Assessment of Pollock (*Pollachius virens*) in Divisions 4VWX and Subdivision 5Zc for 1991

by

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Abstract

The Canadian TAC for pollock in 1991 remained at 43,000 t in the second year of the multi-year management plan. The domestic catches for 1990 and 1991 were 6,822 and 5,202 t below the TAC with both mobile and fixed gear fleets below their allocations. The foreign bycatch of pollock increased to near 1988 levels due mostly to increased Cuban landings. For 1991 much of the foreign fishery was managed under domestic silver hake allocations. The shift in the 4VW pollock fishery from 4W to 4V during 1984-1990 changed in 1991 with landings in 4W almost double 4V. Overall landings in 4VW are consistent with 1990 but indicate a marked decrease over the 1985-1989 period. Research surveys indicate an increase in the age 4-9 abundance in the early 1980s with subsequent estimates highly variable but stable. For the 1979-1987 period recruitment has been average or above. As in last year's assessment only R.V. numbers at age were used to calibrate the cohort analysis using linear least squares to estimate fishing mortality. The ADAPT formulation imposing a domed PR on the unestimated older ages was replaced with a flat-topped PR. The F for 1991 using the flat-topped PR was 0.45. Bias corrections were used on all estimated ages, and catch projections to 1993 under the multi-year management plan indicate that a constant catch of 43,000 t to 1993 implies a fishing mortality of 0.53 and 0.59 respectively. Assuming average recruitment, biomass should remain stable. However, future advice at the $F_{0.1}$ target level is likely to be for lower catch. The drop in landings since 1989, decreased commercial catch rates, and various industry concerns indicate that the stock should be watched carefully.

Résumé

En 1991, deuxième année d'existence d'un programme de gestion pluriannuel, Le TPA canadien de goberge a été maintenu à 43 000 t. Les prises des navires canadiens en 1990 et 1991 ont été respectivement inférieures de 6 822 t et 5 202 t au TPA, avec les prises des flottilles de pêche aux engins mobiles ainsique celles des engins fixes étant inférieures aux allocations de ces deux flottilles. Quant aux prises accidentelles étrangères, elles ont presque atteint leurs niveaux de 1988, en raison surtout de la hausse des débarquements dès navires cubains. La concentration de la pêche de la goberge dans la division 4V plutôt que dans la division 4W, phénomène observé de 1984 à 1990, s'est inversée en 1991, les débarquements en provenance de 4W représentant près du double de ceux de 4V. Les débarquements globaux provenant de 4VW sont comparables à ceux de 1990, mais nettement inférieurs à ceux de la période 1985-1989. D'après les résultats des campagnes d'évaluation, l'abondance des poissons de quatre à neuf ans a augmenté depuis le début des années 80, les estimations des années subséquentes étant très variables, mais de façon stable. Durant la période 1979-1987, le recrutement a été égal ou supérieur à la moyenne. Comme dans l'évaluation de l'an dernier, on n'a utilisé que les chiffres provenant des navires scientifiques pour étalonner l'analyse des cohortes au moyen de la méthode des moindres carrés linéaires, cela dans le but d'estimer la mortalité due à la pêche. On a abandonné la formule ADAPT fondée sur une courbe de recrutement partiel en forme de dôme pour les poissons plus âgés non estimés au profit d'une courbe de recrutement partiel à plateau, qui a abouti à une valeur F de 0,45 pour 1991. On a procédé à des corrections de justesse pour tous les âges estimés; selon les projections de prises pour 1993 établies dans le cadre du plan pluriannuel, des captures constantes de 43 000 t jusqu'en 1993 correspondraient à une mortalité due à la pêche de 0,53 et 0,59 respectivement. Dans l'hypothèse d'un recrutement moyen, la biomasse devrait s'avérer stable, mais il est vraisemblable que les avis ultérieurs relatifs au niveau-cible F0.1 préconiseront des prises plus basses. La baisse des débarquements depuis 1989 et le recul des taux de prises commerciales, ainsi que les inquiétudes diverses de l'industrie militent en faveur d'une surveillance attentive des stocks.

Introduction

Description of the fishery

For the second year in a row pollock landings (39,471 t) have fallen significantly below the TAC of 43,000 tonnes (Table 1, Figure 1). Canadian landings consistently account for the majority of the catch. Catches by foreign fleets have been primarily incidental with the major share taken by the USSR and Cuban trawlers fishing for silver hake and other groundfish, or by the USA fishing on the northeast peak of Georges Bank (Table 1). Since the extension of jurisdiction in 1977, catches by foreign vessels other than the USA have generally averaged less than 2000 t. With the definition of the new international boundary, the ICJ line (Figure 2)in 1984, no USA catches have been reported. However, USA landings in the Gulf of Maine and Georges Bank have progressively dropped from a high of 24,000 t in 1986 to about 7,000 t in 1991.

The pollock fishery is prosecuted mainly in 4X & 5Zc with a smaller portion taken in 4VW (Figure 3). The shift in the 4VW pollock fishery from 4W to 4V during 1984 - 1990 has changed in 1991, with landings in 4W almost double the landings in 4V. 1991 Canadian landings of 11,579 t in 4VW are consistent with 1990 landings (12,194 t) but indicate a marked decrease compared to the 1985 - 1989 period (Table 2). The fishery in 4VW is dominated by large offshore vessels greater than 100 ft. with mobile gear and in 4X & 5Zc by inshore vessels less than 65 ft. both mobile and fixed gear.

Seasonal breakdowns (Table 3) indicate a year round fishery, although with a bias toward May - August especially in 4X & 5Zc. Small mesh landings by the USSR (1,177 t) remained at about the 1990 level, high compared to the 1981 - 1987 period. The overall small mesh landings (1,674 t) show an increase, due to increased Cuban landings. This year foreign catches caught under domestic allocations (i.e. Seafreeze) were reported as Canadian landings whether they were landed in a foreign country or Canada. Other foreign landings (foreign allocations) were reported through NAFO, although NAFO landings in some cases, duplicated already reported domestic landings. IOP data was available to provide total foreign landings.

The Canadian catch is broken down by gear, area and season in Table 4. The large trawler tonnage class (TC)4+ landings remained close to the 1990 level with increased landings in 4X while remaining low compared to the 1985 - 1989 period. Prior to 1985 pollock allocations were generally not taken by this gear sector. However, since that time the offshore has chosen to fish these previously underutilized enterprise allocations. This current decrease in landings both total and by area may be attributable to

various factors: a) the offshore fleet not taking their remaining allocation during the winter fishery due to a reported lack of abundance or availability of pollock, pollock were described as being "spotty"; b) the frozen block market was soft due to a flood of minced Alaskan pollock at very low prices; c) cod were more available in 4W, so it wasn't worth going to 4V just for pollock; d) haddock were expected to be more abundant around the 4W haddock closed area and the offshore directed for it (5% of overall quota rather than per trip); and, e) anecdotal information also suggests that more activity was directed toward 4X because of problems in 4V, big cod and haddock bycatch in 4X were worth going after.

4X & 5Zc landings for otter trawlers TC 1-3 increased substantially (40%) while in 4VW the landings for the inshore trawler fleet decreased (30%). As well, marked changes were noted in the seasonal fishing patterns in both areas. These changes and increased landings were probably due to the implementation of ITQ's, the transfer options and 3 2 1 policy (charging an overrun of one ITQ species against another in an established ratio) and the vessel replacement policy for the offshore, which allowed them to fish offshore allocations with inshore vessels. Fixed gear landings dropped by about 2,800 t mostly in 4X & 5Zc. Industry indicated a late start to the fishery (cold water), poor catch rates due to a lack of big fish and more competition for good fishing grounds.

The shortfall in 1991 Canadian allocations (from quota reports) amounted to 4,362 t. The mobile gear sector >100 ft and 65 - 100 ft had a combined shortfall of 2,842 t. Mobile gear <65 ft ITQ fleet had a shortfall of 407 t while mobile gear <45 ft (Generalist fleet) and mobile gear <45 ft (ENS non ITQ fleet) had a combined shortfall of 58 t. These two fleets direct for cod and haddock in a CHP trip limit fishery. Fixed gears (<45 ft and 45 - 65 ft) had a combined shortfall of 860 t. Quota allocations and associated catch for 1991 are presented in Table 5. For 1991 quota reports vary more than usual compared to actual landings. This is probably due to the vessel replacement program and the 3 2 1 policy where landings from one gear sector or species are reported against another quota.

Since 1982, the pollock fishery has been regulated by quotas on four gear sectors: 1) fixed gear; 2) mobile gear greater than 100 ft; 3) mobile gear less than 65 ft; and, 4) mobile gear 65 - 100 ft. In 1988 mobile gear and fixed gear less than 65 ft were further divided: a) mobile gear and fixed gear less than 45 ft; and, b) mobile gear and fixed gear 45 - 65 ft. Seasonal quotas and trip limits were introduced in 1986 for mobile gear <65 ft in order to extend the fishery to the end of the year. Seasonal quotas are applied to the mobile gear <45 ft to allow a larger portion of the catch to be taken during the summer when they are less subject to weather conditions. In 1989 the mobile gear fleet <45 ft was further split into specialist and generalist categories. These two

fleets as well as the 45 - 65 ft fleet, were regulated through licence condition and trip limits replacing the variation order as a means of controlling the fishery. CHP management was also introduced as a means of addressing the problem of misreporting by area and species but was later discontinued.

Individual boat quotas were not introduced in 1990 as planned and the fishery continued to be managed using licence condition and trip limits. CHP management continued in 4X for the first half of the year resulting in very little pollock being taken, as cod and haddock were preferentially fished. CHP management was then replaced with a pollock directed fishery with various bycatch options. For the last three months of the year vessel quotas were used to divide up the remaining quota for mobile gear <65 ft. Georges Bank was managed separately with eight trips of 35,000 lbs between June 1 and Oct. 31 for mobile gear <65 ft using 130mm square mesh gear. The fishery was open to fixed gear all year provided that small hooks were used until June 1.

Management initiatives in 1991, including the introduction of ITQ's (cod haddock pollock 4VWX), have resulted in changes to gear sector regulation. Mobile gear <65 ft is now divided into three categories or fleets; a) mobile gear <65 ft ITQ fishery; b) mobile gear <45 ft generalists; and, c) mobile gear <45 ft non ITQ fishery ENS. The non ITQ fleet sectors and species continue to be managed using licence conditions and trip limits. For 1991 Georges Bank was not included in ITQ's and was managed separately with each mobile gear vessel <65 ft allowed four trips per month of 35,000 lbs. of cod and haddock to a maximum of 280,000 lbs (June 1 - Oct. 31). If haddock landings exceeded 100,000 lbs then that vessel was closed out of the fishery regardless of the amount of cod landed. Pollock landings were reported against vessel ITQ's. As well a new logbook and catch monitoring system have been put in place. New regulations dealing with dumping and discarding fish at sea, mesh size, vessel replacement etc. have also been introduced. These programs may result in changes to catch effort data, and in how it compares to quota reports.

Distribution maps of catch per unit effort as recorded by the International Observer Program (IOP) on Canadian vessels in 1991 are shown in Figure 4. Observer coverage of the domestic fleet was approximately 25%. In recent years observer coverage has varied between 20 and 50 %, depending on fishing activity and funding levels. Fishing patterns were similar to those of recent years with extended fishing effort, compared to years prior to 1987. However, the fishery distribution has shifted somewhat from 4V to a more 4W and 4X fishery, especially in the first part of the year (Jan.-June).

Catch at Age

The catch at age prior to 1991 was taken from Annand and Beanlands (1991). Catch and mean weight at age for 1991 landings were estimated using samples from the commercial fisheries. Sampling for 1991 is shown in Table 6. Sampling was somewhat low for gillnetters and small otter trawlers TC1-3, while sampling improved for the otter trawlers TC4+ (4VW). Seasonal age length keys for otter trawlers TC4+ (4VW) and for TC4+ otter trawlers (4X+5), and annual keys for small trawlers TC1-3 (4VWX+5) and fixed gears for (4VWX+5) were generated. Length weight parameters were obtained from analysis of the 1991 summer groundfish survey collections. Input data for generating the six keys used for the Canadian catch at age are given in Table 7. These keys accounted for 37,798 t or 96% of the entire catch, the difference consisting of the foreign by-catch. The age composition of the small mesh catch at age was based on pollock length frequencies from IOP data for the USSR and Cuban fisheries (1981 - 1991). Weights at age were from the July RV survey. The total combined catch at age reflects the total landings (37,472 t of pollock in 4VWX and 5Zc). The total catch at age is given in Table 8 along with the Canadian catch at age and the small mesh and foreign catch-at-age matrices. As in most years only four or fewer year-classes contributed significantly to the annual landings.

Catch at age for 1991 was dominated by the 1984 - 1987 year-classes (ages 4 - 7) accounting for 79% of both the catch in number and weight (Table 9). The 1988 year-class at age 3 was 9% of the catch numbers, the same as the 1987 year-class at age 3 in 1990. These are the highest observed values at that age since 1983. As in 1990, the 1985 year-class remains the strongest in the overall catch at age (numbers and weight). The small mesh catch at age contributed 95% of age 2 fish and 50% of age 3 fish to the total catch at age. The 1985 year-class accounted for 27% and 25% of the 4VW (TC)4+ and GN landings respectively. However age 4 and 5 fish contributed significantly (34%) to the GN catch at age while accounting for only 17% of the (TC)4+ numbers. Differences were again noted in the age composition of the large trawler catch between 4VW and 4X&5Zc (Figure 5).

The observed catch at age for 1991 was compared to that projected in the 1990 assessment (Figure 6). The catch of the 1986 and 1987 year-classes at ages 4 and 5 were higher than predicted. Conversely, the catch of the 1985 year-class at age 6 was somewhat lower than projected. Weight at age appears to indicate a decline in recent years (Table 10, Figure 7).

Abundance Indices

Commercial Catch Rates

Commercial catch rates are not used for calibration purposes, however because of changes observed in the 1990 and 1991 offshore fishery, catch rates were investigated. A Canadian catch rate series (CPUE) for stern OTB's TC5 for April to November was estimated using Regional data (Figure 8) (1974 - 1991) and is presented in Table 11. The higher resolution of the ZIFF (zonal interchange file format) data (set by set information) can result in less recorded effort for the same catch thus increased catch rates, so was not used for the series in order to be consistent over time. In both cases 1991 catch rates showed a marked decrease compared to 1990 values. A monthly catch rate series was also estimated for 1989, 1990 and 1991 from the Regional data base (Figure 9). Catch rates were consistently higher in 1990 (January through September) but dropped sharply in the October - December period. These observations were consistent with industry reports that the offshore fleet (Nat. Sea) had some difficulty catching pollock during their winter fishery. The monthly trend was similar in 1989 and 1991 although generally lower in 1991. A catch rate series for April to November, 1982 - 1991 was also calculated on a set by set basis from the IOP data (Table 12). This series did not show the same increase in catch rate between 1989 and 1990 and in fact was lower than catch rates calculated on a trip basis for the first time in the time series. However the 1991 value showed a significant decline with a value somewhat higher than that calculated from the regional data set and about equal to the ZIFF value of .599.

Research Surveys

Three vessels have been involved in the summer stratified random surveys of the Scotian Shelf (Figure 10) since 1970. After analysis of comparative fishing experiments, pollock catches were found to be the same between the different research vessels and hence no conversion factors were applied. The estimated total numbers at age from these surveys for strata 40-95 are in Table 13 and ages 4-9 and 1-3 abundance are plotted in Figure 11.

The research surveys from 1970 - 1991 indicate an increase in the age 4-9 abundance from the early 1980s with subsequent estimates highly variable but stable. However, the 1990 survey total numbers appear to be anomalously high especially for ages 2 and 3. In general the survey exhibits pronounced year effects making it difficult to determine year-class strengths and short-term changes in abundance. Efficiency estimates for pollock in the

1991 July RV survey indicate that the set to strata allocation was inefficient (-0.18%). However, the stratified random design was somewhat advantageous for pollock (5.07%). Distribution maps (Figure 12) indicate that very few pollock were caught in the 4VW portion of the survey especially for ages 4 and older although in the fishery older fish are more prevalent in 4VW.

Stratified average numbers per tow and mean numbers per standard tow and survey CV's are given in Tables 14, 15 and 16 respectively.

Sequential Population Analysis

Modifications to the adaptive framework used in last year's assessment were investigated because of the sensitivity of the SPA numbers to varying the dome by small amounts (Figure 13). As well it was noted that using a flat topped PR no longer resulted in survey K values increasing with age. As a result the formulation imposing a domed PR on the non-estimated older ages was removed and replaced with a flat topped PR. Cohort analysis of ages 2-11 from 1974 - 1991 was calibrated using ADAPT with the above formulation. Natural mortality was assumed to be constant at 0.2 for all ages and years. The RV numbers at ages 4-9 were used to estimate fishing mortality at ages 4-9. The Fs for ages 2-3 and 10-11 were based on the weighted average of ages 7-9 and the PR (historic) given below.

Age	2	3	4	5	6	7	8	9	10	11
PR	.012	.153	.407	.649	.841	1	1	1	1	1

Partial recruitment was estimated for the 1977-1986 period from the ratio of Fs at younger ages to fully recruited Fs. The input PR and Ft were from last years assessment.

Diagnostics from previous runs indicated that intercepts were not necessary between RV and SPA numbers. The ADAPT summary table is given in Table 17. The estimated numbers and slopes were all significant except for the age 4 numbers (Table 18). Log residuals (Table 19) were reviewed and yearly patterns observed. The fishing mortality for fully recruited ages (7, 8 and 9) in 1991 was 0.45. The 1987 year-class at age 4 is poorly estimated in ADAPT with the CV = 0.63 and a bias of 23%. The CV's for the other estimated ages

(5-9) were in the 0.40 range and the bias ranged from 8 to 12%. The CV's on the slopes were in the range of 0.17. The fishing mortality matrix, beginning of year numbers and midyear biomass are given in Tables 20, 21, and 22.

The 1979 (76 million) and the 1985 (51 million) year-classes at age 2 are the largest observed for the 1974 - 1991 time period (Figure 14). The 1980 - 1984 year-classes are all above the long term mean of 31 million. Beginning of year biomass (2+) and population numbers ages 4-9 (Figures 15 & 16 respectively) have increased since 1984 reflecting the strong and above average year-classes since 1979. 1991 biomass levels have declined slightly but are still near their maximum. Fully recruited fishing mortalities have remained stable between 0.45 and 0.52 since 1986 and are currently above the $F_{0.1}$ target level (Figure 17). In general abundance increased substantially in the early 1980s and has remained high due to continued recruitment since 1979. Given the relatively stable catches throughout most of the 1980s, fishing mortality has generally fluctuated inversely with stock size. However the apparent sharp decline in F in 1984 is most likely due to variability in the catch at age. Except for the drop in recent years, landings have remained relatively constant since 1985 (43,000-46,000 t) while fishing mortality has remained above the $F_{0.1}$ target level.

Yield per recruit

A series of yield per recruit calculations were attempted using various PR's and age groups. Yield per recruit values at $F_{0.1}$ varied between 0.28 and 0.38. A mean yield per recruit $F_{0.1}$ value of 0.3 was chosen in order to minimize interannual variation caused by data problems in yearly $F_{0.1}$ calculations.

Prognosis

It was noted that the ADAPT value for the 1987 year-class at age 4 had both a high CV and a bias value of 23%. Projections were done with the 1988 and 1989 year-classes set to the long term geometric mean of 31 million fish. The 1987 year-class estimate of 35 million was used in projections, however corrections for bias were used on all estimated ages. The 1992 and 1993 recruitment estimates were also set to the geometric mean. Catch projections were run to 1994 to allow evaluation to the end of the current multiyear plan (1993).

The following input data were used in the catch projections:

Age	1992 beginning numbers ('000) bias corrected Pop. numbers	Weight[a] (kg)	PR[b]
2	31000	.69	.003
3	25242	1.22	.066
4	14167	1.84	.257
5	12912	2.49	.442
6	15150	3.05	.680
7	8622	3.61	1.000
8	2047	4.06	1.000
9	1355	4.69	1.000
10	669	5.07	1.000
11	449	6.49	1.000
12+	203	5.10	1.000

[a]1988-1991 average
[b]1988-1991 average

Projections were done using a multiyear TAC of 43,000 t and in 1994 an $F_{0.1}$ value of 0.3. Results of these projections are given in Table 23. The 1992 and 1993 TAC's of 43,000 t imply a fishing mortality of 0.53 and 0.59 respectively. Assuming average recruitment, biomass will remain relatively stable. Future advice at the $F_{0.1}$ target is likely to be for lower catch.

Although biomass is relatively high, a source of concern for this stock is the drop in catch in 1989, 1990 and in 1991 to below the TAC with both large mobile gear and fixed gear failing to take their allocations. Commercial catch rates, although not used in the calibration, are at their lowest point in the time series. As well industry reported a lack of availability or abundance of larger pollock although comments from fishermen noted large numbers of small pollock which are generally avoided by much of the industry. In general pollock have been described as "spotty". Various management initiatives (i.e. the introduction of ITQs, and CHP fishery for generalists) may also have impacted pollock landings.

References

Annand, C., and D. Beanlands. 1991. Assessment of Pollock (*Pollachius virens*) in Divisions 4VWX and Subdivisions 5Zc for 1990. CAFSAC Research Document 91/35.

Table 1a. Pollock landings (t round fresh) by country for divs. 4VWX and Subdiv. 5Zc, 1974-1977.

Year	Canada	Fed. Rep. Germany	German Dem. Rep.	Japan	Spain	USSR	United Kingdom	U.S.A.	Other	Total
1974	24975	149	-	40	1500	2301	47	435	14	29461
1975	26548	236	95	-	708	2004	-	403	124	30118
1976	23565	994	24	-	303	1466	-	443	385	27180
1977	24653	368	-	1	-	182	-	325	53	25582

Table 1b. Pollock landings (t round fresh) by country for divs. 4VWX and Subdiv. 5Zc, 1978-1991.

Year	Canada	Japan	France		Cuba	USSR	U.S.A.	Other	Total
			St. Pierre & Mainland						
1978	26801	110	15	18	141	502	451	-	28038
1979	29967	19	8	15	50	1025	391	7	31482
1980	35986	81	19	80	32	950	443	-	37591
1981	40270	15	17	73	-	358	918	-	41651
1982	38029	3	30	14	84	297	840	-	39297
**1983	32749	6	22		261	226	1324	-	34588
1984	33465	1	46		123	97	1691	1	35424
1985	43300	17	77		66	336	-	-	43796
1986	43249	51	77		387	564	-	4	44332
1987	45330	82	28		343	314	-	-	46097
1988	41831	1	-		225	1054	-	-	43111
*1989	41112	1	-		99	1782	-	-	42994
*1990	36178	-	-		261	1040	-	-	37479
*1991	37798	38	-		459	1177	-	-	39472

* - Provisional catch statistics
** - From 1983 on, French catches are combined

Table 2 Pollock landings (t, round fresh) for divisions 4VWX and Subdivision 5Zc, 1974-1991.

Year	4V	4W	4X	5Y	5Zc	Total 4VW	Total 4X+5Zc	Total
1974	307	4740	19731	680	4003	5047	24414	29461
1975	799	5697	17977	420	5225	6496	23622	30118
1976	1102	3424	19164	57	3433	4526	22654	27180
1977	1347	6082	14381	237	3535	7429	18153	25582
1978	2931	4910	14997	341	4859	7841	20197	28038
1979	4877	4963	18219	573	2850	9840	21642	31482
1980	3893	7511	20110	530	5547	11404	26187	37591
1981	2316	15678	18689	713	4255	17994	23657	41651
1982	2939	9373	20771	926	5288	12312	26985	39297
1983	5491	5787	17603	1079	4628	11278	23310	34588
1984	5474	6043	18926	2091	2890	11517	23907	35424
1985	12085	3262	26685	853	911	15347	28449	43796
1986	15250	4046	22845	654	1537	19296	25036	44332
1987	12820	4425	26756	-	2096	17245	28852	46097
1988	11871	4240	24596	-	2404	16111	27000	43111
**1989	12027	3863	23283	530	1409	*17772	25222	*42994
**1990	8150	4044	21903	346	1735	*13495	23984	*37479
**1991	4131	7448	25533	465	1718	*11756	27716	*39472

* - Includes catch where division is unknown.
** - Data from DFO Statistics Branch, provisional data for countries other than Canada.

Table 3 Pollock landings (t round fresh) by season and country for NAFO divs. 4VWX and Subdiv. 5Zc.

Canada (Maritimes & Newfoundland)

Year	4VW				4X + 5Zc			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1974	713	1257	807	2777	1643	11738	8817	22198
1975	1223	1005	1854	4082	1836	9866	10764	22466
1976	425	845	1186	2456	2078	12167	6864	21109
1977	931	1428	4748	7107	6010	5880	5656	17546
1978	3875	2696	510	7081	5835	7484	6401	19720
1979	1406	5477	1927	8810	4558	10023	6576	21157
1980	2493	4301	3633	10427	6353	13188	6018	25559
1981	4056	2437	11055	17548	5792	7170	9760	22722
1982	3030	4082	4774	11886	3096	14664	8383	26143
1983	2029	7099	1644	10772	4879	14212	2886	21977
1984	2288	4744	4217	11249	2820	13900	5496	22216
1985	3861	5031	5959	14851	6589	15673	6187	28449
1986	5522	8157	4534	18213	5859	14091	5086	25036
1987	6177	5521	4780	16478	5766	16496	6590	28852
1988	4744	5807	4397	14948	3761	15710	7412	26883
*1989	4050	7538	4302	15890	6743	12471	6008	25222
*1990	4752	4529	2913	12194	3126	13839	7019	23984
*1991	4391	2282	3994	10667	6668	13719	6744	27131

* - Data from DFO Statistics Branch

USSR

Year	4VW					4X + 5Zc				
	Jan-Apr	May-Aug	Sept-Oct	UK Mon.	Total	Jan-Apr	May-Aug	Sept-Dec	UK Mon.	Total
1974	194	903	628	-	1725	11	512	53	-	576
1975	471	981	221	-	1673	58	149	124	-	331
1976	555	488	291	-	1334	10	58	64	-	132
1977	17	82	-	-	99	39	44	-	-	83
1978	9	459	8	-	476	-	26	-	-	26
1979	4	928	-	-	932	6	87	-	-	93
1980	122	715	-	-	837	-	113	-	-	113
1981	45	311	-	-	356	2	-	-	-	2
1982	-	297	-	-	297	-	-	-	-	-
1983	16	204	-	-	220	-	6	-	-	6
1984	-	97	-	-	97	-	-	-	-	-
1985	-	336	-	-	336	-	-	-	-	-
1986	-	564	-	-	564	-	-	-	-	-
1987	-	314	-	-	314	-	-	-	-	-
1988	96	958	-	-	1054	-	-	-	-	-
**1989	605	1177	-	-	1782	-	-	-	-	-
**1990	342	698	-	-	1040	-	-	-	-	-
**1991	151	640	2	-	793	-	384	-	-	384

** - Provisional data from NAFO Circular letters

Table 3 (Continued)

Other Foreign Countries

Year	4VW					4X + 5Zc				
	Jan-Apr	May-Aug	Sept-Oct	UK Mon.	Total	Jan-Apr	May-Aug	Sept-Dec	UK Mon.	Total
1974	176	196	173	-	545	746	605	289	-	1640
1975	421	57	263	-	741	145	253	427	-	825
1976	254	318	162	2	736	288	237	888	-	1413
1977	10	194	19	-	223	168	304	52	-	524
1978	36	153	95	-	284	200	111	140	-	451
1979	22	22	54	-	98	118	136	138	-	392
1980	101	38	1	-	140	272	128	115	-	515
1981	90	-	-	-	90	410	269	254	-	933
1982	23	106	-	-	129	365	221	256	-	842
1983	18	268	-	-	268	358	497	472	-	1327
1984	87	83	1	-	171	387	528	776	-	1691
1985	82	70	8	-	160	-	-	-	-	-
1986	204	291	24	-	519	-	-	-	-	-
1987	110	311	32	-	453	-	-	-	-	-
1988	4	222	-	-	226	-	-	-	-	-
**1989	99	1	-	-	100	-	-	-	-	-
**1990	153	108	-	-	261	-	-	-	-	-
**1991	209	169	-	1	379	-	118	-	-	118

** - Provisional data from NAFO Circular letters

Table 4 Nominal landings of pollock in NAFO divs. 4VW and 4X and Subdiv. 5Zc for Canada (Maritimes, Quebec and Newfoundland).

OTTER TRAWLERS -- Tonnage Classes 4+

Year	4VW				4X + 5Zc			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	1523	212	138	1873	686	1865	1581	4132
1971	629	63	208	900	919	3473	2073	6465
1972	417	90	545	1052	1461	5800	4138	11399
1973	726	276	2173	3175	3259	4227	3239	10725
1974	707	1113	628	2448	1057	6350	5964	13371
1975	1222	926	1776	3924	1042	5699	5361	12102
1976	424	737	1081	2242	877	5418	2746	9041
1977	912	1358	4545	6815	4846	1522	2661	9029
1978	3558	2107	377	6042	4676	3383	2411	10470
1979	1368	5194	1715	8277	3487	3421	1004	7912
1980	2448	3949	3412	9809	4321	3409	2411	10141
1981	3980	1382	9017	14379	4280	558	4956	9794
1982	2919	3084	4123	10126	1628	3917	3665	9210
1983	1879	6144	1032	9055	2890	2652	396	5938
1984	2155	3416	3559	9130	729	1633	564	2926
1985	3628	4339	5502	13469	581	835	879	2295
*1986	4861	6499	3957	15317	1326	939	235	2500
*1987	5609	4178	3998	13785	2435	2518	2408	7361
*1988	3951	3588	4244	11783	755	3301	2951	7007
*1989	3006	4933	3669	11608	1498	2489	2596	6583
*1990	4154	2832	1836	8822	1654	1835	1268	4757
*1991	3851	1533	2487	7871	1513	2607	1496	5616

* - Provisional

Table 4 (Continued)

OTTER TRAWLERS -- Tonnage Classes 1-3

Year	4VW				4X + 5Zc			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	8	0	0	8	336	2042	483	2861
1971	4	0	0	4	245	1708	717	2670
1972	0	9	1	10	537	2035	902	3474
1973	0	0	2	2	1922	6762	618	9302
1974	0	39	40	79	562	3398	591	4551
1975	0	0	0	0	745	2610	836	4191
1976	0	0	0	0	1039	2844	715	4598
1977	0	2	0	2	896	2224	808	3928
1978	9	23	2	34	955	2187	961	4103
1979	0	8	2	10	869	4043	1170	6082
1980	2	137	18	157	1523	4033	823	6379
1981	32	302	44	378	957	3178	1547	5682
1982	58	220	93	371	713	4775	1734	7222
1983	84	155	23	262	1403	6829	855	9087
1984	119	598	252	969	1847	8492	3015	13354
1985	197	151	89	437	5408	8564	1386	15358
*1986	379	804	44	1227	3797	4801	594	9192
*1987	504	311	73	888	2747	5859	483	9089
*1988	556	708	13	1277	2739	6196	244	9179
*1989	934	1296	60	2290	4533	2366	48	6947
*1990	403	594	492	1489	533	3985	1996	6514
*1991	317	72	641	1030	4334	5164	2086	11584

* - Provisional

Table 4 (Continued)

GILLNET, LONGLINE and MISCELLANEOUS Gears -- all tonnage classes

Year	4VW				4X + 5Zc			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	0	46	224	270	53	893	663	1609
1971	0	118	72	190	5	979	544	1528
1972	0	137	170	307	8	927	845	1780
1973	6	101	139	246	9	2196	1335	3540
1974	6	105	139	250	24	1990	2262	4276
1975	1	79	78	158	49	1557	4567	6173
1976	1	108	105	214	162	3908	3403	7473
1977	19	68	203	290	268	2134	2188	4590
1978	308	566	131	1005	204	1914	3029	5147
1979	38	275	210	523	202	2559	4402	7163
1980	43	215	203	461	509	5746	2784	9039
1981	44	753	1994	2791	555	3434	3257	7246
1982	53	778	558	1389	755	5972	2984	9711
1983	66	800	589	1455	586	4731	1635	6952
1984	14	730	406	1150	244	3775	1917	5936
1985	36	541	368	945	600	6274	3922	10796
*1986	264	732	403	1399	716	8422	4202	13340
*1987	69	1022	709	1800	589	8100	3696	12385
*1988	80	1339	340	1759	260	6223	4230	10713
*1989	110	1309	573	1992	712	7616	3364	11692
*1990	196	1104	584	1884	939	8018	3755	12712
*1991	223	677	865	1765	822	5948	3162	9932

* - Provisional

Table 5 a) Management Table for Pollock 1991 (Allocations & catch)

Year	Fleet	Initial Alloc. (t)	Final Alloc. (t)	Reported Catch (t) (Quota Rpts.)	Percent Taken (%)	Remarks
1991	All Vessels	43,000	43,000	38,638	90%	
	Fixed Gear <45'	12,070	12,070	11,203	93%	
	Fixed Gear 45-65'	315	315	322	102%	
	Mobile Gear >100'	20,500	18,752	16,070	86%	Enterprise Allocation
	Mobile Gear 65-100'	275	1,723	1,563	91%	Enterprise Allocation Initial allocation changed due to transfers from MG >100'.
	Mobile Gear <65' ITQ Fishery	9,708	9,839	9,432	96%	ITQ fishery allocation based on catch history 1986-1989
	Mobile Gear <45' Generalists	28	105	35	35%	Generalist fishery; competitive
	Mobile Gear <45' Non ITQ Fishery (ENS)	0	1	13	1297%	
	Mobile Gear <65' Quota Reserve	104	195	0	0%	Allocation to IQ boats who chose to use fixed gear.

Table 5 b) Management Table for Pollock 1991 (Pollock Closures, Trip Limits, etc.)

Stock	Gear Cat.	Date	Lic. Cond.	Remarks
Fixed Gear <45' - Scotia-Fundy				
Cod, Haddock, Pollock 4VWX5	A4(Handlines)	March 1	Lic. Cond.	450 kg.
Cod, Haddock, Pollock 4VWX5	A4(Handlines)	June 1	Lic. Cond.	2,270 kg. Cod 1,500 kg. Had
Cod, Haddock, Pollock 4VWX5	A4(Handlines)	Nov 21	Lic. Cond. & 1991-129 (4X cod only)	1,500 kg. Cod 1,500 kg. Had
All Groundfish 4VWX5	A4(Handlines)	May 1	Lic. Cond	2,000 kg.
Fixed Gear 45-65' - Scotia-Fundy				
Pollock 4VWX5	A160-A199	Nov 15	1991-125	10% bycatch
Cod, Haddock, Pollock 4VWX5	A4(Handlines)	March 1	Lic. Cond.	450 kg.
Cod, Haddock, Pollock 4VWX5	A4(Handlines)	June 1	Lic. Cond.	2,270 kg. Cod 1,500 kg. Had
Cod, Haddock, Pollock 4VWX5	A4(Handlines)	Nov 21	Lic. Cond. & 1991-129 (4X cod only)	1,500 kg. Cod 1,500 kg. Had
Mobile Gear <45'- Scotia-Fundy				
Cod, Had, Pol 4X5Y	C1 Generalists	Jan 23	Lic. Cond.	3,300 lb. comb. Cod & Had; Pollock 10% bycatch, 1 trip/7 days
Cod, Had, Pol 4X5Y	C1 Generalists	Feb 6	Lic. Cond.	3,300 lb. comb. Cod & Had - total Had not to exceed 1100 lb. per trip; Pollock 10% bycatch, 2 trips/7 days
Cod, Had, Pol 4X5Y	C1 Generalists	Mar 6	Lic. Cond.	No licence conditions to be issued until further notice
Cod, Had, Pol 4X5Y	C1 Generalists	Mar 19	Lic. Cond.	3,300 lb. comb. Cod & Had - total Had not to exceed 1100 lb. per trip; Pollock 10% bycatch, 2 trips/7 days

Table 5 b) Continued

Stock	Gear Cat.	Date	Lic. Cond.	Remarks
Cod, Had, Pol 4X5Y	C1 Generalists	May 1	Lic. Cond.	3,300 kg. combined Cod, Had & Poll/7 days
Cod, Had, Pol 4X5Y	C1 Generalists	July 17	Lic. Cond.	10% bycatch only combined Cod, Had & Poll
Cod, Had, Pol 4X5Y	C1 Generalists	July 24	Lic. Cond.	1,500 kg. combined Cod, Had & Poll/7 days
Cod, Had, Pol 4X5Y	C1 Generalists	Sept 25	Lic. Cond.	680 kg. combined Cod, Had & Poll/7 days
Cod, Had, Pol 4X5Y	C1 Generalists	Nov 6	Lic. Cond.	2,270 kg. combined Cod, Had & Poll/7 days
Pollock 4VW	C3 (ENS) Competitive	Jan 1	Lic. Cond.	2,250 kg.
Pollock 4VW	C3 (ENS) Competitive	March 1	Lic. Cond.	Closed until further notice
Mobile Gear <45' ~ Gulf-based				
*Pollock 4VWX5	C50-C149	Jan 1	Lic. Cond.	2,250 kg.
Pollock 4VWX5	C50-C149	May 1	Lic. Cond.	1,500 kg.
Pollock 4VWX5	C50-C149 C2100-C2899	July 1	Lic. Cond.	10% bycatch
Pollock 4VWX5	C50-C149 C2100-C2899	Sept 1	Lic. Cond.	0 kg. 0% bycatch
Gulf-based 45-65' Mobile Gear				
Pollock 4VWX5	C350-C600	Jan 1	1991-013	10% bycatch only
Pollock 4VWX5	C350-C600	May 1	1991-061	Revokes 1991-013 as per Lic. Cond; 1500 kg./ 10% bycatch

* Due to cod quota need bycatch.

Table 6 Canadian commercial samples available for pollock in divs. 4VW and in Div. 4X and Subdiv. 5Zc by gear and season for 1991.

	OTB 4+				OTB TC, 1-3				GN				LL & Others			
Area	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
4VW	12	7	8	27	1	-	1	2	-	1	2	3	-	-	-	-
4X+5Zc	14	10	5	29	7	2	2	11	2	4	2	8	-	7	-	7

Table 7 Grouping of catch by gears and time period for estimation of removals-at-age for 1991. OTB trawls are primarily stern bottom trawls, but there are some side trawls; GN are gillnets, LL are longlines, and Others are primarily inshore fisheries.

Period	Tonnage Class	Gear	No. of Samples	Area	Number Aged	Number Measured	Catch (t)	Weight-Length Relationship		Cruise	Date
								a	b		
Jan-Dec	TC 1-6	GN, LL, Other	18	4VWX+5	562	3950	11697	0.0129	2.95600	Needler 154/Hammond 231	July 1991
Jan-Dec	TC 1-3	OTB	13	4VWX+5	410	3240	12613	0.0129	2.95600	Needler 154/Hammond 231	July 1991
Jan-Apr	TC 4+	OTB	12	4VW	353	2775	3851	0.0128	2.95990	Needler 154/Hammond 231	July 1991
May-Aug	TC 4+	OTB	7	4VW	204	1571	1533	0.0128	2.95990	Needler 154/Hammond 231	July 1991
Sept-Dec	TC 4+	OTB	8	4VW	223	1896	2487	0.0128	2.95990	Needler 154/Hammond 231	July 1991
Jan-Apr	TC 4+	OTB	14	4X+5	462	3225	1513	0.0129	2.95600	Needler 154/Hammond 231	July 1991
May-Aug	TC 4+	OTB	10	4X+5	341	2250	2607	0.0129	2.95600	Needler 154/Hammond 231	July 1991
Sep-Dec	TC 4+	OTB	5	4X+5	182	1185	1496	0.0129	2.95600	Needler 154/Hammond 231	July 1991

Table 8. Catch at age (in thousands)

TOTAL CATCH AT AGE

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0	0	0	0	0	8	0	10	0	1	1	1	1	0	1	0	8	0
2	197	175	178	36	23	98	171	871	134	56	87	37	60	10	27	71	51	300
3	5603	1058	1361	1476	835	2763	291	1334	4018	1999	803	493	635	467	683	585	1226	1427
4	2662	4023	1974	2873	3119	5786	1864	673	1589	9514	3493	2190	3062	2259	2669	4371	2139	3696
5	2356	2090	3649	1785	3084	3482	5306	2044	563	1256	7155	4160	3562	4908	3290	3952	3996	3159
6	1088	1904	1089	2181	1276	1705	3169	4019	1873	238	639	6183	3595	3538	3390	2378	2549	3944
7	317	835	1089	732	1167	528	1075	2432	2295	524	92	1105	3306	2404	1860	1977	1551	1681
8	164	196	207	417	257	249	277	713	1069	835	217	131	299	1736	1181	886	851	782
9	80	55	36	108	143	47	168	208	389	428	210	139	82	177	1005	675	545	349
10	83	57	14	19	17	15	32	148	172	163	92	230	117	39	43	402	243	288
11	74	35	18	25	19	14	9	31	87	50	18	85	171	48	19	15	88	192
12	40	31	49	80	18	0	2	24	22	58	23	59	116	98	97	14	34	203

CANADIAN CATCH AT AGE

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0	0	0	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0
2	185	167	126	36	23	98	128	42	132	54	22	24	4	8	27	44	6	16
3	4784	986	1207	1433	786	2752	244	1333	3516	1857	720	477	317	428	618	495	1018	688
4	2364	3567	1738	2855	3070	5582	1733	672	1584	9309	3491	2179	2868	2231	2493	3691	1940	3213
5	2125	1852	3170	1760	3022	3341	5035	2043	563	1248	7152	4126	3519	4859	3235	3772	3674	3043
6	954	1660	939	2128	1222	1645	3113	4019	1872	237	639	6178	3575	3489	3345	2335	2484	3885
7	273	795	1001	710	1142	495	1047	2432	2294	523	91	1102	3291	2372	1784	1911	1531	1666
8	144	132	194	395	246	248	269	712	1067	833	215	126	298	1672	1146	847	835	772
9	64	45	35	90	134	47	165	207	389	428	207	134	82	175	991	650	535	337
10	51	56	12	19	17	15	32	148	172	163	89	221	113	35	43	382	243	285
11	33	34	16	25	19	14	9	31	87	50	18	78	165	44	17	12	86	188
12	10	30	42	80	18	0	2	24	22	58	21	57	113	95	93	10	28	202

FOREIGN CATCH AT AGE

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	12	8	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	291	67	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	162	228	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	152	87	237	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	77	78	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	20	23	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	9	4	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	6	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SMALL MESH GEAR CATCH AT AGE

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0	0	0	0	0	0	0	10	0	0	1	1	1	0	1	0	0	0
2	0	0	35	0	0	0	43	829	2	2	65	13	56	2	0	27	45	284
3	528	6	33	43	49	11	47	1	502	142	83	16	310	39	65	90	208	739
4	136	229	77	18	49	204	131	1	5	205	2	11	194	28	176	680	199	483
5	79	151	242	25	62	141	271	1	0	8	3	34	43	49	55	180	322	116
6	57	166	86	53	54	60	56	0	1	1	0	5	20	49	45	43	65	59
7	24	17	46	22	25	33	28	0	1	1	1	3	15	32	76	66	20	15
8	10	60	0	22	11	1	8	1	2	2	2	5	1	64	35	39	16	10
9	10	9	0	18	9	0	3	1	0	0	3	5	0	2	14	25	10	12
10	29	0	0	0	0	0	0	0	0	0	3	9	4	4	0	20	0	3
11	38	0	0	0	0	0	0	0	0	0	0	7	6	4	2	3	2	4
12	29	0	0	0	0	0	0	0	0	0	2	2	3	3	4	4	6	1

Table 9. Total percent catch at age and total percent biomass at age for 4VWX5 pollock. (1974 - 1991)

PERCENT CATCH AT AGE

	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
2	2	2	2	0	0	1	1	7	1	0	1	0	0	0	0	0	0	2
3	44	10	14	15	8	19	2	11	33	13	6	3	4	3	5	4	9	9
4	21	39	21	30	31	39	15	5	13	63	27	15	21	14	19	29	16	23
5	19	20	38	18	31	24	43	16	5	8	56	28	24	31	23	26	30	20
6	9	18	11	23	13	12	26	32	15	2	5	42	24	23	24	16	19	25
7	3	8	11	8	12	4	9	19	19	3	1	7	22	15	13	13	12	11
8	1	2	2	4	3	2	2	6	9	6	2	1	2	11	8	6	6	5
9	1	1	0	1	1	0	1	2	3	3	2	1	1	1	7	4	4	2
10	1	1	0	0	0	0	0	1	1	1	1	2	1	0	0	3	2	2
11	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	1

PERCENT BIOMASS AT AGE

	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
2	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3	27	4	6	7	4	10	1	6	12	7	4	2	2	1	2	2	4	4
4	18	27	14	18	20	29	10	4	11	47	24	10	14	10	12	18	12	16
5	24	22	39	18	29	29	39	14	5	12	55	27	21	27	21	23	27	19
6	15	24	15	31	18	18	29	32	20	3	7	45	27	23	26	18	20	29
7	6	14	19	13	19	7	12	25	26	7	1	9	28	20	16	18	16	15
8	3	4	4	9	6	4	4	10	14	12	4	1	3	16	12	9	9	8
9	2	1	1	3	4	1	3	3	5	7	4	2	1	2	11	8	7	4
10	2	1	0	1	0	0	1	3	3	3	2	3	2	1	1	5	3	4
11	2	1	1	1	1	0	0	1	2	1	0	1	2	1	0	0	1	3

Table 10. Mean weights at age.

TOTAL WEIGHT AT AGE

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	.00	.00	.00	.00	.00	.19	.00	.00	.00	.63	.36	.00	.10	.00	.00	.00	.25	.14
2	.82	.86	.59	.79	1.14	.77	1.03	.68	.76	.83	.73	.74	.35	.64	1.17	.67	.49	.47
3	1.38	1.26	1.21	1.10	1.23	1.18	1.68	1.74	1.19	1.25	1.64	1.49	1.13	1.32	1.37	1.23	1.35	.95
4	1.94	1.95	1.92	1.52	1.80	1.55	2.08	2.54	2.69	1.66	2.36	1.96	2.00	1.96	1.88	1.77	2.03	1.69
5	3.00	3.06	2.81	2.48	2.60	2.62	2.77	2.91	3.51	3.12	2.67	2.73	2.52	2.50	2.64	2.48	2.55	2.29
6	4.09	3.81	3.71	3.50	3.90	3.40	3.46	3.34	4.18	4.12	3.84	3.12	3.29	2.94	3.21	3.25	2.95	2.79
7	5.08	5.06	4.67	4.52	4.59	4.34	4.12	4.32	4.45	4.83	5.41	3.42	3.61	3.71	3.51	3.80	3.83	3.34
8	6.16	6.52	5.64	5.47	6.02	5.55	5.58	5.93	5.19	5.08	5.97	4.39	4.20	4.03	4.23	4.10	4.11	3.84
9	6.68	7.49	7.02	6.62	6.91	6.61	6.50	6.90	6.12	5.84	5.90	6.10	5.66	4.55	4.41	4.81	4.92	4.65
10	7.39	7.49	7.80	7.25	7.37	7.14	9.07	7.77	7.64	6.48	6.32	5.86	6.09	6.26	5.26	5.16	5.10	4.77
11	8.58	8.22	8.76	10.02	8.38	8.79	8.40	7.54	8.00	8.00	7.69	6.17	6.11	6.15	7.18	7.77	5.94	5.08
12	10.03	9.59	9.11	11.30	10.03	.00	11.65	9.22	8.65	8.72	8.53	7.52	6.68	7.57	8.46	7.39	7.22	5.62

CANADIAN WEIGHT AT AGE

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	.00	.00	.00	.00	.00	.19	.00	.00	.00	.63	.00	.00	.00	.00	.00	.00	.00	.00
2	.83	.86	.63	.79	1.14	.77	1.12	1.01	.76	.84	1.46	.94	.83	.72	1.17	.83	.76	.48
3	1.43	1.27	1.23	1.11	1.26	1.18	1.77	1.74	1.24	1.25	1.68	1.52	1.39	1.37	1.46	1.26	1.45	1.12
4	1.98	1.99	1.94	1.52	1.81	1.54	2.10	2.54	2.70	1.67	2.36	1.96	2.02	1.97	1.92	1.88	2.05	1.75
5	3.02	3.10	2.80	2.48	2.59	2.63	2.80	2.91	3.51	3.13	2.67	2.74	2.52	2.51	2.64	2.51	2.55	2.31
6	4.05	3.87	3.73	3.49	3.88	3.38	3.47	3.34	4.18	4.11	3.84	3.12	3.29	2.95	3.22	3.26	2.96	2.80
7	5.03	5.07	4.65	4.50	4.59	4.33	4.14	4.32	4.45	4.83	5.41	3.43	3.61	3.72	3.51	3.83	3.84	3.34
8	6.06	6.51	5.62	5.45	6.00	5.54	5.56	5.93	5.19	5.08	5.97	4.39	4.20	4.04	4.23	4.12	4.12	3.83
9	6.62	7.47	7.04	6.55	6.84	6.61	6.51	6.90	6.12	5.84	5.90	6.13	5.66	4.55	4.41	4.84	4.94	4.65
10	7.22	7.69	7.71	7.25	7.37	7.14	9.07	7.77	7.64	6.48	6.34	5.89	6.09	6.32	5.26	5.19	5.10	4.75
11	8.12	8.47	8.67	10.02	8.38	8.79	8.40	7.54	8.00	8.00	7.69	6.19	6.11	6.27	8.03	8.66	5.94	5.07
12	9.37	9.89	9.19	11.30	10.03	.00	11.65	9.22	8.65	8.72	8.76	7.56	6.86	7.62	8.52	7.44	7.39	5.61

FOREIGN WEIGHT AT AGE

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.59	.84	.63	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	1.24	1.13	1.04	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	1.81	1.68	1.88	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	2.89	2.32	2.83	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	3.97	3.25	3.52	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	5.23	4.33	4.83	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	6.70	5.13	5.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	6.72	5.13	6.70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
10	7.00	.00	8.26	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	8.43	.00	9.46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	13.00	.00	8.59	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

SMALL MESH GEAR WEIGHT AT AGE

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.36	.00	.10	.00	.00	.00	.25	.14
2	.00	.00	.42	.00	.00	.00	.77	.66	.62	.43	.48	.37	.32	.32	.26	.42	.45	.47
3	1.02	1.11	.92	.74	.83	1.23	1.25	1.52	.84	1.15	1.29	.62	.87	.79	.50	1.08	.86	.79
4	1.47	1.74	1.43	1.65	1.66	1.81	1.86	1.74	2.15	1.28	2.50	1.39	1.68	1.40	1.22	1.19	1.85	1.29
5	2.71	3.04	2.90	2.82	2.88	2.49	2.15	2.96	.00	2.52	2.82	2.35	2.49	1.92	2.39	2.04	2.59	1.85
6	4.90	3.47	3.68	3.90	4.32	3.53	2.72	3.63	3.54	4.38	3.77	2.92	3.24	2.65	2.70	2.82	2.80	2.69
7	5.50	5.62	5.13	4.95	4.45	4.48	3.14	4.28	4.97	4.52	4.97	3.04	3.20	2.94	3.36	3.08	3.68	3.40
8	7.01	6.64	.00	5.90	6.45	5.98	6.32	5.41	6.30	4.35	5.60	4.29	3.85	3.61	4.33	3.69	3.77	3.89
9	7.01	8.00	.00	6.92	8.01	.00	6.37	7.36	8.82	5.03	5.87	5.40	.00	4.78	4.30	3.99	4.32	4.54
10	7.73	.00	.00	.00	.00	.00	.00	8.87	7.43	7.08	5.96	5.35	6.14	5.74	.00	4.45	5.74	6.02
11	8.99	.00	.00	.00	.00	.00	.00	.00	.00	7.61	7.25	5.94	6.04	4.84	.00	4.19	6.12	5.86
12	10.20	.00	.00	.00	.00	.00	.00	.00	8.50	8.39	6.19	6.46	.00	5.96	7.04	7.24	6.45	8.25

Table 11 Commercial catch rates (t/hr) for pollock (main species) in divisions 4VWX and Subarea 5.

		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Canadian OTB-2 (TC5) CPUE (t/hr)																			
(Regional)	April-November	.66	.70	.57	.78	.89	1.09	.94	1.01	1.32	1.05	1.33	.96	1.26	.94	.904	.987	1.499	.526

Table 12 International Observer Program catch rates (t/hr) for pollock (main species) in divisions 4VWX and Subarea 5.

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Canadian OTB-2 (TC5) CPUE (t/hr)										
April-November	1.95	1.42	2.05	2.37	1.75	1.06	1.15	1.073	1.097	.603

Table 13 Stratified total numbers at age (x 10^{-3}) in Canadian summer bottom trawl surveys (strata 40-95).

Year

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	30	0	0	0	30	0	0	0	0	0	49	29	0	426	148	30	216	0	86	55	645	83
2	7613	3109	82	1649	179	37	122	1108	29	0	4842	673	832	504	1989	6694	2570	2504	122	231	41392	4568
3	1866	2573	55	2021	3989	77	928	3266	610	462	5328	744	11816	3884	966	20433	2770	10375	2541	588	31771	4824
4	1132	713	618	9117	975	1375	2826	4177	2525	2676	14106	215	1129	7218	2965	15116	4090	15614	4896	3597	13403	4324
5	825	165	1361	3467	1183	1182	5264	8604	3915	3389	22393	2142	502	830	8509	14751	4273	24762	9311	4090	22173	5653
6	750	76	595	347	549	1587	1328	5999	1459	2462	5947	2140	1558	203	1297	12336	5865	9752	8285	3784	8323	6253
7	505	135	157	213	643	252	2289	779	1372	1007	3378	1491	1070	383	892	1865	4304	7099	7738	4768	2221	1850
8	276	46	288	197	365	389	836	1308	424	715	1052	1028	628	1113	1934	527	309	5802	4284	2290	1457	1959
9	106	31	209	248	278	151	183	458	198	44	412	461	553	703	2920	951	47	221	2477	1319	911	858
10	0	95	100	10	158	35	188	219	91	155	245	321	306	239	1811	1475	438	502	169	484	280	269
11	153	0	52	83	368	40	62	129	0	0	0	121	50	250	301	497	575	379	184	119	130	147
12+	28	0	111	48	131	0	203	49	98	0	0	54	208	86	662	477	377	1490	696	218	516	42
UK	0	0	17	59	0	0	45	15	71	99	122	195	143	116	186	15	31	129	0	55	0	0
TOTAL	13312	6943	3646	17459	8848	5125	14275	26110	10793	11047	57875	9612	18796	15954	24578	75167	25866	78630	40789	21597	123222	30830
4+	3774	1261	3491	13730	4651	5010	13179	21721	10083	10450	47534	7972	6006	11024	21290	47996	20279	65622	38039	20668	49414	21355
5+	2642	548	2873	4613	3676	3636	10353	17544	7558	7773	33428	7756	4877	3806	18324	32879	16189	50008	33143	17072	36011	17031
6+	1817	383	1512	1147	2493	2454	5089	8940	3642	4384	11035	5615	4375	2976	9815	18129	11915	25246	23832	12982	13838	11378

Table 14 Stratified average numbers per tow in Canadian summer bottom trawl surveys (strata 40-95).

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	.007	.000	.000	.000	.007	.000	.000	.000	.000	.000	.012	.007	.000	.100	.035	.007	.051	.000	.020	.013	.152	.020
2	1.815	.733	.019	.389	.042	.009	.029	.261	.007	.000	1.142	.159	.196	.119	.471	1.579	.606	.591	.029	.055	9.763	1.077
3	.445	.807	.013	.477	.941	.018	.219	.770	.147	.109	1.257	.175	2.787	.916	.229	4.819	.653	2.447	.599	.139	7.494	1.138
4	.270	.168	.146	2.150	.230	.324	.667	.985	.607	.631	3.327	.051	.266	1.702	.702	3.565	.965	3.683	1.155	.848	3.161	1.020
5	.197	.039	.321	.818	.279	.279	1.242	2.028	.941	.799	5.282	.505	.118	.196	2.013	3.479	1.008	5.840	2.196	.965	5.230	1.333
6	.179	.018	.140	.082	.130	.374	.313	1.415	.351	.581	1.403	.505	.368	.048	.307	2.910	1.383	2.300	1.954	.893	1.963	1.475
7	.120	.032	.037	.050	.152	.059	.540	.184	.330	.238	.797	.352	.252	.090	.211	.440	1.015	1.674	1.825	1.125	.524	.437
8	.066	.011	.068	.047	.086	.092	.197	.308	.102	.169	.248	.242	.148	.262	.458	.124	.073	1.369	1.010	.540	.344	.462
9	.025	.007	.049	.059	.066	.036	.043	.108	.048	.010	.097	.109	.130	.166	.691	.224	.011	.052	.584	.311	.215	.202
10	.000	.022	.024	.002	.037	.008	.044	.052	.022	.036	.058	.076	.072	.056	.428	.348	.103	.118	.040	.114	.066	.064
11	.036	.000	.012	.020	.087	.009	.015	.030	.000	.000	.000	.028	.012	.059	.071	.117	.136	.089	.043	.028	.031	.035
12+	.007	.000	.026	.011	.031	.000	.048	.012	.023	.000	.000	.013	.049	.020	.157	.112	.089	.352	.164	.051	.122	.010
UK	.000	.000	.004	.014	.000	.000	.011	.004	.017	.023	.029	.046	.034	.027	.044	.003	.007	.030	.000	.013	.000	.000
TOTAL	3.174	1.638	.860	4.118	2.087	1.209	3.367	6.158	2.595	2.606	13.650	2.267	4.433	3.763	5.816	17.729	6.101	18.546	9.621	5.094	29.065	7.273
4+	.900	.297	.823	3.238	1.097	1.182	3.108	5.123	2.424	2.465	11.211	1.880	1.417	2.600	5.038	11.320	4.783	15.478	8.972	4.875	11.656	5.038
5+	.630	.129	.678	1.088	.867	.858	2.442	4.138	1.817	1.833	7.884	1.829	1.150	.898	4.336	7.755	3.818	11.795	7.817	4.027	8.495	4.018
6+	.433	.090	.357	.270	.588	.579	1.200	2.109	.876	1.034	2.603	1.324	1.032	.702	2.323	4.276	2.810	5.955	5.621	3.062	3.265	2.685

Table 15 Mean number/tow for 4VWX + 5 Pollock in Canadian summer bottom trawl surveys (strata 40-95)[1].

Stratum	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	All
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.26	.41	45.11	.34	.51	3.09	2.83	2.39
41	0	3.94	0	0	0	0	0	0	.31	0	0	1.46	.65	1.30	.29	1.03	.21	37.43	9.14	14.10	3.89	4.32	3.55
42	.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.34	0	.16	.33	0	.39	.22	.08
43	0	0	0	0	0	0	0	0	0	0	0	0	.21	.23	0	0	0	0	0	0	0	0	.02
44	0	0	0	0	0	0	0	.17	0	0	0	0	0	0	0	.26	.83	.34	0	0	0	.26	.08
45	0	0	.19	0	0	0	0	0	0	0	0	0	0	0	0	21.63	.17	5.85	0	0	0	0	1.27
46	0	0	0	0	0	0	0	.34	0	0	0	0	.97	16.47	0	3.09	.69	0	.97	13.35	2.07	.34	1.74
47	0	0	0	.37	0	.44	0	0	0	.61	0	0	.51	.26	0	0	0	0	0	.66	0	0	.13
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0		4.05	0	0	0	0	5.35	0	.52	0	0	0	0	0	.45
50	0	0	0	0	0	.36	0	0	0	1.56	0	15.10	1.09	0	0	0	.34	.34	0	0	32.73	0	2.34
51	0	0	0	0	0	0	.85	.49	3.13	25.93	0	2.92	571.50	0	0	96.76	1.09	133.02	22.13	6.09	21.23	0	40.22
52	0	1.14	.46	0	0	0	0	.55	.49	3.60	0	0	5.05	3.60	113.75	6.69	60.03	.34	.85	.52	.65	7.29	9.31
53	0	0	0	0	0	0	0	.34	0	0	0	0	0	0	0	0	.34	0	.58	0	0	3.83	.23
54	0	0	.34	0	0	0	0	0	.39	0	0	0	0	0	0	1.05	0	0	0	0	0	0	.08
55	0	0	0	0	0	0	0	0	0	0	0	.29	1.42	.26	0	0	.13	.12	0	.15	.68	8.36	.54
56	.39	.27	0	.18	0	0	0	.34	0	0	0	0	0	.16	2.97	1.94	.17	.70	4.73	.35	1.40	19.19	1.49
57	0	0	0	0	0	0	0	0		0	0	0	.49	0	0	0	0	0	0	0	0	0	.02
58	0	0	0	0	0	0	0	0	0	0	0	0	0	2.27	0	0	.21	0	1.03	0	.20	0	.17
59	.76	.44	0	.88	0	0	.20	.63	.24	0	0	0	0	.58	17.06	2.34	10.47	3.94	9.43	.78	0	0	2.16
60	75.99	0	.83	4.12	0	5.07	0	.97	14.72	2.89	353.50	.97	6.55	29.17	36.66	12.40	8.92	337.21	10.49	40.88	111.02	35.08	49.43
61	0	0	0	.51	0	20.26	0	2.78	0	0	0	0	2.74	1.46	1.61	5.06	3.78	11.67	3.28	3.28	3.09	4.52	2.91
62	0	.65	0	0	8.10	2.73	.51	0	3.82	1.22	55.19	6.87	.78	0	1.29	60.12	14.78	3.98	6.85	2.80	13.68	1.51	8.27
63	0	0	0	0	0	3.31	6.13	1.17	0	5.83	.51	5.41	.31	4.86	0	1.46	2.57	6.69	.55	8.23	5.14	4.09	2.56
64	0	0	.19	0	0	0	.32	1.79	3.52	.97	0	0	0	41.22	.62	2.96	.28	4.57	1.58	23.77	1.37	6.00	4.05
65	.19	14.00	0	0	25.03	1.17	2.33	1.98	.41	.21	0	.85	.15	.51	1.29	2.72	.19	5.65	1.88	3.31	.82	13.27	3.45
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.24	.39	.55	0	2.19	0	0	.29
70	2.19	3.46	.38	27.47	2.40	.49	96.62	18.47	74.79	9.30	1.09	16.40	0	42.41	6.56	60.82	19.36	72.06	74.27	9.07	364.41	41.63	42.90
71	0	0	0	.55	0	0	0	6.35	3.04	0	4.86	1.37	0	.97	1.63	27.79	4.63	108.57	6.85	1.03	4.03	6.02	8.08
72	2.06	22.75	.82	1.09	2.57	0	2.13	1.74	.46	.34	16.42	5.83	.49	5.47	1.75	377.22	6.18	3.60	8.51	14.41	.98	2.07	21.68
73	0	0	0	0	0	0	0	.55	0	0	.38	0	0	0	0	.49	2.13	.51	0	0	0	0	.18
74	0	.49	0	0	0	0	0	0	0	0	.52	0	0	0		0	1.88	.55	0	0	0	0	.16
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.51	0	1.03	0	0	1.03	0	0	.12
76	1.09	.49	0	9.24	8.07	7.70	2.19	20.79	1.75	0	1.17	0	0	6.03	50.95	0	26.74	1.68	35.97	4.31	439.15	2.44	28.17
77	0	0	.44	1.84	0	0	0	0	0	.58	0	0	0	1.03	0	0	0	23.50	0	0	.22	.56	1.28
78	1.46	2.43	.88	.97	0	1.09	0	0	1.75	1.72	0	0	0	0	0	3.89	.36	0	4.12	0	20.78	0	1.79
80	.65	.52	.19	.46	0	0	.23	34.81	.55	0	.97	0	.51	1.46	0	1.84	3.25	14.67	.22	1.42	1.35	2.99	3.00
81	0	2.92	0	6.00	1.30	0	.29	0	2.11	0	2.42	1.46	1.80	2.73	.26	.46	8.14	.68	2.36	.73	104.49	18.36	7.11
82	.49	.92	.46	0	0	0	.32	.73	1.02	13.64	1.35	4.04	1.41	1.00	.88	.49	1.03	4.25	3.62	38.11	2.98	34.58	5.06
83	0	0	2.43	0	0	0	1.95	.49	0	.58	.78	0	.52	.51	1.54	.49	0	1.64	1.03	0	12.43	49.97	3.38
84	0	.55	1.25	1.78	1.34	1.58	21.52	2.38	.49	9.82	.25	16.54	.26	0	3.43	3.56	2.40	4.72	14.68	.74	5.60	9.39	4.65
85	23.72	0	7.00	83.38	2.17	0	1.99	127.10	1.59	19.79	32.42	3.57	58.78	1.70	23.70	13.35	46.03	14.24	127.16	23.64	6.56	9.28	28.51
90	9.85	0	0	0	3.98	1.19	8.17	.78	8.61	3.28	1.35	15.75	2.60	8.20	0	90.55	2.94	.23	1.98	1.56	17.39	43.42	10.08
91	0	.38	25.14	5.64	1.13	.65	2.52	1.53	0	46.01	1.92	.53	.60	1.88	3.09	6.06	26.08	64.80	3.65	6.57	3.70	4.23	9.37
92	.32	0	4.37	1.63	3.19	2.02	2.10	3.68	2.27	0	0	.29	11.08	1.03	.36	.65	8.43	3.47	5.93	.51	2.06	1.23	2.48
93		0	0	1.54	0	.46	.58	1.16	0	.69	1.32	0	4.25	1.94	0	46.94	.65	4.12	0	.34	.92	.97	2.99
94	0	0	0	0	.42	.46	2.17	0	0	1.03	.51	0	0	0	.55	.49	0	0	0	0	0	.94	.30
95	0	0	2.02	0	1.54	.70	0	0	0	1.06	1.21	2.92	0	.67	0	.92	0	0	0	1.64	0	0	.58

1. Survey vessels: 1970 - 1981 A.T. Cameron
1982 Lady Hammond
1983 - 1988 Alfred Needler

Table 16 Survey coefficients of variation (CVs), 1974-1991

SURVEY CVs									
Age	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**
2	.684	.669	.562	.731	.468	1.000	.500	.736	.737
3	.906	.446	.481	.517	.508	.504	.466	.485	.674
4	.907	.508	.452	.720	.704	.411	.437	.548	.709
5	.437	.452	.551	.852	.653	.346	.407	.581	.656
6	.470	.390	.640	.747	.416	.331	.395	.357	.582
7	.318	.351	.699	.618	.337	.414	.424	.304	.372
8	.366	.699	.706	.631	.354	.438	.375	.306	.287
9	.284	.378	.653	.403	.288	.563	.384	.312	.268
10	.845	.495	.668	.407	.542	.468	.415	.405	.296
11	.488	.564	.779	.507	1.000	1.000	1.000	.396	.486
Age	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
2	.361	.775	.715	.602	.853	.333	.421	.705	.404
3	.530	.271	.736	.541	.656	.292	.533	.541	.297
4	.468	.386	.776	.354	.680	.266	.496	.400	.261
5	.557	.359	.548	.232	.616	.394	.366	.315	.264
6	.282	.314	.279	.191	.416	.480	.335	.295	.286
7	.509	.521	.290	.182	.318	.528	.316	.234	.261
8	.400	.395	.281	.223	.291	.590	.287	.211	.181
9	.256	.344	.346	.359	.420	.605	.291	.241	.318
10	.311	.312	.301	.283	.347	.590	.245	.379	.246
11	.280	.205	.290	.272	.317	.526	.358	.533	.711

Table 17.

Parameters of the ADAPT framework

-Year-class estimates
$N_{i,1991}$ $_{i}$ = 4-9

-Calibration constants for July RV numbers
K_i $_{i}$ = 4-9

Framework: assumptions and structure imposed

-Natural mortality equal to 0.2
-Error in catch at age assumed negligible
-No intercepts
-Partial recruitment for ages 2-3 in 1991 was the average from 1977-1986, ages 10 and 11 assumed to be fully recruited
-F on oldest age group calculated as a weighted F for ages 7-9

Input

-$C_{i,t}$ i = 2 to 11 t = 1974-1991

-$RV_{i,t}$ i = 4 to 9 t = 1974-1991

Objective Function

Minimize

$$\sum_{i,t} \{\ln RV_{i,t} - \ln K_i N_{i,t}\}^2$$

Summary

-Number of observations = 108
-Number of parameters = 12

Table 18. Final parameter estimates and significant statistics for age 4-9 numbers and 4-9 slopes from ADAPT. Correlation matrix pertains to the correlations between the estimated parameters.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.010848
MEAN SQUARE RESIDUALS 0.476418

PAR. EST.	STD. ERR.	T-STATISTIC	BIAS */*
22261.839191	13954.309628	1.595	23.05
24046.760674	11656.042542	2.063	12.86
15823.561861	6552.845794	2.415	9.63
4619.091813	1706.670239	2.706	7.52
2721.432819	1110.357378	2.451	8.50
1209.140062	524.597557	2.305	10.28
246.905269	42.459748	5.815	.87
540.214540	91.075499	5.932	.92
660.699504	111.218207	5.941	1.04
890.425139	151.299529	5.885	1.21
1342.865444	228.530556	5.876	1.18
1300.253845	221.557726	5.869	1.09

Parameter Correlation Matrix

#	1	2	3	4	5	6	7	8	9	10	11	12
1	1.000	.041	.030	.021	.016	.009	-.242	-.014	-.010	-.008	-.007	-.007
2	.041	1.000	.045	.033	.025	.015	-.170	-.187	-.016	-.013	-.011	-.010
3	.030	.045	1.000	.048	.036	.022	-.123	-.142	-.179	-.018	-.016	-.015
4	.021	.033	.048	1.000	-.005	.033	-.086	-.108	-.149	-.225	-.086	-.141
5	.016	.025	.036	-.005	1.000	.055	-.068	-.082	-.110	-.156	-.236	-.108
6	.009	.015	.022	.033	.055	1.000	-.039	-.048	-.069	-.107	-.167	-.248
7	-.242	-.170	-.123	-.086	-.068	-.039	1.000	.060	.042	.033	.028	.027
8	-.014	-.187	-.142	-.108	-.082	-.048	.060	1.000	.050	.041	.035	.034
9	-.010	-.016	-.179	-.149	-.110	-.069	.042	.050	1.000	.056	.048	.047
10	-.008	-.013	-.018	-.225	-.156	-.107	.033	.041	.056	1.000	.070	.070
11	-.007	-.011	-.016	-.086	-.236	-.167	.028	.035	.048	.070	1.000	.074
12	-.007	-.010	-.015	-.141	-.108	-.248	.027	.034	.047	.070	.074	1.000

Table 19. Residuals between observed RV and predicted RV by age and year.

LOG RESIDUALS FOR RV INDEX

#	74	75	76	77	78	79	80	81	82	83
4	-.635	-.616	.368	.287	-.611	-.769	1.898	-.957	-.344	-.207
5	-.997	-.597	.273	1.205	-.046	-.675	1.080	-.263	-.335	-.962
6	-.906	-.199	.024	.921	-.151	-.128	.247	-.823	-.010	-.895
7	.342	-1.044	.815	.081	-.027	-.218	.506	-.659	-1.042	-.957
8	.215	.375	.677	.974	.049	-.442	-.049	-.361	-1.012	-.676
9	.387	.148	.437	.998	.444	-1.491	-.454	-.259	-.038	.107

#	84	85	86	87	88	89	90	91
4	-.659	1.138	-.207	1.346	.157	-.631	.703	.000
5	-.340	.575	-.512	1.286	.473	-.335	.791	-.620
6	-.251	.439	-.021	.679	.616	-.099	.760	-.202
7	.720	.625	-.211	.499	.793	.485	-.337	-.372
8	.827	.309	-.659	.424	.234	-.220	-.390	-.276
9	.843	.697	-1.391	.057	.496	-.244	-.481	-.257

SUM OF RV RESIDUALS : 1.587535556E-4 MEAN RESIDUAL : 1.46994033E-6

Table 20. Fishing mortality matrix for divs. 4VWX5 pollock.

FISHING MORTALITY

	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
2	.013	.007	.005	.001	.001	.022	.013	.013	.003	.002	.003	.001	.002	.000	.001	.002	.002	.005
3	.251	.089	.073	.056	.025	.207	.084	.135	.075	.062	.030	.018	.028	.020	.018	.017	.049	.069
4	.340	.288	.240	.218	.160	.238	.210	.284	.237	.254	.146	.109	.146	.133	.153	.155	.078	.203
5	.376	.491	.462	.355	.385	.271	.358	.376	.409	.298	.309	.260	.259	.367	.293	.355	.207	.157
6	.494	.599	.517	.559	.466	.381	.424	.508	.714	.303	.244	.481	.376	.444	.469	.357	.408	.322
7	.572	.914	.851	.811	.673	.357	.442	.684	.619	.440	.183	.873	.516	.466	.445	.556	.419	.514
8	.681	.871	.604	.987	.769	.288	.321	.599	.750	.480	.329	.428	.618	.568	.440	.394	.496	.382
9	.512	.514	.380	.752	1.224	.296	.321	.426	.791	.792	.210	.362	.525	.963	.778	.487	.451	.384
10	.758	.881	.240	.354	.247	.373	.346	.525	.768	.961	.382	.374	.596	.513	.655	.857	.323	.454
11	.588	.870	.780	.856	.721	.327	.397	.641	.668	.521	.242	.726	.524	.517	.503	.495	.445	.454

Table 21. Beginning of year population numbers for divs. 4VWX5 pollock.

POPULATION NUMBERS (000S)

	74	75	76	77	78	79	80	81	82	83
2	16922	26209	36878	46212	19975	4988	14410	76317	45223	36194
3	27895	13677	21300	30032	37803	16333	3995	11644	61695	36904
4	10211	17769	10240	16207	23252	30194	10872	3008	8326	46877
5	8308	5951	10907	6598	10670	16215	19486	7215	1853	5379
6	3084	4670	2982	5629	3787	5946	10125	11153	4058	1008
7	804	1541	2101	1456	2635	1945	3325	5422	5494	1627
8	366	372	505	735	529	1101	1115	1749	2239	2422
9	220	152	127	226	224	201	676	662	787	866
10	173	108	74	71	87	54	122	401	354	292
11	181	66	37	48	41	56	30	71	194	134
2+	68165	70514	85151	107214	99003	77033	64156	117642	130224	131703

	84	85	86	87	88	89	90	91
2	37958	30720	31754	51156	47975	34777	28685	60927
3	29582	30998	25118	25944	41874	39254	28409	23440
4	28405	23494	24933	19990	20818	33666	31609	22150
5	29771	20095	17253	17643	14322	14630	23608	23944
6	3267	17900	12689	10903	10004	8749	8402	15713
7	660	2097	9061	7136	5725	5123	5012	4572
8	858	416	717	4427	3667	3004	2406	2700
9	1227	506	222	316	2054	1934	1658	1199
10	321	815	288	107	99	772	972	864
11	91	179	459	130	53	42	268	576
2+	132091	127219	122493	137752	146591	141951	131030	156085

Table 22. Midyear biomass for divs. 4VWX5 pollock.

MIDYEAR BIOMASS

	74	75	76	77	78	79	80	81	82	83
2	12426	20273	19627	32982	20605	3447	13403	46543	31200	27199
3	31047	14943	22513	29047	41788	15829	5851	17196	64166	40455
4	15318	27472	15885	20085	35231	37987	18564	6059	18169	62677
5	18941	13145	22455	12559	20987	33924	41402	15952	4878	13230
6	9099	12258	7898	13819	10778	15341	26021	26708	11118	3260
7	2845	4700	6079	4137	8069	6473	10103	15541	16688	5800
8	1500	1489	1960	2353	2040	4832	4846	7140	7498	8929
9	1051	812	679	965	827	1047	3427	3395	3054	3207
10	823	495	469	397	519	294	854	2219	1732	1120
11	1073	335	205	297	225	382	193	361	1040	766

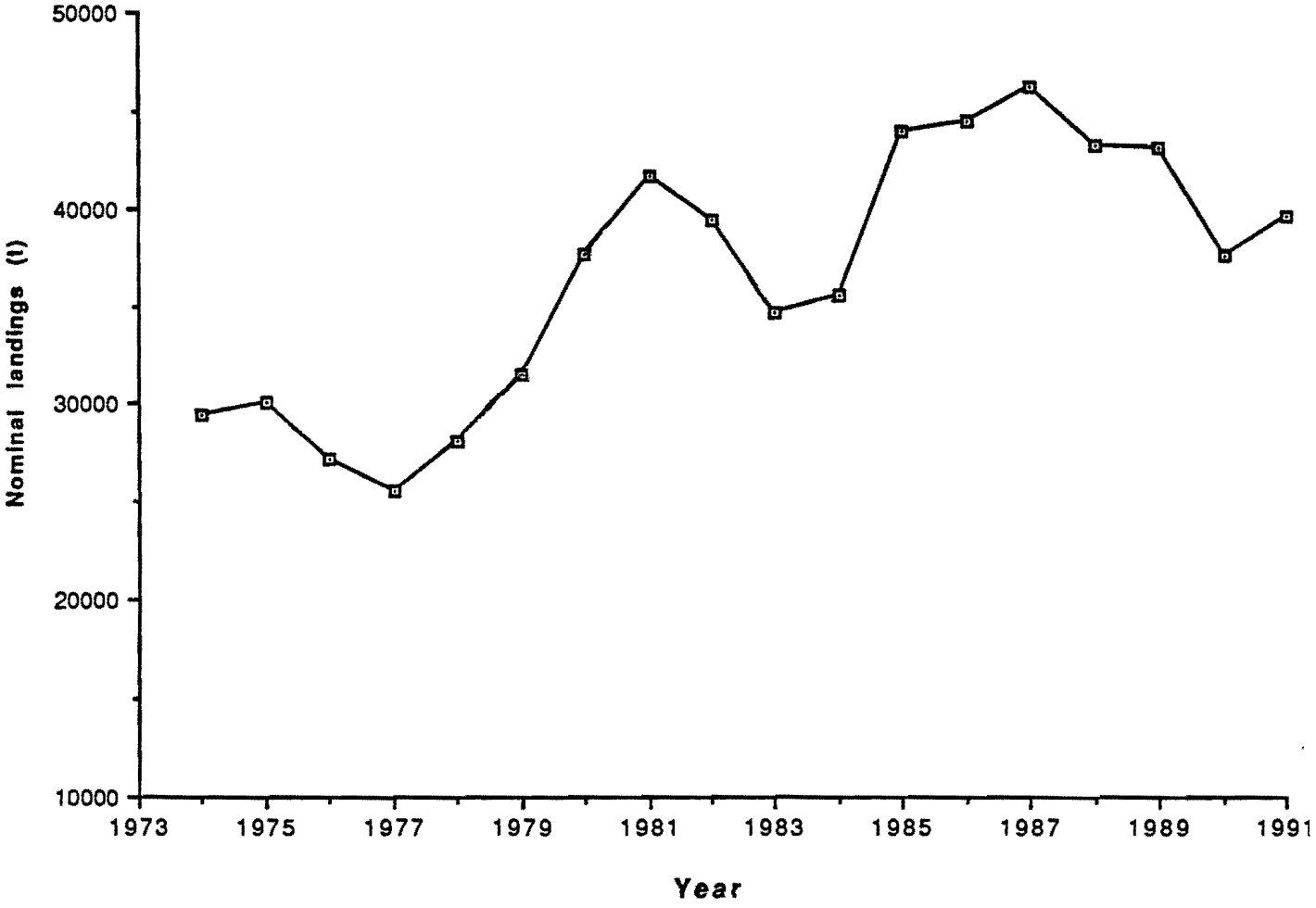
	84	85	86	87	88	89	90	91
2	25029	20658	10178	29671	50859	21135	12636	25900
3	43414	41608	25313	30781	51607	43402	33975	19497
4	56732	39531	42218	33366	32942	50146	56006	30786
5	62264	44037	34905	33696	29848	27897	49519	46129
6	10138	40555	31716	23665	23404	21823	18585	34206
7	2740	4403	23351	19316	14793	13668	14332	10901
8	3976	1354	2056	12441	11462	9283	7129	7850
9	5936	2359	893	851	5777	6727	5999	4220
10	1540	3635	1210	481	350	2457	3863	3025
11	568	722	1995	570	271	236	1175	2150

Table 23. Catch Projections for 4VWX5Zc Pollock

M.Y.P[1]	F		2+ beginning of year biomass ('000)			Catch ('000)	
43,000t in 92/93	1992	1993	1992	1993	1994	1992	1993
	.53	.59	179	169	160	43	43

[1] Multi-year Management Plan

Fig. 1 . Nominal landings for all countries of divs. 4VWX and Subdiv. 5Zc pollock.



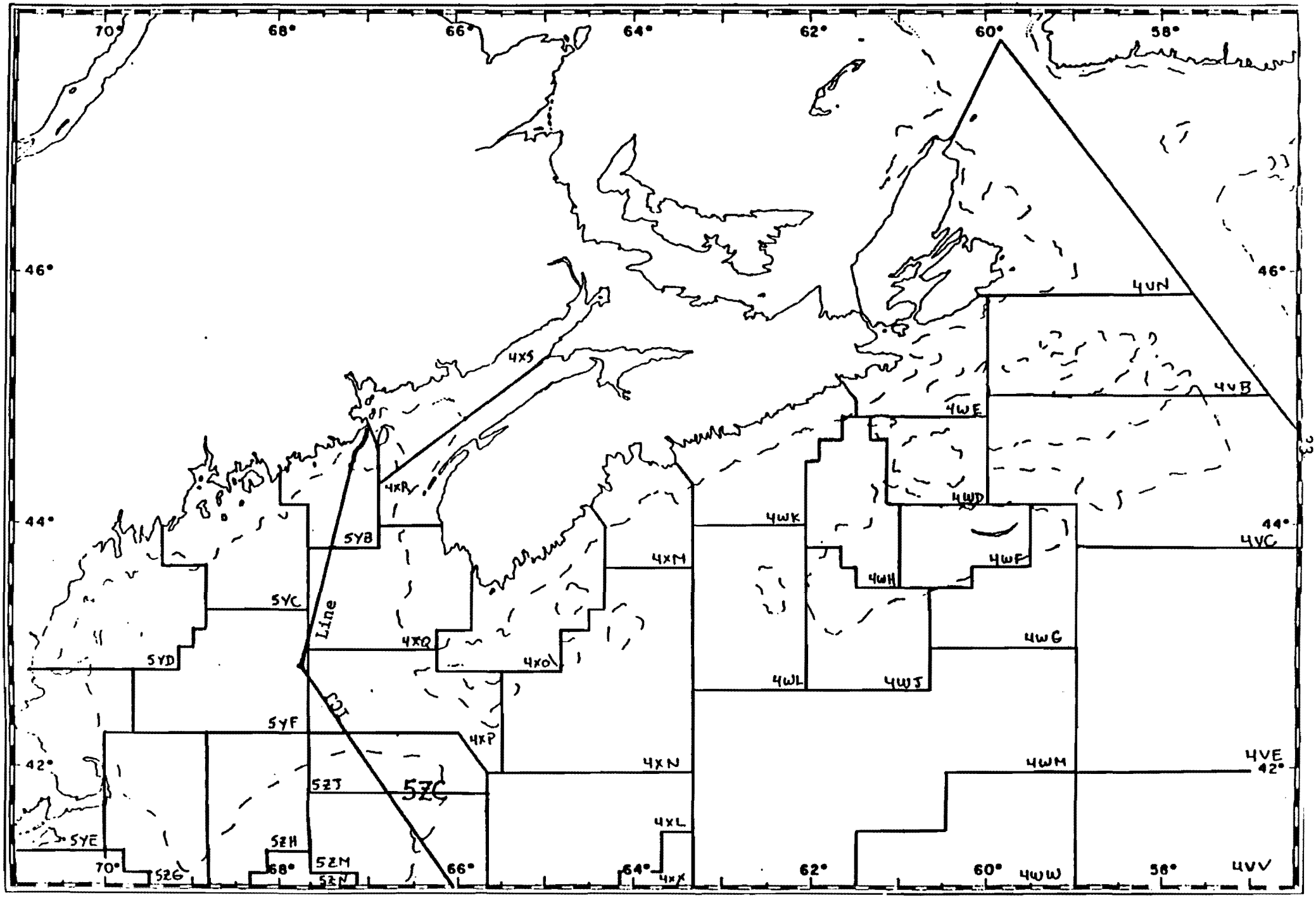
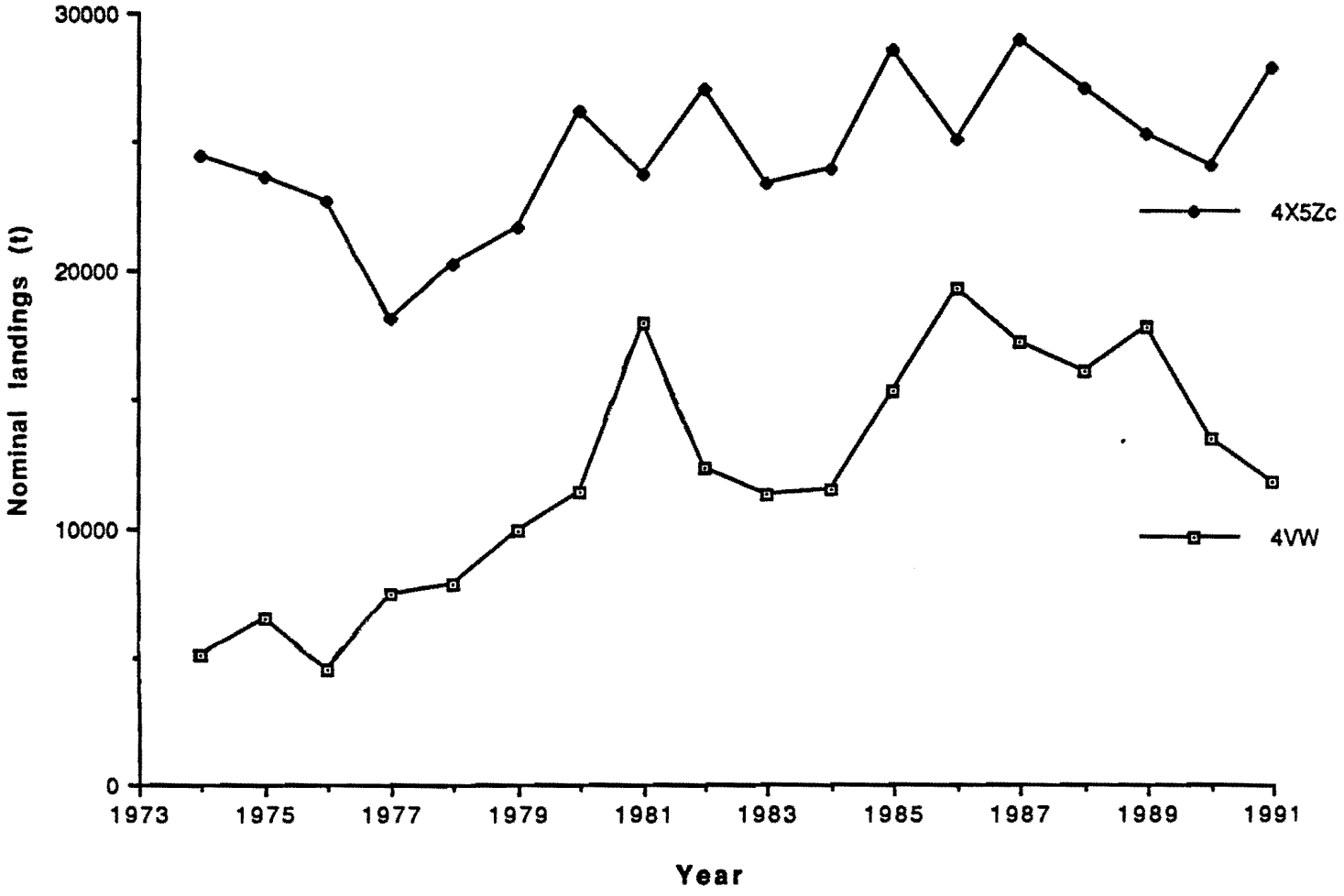
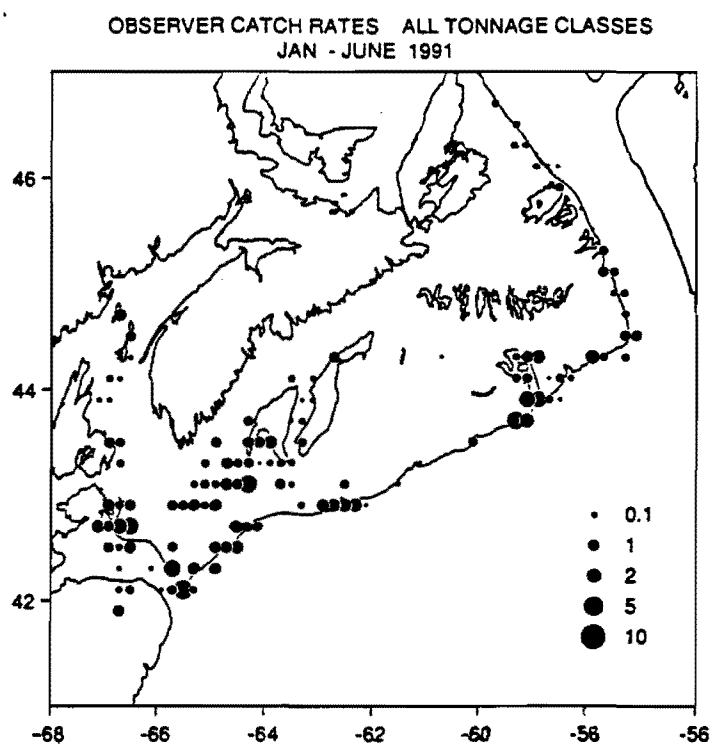
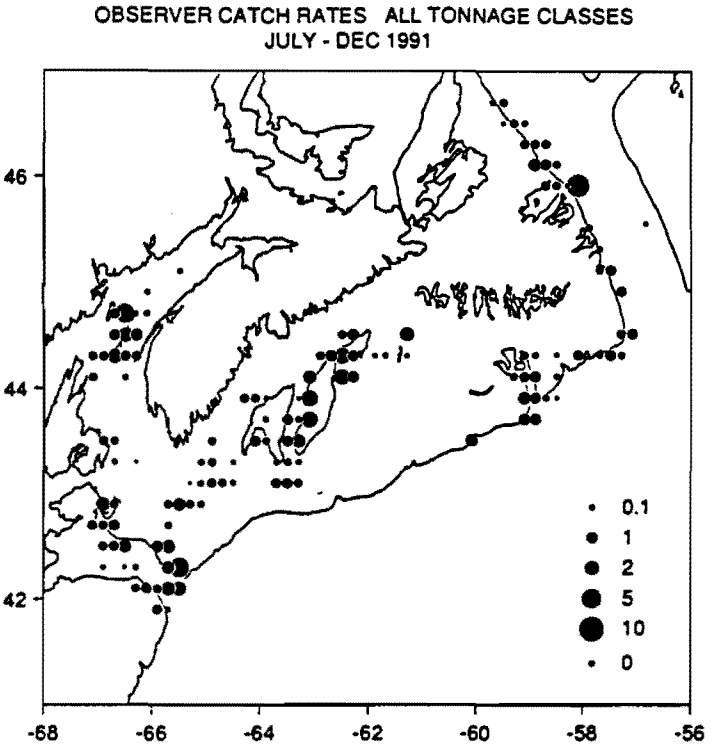


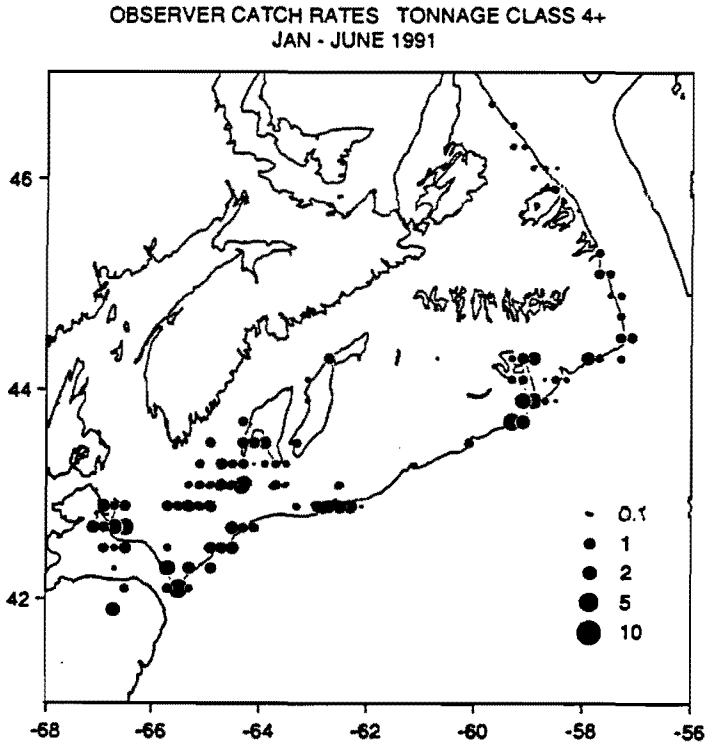
Fig. 2. Diagram of ICJ line which now defines the boundary for the new management unit for 4VWX5 pollock.

Fig. 3 . Nominal landings, by area, for all countries of divs. 4VWX and Subdiv. 5Zc pollock.









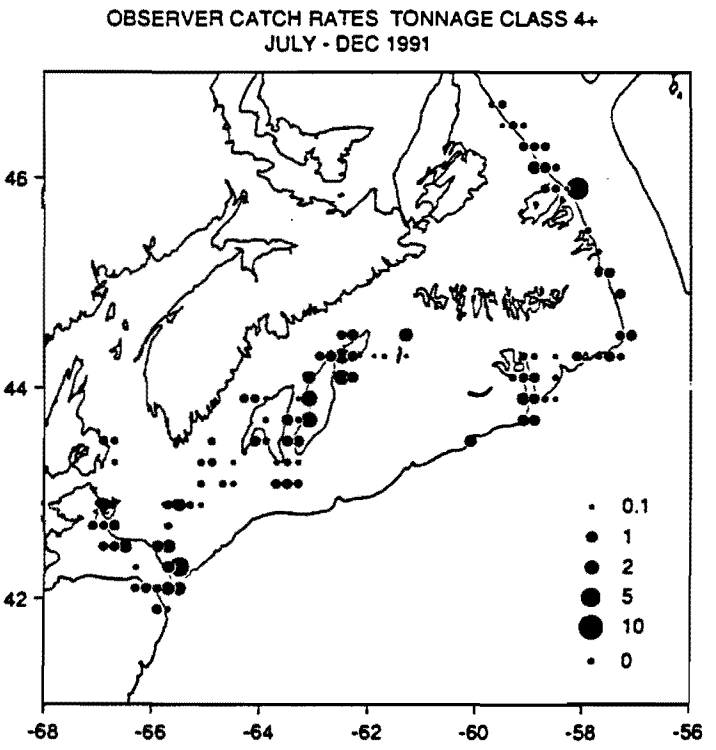


Figure 4. International Observer catch rates (tonnes/hr.) for 4VWX5 pollock. (Jan.-June; July-Dec.)

Fig. 5 . Comparison of percent catch at age for Canadian large trawlers in 4VW and 4X5Zc.

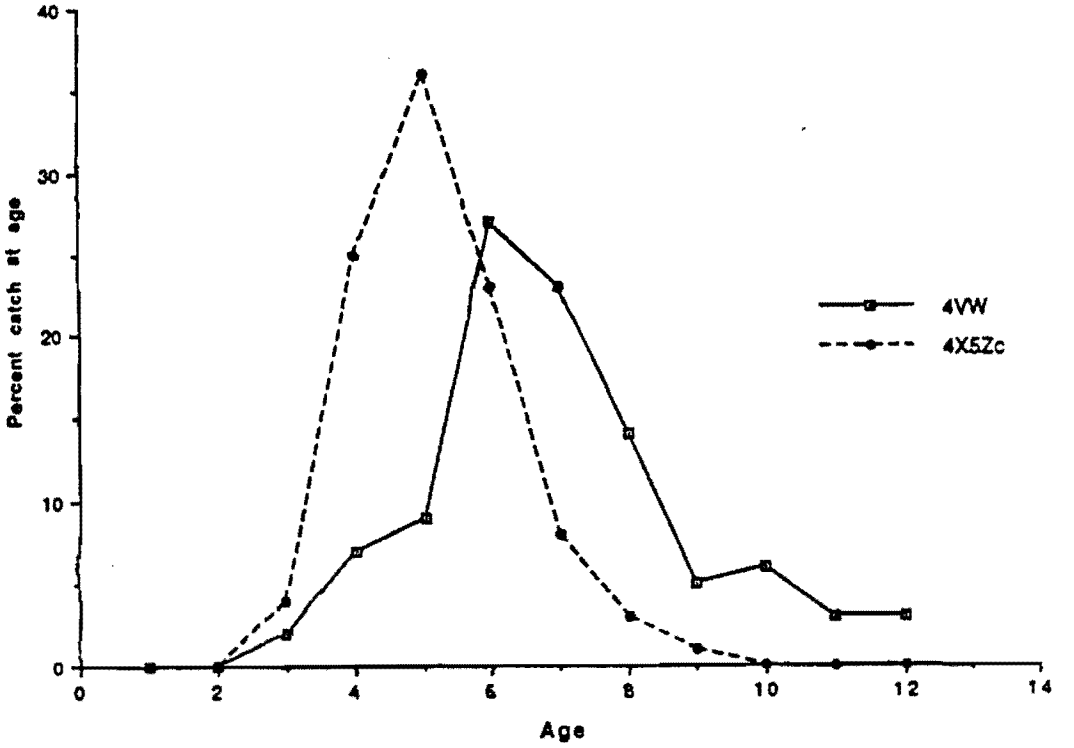


Fig. 6. Percent projected catch at age vs percent catch at age for 1991.

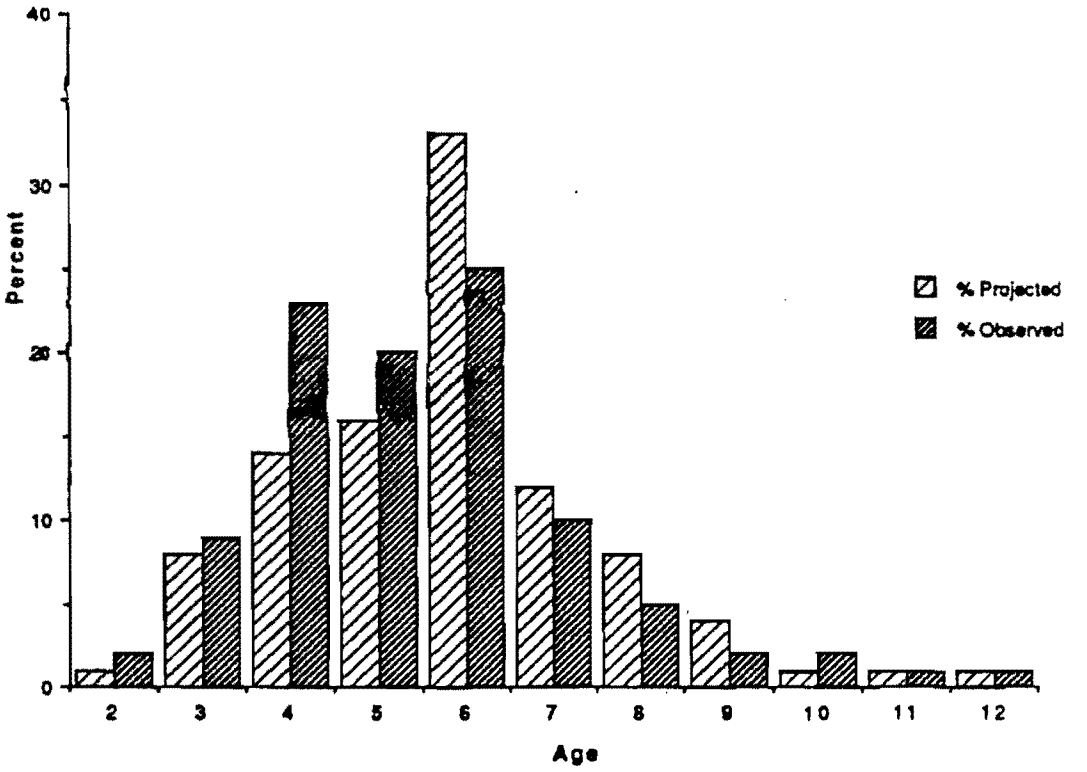


Fig. 7 . Total commercial weights at age for pollock 1974 - 1991.

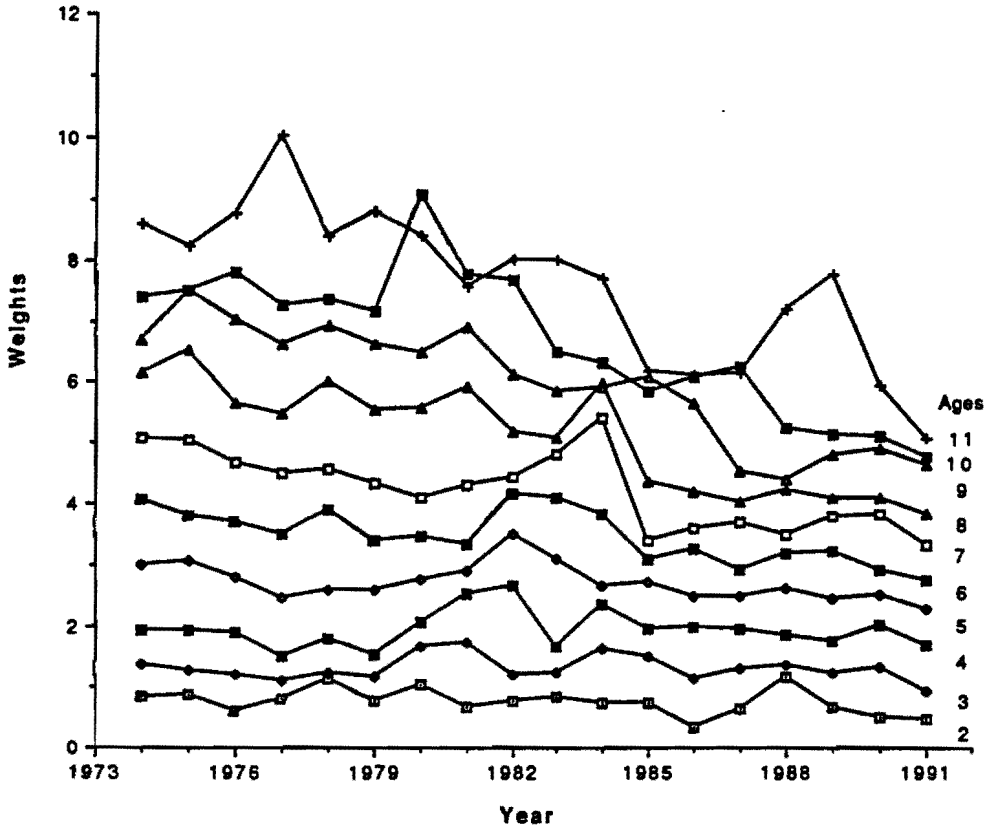


Fig. 8 . Catch rate indices for divs. 4VWX and Subdiv. 5Zc pollock (commercial vs IOP).

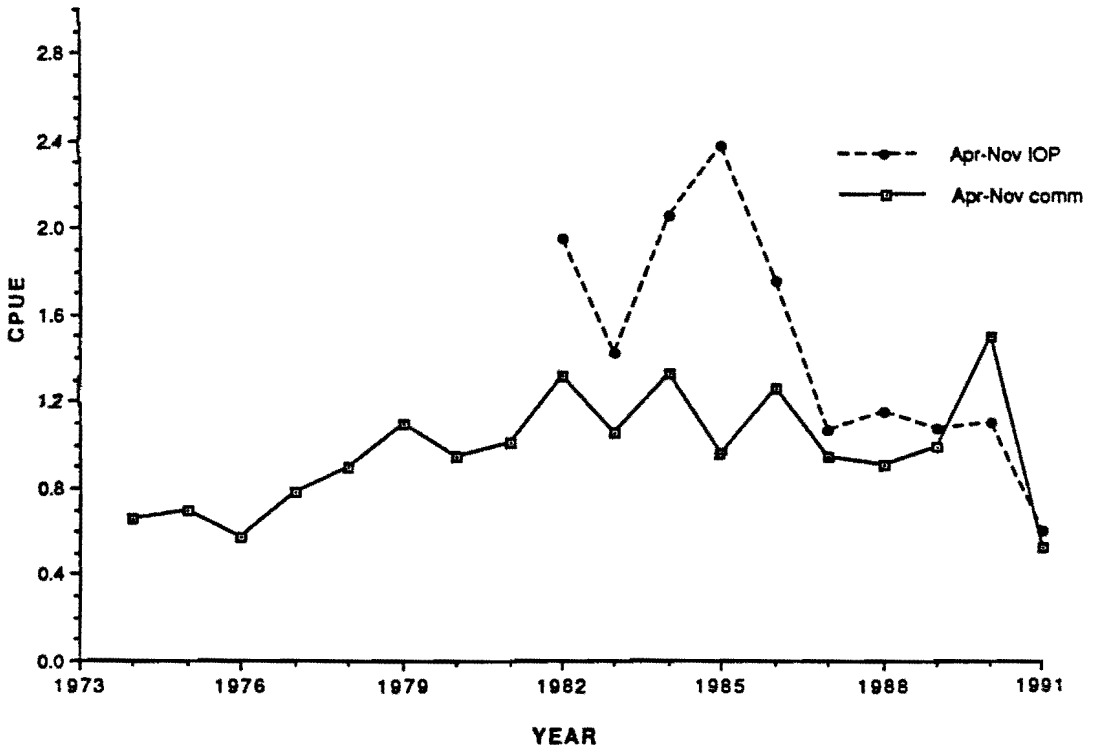
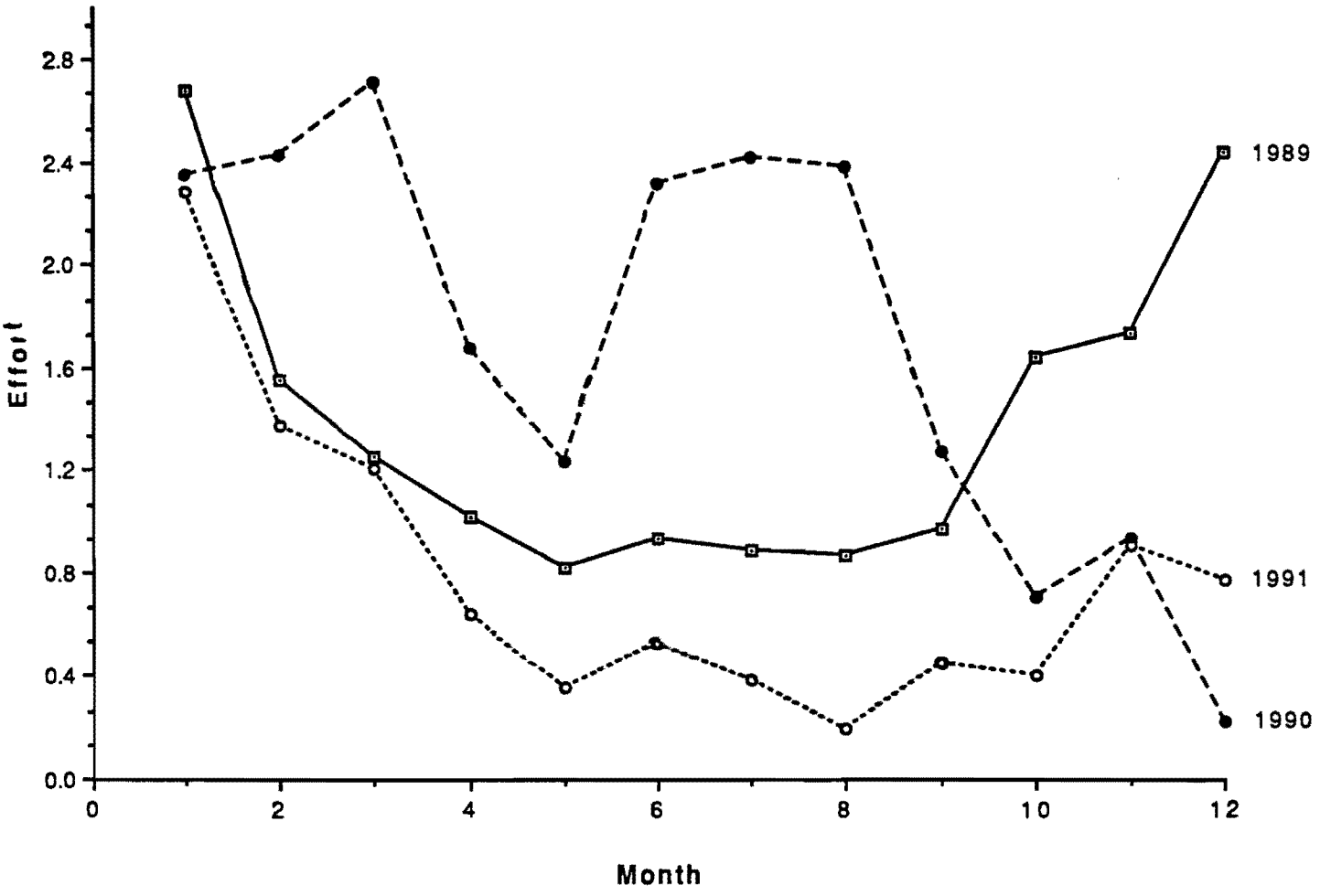


Fig. 9 . Comparison of monthly catch rates for large trawlers for 1989,1990, and 1991 based on regional data.



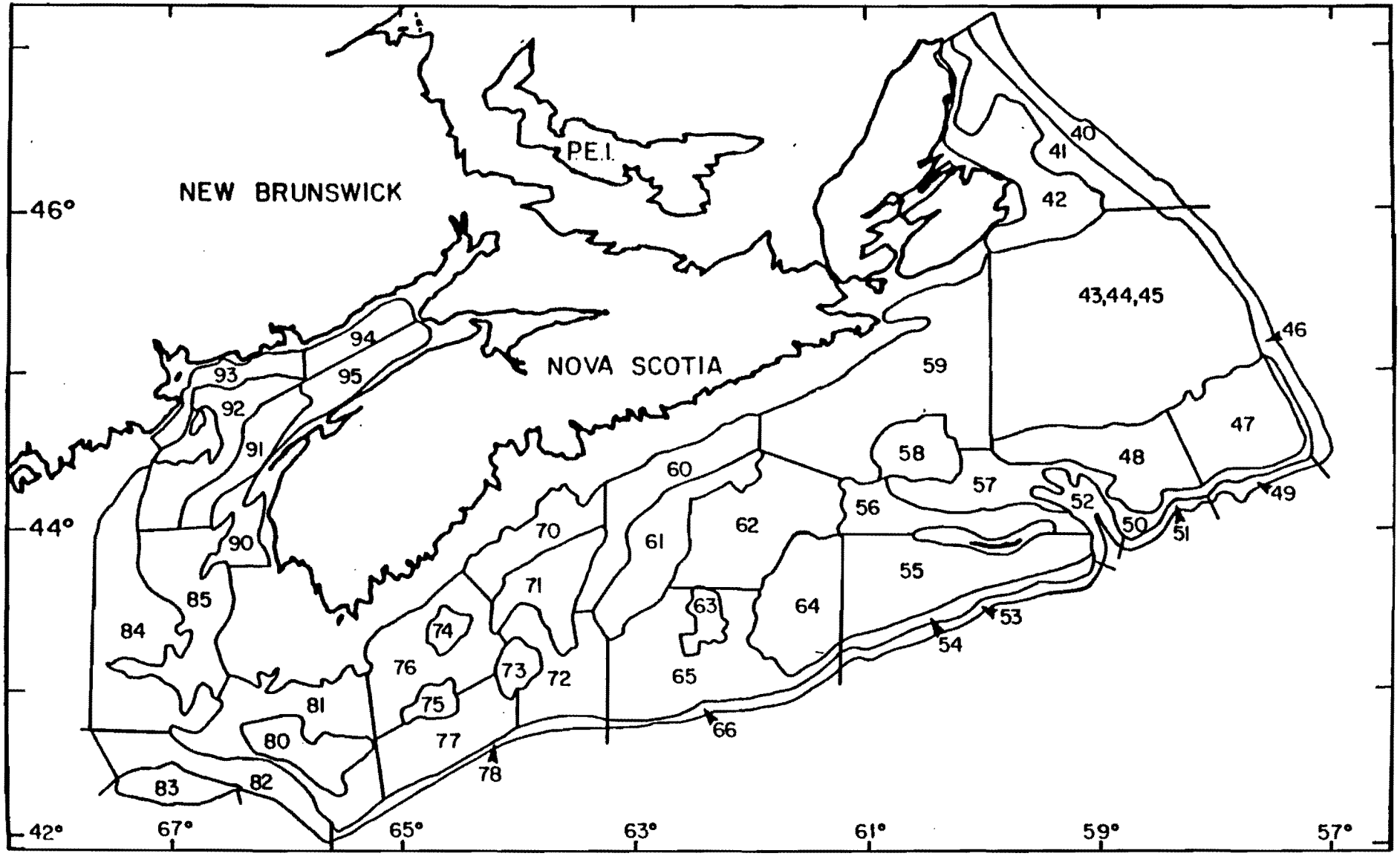


Figure 10. Stratification used for Canadian RV bottom trawl surveys (divs. 4VWX and Sudiv. 5Zc).

Figure 11. July RV stratified numbers (age 4 -9 and 1-3) for divs. 4VWX5 pollock.

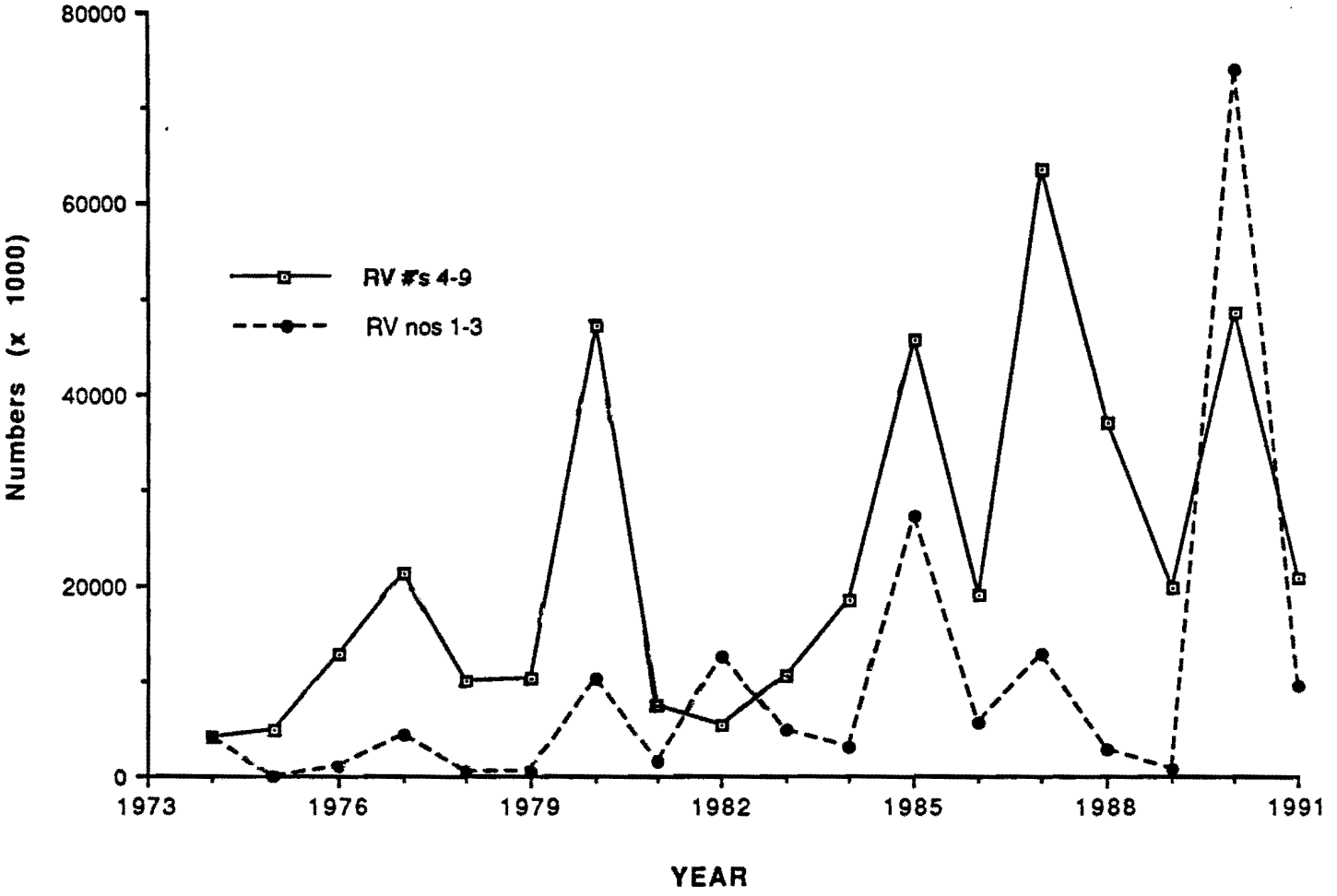
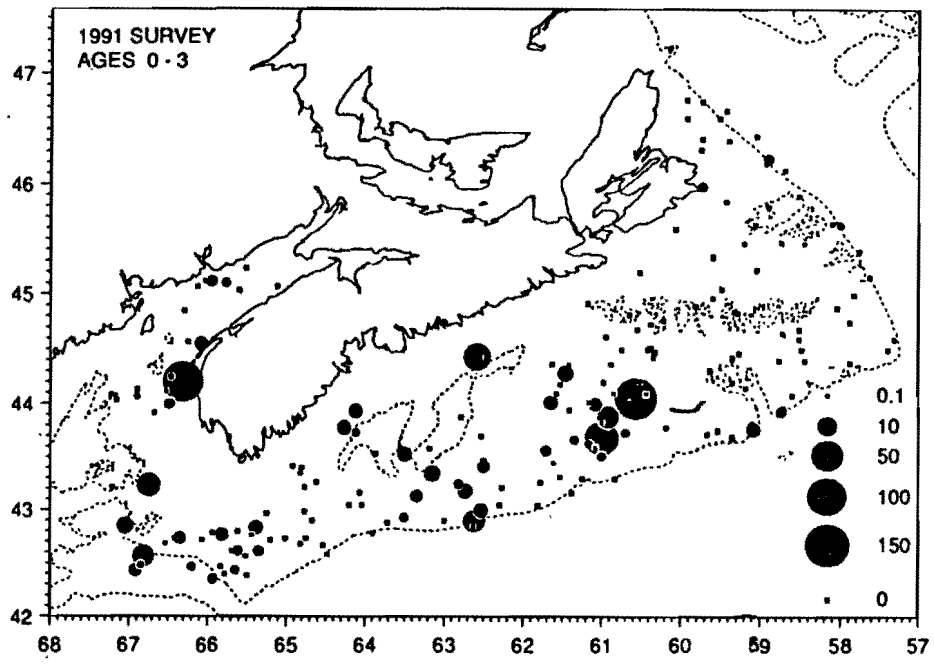
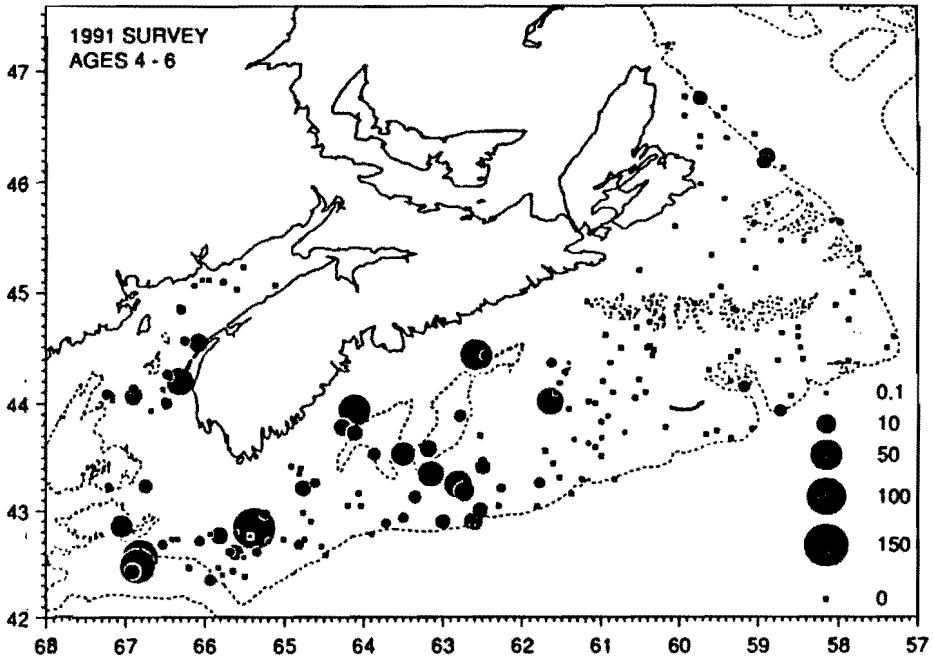


Figure 12. Research vessel survey catches of pollock in July 1991. (ages 0-3;4-6;7+)





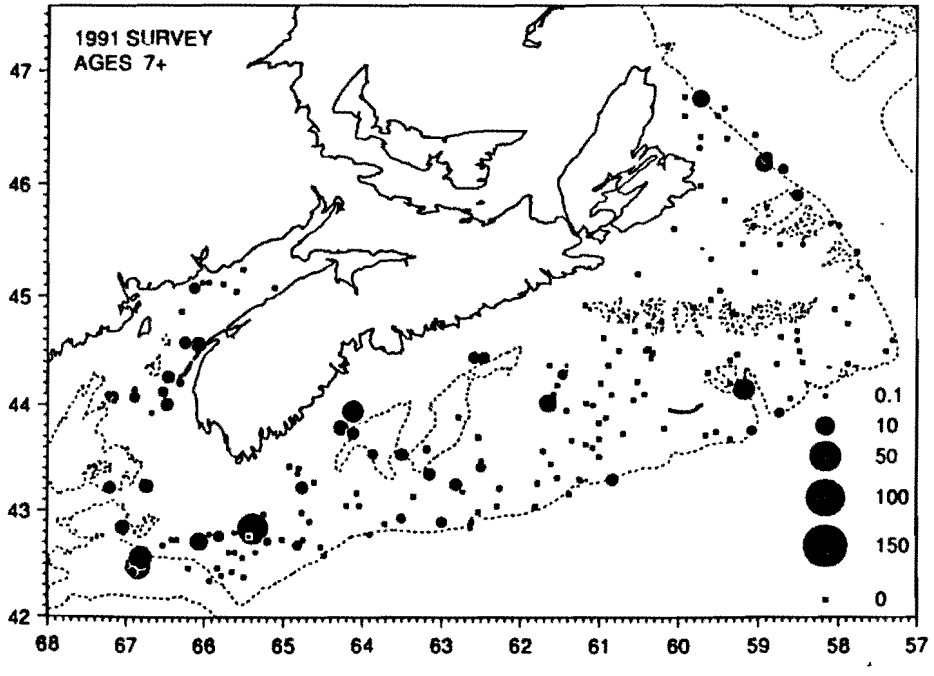


Fig. 13. Comparison of pollock SPA numbers for varying domes.

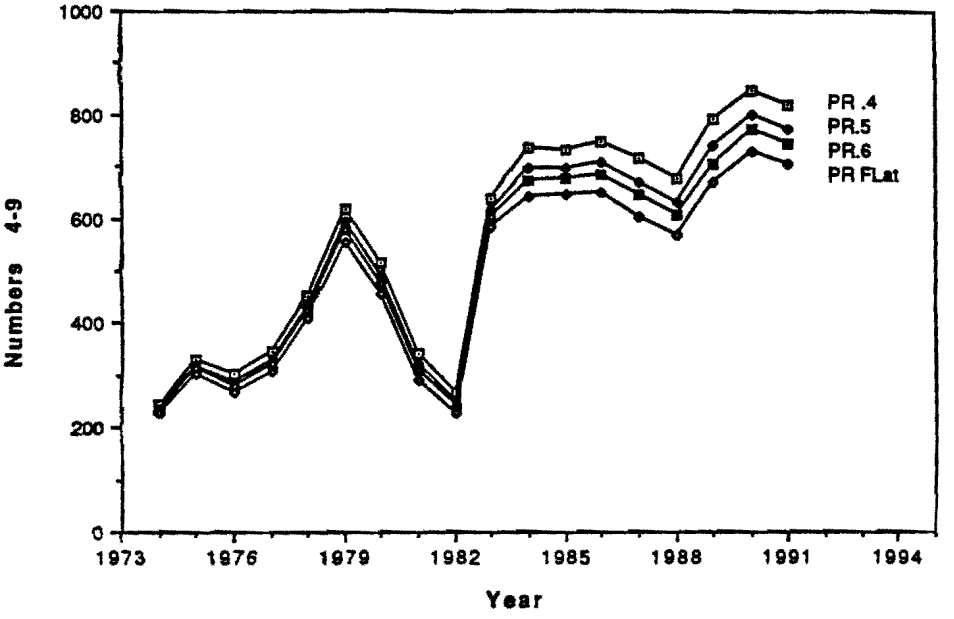


Fig. 14. Recruitment series for age 2 pollock in divs. 4VWX and 5Zc.

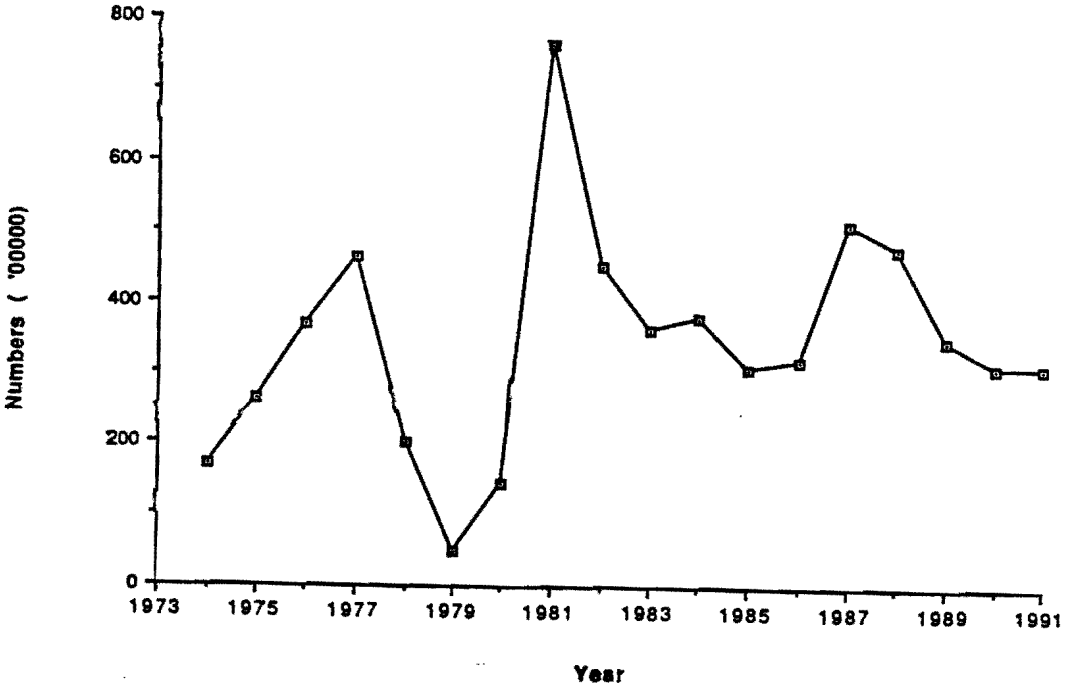


Fig. 15. Beginning of year 2+ biomass for pollock in divs. 4VWX and 5Zc.

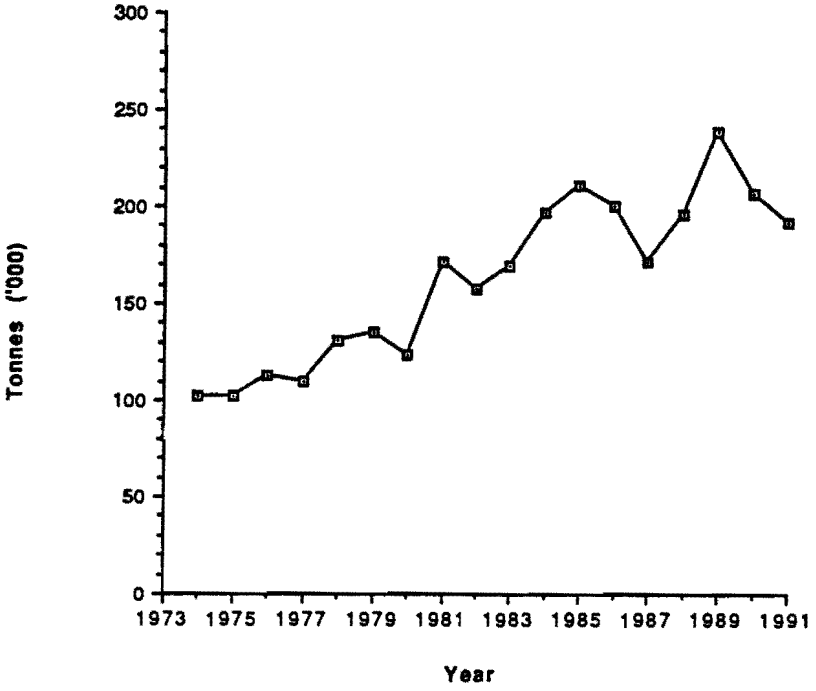


Fig. 16. Population numbers (ages 4-9) for divs. 4VWX and 5Zc.

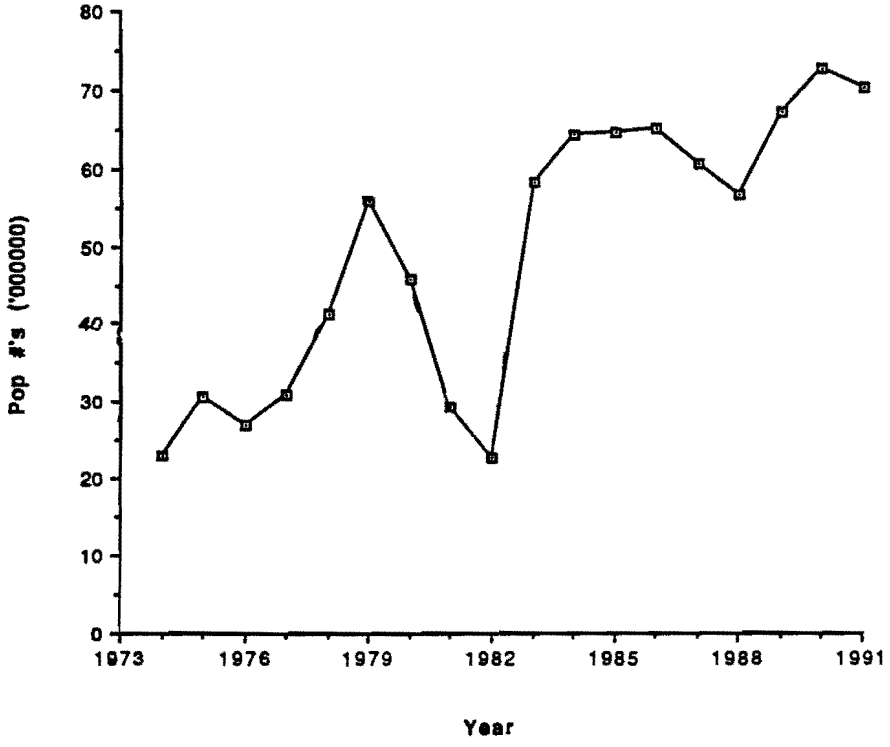


Fig. 17. Fully recruited F's for pollock in divs. 4VWX and 5Zc.