit or bycatch restrictions for the whole year. This report summarizes the information for this fishery during the 1987 fishing year.

Nominal Catch

The nominal landings for Canada and selected countries for the period 1970-1987 are presented along with TAC information to 1988 in Table 1. Total landings for the same period are presented in Figure 1. The landings for 1985 were updated to match the final statisitics from NAFO. Landings in 1987 were 1508 t less than landings for 1986 but still exceeded the TAC by 1248 t. No landings were reported for France despite a 100 t allocation and less than 1 t was reported as bycatch from the Japanese redfish fishery.

Longliners remain the major gear component in this fishery (Table 2), while the importance of otter trawls has been diminishing over the last two years. The trends in landings by each of the gear components over time are presented in Figure 2. Landings by tonnage class and gear for Canadian vessels are given in Table 3 for 1986 and 1987. Almost all components with the major exception of longlines tonnage class 1 (TC-1) exhibited lower landings in 1987 compared to 1986.

The allocation schedule and a listing of subsequent management measures for this fishery is given in the Appendix. This fishery was under management restrictions as soon as it opened in 1987. The trip limits set during the year (Appendix) were restrictive for all components except for the TC-1 longliners. This was reflected in the landings given in Table 3. The seasonal breakdown in Table 4 also illustrates the effect of these restrictions on the landings by otter trawls and seines. There was relatively little activity by these components after mid-May when trip limits were cut back first to 4500 kg and then to lower amounts.

Research Surveys

The stratified mean numbers and mean weight per tow from the July research surveys between 1970-1987 are given in Table 5. The historical research survey data has been completely edited recently and modifications to the entries in Table 5 for 1973 and 1977 reflect changes which have resulted from this edit. In both cases the changes were due to sets being assigned to the wrong stratum, however the changes to the original estimates were slight and do not change the interpretation of this abundance index.

The strongest year-classes in the 1987 survey are in decreasing order 1981, 1980 and 1982. The 1980 year-class had appeared to be relatively strong in past surveys. Although the mean number per tow in 1987 for this year-class is above the median mean number per tow for age 7 in past years this year-class no longer appears to be exceptional in any way. The 1981 and 1982 year classes do not to stand out in the survey as being extremely strong.

The trend in mean numbers (total for all ages) and mean weight per tow over the 18 years of the survey are presented in Figure 3. The 1985 point continues to stand out as being extreme while the indices for 1987 indicate a potential drop in abundance. The mean numbers per tow for each of the three strata in the survey are given in Table 6. The mean number for stratum 41 has dropped considerably compared to that observed in the 1986 survey. In the past, survey catches in stratum 41 were mainly composed of recruited year classes.

The trends in mean numbers, mean weight and landings centered by their respective medians and scaled by their median absolute deviations are compared in Figure 4 (see Smith, MS 1987 for details). As was noted in last years document (Smith, MS 1987), the survey trend does exhibit three years where the relative magnitude of changes in abundance appear to be unreasonable, however the general agreement in the survey indices and the landings appeared quite good. This fact will become more important in the next few years when it is expected that sequential population analysis will become a regular feature of this stock assessment.

Commercial Catch at Age

Details of the data collected and used to estimate the age composition of the commercial catch are given in Table 7. The distribution of samples by gears reflects the impact of the management measures discussed earlier. Longliners TC-1 were well sampled throughout the year while mobile gears were represented by very few samples.

The longline age composition estimates and weight at age for the period 1970-1987 are presented in Tables 8 and 9. The 1980 year-class dominated the 1987 landings as was the case for the 1986 fishery. The 1979 and 1981 year-classes appear to be of reasonable strength when compared to landings at the same age in previous years. There appears to be a decreasing trend in weight at age for ages 7,8 and 9 since 1981. However the landings have been sampled more consistently throughout the fishing season in recent years and this may be driving this trend.

The catch at age for the major gear components for the period 1984-1987 are presented in Table 10. The 1980 year-class dominates in the catch of all of these gears in 1987. The numbers landed at age by each of the major gear components for 1987 are compared in Figure 5. Note that all gears are concentrating on the same group of year-classes.

The age compositions of the total catches for the period 1984-1987 are given in Table 11.

Catch per Unit Effort

Estimates of longliner catch per unit effort (CPUE) for the period 1968-1987 are given in Table 12. The proportion of catch with effort reported continues to be low for this gear category with 8% of the 1987 longline catch being represented. Effort data is reported for vessels TC-2 and greater, and given that more than half of the longline catch was landed by TC-1 vessels it is probable that the 1987 estimate of CPUE does not represent overall conditions in the fleet. It is also possible that the trip limits and bycatch restrictions in place in 1987 may have been restrictive enough to further reduce the usefulness of the catch rates from TC 2 and larger, vessels.

An analysis of catch rates from longlines and otter trawls for the period 1981-1986 was carried out in last years document (Smith, MS 1987). A multiplicative model was used and it was found that there was not a significant relationship between catch rate and time. This analysis was not done this year for the 1981-1987 data because of last years findings.

Mortality Estimates

Total mortality estimates from longliner CPUE (numbers) for the years 1980-1987 are given in Table 13 with the mean mortality estimate for the period. The long term mean estimates continue to indicate that fishing mortality for this gear was in excess of $F_{0.1}$. Specifically the estimated average fishing mortality for fully recruited ages (7+/8+) was 0.315, assuming that natural mortality is equal to 0.2. The annual total mortality estimates used to calculate this average fishing mortality were highly variable (ranging from 0.102 to 0.900) and individually indicated fishing mortalities either much higher or lower than this level for any one year. These estimates were also calculated with the estimated CPUE from the longliners and the caveats raised in the previous section apply here as well.

Research survey mean numbers at age (Table 5) were also used to estimate average total mortality and the results for 1980/81-1986/87 are presented in Table 14. The estimates of total mortality from this data, although more variable than the longliner based estimates indicate that the fully recruited fishing mortality from the survey (5+/6+) was at the same level (0.307).

Estimation of Stock Size

In the last three assessments of this stock the population biomass B, has been estimated using the catch equations, i.e.,

$$\hat{B} = \frac{C\,Z}{F(1 - e^{-z})}.$$

The catch, C, is set to be the average of the catches from recent years and the fishing and total mortalities (F and Z) are chosen to reflect current conditions. In the assessment of the 1986 fishing year the period of 1980-1986 was chosen for the average catch under the assumption that the population had been relatively stable over this time. This also assumes that the age structure, recruitment and partial

recruitment were been stable over the same period. This year, using the period 1981-1987, and assuming that F is at least 0.31 (Table 13) the biomass was estimated to be 46,642 t. The $F_{0.1} = 0.2$ catch is estimated as,

$$\hat{C} = \frac{F_{0.1}}{Z_{0.1}} \hat{B} \left(1 - e^{-z_{0.1}}\right)$$

$$= 7689 \text{ t}$$

Last year's estimate from the above method was 6192 t.

The assumption of stability made in the above method was evaluated by using a cohort model for the 4 years of catch at age data available (1984-1987) and fishing mortalities for the last year equal to 0.2, 0.3 and 0.4. This analysis indicated that the stock appeared to be relatively stable for fishing mortalities between 0.2 and 0.4 (Figure 6) but the exact level of exploitation in this range could not be precisely determined. Further, there appeared to be some evidence of convergence towards $F = 0.2$ in 1984 (Figure 7) in the cohort analysis which indicated that the current fishing mortality was not less than 0.2. The apparent consistency between the mortality from the commercial and research data, despite the degree of variability inherent in both data sets, and the results from the cohort analysis indicated that the actual fishing mortality was probably not outside the range of 0.2 to 0.4.

Given the range of fishing mortalities presented in the last section, biomass and reference catch levels are presented here assuming F in 1987 was 0.4 or 0.2. The biomass was estimated using the average catch for 1981 to 1987. The implied F for the 1988 TAC of 7,500 t is also given.

	$F = 0.2$	$F = 0.4$
Biomass (t)	68,709	37,654
$F_{0.1}$ catch (t)	11,326	6,207
F for 1988 TAC	0.13	0.24

Note that the TAC of 7,500 t for 1988 is within the range given above.

References

Sinclair, A. MS 1986. Longline-Otter trawler interactions in cod fisheries on the Scotian Shelf: Implications of differences in partial recruitment. CAFSAC Res. Doc. 86/94 27 p.

Smith, S.J. MS 1987. Subdivision 4Vn Cod (May-December): Status review for the 1986 fishing year. CAFSAC Res. Doc. 87/39. 32 p.

Smith, S.J. and A.F. Sinclair. MS 1986. Subdivision 4Vn Cod (May-December): Status review for the 1985 fishing year. CAFSAC Res. Doc. 86/39 27 p.

Table 1. Nominal cod catch (t) by country in Subdivision 4Vn (May- Dec.)

Year	Canada	France	Spain	Portugal	Others	Total	TAC
1970	8701	34	1141	-	12	9888	-
1971	8469	1	2161	-	-	10631	-
1972	6729	745	1171	459	-	9104	-
1973	5245	-	241	189	73	5748	-
1974	4836	-	852	84	212	5984	10000
1975	3363	-	89	360	186	3998	10000
1976	5746	211	-	-	-	5957	10000
1977	7786	135	-	-	-	7921	3500
1978	5496	53	-	-	-	5549	3500
1979	6301	73	-	-	-	6374	3400
1980	9976	214	-	-	-	10190	5000
1981	12476	172	-	-	-	12648	*
1982	12101	232	-	-	-	12333	**
1983	9192	170	-	-	-	9362	14000
1984	10443	-	-	-	1	10444	14000
1985	12491	-	-	-	3	12494	12000
1986 a	11755	-	-	-	1	11756	12000
1987 a	10248	-	-	-	<1	10248	9000
1988							7500

* initially set at 7500 t, increased in September to 10,000 t.
** initially set at 10500 t, increase November 1 to 14,000 t.
a Preliminary statistics

Table 2. Nominal catch (t) of cod in Subdivision 4Vn (May-December) by gear type for all countries, 1970-1986.

Year	Otter Trawls	Seines	Longlines	Handlines	Misc.	Total
1970	4859	83	3229	495	1222	9888
1971	5308	109	3728	696	790	10631
1972	4418	121	3185	286	1094	9104
1973	2099	143	1982	404	1120	5748
1974	2842	138	1469	568	967	5984
1975	1851	100	875	360	812	3998
1976	4375	83	620	310	569	5957
1977	4613	554	1805	595	354	7921
1978	1600	326	3035	466	122	5549
1979	624	278	4483	640	349	6374
1980	1150	561	6440	1820	219	10190
1981	1488	557	9801	741	61	12648
1982	2785	724	7287	1360	177	12333
1983	2448	863	5101	924	26	9362
1984	3344	1112	4831	1112	45	10444
1985	5081	1162	4823	1408	20	12494
1986 *	3185	1277	5872	1191	231	11756
1987 *	1867	1185	6272	842	82	10248

* Preliminary statistics.

Table 3. Nominal catch of cod by Canadian vessels in 4Vn (May-Dec.) by tonnage class and gear. Percentage of gear total catch by tonnage class is in parentheses.

Tonnage Class (GT)	Otter Trawls	Seines	Longlines	Handlines	Other	Total
1986						
0-24.9	65	479	3590	1175	71	5380
25-49.9	1101	687	2098	7	160	4053
50-149.9	1386	111	184	9	-	1690
150-499.9	363	-	-	-	-	363
500-999.9	236	-	-	-	-	236
1000+	33	-	-	-	-	33
Total	3184	1277	5872	1191	231	11755
1987						
0-24.9	35 (2)	372 (31)	4719 (75)	839 (100)	4 (5)	5969
25-49.9	660 (35)	669 (57)	1452 (23)	3 (0)	19 (23)	2803
50-149.9	586 (31)	144 (12)	101 (2)	-	59 (72)	890
150-499.9	312 (17)	-	-	-	-	312
500-999.9	252 (14)	-	-	-	-	252
1000+	22 (1)	-	-	-	-	22
Total	1867	1185	6272	842	82	10248

Table 4. Nominal catch (Canada) for the cod fishery in 4Vn (May-December) by month and year.

a) 1986

Gear	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Longlines	592	529	542	760	1056	1100	980	313	5872
Handlines	12	64	289	372	278	139	33	4	1191
Otter Trawls	807	387	747	224	629	292	42	56	3184
Seines	527	274	232	59	139	39	6	1	1277
Shrimp Trawl	13	9	4	3	6	6	-	-	41
Other	103	29	23	-	33	-	2	-	190
Total	2054	1292	1837	1418	2141	1576	1063	374	11755

b) 1987

Gear	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Longlines	823	598	535	938	752	1705	818	103	6272
Handlines	15	122	239	174	128	146	17	1	842
Otter Trawls	1064	152	187	34	91	56	54	229	1867
Seines	553	269	65	37	61	91	109	0	1185
Shrimp Trawl	2	9	42	3	7	12	0	0	75
Other	0	4	1	1	1	0	0	0	7
Total	2457	1154	1069	1187	1040	2010	998	333	10248

Table 5. 4Vn cod (May-Dec.) Research vessel abundance indices (mean number per tow) by age group.

	AGE															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	UK	No. tow	Kg. tow
1970	-	6.35	1.77	4.78	10.90	10.46	4.50	2.59	0.84	-	0.29	0.14	0.13	0.21	42.96	57.47
1971	-	1.17	42.40	10.09	26.51	16.16	10.65	3.59	1.97	0.54	-	-	0.56	0.40	114.05	128.20
1972	-	0.52	0.28	2.35	0.30	1.61	1.47	0.39	0.27	0.25	0.19	-	0.37	0.37	8.39	22.12
1973	-	-	2.62	4.48	18.59	0.73	3.06	2.91	0.46	0.22	-	-	-	0.22	35.28	52.58
1974	-	-	0.61	1.36	2.79	3.21	0.40	0.50	0.26	0.22	0.11	-	-	-	9.47	14.44
1975	-	0.61	6.42	8.58	4.65	0.81	1.00	0.58	0.21	0.33	-	0.11	-	0.16	23.47	22.12
1976	-	6.49	2.25	1.48	1.93	1.55	0.73	1.79	1.65	1.41	0.24	0.23	0.47	-	20.21	43.41
1977	-	0.25	6.26	4.01	2.74	1.90	0.72	0.21	0.24	0.14	0.21	0.24	0.15	0.09	17.16	24.58
1978	-	0.66	9.13	19.31	5.54	4.38	1.53	1.17	0.44	0.43	-	-	0.11	0.12	42.84	67.55
1979	-	1.30	0.79	5.15	2.51	0.59	1.72	0.56	0.29	0.15	-	0.17	0.45	-	13.66	27.58
1980	-	1.88	10.52	3.97	23.58	16.40	5.15	1.16	0.45	0.37	0.37	-	-	-	63.84	85.55
1981	0.33	4.36	16.91	36.48	12.02	25.45	11.50	1.26	0.93	0.86	0.24	0.16	0.31	0.17	110.98	161.81
1982	-	2.53	1.74	5.77	10.22	7.61	9.25	3.41	1.32	0.45	0.10	0.23	-	0.10	42.73	74.82
1983	-	4.37	22.11	7.90	10.64	10.04	1.70	3.41	1.52	0.66	0.25	-	0.43	0.27	63.30	78.60
1984	2.83	7.25	10.02	10.48	13.51	8.75	3.58	1.81	1.58	0.85	0.32	0.41	0.46	0.28	62.14	102.30
1985	-	0.48	3.75	19.10	125.95	52.13	22.38	7.26	1.44	0.77	0.67	-	0.37	3.63	237.94	295.97
1986	-	1.33	6.36	11.13	8.11	17.55	6.38	4.92	2.17	1.02	0.55	0.10	0.22	0.09	59.93	83.83
1987	-	0.21	3.70	4.14	5.13	8.89	6.63	2.80	1.18	0.62	0.97	0.31	-	0.08	34.66	49.21

Table 6. A comparison of the mean numbers of cod caught per tow for each stratum in the 4Vn summer survey (Numbers corrected for distance towed).

Stratum no.		40	41	42
Percent of area:		27.5%	29.8%	42.7%
Depth range:		>100 fm.	51-100 fm.	≤50 fm.
Year	Vessel			
1970	ATC	0.49	107.81	25.02
1971	ATC	1.25	320.84	41.99
1972	ATC	5.07	8.81	10.16
1973	ATC	1.01	59.39	40.66
1974	ATC	8.12	14.50	6.83
1975	ATC	0.00	71.88	4.86
1976	ATC	0.00	16.58	35.73
1977	ATC	0.36	23.35	23.66
1978	ATC	2.53	62.40	55.16
1979	ATC	2.72	15.62	19.34
1980	ATC	0.34	135.79	54.44
	LH	0.29	127.99	69.37
1981	ATC	79.19	37.39	182.64
	LH	123.88	80.37	60.86
1982	LH	6.74	75.70	42.93
1983	AN	7.63	113.18	64.30
	LH	7.62	149.24	44.03
1984	AN	2.31	99.29	74.76
1985	AN	0.77	76.55	502.88
1986	AN	1.65	153.55	32.26
1987	AN	2.06	52.03	43.55

Table 7. Data used to generate 1987 catch at age estimates for 4Vn (M-D) cod. Length-weight parameters: a=0.00865, b=2.99645.

Gear	Time Period	# of samples Length (age)	No. Measured	No. Aged	Catch (t)
Longlines	May-Sept	13 (11)	4280	625	3646
	Oct-Dec	10 (9)	3378	465	2626
Handlines	May-Sept	1 (11)	588	625	678
	Oct-Dec	1 (9)	219	465	164
Otter Trawls	May-Sept	2 (3)	661	157	1528
	Oct-Dec	5 (5)	1486	216	339
Seines	May-Sept	1 (3)	346	157	985
Seines *	Oct-Dec	0 (0)	0	0	200

*Used Otter Trawl Oct-Dec samples.

Table 8. 4Vn Cod(May-Dec): catch at age by longlines(thousands)

AGES	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-
3	3	10	-	7	15	44	-	-	35	-	-	85	32	8	5	12	3	6
4	62	43	676	133	179	177	-	-	277	17	8	221	227	69	116	48	102	49
5	322	236	39	437	181	127	5	-	265	208	105	310	662	412	306	317	434	472
6	314	492	604	87	184	73	10	-	197	480	532	409	477	436	438	335	838	525
7	181	600	444	193	54	36	25	-	120	305	747	672	805	294	400	469	530	671
8	208	63	209	230	66	17	27	-	76	185	386	529	507	492	228	309	323	365
9	56	152	2	51	82	13	17	-	49	91	219	267	209	163	250	176	181	213
10	40	48	21	17	26	11	15	-	54	17	127	151	78	137	152	153	117	155
11	82	14	50	9	-	4	10	-	20	39	32	57	50	35	69	61	59	74
12	21	7	2	5	4	-	10	-	18	8	8	52	22	33	23	28	43	50
13	17	28	1	6	1	-	-	-	13	4	8	53	8	11	8	16	16	27
14	11	1	-	1	1	1	-	-	3	4	-	5	3	5	4	4	8	17
15	1	7	1	-	1	-	-	-	8	-	-	8	2	5	4	5	5	7
16	-	5	1	2	1	-	10	-	4	-	-	18	15	11	6	7	21	19

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

AGES	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	0.28	-	-	-	-	-	0.21	-	-	-	-	-	-
3	0.60	0.48	-	0.40	0.49	0.53	-	-	0.56	-	-	0.50	0.58	0.65	0.56	0.51	0.53	0.58
4	0.79	0.77	0.82	0.72	0.81	0.84	-	-	0.99	0.93	0.73	0.90	0.91	0.84	0.80	0.79	0.90	0.81
5	1.09	1.04	0.91	1.17	1.28	1.29	1.82	-	1.40	1.63	1.22	1.35	1.33	1.22	1.27	1.14	1.21	1.14
6	1.67	1.45	1.72	1.75	1.72	1.79	2.46	-	2.14	2.54	2.03	2.15	1.79	1.63	1.61	1.45	1.55	1.32
7	2.14	2.01	1.66	1.78	2.65	2.29	3.08	-	3.27	3.78	2.49	2.94	2.09	2.12	2.04	2.00	2.01	1.76
8	3.11	4.33	2.10	2.14	2.40	2.00	4.18	-	4.14	3.92	3.14	4.28	3.01	2.31	2.55	2.38	2.51	2.44
9	4.38	3.60	9.29	2.79	2.50	3.18	4.23	-	4.97	4.99	4.55	5.21	4.09	3.50	3.19	2.77	3.15	3.40
10	4.39	5.24	6.91	5.33	3.14	3.50	6.19	-	5.27	6.95	6.21	6.23	5.87	3.95	3.70	3.15	4.15	4.00
11	5.15	6.29	3.46	5.98	7.72	4.41	6.07	-	6.27	7.78	6.99	7.75	6.22	6.41	5.37	4.22	5.50	6.23
12	8.07	8.55	9.29	5.68	4.15	7.72	7.50	-	6.45	9.78	7.65	9.29	7.39	8.53	8.29	7.10	6.06	7.44
13	8.79	4.84	15.23	7.24	11.06	11.06	-	-	7.98	10.72	8.36	8.80	8.91	9.75	9.87	8.21	6.79	8.04
14	9.49	13.45	-	10.15	10.26	8.79	-	-	8.93	6.88	-	8.53	8.60	10.22	10.99	10.75	9.44	7.84
15	12.02	12.03	11.06	13.03	11.37	-	-	-	9.16	-	-	9.45	11.94	11.34	10.93	12.84	11.00	10.82
16	-	10.71	15.23	7.01	6.08	8.48	9.39	-	14.09	-	-	11.59	10.80	12.24	10.81	13.92	9.61	14.31

Table 10. 4Vn cod(May-Dec): catch at age by longlines, handlines, otter trawls and seiners for 1984-1987 (thousands).

Age	Longlines				Handlines				Otter trawls				Seines			
	84	85	86	87	84	85	86	87	84	85	86	87	84	85	86	87
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	5	12	3	6	3	0	1	14	6	3	0	1	0	1	0	0
4	116	48	102	49	22	0	14	32	243	66	64	13	11	21	42	30
5	306	317	434	472	83	0	31	102	645	783	442	122	107	205	179	150
6	438	335	838	525	115	0	75	101	795	818	967	222	236	184	346	267
7	400	469	530	671	112	0	103	107	295	819	359	374	116	172	134	328
8	228	309	323	365	41	0	109	64	144	377	184	175	37	140	79	95
9	250	176	181	213	52	0	56	43	31	141	82	84	37	33	42	41
10	152	153	117	155	28	0	25	22	27	104	30	52	15	23	19	21
11	69	61	59	74	12	0	12	6	6	26	9	23	4	6	9	8
12	23	28	43	50	4	0	7	2	1	4	3	10	2	1	3	2
13	8	16	16	27	2	0	1	2	0	1	2	5	1	0	2	0
14	4	4	8	17	1	0	0	0	0	0	0	2	0	0	0	1
15	4	5	5	7	1	0	0	0	1	0	0	0	0	0	0	0
16	6	7	21	19	1	0	5	0	1	0	0	0	1	0	0	0

Table 11. 4Vn cod (May-December): catch at age for total landings for 1984-1987 (thousands).

Age	Year 1984	1985	1986	1987
1	0	0	0	0
2	0	0	0	0
3	14	18	4	21
4	394	152	222	125
5	1146	1473	1086	853
6	1591	1510	2226	1124
7	927	1648	1126	1492
8	452	933	695	705
9	372	395	361	384
10	223	316	191	252
11	91	105	89	112
12	30	37	56	65
13	11	19	21	34
14	5	5	8	20
15	6	6	5	7
16	9	8	26	19

Table 12. Longliner catch of cod and associated catch-per-unit-effort for 1968-1987, 4Vn(May-Dec).

Year	Longliner Catch (t)	Proportion of catch with effort reported	CPUE (t/1000 hks)
1968	2455	0.066	0.452
1969	3300	0.097	0.646
1970	3229	0.130	0.625
1971	3728	0.071	0.507
1972	3185	0.138	0.440
1973	1982	0.192	0.338
1974	1469	0.197	0.325
1975	875	0.022	0.232
1976	620	0.011*	0.084
1977	1805	0.027	0.499
1978	3035	0.141	0.422
1979	4483	0.169	0.545
1980	6440	0.111	0.504
1981	9801	0.028	0.666**
1982	7287	0.077	0.408
1983	5101	0.105	0.319
1984	4831	0.111	0.435
1985	4823	0.099	0.357
1986	5872	0.068	0.519
1987	6272	0.081	0.370

* based on one log record
** calculated for records from May to September only.

Table 13: Total mortality estimates derived from longliner CPUE (numbers) at age, 1980-1987.

Age Groups	80/81	81/82	82/83	83/84	84/85	85/86	86/87	Mean
4+/5+	-.012	.163	.299	-.257	.260	-.467	.435	.060
5+/6+	.115	.345	.449	-.113	.385	-.308	.597	.210
6+/7+	.269	.462	.496	-.015	.450	.004	.697	.337
7+/8+	.434	.900	.534	.102	.607	.285	.745	.515
8+/9+	.385	1.274	.694	.183	.699	.345	.723	.615
9+/10+	.277	1.427	.380	.043	.829	.337	.658	.565
10+/11+	.043	1.429	.466	.367	.984	.411	.731	.633
11+/12+	-.900	1.544	.320	.434	.838	.085	.641	.423

Table 14: Total mortality estimates derived from research survey CPUE (numbers) at age, 1980-1987.

Age Groups	80/81	81/82	82/83	83/84	84/85	85/86	86/87	Mean
4+/5+	⁻.028	1.006	.285	.154	⁻1.630	1.738	.675	.314
5+/6+	.150	.856	.581	.472	⁻1.033	1.872	.649	.507
6+/7+	.438	1.012	1.003	.677	⁻.705	1.747	.964	.734
7+/8+	.646	1.012	.821	.367	⁻.420	1.393	.953	.682
8+/9+	⁻.128	.580	.584	.517	⁻.186	1.226	1.054	.521
9+/10+	⁻.380	1.110	.312	.299	⁻.333	1.246	.740	.428
10+/11+	⁻.173	1.398	⁻.077	.091	⁻.700	1.735	.376	.379
11+/12+	⁻.548	.981	⁻.487	⁻.191	⁻1.001	2.433	.901	.298

Figure 1. Nominal landings for 4Vn cod (May-Dec.). 1970-1987.

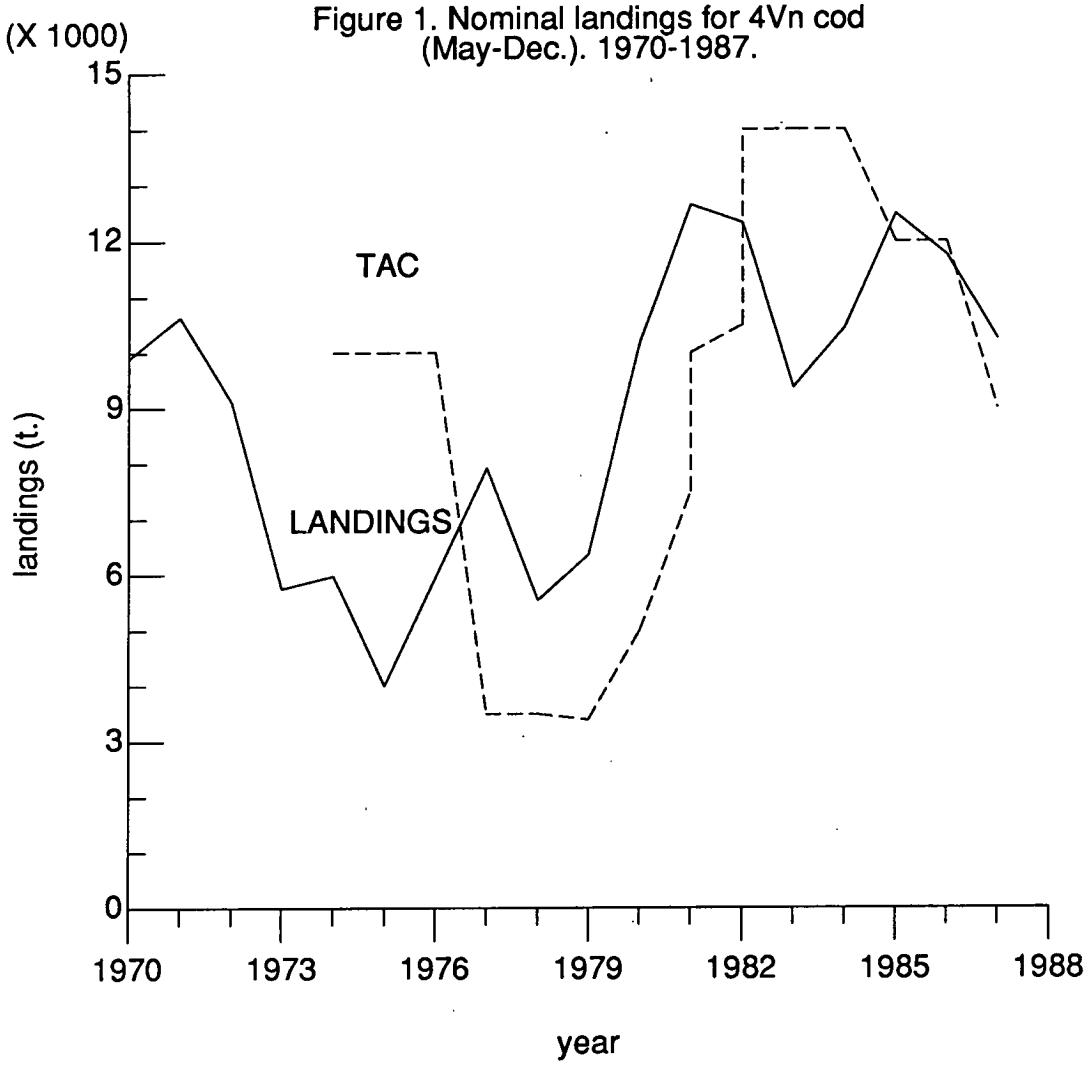


Figure 2. Cumulative catch by gear.
4Vn cod (May-Dec.).

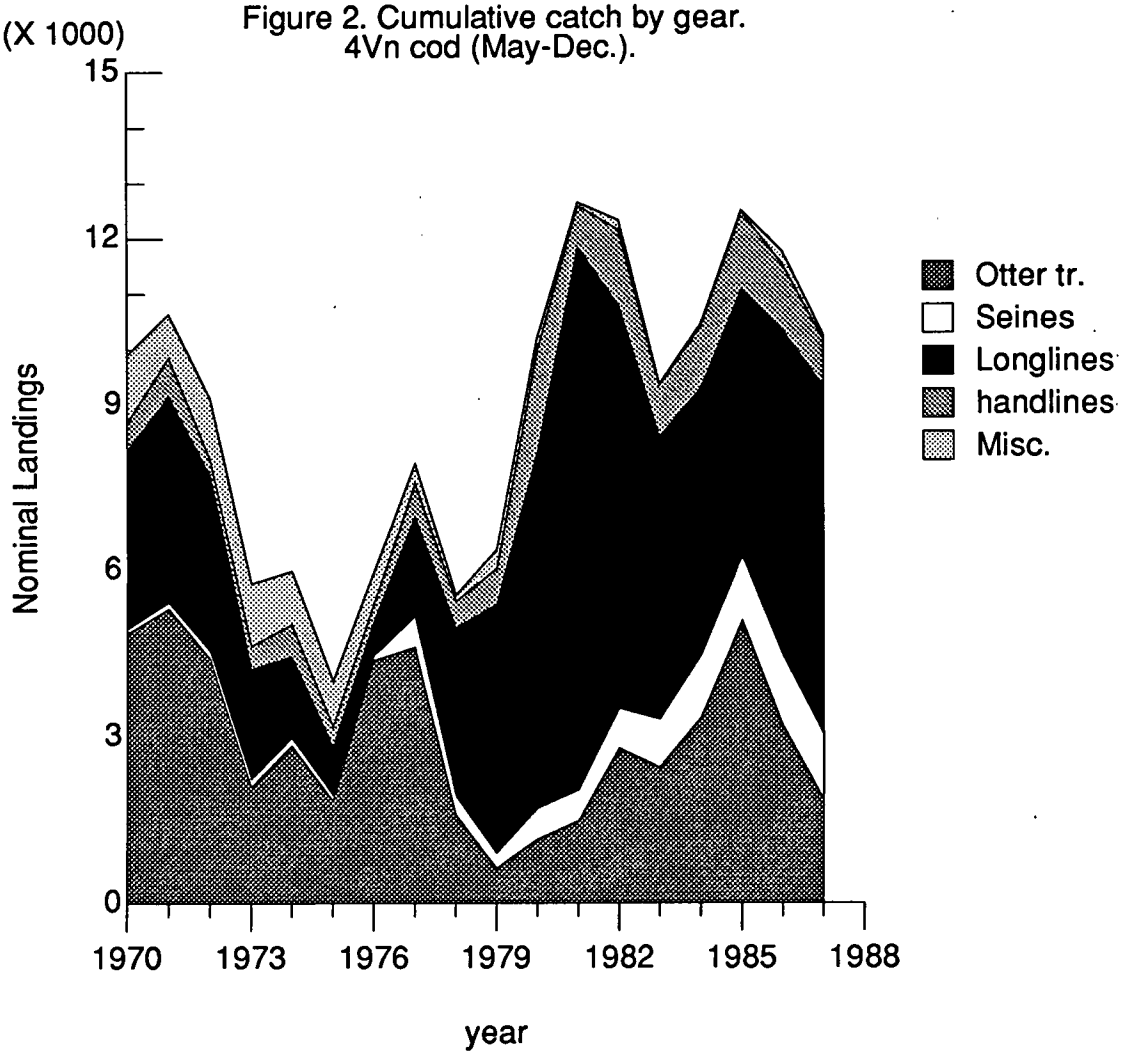


Figure 3. Research Survey mean no./tow and mean wt./tow. 4Vn cod (May-Dec.)

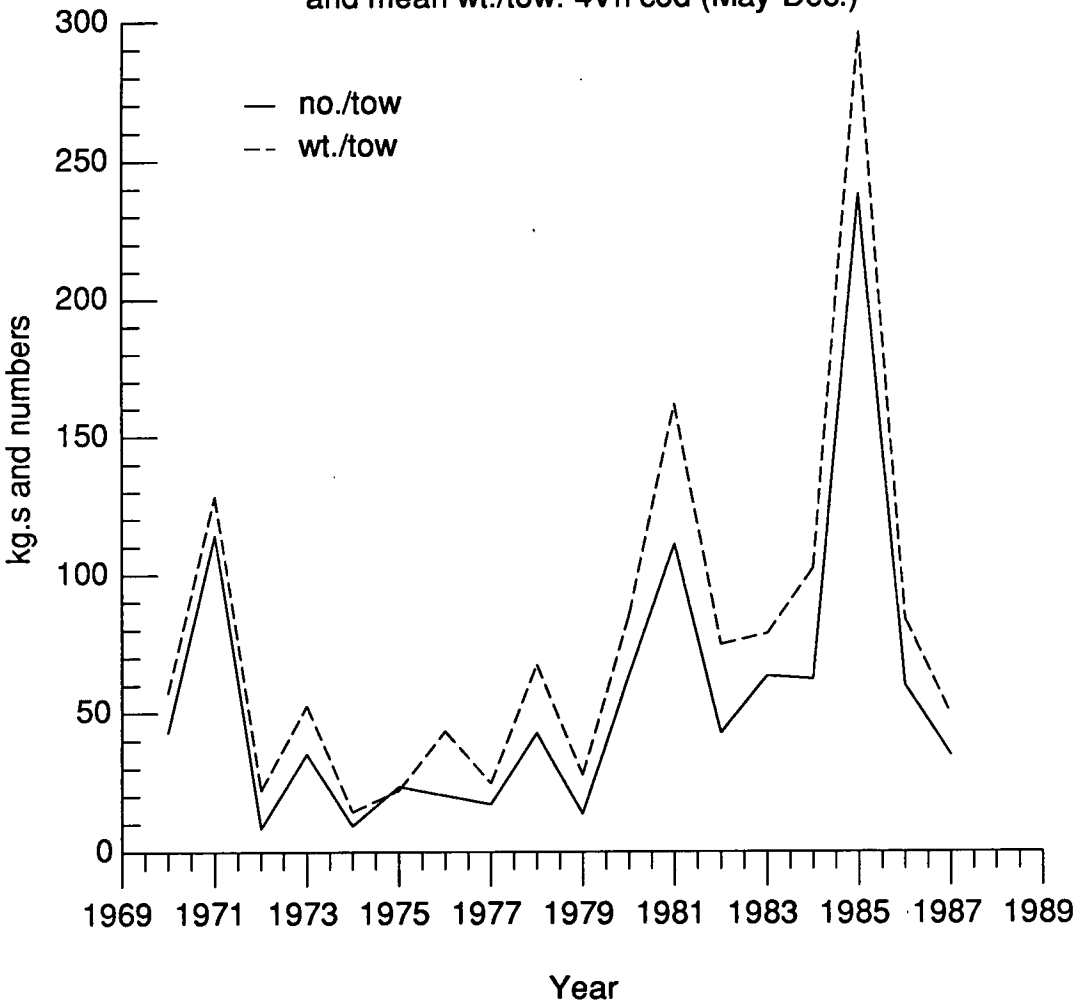


Figure 4. Standardized trends for landings and survey indices.

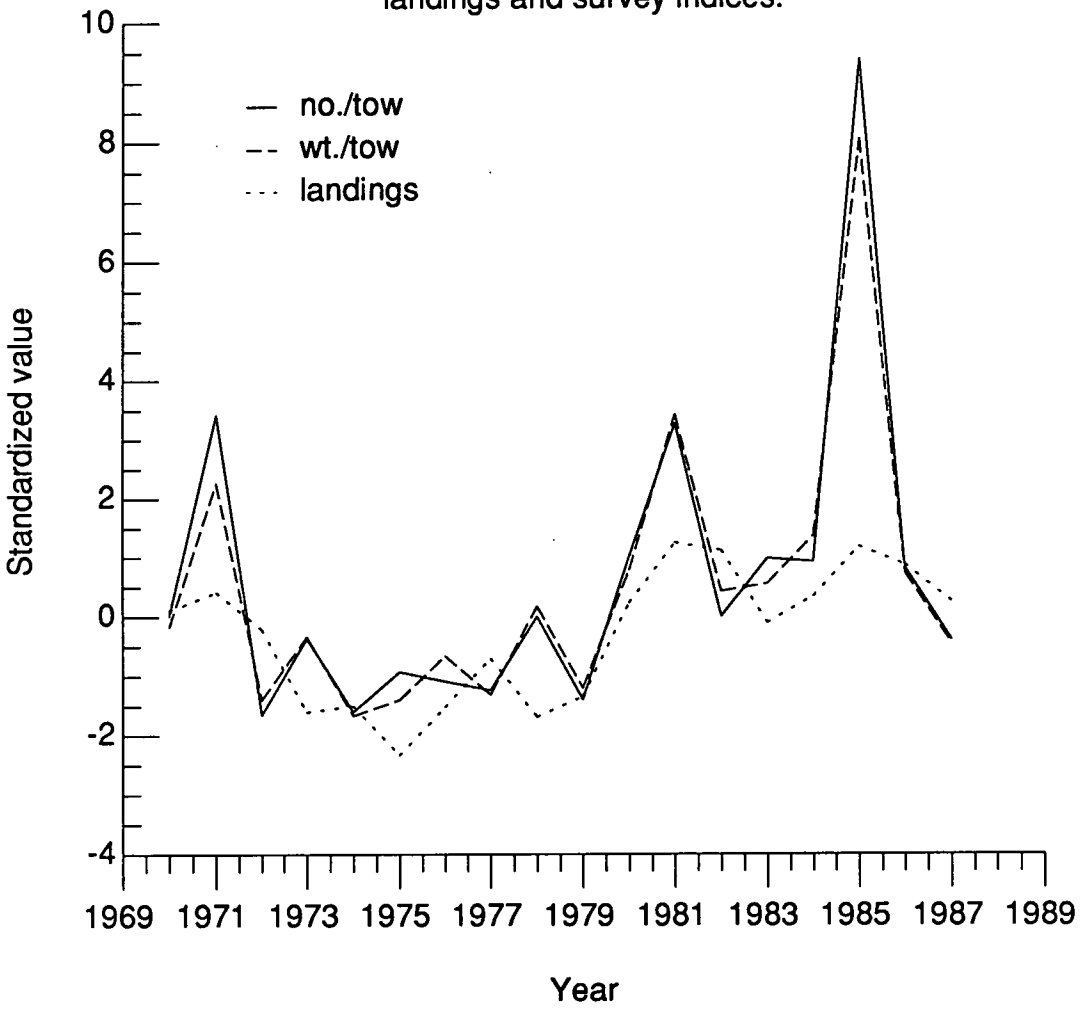


Figure 5. Numbers (millions) landed at age by gear type. 4Vn cod (May-Dec.)

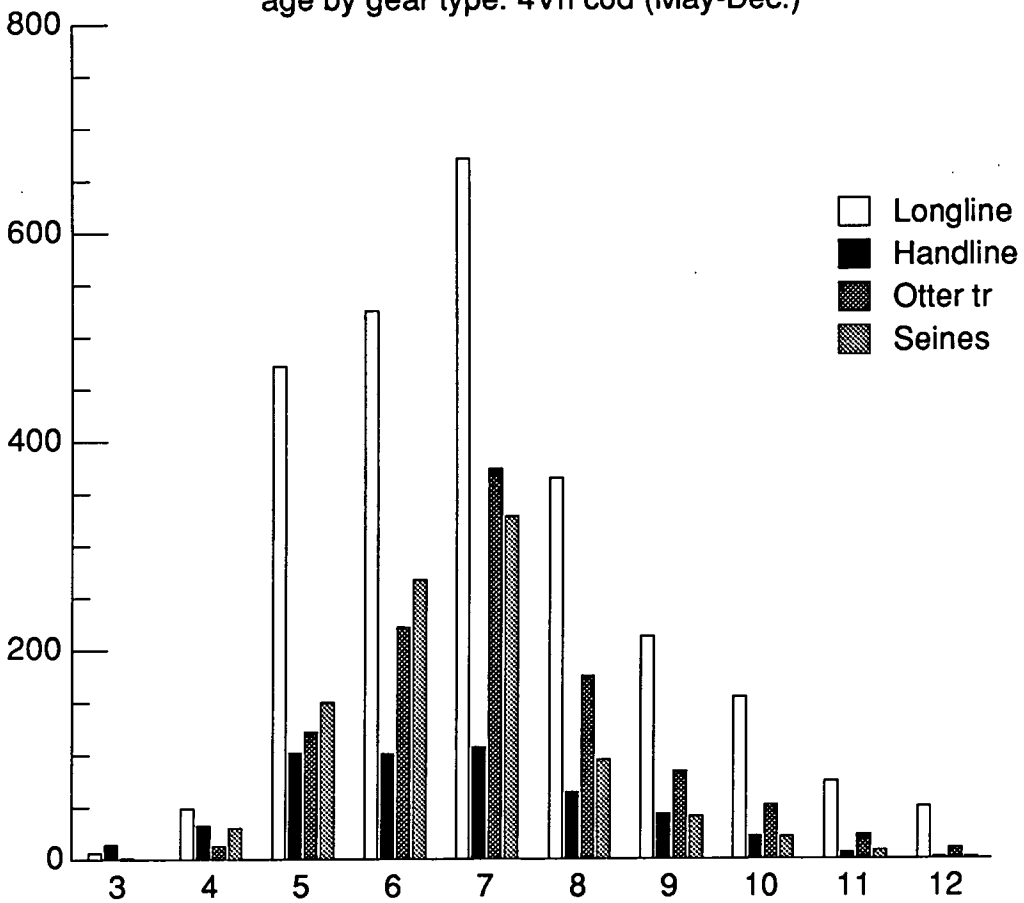


Figure 6. 4Vn cod: estimated 6+ biomass for various fishing mortalities.

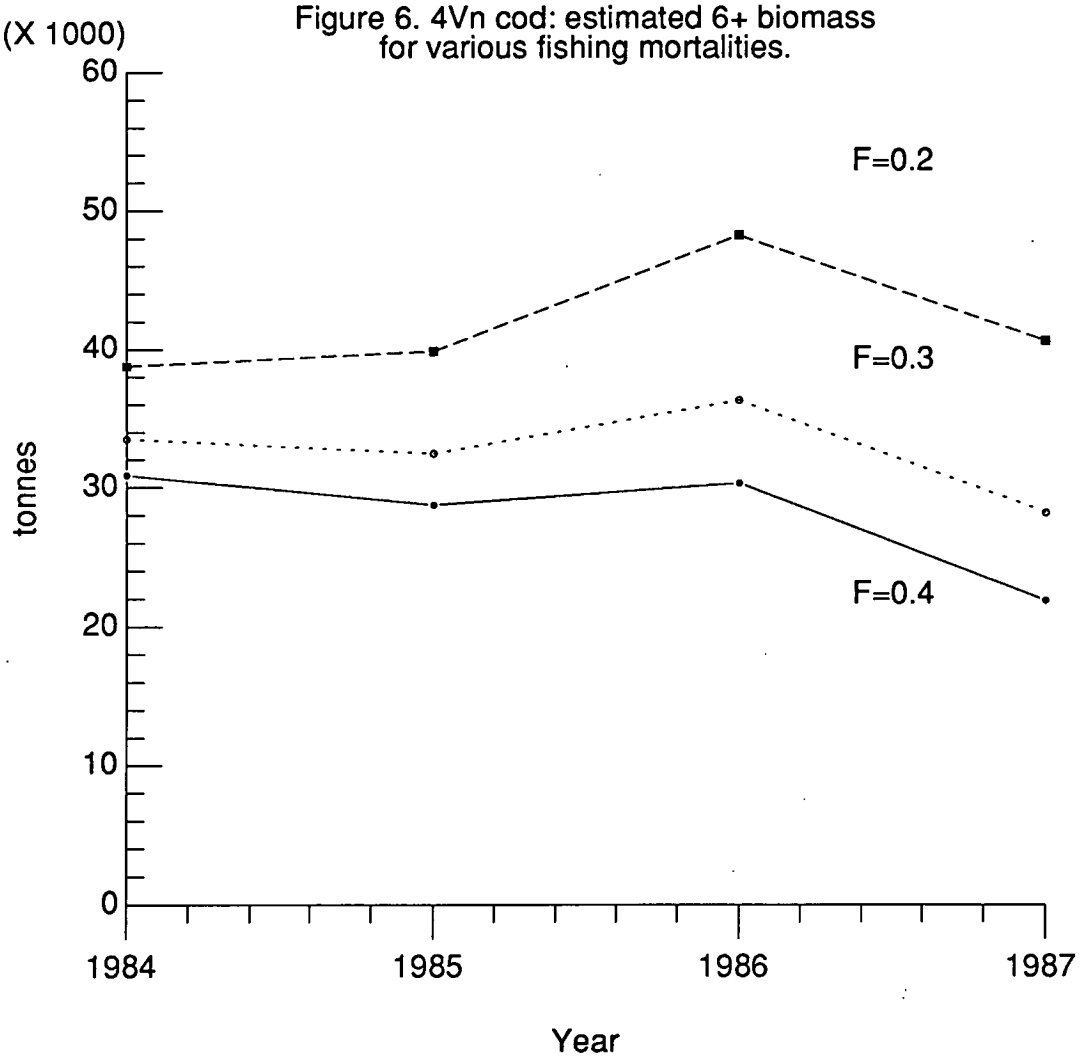
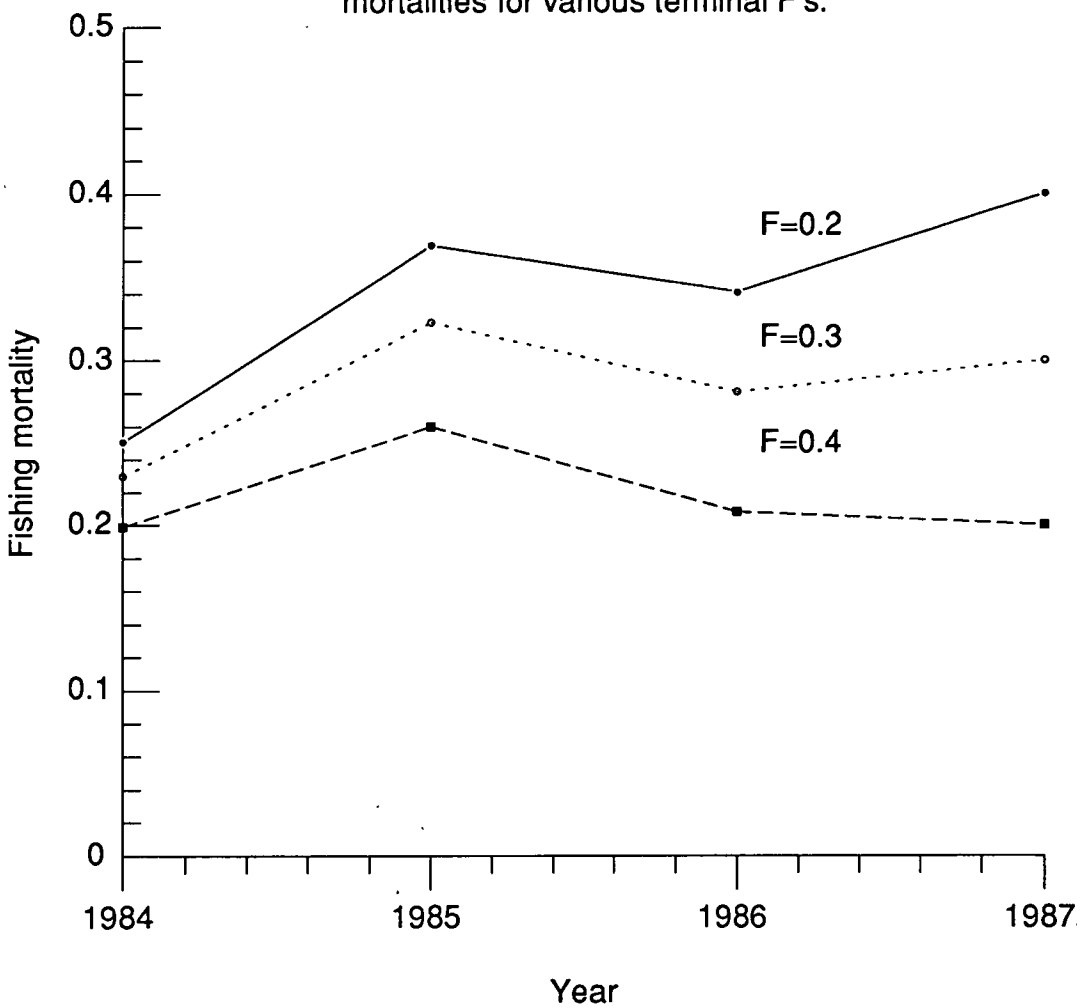


Figure 7. 4Vn cod: estimated fishing mortalities for various terminal F's.



Appendix: 4Vn Cod (May-Dec). Allocation Schedule and Management Measures.

Gear	Season	Closure	Allocation[1]	Catch[2]	Measure
Fixed Gear					
< 65'	May 1 - June 30	May 1	1350	1583	9000 kg Trip limit
	July 1 - Aug. 31	July 1	1350	2007	9000 kg Trip limit
	Sept. 1 - Oct. 31	Sept. 1	1750	2800	9000 kg Trip limit
	Nov. 1 - Dec. 31	Nov. 17	1290	663	6800 kg Trip limit
		Nov. 25			1500 kg Trip limit
65-100'	May 1 - Dec. 31		35		
Mobile Gear					
< 65'	May 1 - June 11	May 1	800	1280	9000 kg Trip limit
		May 22			2200 kg Trip limit
		May 29			0 kg Trip limit
					10% bycatch
	June 12 - Aug. 31	June 12	400	636	1800 kg Trip limit
		June 16			4500 kg Trip limit
		June 23			2500 kg Trip limit
		July 7			0 kg Trip limit
					10% bycatch
		Aug. 6			0 kg Trip limit
					10% bycatch
	Sept. 1 - Oct. 31	Sept. 1	225	315	1500 kg Trip limit
		Oct. 9			0 kg Trip limit
					10% bycatch
	Nov. 1 - Dec. 31	Nov. 17	698	45	1500 kg Trip limit
					10% bycatch
		Nov. 27			0 kg Trip limit
					10% bycatch
Mobile gear	< 65'				
(shrimp)	May 1 - Dec. 31		37	51	
(sector)	May 1 - Dec. 31		225	159	
Mobile (65-100')	May 1 - Dec. 31		85	111	
All < 100'	May 1 - Dec. 31		625	404	

1 This reflects the final allocation schedule as per the 1987 Canadian Atlantic Quota report (31/Dec/88) and differs from the original scheme given in the 1987 Atlantic Groundfish Management Plan.

2 Preliminary statistics only.