DFO Atlantic Fisheries
Research Document 95/30

MPO Pêches de l'Atlantique
Document de recherche 95/30

The 1994 Assessment of Pollock (*Pollachius virens*) in NAFO Divisions 4VWX and Subdivision 5Zc

by

John D. Neilson and Peter Perley
Department of Fisheries and Oceans
Biological Station
St. Andrews, New Brunswick
E0G 2X0

Abstract

Landings of pollock in the management unit 4VWX5Zc were 15,250 in 1994, considerably less than the TAC of 24,000. Most gear sectors were unable to catch their allocations, and fishermen have reported that pollock were comparatively scarce.

An analytical assessment of the resource was completed using landings statistics, sampling for size and age composition of the commercial catch and trends in commercial fishery catch rate. Population abundance estimates indicate that the stock is in a depleted state. Biomass has declined steadily since 1985 and is now at the lowest level in the series. This decline has been due to high exploitation, not poor recruitment, although the 1990 yearclass appears to be the weakest in the series. The current exploitation rate is almost twice the $F_{0.1}$ level.

If the TAC of 14500 t is taken in 1995, the resulting fully recruited fishing mortality will be about 0.38. The beginning of year biomass (5+) will drop from 47022 t in 1995 to 39565 t in 1966 as the weak 1990 yearclass moves into the fishery. Even with an $F_{0.1}$ harvest level, the 5+ biomass will not start to increase in 1997.

Résumé

En 1994, les débarquements de goberge provenant de 4VWX5Zc se sont chiffrés à 15 250 t, ce qui était bien inférieur au TAC de 24 000 t. La plupart des flottilles d'engins divers n'ont pu capturer leur allocation et les pêcheurs ont indiqué que la goberge était relativement rare.

On a procédé à une évaluation analytique de la ressource en utilisant les statistiques de débarquement, l'échantillonnage des prises commerciales pour en déterminer la composition selon l'âge et selon la taille, et les tendances du taux de prises commerciales. Selon les estimations d'abondance de la population, le stock est en déclin. La biomasse a constamment diminué depuis 1985 et se trouve à son plus bas niveau de la série. Cette baisse est le résultat d'une forte exploitation et non d'un piètre recrutement, quoique la classe d'âge de 1990 semble être la plus faible de la série. Le taux d'exploitation actuel est presque le double du niveau $F_{0,1}$.

Si le TAC de 14 500 t est capturé en 1995, la mortalité par pêche dans le stock pleinement recruté serait d'environ 0,38. La biomasse de début d'année (5+) passera de 47 022 t en 1995 à 39 565 t en 1996, alors que la faible classe d'âge de 1990 s'intégrera à la pêche. Même avec un taux de récolte au niveau $F_{0.1}$, la biomasse des poissons d'âge 5+ ne commencera pas à augmenter en 1997.

Introduction

Description of the Fishery

The 1994 total allowable catch (TAC) for 4VWX5Zc pollock was 24,000 t. Canadian landings (15,240 t) are considerably less than the quota, and are the lowest recorded since 1978 (Fig. 1, Table 1). The 1994 landings continue the recent trend of comparatively small contributions to total landings in the eastern portion (4VW) of the management unit (Table 2, Fig. 2). However, management measures have had considerable impact on the fishery in the 4VW component in recent years. For example, the cod management unit in 4VsW has been closed since September 1993, thus restricting opportunities for pollock fishing on the eastern Shelf. Landings in 4X have declined since 1991. In contrast, landings from 5Zc have increased slightly since 1985 amd have remained relatively stable since 1992.

Table 3 shows landings information aggregated into trimester and gear categories[1]. A variety of fishing gear is used, including primarily mobile gear (otter trawls) and fixed gear (gill nets, handlines and longlines). While it can be seen that landings declined in most categories when compared with 1993, a particularly sharp drop is apparent for Tonnage Class (TC) 4+ mobile in the first trimester, 4X+5Zc. The reduced participation of this fleet sector is thought to be attributable in part to bycatch concerns and a greater emphasis on the redfish fishery.

There are six gear components which receive quota allocation. The quotas and catch to date (December 31, 1994, as obtained from the the Preliminary Final Canadian Atlantic Quota Report) are listed below:

Gear Component	% of Quota Caught
Fixed <45'	101
Fixed 45-64'	44
Mobile <45' (generalist)	85
Mobile < 65' (ITQ)	75
Mobile 65'-100'	95
Vessels > 100'	34

Thus, it can be seen that most gear components did not catch their allocation resulting in a considerable shortfall in total landings compared with the TAC of 24,000 t.

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[1] Mobile gear included bottom otter trawls (side and stern), midwater trawls (side and stern), bottom pair trawl, midwater pair trawl, shrimp trawl, and Danish and Scottish Seine. Fixed gear included gillnet (set or fixed), gillnet (drift), longline, jigger, troller lines, mechanized squid jigger, handline (baited),trap, pot, weir and miscellaneous.

Apart from the domestic fishery, pollock landings in recent years also are made by foreign vessels participating with Canadian companies in the silver hake fishery. In such cases, the vessels receive pollock bycatch allowances, most of which was landed in Canada. Pollock landings in the 1994 silver hake fishery were the lowest since 1978 (10 t, Table 2). Russia (which prior to 1994 operated as vessels from the USSR) did not participate in the fishery, apparently due to the late start of the silver hake fishery. The participation of Cuban vessels was reduced, also due to the late start of the fishery and the lower silver hake TAC in 1994. The mandatory use of grates in 1994 also reduced the bycatch of pollock (M. Showell, Marine Fish Division, BIO, pers. comm.) According to Cooper et al. (1993), the use of 40 mm separator grates reduced the bycatch of pollock by 85 to 95%. Changes to the boundary of the Small Mesh Gear Line in 1994 (Branton 1994) also reduced the bycatch of pollock.

Reports from industry indicate concerns with changing distribution of this resource. For example, longline fishermen are reporting that fish are higher in the water column and more dispersed. Gillnet fishermen report a general westward shift in the resource with a greater proportion of their landings coming from the Bay of Fundy. With the exception of the inshore trap fishery and the longline fishery, most participants report that pollock were scarce compared with previous years, and large pollock were difficult to find throughout the management unit.

Catch at Age

A problem with miscoding of ages by one year greater than the correct value through the period 1991 to 1994 was detected, affecting about 30% of the ages entered in the database. This error necessitated recalculation of the catch at age throughout that time period.

One individual was responsible for completing the age interpretations in 1994. Appendix 1 documents the precision of the age determinations for this stock. In tests where the age reader was presented with a sample to be re-aged, the reader achieved 86% agreement, with no obvious bias.

We evaluated whether the previous convention for aggregation of commercial samples was appropriate, given the changing nature of the pollock fishery over the last several years. In the past, seasonal age length keys were generated separately for bottom otter trawl (OTB) tonnage class (TC) 4+ in 4VW and 4X+5. Annual keys were generated for OTB TC 1-3 (4VWX+5) and miscellaneous gears (4VWX+5). Given the current fishery, the previous conventions for aggregation appeared inappropriate. For example, there were sufficient samples to stratify by area 4VW and 4X+5 and by trimester for the OTB TC 1-3 vessels. Stratifying on such bases is important because there are considerable differences in growth rate between areas and among trimesters (Fig. 3). Also, we established separate aggregations for gillnets, longlines and traps (the latter only in 1994). The latter category, although accounting for a small proportion of landings, is of special significance since being a coastal gear, the size and age structure of the catch will likely differ.

Supplemental 'B' landings accounted for 12.6 t in 1994. Of that total, 9.4 t were from fixed gear, and 3.2 t from mobile gear. For the purposes of constructing the catch at age, it was assumed that the 3.2 t from mobile gear could be attributed to the small mobile gear category (OTB TC 1-3). The details of how the catch at age was constructed for the Canadian fishery is given in Table 4.

Table 5 includes sampling information for the four years when the catch at age was recalculated.

Landings from the vessels participating in the small mesh gear silver hake fishery were attributed to the foreign small mesh gear fishery for the purpose of constructing the catch at age.

We also evaluated how length-weight parameters were calculated. In previous assessments, length-weight parameters were obtained from examination of length-weight relationships obtained from the most recent summer survey. However, that procedure needed improvement inasmuch as relatively few pollock are measured during a single survey. Sampling variability may have been the cause of the considerably different values of the length-weight relationships reported in recent assessments. Furthermore, analyses of surveys completed from 1979 to 1994 revealed a time trend in 4VW (Table 6). The biological implications of the time trend are not clear, but the possibility that the trend in length-weight relationships is related to changes in the size of range of fish measured over time requires evaluation. Given the above trend, we elected to use the average length and weight parameter values over the past five years. The resultant values for 4VW, 4X and 4VWX are shown on Table 6. Since we do not have recent spring or fall surveys, we used the summer values for the 1st and 3rd trimesters. For comparison, results for seasonal surveys conducted in the early to mid 1980's are also shown on Table 6.

The resulting catch at age and weight at age matrices are reported in Tables 7 and 8, respectively. The 1994 age composition in the overall fishery landings is shown relative to the 10-yr mean on Fig. 4. Five, six, seven and eight year old fish are accounting for a greater proportion of total landings than they have in the past, and there are comparatively few age 3 and 4 fish. The problem with miscoded ages seems to have contributed marginally to the observed decline in weights-at-age, but does not account for the trend completely.

Abundance Indices

Research Surveys

Figure 5 shows the distribution of sets where pollock were caught compared with the three past years. Inspection of the plots appears to indicate that there has not been a dramatic shift in the distribution of pollock in recent years. The density of pollock are shown by research vessel survey stratum in Table 9 and Fig. 6. Comparison of the catch rate by stratum in 1994 to the longer-term average over the duration of survey (Fig. 6) indicates that strata 45 - 51,53,66 (all on the Eastern Scotian Shelf and usually associated with pollock catches) did not have any pollock catches in 1994.

Regarding abundance trends from the survey, results for pollock are typically highly variable. As noted in previous assessments, it is difficult to track cohorts from year to year, as the survey appears to show pronounced interannual variation (Tables 10 and 11, Fig. 7). We attempted to examine whether using a smaller index area (in this case 4X only) would yield a more stable series, but similar effects were noted (Fig. 8). Thus, we concluded that the available research survey information required more work and analyses before it used as an index of abundance for this species.

Commercial Catch Rates

Given the observations that the research vessel series required further development before it could be employed as a reliable index of abundance, the stock assessment completed last year employed commercial fishery catch rates for TC5 mobile gear as an index of abundance for the stock. The use of catch rates was criticized by some members of industry initially, who indicated that inclusion of the whole stock area in the calculations could bias the outcome because of the restrictive management measures in place in the eastern portion of the Scotian Shelf. It was also noted that differences in the way that fleet managers deploy their fishing operations might influence the catch rates.

To address these concerns, more attention was given to the examination of commercial catch rates. Two approaches were attempted in the analyses of catch rate data. The first approach employed, as was done last year, data from the International Observer Program (IOP), including a variant where only data from 4X were included to examine whether inclusion of the whole management unit did, as industry suggested, influence the catch rate series. The second approach recognized that the contribution of the larger tonnage classes to total landings has been following a decreasing trend, compromising the utility of the series in the future. Thus, a broader range of tonnage classes is included in the development of a standardized catch rate series.

Catch Rates from IOP

Nominal IOP catch rates[2] were generated by using the International Observer Program database for the years 1982 to 1994, for 4VWX5Zc. Data were selected for OTB TC5 where main species caught was pollock. Months included in the analyses were, as before, April through November. As can be seen on Fig. 9, the catch rate series has declined since 1985. Also shown in Fig. 9 is the series for 4X only. While initial values of the series are erratic due to poor observer coverage in 4X in the early years, the series tracks that of the overall series very well from 1987 onward.

Standardized Catch Rates from ZIFF

To include a broader spectrum of the fishery, a standardized catch rate series was constructed

[2] Four ORACLE IOP tables were used to generate catch rate data: TRIVES. GEA,CAT and SETNO tables. To extract the appropriate data, these tables were linked to each other by the trip number which is the key field for all tables. Gear is then keyed to set number by the gear cod and set number is keyed to the catch by the set number, yielding an output file file with pollock dat selected for area, gear type, tonnage class, main species caught (MSPEC= pollock)

using catch - effort data available from ZIFF. This analysis included all tonnage classes, throughout the Scotian Shelf where pollock comprised greater than 50% of the catch.[3] Factors in the catch rate standardization included year, month, tonnage class and area in a similar approach to that employed by Hanke (1993). Recognizing that the increasing use of square mesh by the fishery can influence catch rates, square/diamond was also included as a factor. The results of the analyses are given in Appendix 2. Significant factors in the analyses were year, month and tonnage class. Unexpectedly, the square/diamond factor was not significant. The reason for this is not clear, since comparison of catch rates for TC1-3 in 1994 for pollock indicated a catch rate of 0.22 and 0.43 t/h for square and diamond mesh, respectively.

Fig. 10 shows the two catch rate series on the same scale. Both series show a similar gradual decline, although the standardized ZIFF series is smoother. To determine which series is more useful as an index of abundance, we plotted the age-disaggregated series in Fig. 11. The standardized series appeared to show a year effect for the first two years. The IOP series is longer, and appeared to reflect the strong 1979 year class very well, as well as the more recent 1988 and 1989 year-classes.

On the basis of examination of data from Fig. 11, we included the IOP series as the index for the VPA (Table 12). To obtain the age disaggregated catch rates, the same method of aggregation was used as was done for the Canadian catch at age. The OTB TC 1-3 and OTB TC4+ were aggregated by area and by trimester and then combined to create one catch at age table for OTB. Using the catch weight at each age and dividing by the total effort for OTB, the age disaggregated catch rates shown in Table 12 were obtained.

Sequential Population Analyses

Estimation of Stock Parameters

The adaptive framework of Gavaris (1988) was used to calibrate the sequential population analysis with the commercial catch rate date shown in Table 12, using the following data:

$C_{a,y}$ = catch	a= 1 to 12, y = 1974 to 1994
$I_{a,y}$=TC5 catch rates	a= 4 to 10, y = 1982 to 1994

[3] The SQL FORMS program CEFRM was used to get pollock data for the entire management unit. The data contained data disaggregated to the subtrip level and had the data fields for CFV, tonnage class codes, NAFO area, effort (hrs), live weight in metric tons and the landed date. To ensure that vessels using small mesh in the silver hake fishery (Footnote 3 cont) were not included, CFVs < 990000 were selected only.

Catch rates for the standardized series used records where pollock made up 50% or more of the catch, and to do this, the total weight of the catch had to be calculated. The output from CEFRM is used as the main table. The CFV number , trip number and the subtrip number were used to match with the identified_catches table so that a total weight corresponding with each pollock record is calculated and from this a table with pollock weight and total weight by trip by subtrip by area is generated (ie. for every record that CEFRM produced for pollock, a field with total weight is added). From the newly generated table, the pollock records where pollock is greater than 50% of the the catch can be calculated by dividing pollock weight by the total weight.

Only data from the years 1987-1994 were used since data before 1987 were summarized at the trip level.

where a is age, and y is year. The model provided estimates of the abundances of ages 5 to 12, and ages 3 and 4 were estimated using partial recruitment values of 0.1 and 0.3, as used in the assessment completed last year.

The IOP commercial catch rate was treated as a midyear index and compared with midyear population abundance. The statistical error in the survey size sample data was assumed to be independent and identically distributed and the error in the catch at age was assumed negligible. Natural mortality , M, was assumed constant at all ages and equal to 0.2. The fishing mortality rate, F, for the oldest age (12) was taken as the arithmetic average of ages 7, 8, 9 and 10. Using this formulation, beginning of year population estimates were obtained for ages 5-11

The relative error and bias of the resulting population abundance estimates is shown on Table 13 and Fig. 12.

Assessment Results

For each cohort, the terminal population abundance estimates from ADAPT were adjusted for bias and used to construct the history of stock status (Tables 14-16). The assessment results are summarized in Figs. 13-16. Recruitment after the strong 1979 yearclass has been close to the longterm average of 28 million fish. The most recently estimated yearclass (1990, more recent years are estimated by trends in partial recruitment) in the model,however, appears to be the weakest in the series.

The exploitation rate has been increasing since 1984 and reached a peak in 1992. Although recent values have declined somewhat, the current exploitation rate is still almost twice the target level.

Prognosis

If the TAC of 14,500 is taken in 1995, the resulting fully recruited fishing mortality will be about 0.38 (Table 17). The beginning of year biomass will drop from 47022 t in 1995 to 39565 t in 1996 as the weak 1990 yearclass moves into the fishery. The $F_{0.1}$ catch in 1996 is 11,000 t. Even with an $F_{0.1}$ harvest strategy, the 5+ biomass (the approximate spawning stock) will not start to increase in 1997. The uncertainty associated with the projected yield is about 29%, based on the precision of the estimates of ages 5-10 in the current assessment.

However, with increased use of square mesh gear and bycatch reduction measures in the small mesh silver hake fishery, yearclasses recruiting to the fishery will have a greater opportunity to spawn.

Acknowledgements

We thank Joe Hunt, Stratis Gavaris, Don Clark and Ed Trippel who all gave freely of their time in helping us interpet the results presented here. J. Porter and S. Gavaris reviewed an earlier version of the document. H. Sampson provided the age determinations for this stock assessment. We are grateful to the many members of the fishing industry who took time to participate in the process of stock assessment this year.

Literature Cited

Branton, R. 1994. Reduction of bycatches in the Scotian Shelf silver hake fishery. Project Summary. Industry Services and Native Fisheries No. 47, 4 p.

Cooper, C. Greencorn, C., and Matthews, D. 1993. Silver hake separator grates at various bar spacings and angles. Project Report #180, Industry Services and Native Fisheries Branch, Department of Fisheries and Oceans, Halifax. 35 p.

Gavaris, S. 1988. An adaptive framework for the estimation of population size. CAFSAC Res. Doc. 88/29, 12 p.

Hanke, A. Commercial fishery based estimate of pollock abundance on the Scotian Shelf. DFO Atlantic Fisheries Research Document 93/43, 6 p.

Trippel, E.A. and L.L. Brown. 1994. Assessment of Pollock (*Pollachius virens*) in Division 4VWX and Subdivision 5Zc for 1993. DFO Atlantic Fisheries Research Document 94/67, 43 p.

Table 1. Pollock landings (t round fresh) by country for NAFO Divs. 4VWX and Subdiv. 5Zc (Source: Trippel and Brown 1994, DFO ZIFF & IOP Data)

	Canada	Japan	France		Cuba	USSR(Russia)	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	37931	38			459	1177			39605
1992	32002	72		9	1015	1006			34104
1993	20253				644	176			21073
1994	15240				10				15250

Data from 1992 to 1994 are provisional.

Table 2. Pollock landings (t) by season and country for NAFO divs. 4VWX and Subdiv 5Zc.

Canada (Maritimes & Newfoundland)

	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	4711	2144	3896	10751	6781	13746	6653	27180
1992	3153	2369	2586	8108	4566	13814	5514	23894
1993	809	1215	391	2415	4285	9433	4121	17839
1994	752	974	427	2152	1789	7923	3376	13088

USSR

	4VW				4X + 5Zc			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	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				0
1983	16	204		220		6		6
1984		97		97				0
1985		336		336				0
1986		564		564				0
1987		314		314				0
1988	96	958		1054				0
1989	605	1177		1782				0
1990	342	698		1040				0
1991	151	640	2	793		384		384
1992	519	350		869	2	135		137
1993	21	125		146		30		30
1994	0	0	0	0	0	0	0	0

Other Foreign Countries

	4VW					4X + 5Zc				
	Jan-Apr	May-Aug	Sept-Dec	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			286	358	497	472		1327
1984	87	83	1		171	387	528	776		1691
1985	82	70	8		160					0
1986	204	291	24		519					0
1987	110	311	32		453					0
1988	4	222			226					0
1989	99	1			100					0
1990	153	108			261					0
1991	209	169		1	379		118			118
1992	259	361		1	621	12	464			476
1993	33	213			246	4	343			347
1994		9			9		1			1

Table 3. Nominal landings of pollock in NAFO Divs. 4VWX and Subdiv. 5Zc for Canada(Maritimes,Quebec and Newfoundland)

Otter Trawlers -- Tonnage Classes 4+

	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	4172	1393	2352	7917	1580	2638	1401	5619
1992	2794	1499	1025	5318	1306	2275	1288	4869
1993	718	311	224	1253	2629	651	1457	4737
1994	701	458	174	1333	177	757	860	1794

Otter Trawlers -- Tonnage Classes 1 - 3

	4VW				4X + 5Zc			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	8			8	336	2042	483	2861
1971	4			4	245	1708	717	2670
1972		9	1	10	537	2035	902	3474
1973			2	2	1922	6762	618	9302
1974		39	40	79	562	3398	591	4551
1975				0	745	2610	836	4191
1976				0	1039	2844	715	4598
1977		2		2	896	2224	808	3928
1978	9	23	2	34	955	2187	961	4103
1979		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	319	80	642	1041	4379	5151	2049	11579
1992	236	149	997	1382	2645	6409	1378	10432
1993	29	100	8	137	1367	4290	1132	6789
1994	28	72	17	117	1378	2823	1079	5280

GILLNET, LONGLINE and MISCELLANEOUS Gears -- all tonnage classes

	4VW				4X + 5Zc			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970		46	224	270	53	893	663	1609
1971		118	72	190	5	979	544	1528
1972		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	221	671	902	1794	822	5958	3202	9982
1992	123	722	564	1409	616	5130	2849	8595
1993	62	804	159	1025	289	4492	1532	6313
1994	23	443	237	703	234	4343	1436	6013

Table 4. Aggregations of commercial samples used to construct previous Canadian catch at age matrices, and a new approach adopted in this assessment.

Strategy Used in Past Assessments to Construct Catch at Age, as could be applied to 1994 data.

	4VW		OTB4+		4X5		OTB1-3	MISC	TOTALS
	Trim. 1	Trim. 2	Trim. 3	Trim. 1	Trim. 2	Trim. 3	All areas All year	All areas All year	
Landings	702	461	174	177	757	860	5411	6699	15241
Samples	3	1	3	4	1	8	50	20	90

New Strategy to Construct Catch at Age.

	4VW			4X5		
	Trimester 1	Trimester 2	Trimester 3	Trimester 1	Trimester 2	Trimester 3
Landings	752	974	427	1789	7923	3376
Samples	4	6	6	23	29	22
# of lengths	1563	2573	2157	6536	8617	7344
# of ages	90	168	126	519	763	482

Example: 1994 catch at age construction.

Using the new strategy, length frequency samples from the commercial fishery were combined for the following gear classes:

gillnet
longline
OTB TC4+
OTB TC 1-3
Traps
Misc.

For mobile gear TC 1-3, sufficient samples were present to observe a split by trimester and area (4VW and 4X4). Tthis was also true for the mobile gear TC4+. For gillnets, samples were aggregated over the whole year, but the area split was observed. For both longline and miscellaneous gears, it was necessary to pool samples across all trimesters and aboth areas.

These aggregated length-frequency distributions were then applied to the appropriately aggregated age-length keys, to generate a catch at age for the Canadian fishery.

Table 5. Number of samples taken per gear type by trimester, over the period when the catch at age was revised.

1991

Count of sample		OTB	Gillnet	Longline	Grand Total
Area	trimester				
4VW	1	13	0	0	13
	2	7	1	0	8
	3	9	2	0	11
4VW Total		29	3	0	32
4X5	1	26	2	0	28
	2	12	4	7	23
	3	7	2	0	9
4X5 Total		45	8	7	60
Grand Total		74	11	7	92

1992

Count of Sample		OTB	Gillnet	Longline	Grand Total
Area	trimester				
4VW	1	13	0	0	13
	2	12	4	1	17
	3	3	2	0	5
4VW Total		28	6	1	35
4X5	1	14	2	0	16
	2	22	5	3	30
	3	8	5	2	15
4X5 Total		44	12	5	61
Grand Total		72	18	6	96

1993

Count of Sample		OTB	Gillnet	Longline	Grand Total
Area	trimester				
4VW	1	3	0	0	3
	2	6	0	0	6
	3	2	4	1	7
4VW Total		11	4	1	16
4X5	1	20	0	2	22
	2	23	10	3	36
	3	22	10	2	34
4X5 Total		65	20	7	92
Grand Total		76	24	8	108

1994

Count of Sample		OTB	Gillnet	Longline	Trapnet	Grand Total
Area	trimester					
4VW	1	4	0	0	0	4
	2	4	2	0	0	6
	3	4	0	2	0	6
4VW Total		12	2	2	0	16
4X5	1	22	0	1	0	23
	2	18	5	4	2	29
	3	18	3	1	0	22
4X5 Total		58	8	6	2	74
Grand Total		70	10	8	2	90

Table 6. Comparison of A and B values from the length-weight relationship for various components of the pollock management unit, and by season. Data are from research vessel surveys.

	4VW									4X									4VWX		
	Spring			Summer			Fall			Spring			Summer			Fall			Summer		
	a		b	a		b	a		b	a		b	a		b	a		b	a		b
1978							-1.78942	0.01624	2.91271												
1979	-1.69	0.0204	2.8429	-1.6948	0.0202	2.8786	-2.10926	0.007776	3.097665	-2.0025	0.009943	3.008431	-1.80368	0.015715	2.926614	-2.46087	0.00346	3.295219			
1980	-1.634	0.0232	2.8032	-1.5226	0.03	2.7697	-1.99767	0.010054	3.048897	-1.94029	0.011474	2.975707	-1.48513	0.032724	2.760653	-2.04934	0.008926	3.071432			
1981	-1.989	0.0103	2.9919	-1.524	0.0299	2.7746	-1.98769	0.010287	3.039551	-1.98351	0.010387	3.000445	-1.83289	0.014693	2.936185	-1.9281	0.0118	2.999871			
1982	-1.797	0.0159	2.8905	-1.537	0.029	2.7711	-2.18586	0.006518	3.134042	-1.94551	0.011337	2.978461	-1.53699	0.029041	2.771123	-1.4581	0.034826	2.748111			
1983	-1.865	0.0137	2.9291	-1.5254	0.0298	2.7581	-1.93388	0.011644	2.988019	-1.93151	0.011708	2.969218	-1.9401	0.011479	2.984379	-1.9428	0.011408	3.010042			
1984	-2.016	0.0096	3.011	-1.6833	0.0207	2.8539	-2.26796	0.005396	3.18649	-1.95385	0.011121	2.981919	-1.6997	0.019966	2.872364	-2.14741	0.007122	3.137774			
5-yr mean		**0.0145**	**2.9252**		**0.0279**	**2.7855**		**0.00878**	**3.0794**		**0.011205**	**2.98115**		**0.021581**	**2.864941**		**0.014816**	2.993446			
1985				-1.912	0.0122	2.9642							-1.84788	0.014195	2.942884						
1986				-1.7266	0.0188	2.8525							-1.96976	0.010721	3.016848						
1987				-1.6526	0.0223	2.8276							-1.89001	0.012882	2.963001				-1.73943	0.018221	2.879516
1988				-1.8203	0.0151	2.9184							-1.99748	0.010058	3.029015				-2.02137	0.00952	3.039366
1989				-1.8083	0.0156	2.9141							-1.92215	0.011963	2.993463				-1.73943	0.018221	2.879516
1990				-1.8767	0.0133	2.9421							-1.82137	0.015088	2.932314				0.012695	0.012695	2.966505
1991				-1.8783	0.0132	2.9493							-1.93875	0.011515	2.984832				0.01159	0.01159	2.983639
1992				-1.8386	0.0145	2.9235							-1.83858	0.014502	2.923471				0.023141	0.023141	2.806149
1993				-2.2626	0.0055	3.1779							-1.92585	0.011862	2.968129				0.007354	0.007354	3.095088
1994				-2.0897	0.0081	3.0635							-2.1994	0.006318	3.130189				0.007222	0.007222	3.096578
5-yr Mean	**1994**				**0.0109**	**3.0113**								**0.011857**	**2.987787**					**0.01240**	**2.989592**
	1993				**0.0124**	**2.9814**								**0.012986**	**2.960442**					**0.01460**	**2.946179**
	1992				**0.0143**	**2.9295**								**0.012625**	**2.972619**					**0.015034**	**2.935035**
	1991				**0.0159**	**2.9103**								**0.012301**	**2.980525**					**0.014049**	**2.949709**

Table 7. Catch at age (numbers in thousands), revised method of aggregation.

Total Catch at Age

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	-	-	-	-	-	8	-	10	-	1
2	197	175	178	36	23	98	171	171	134	56
3	5603	1058	1361	1476	835	2763	291	291	4018	1999
4	2662	4023	1974	2873	3119	5786	1864	1864	1589	9514
5	2356	2090	3649	1785	3084	3482	5306	5306	563	1256
6	1088	1904	1089	2181	1276	1705	3169	3169	1873	238
7	317	835	1089	732	1167	528	1075	1075	2295	524
8	164	196	207	417	257	249	277	277	1069	835
9	80	55	36	108	143	47	168	168	389	428
10	83	57	14	19	17	15	32	32	172	163
11	74	35	18	25	19	14	9	9	87	50
12	40	31	49	80	18	-	2	2	22	58

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	1	1	1	-	1	-	8	-	-	-	-
2	87	37	60	10	27	71	51	45	24	56	49
3	803	493	635	467	683	585	1226	1308	2037	903	264
4	3493	2190	3062	2259	2669	4371	2139	3310	5395	3543	682
5	7155	4160	3562	4908	3290	3952	3996	3257	3798	3087	2152
6	639	6183	3595	3538	3390	2378	2549	3543	1980	1412	1398
7	92	1105	3306	2404	1860	1977	1551	1651	1116	553	738
8	217	131	299	1736	1181	886	851	808	449	279	333
9	210	139	82	177	1005	675	545	400	314	104	163
10	92	230	117	39	43	402	243	300	169	38	44
11	18	85	171	48	19	15	88	141	68	21	18
12	23	59	116	98	97	14	34	91	54	13	8

Canadian Catch at Age

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	-	-	-	-	-	-	-	-	-	-
2	185	167	126	36	23	8	128	42	132	54
3	4784	986	1207	1433	786	98	244	1333	3516	1857
4	2364	3567	1738	2855	3070	2752	1733	672	1584	9309
5	2125	1852	3170	1760	3022	5582	5035	2043	563	1248
6	954	1660	939	2128	1222	3341	3113	4019	1872	237
7	273	795	1001	710	1142	1645	1047	2432	2294	523
8	144	132	194	395	246	495	269	712	1067	833
9	64	45	35	90	134	248	165	207	389	428
10	51	56	12	19	17	47	32	148	172	163
11	33	34	16	25	19	15	9	31	87	50
12	10	30	42	80	18	14	2	24	22	58

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1984-1993
1	-	-	-	-	-	-	-	-	-	-	-	-
2	22	24	4	8	27	44	6	45	24	56	49	26
3	720	477	217	428	618	495	1018	1024	2008	901	264	791
4	3491	2179	2868	2231	2493	3691	1940	2571	4508	3521	681	2949
5	7152	4162	3519	4859	3235	3772	3674	2774	3041	2824	2150	3901
6	639	6178	3575	3489	3345	2335	2484	3427	1853	1282	1393	2861
7	91	1102	3291	2372	1784	1911	1531	1592	1036	498	737	1521
8	215	126	298	1672	1146	847	835	793	427	271	333	663
9	207	134	82	175	991	650	535	390	306	100	163	357
10	148	221	113	35	43	382	243	288	167	37	44	168
11	31	78	165	44	17	12	86	138	66	21	18	66
12	24	57	113	95	93	10	28	87	53	13	8	57

Foreign Catch at Age

	1974	1975	1976	1977-1993
1	-	-	-	-
2	12	8	17	-
3	291	67	121	-
4	162	228	160	-
5	152	87	237	-
6	77	78	64	-
7	20	23	42	-
8	9	4	14	-
9	5	2	2	-
10	3	1	2	-
11	3	1	2	-
12	1	1	8	-

Table 7.(Cont.) Catch at age (numbers in thousands), new method of aggregation.

Small Mesh Gear Catch at Age

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	-	-	-	-	-	-	-	10	-	-
2	-	-	35	-	-	-	43	829	2	2
3	528	6	33	43	49	11	47	1	502	142
4	136	229	77	18	49	104	131	1	5	205
5	79	151	242	25	62	141	271	1	-	8
6	57	166	86	53	54	60	56	-	1	1
7	24	17	46	22	25	33	28	-	1	1
8	10	60	-	22	11	1	8	1	2	2
9	10	9	-	18	9	-	3	1	-	-
10	29	-	-	-	-	-	-	-	-	-
11	38	-	-	-	-	-	-	-	-	-
12	29	-	-	-	-	-	-	-	-	-

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	1	1	1	-	1	-	8	-	-	-	-
2	65	13	56	2	-	27	45	284	29	2	-
3	83	16	318	39	65	90	208	739	887	22	1
4	2	11	194	28	176	680	199	483	757	263	2
5	3	34	43	49	55	180	322	116	127	130	5
6	-	5	20	49	45	43	65	59	80	55	1
7	1	3	15	32	76	66	20	15	22	8	-
8	2	5	1	64	35	39	16	10	8	4	-
9	3	5	-	2	14	25	10	12	2	1	-
10	-	9	4	4	-	20	-	3	2	-	-
11	0	7	6	4	2	3	2	4	1	-	-
12	2	2	3	3	4	4	6	1	1	-	-

Table 8. Mean weights at age (kg) for pollock in 4VWX5Zc.

Total Weight at Age

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	-	-	-	-	-	0.19	-	-	-	0.63
2	0.82	0.86	0.59	0.79	1.14	0.77	1.03	0.68	0.76	0.83
3	1.38	1.26	1.21	1.1	1.23	1.18	1.68	1.74	1.19	1.25
4	1.94	1.95	1.92	1.52	1.8	1.55	2.08	2.54	2.69	1.66
5	3	3.06	2.81	2.48	2.6	2.62	2.77	2.91	3.51	3.12
6	4.09	3.81	3.71	3.5	3.9	3.4	3.46	3.34	4.18	4.12
7	5.08	5.06	4.67	4.52	4.59	4.34	4.12	4.32	4.45	4.83
8	6.16	6.52	5.64	5.47	6.02	5.55	5.58	5.93	5.19	5.08
9	6.68	7.49	7.02	6.62	6.91	6.61	6.5	6.9	6.12	5.84
10	7.39	7.49	7.8	7.25	7.37	7.14	9.07	7.77	7.64	6.48
11	8.58	8.22	8.76	10.02	8.38	8.79	8.4	7.54	8	8
12	10.03	9.59	9.11	11.3	10.03	-	11.65	9.22	8.65	8.72

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.36	-	0.1	-	-	-	0.25	0.14	-	-	-
2	0.73	0.74	0.35	0.64	1.17	0.67	0.49	0.53	0.75	0.97	0.86
3	1.64	1.49	1.13	1.32	1.37	1.23	1.35	1.09	1.08	1.19	1.29
4	2.36	1.96	2	1.96	1.88	1.77	2.03	1.93	1.62	1.54	1.54
5	2.67	2.73	2.52	2.5	2.64	2.48	2.55	2.63	2.41	2.17	1.90
6	3.84	3.12	3.29	2.94	3.21	3.25	2.95	3.07	3.03	2.95	3.08
7	5.41	3.42	3.61	3.71	3.51	3.8	3.83	3.42	3.49	3.33	3.79
8	5.97	4.39	4.2	4.03	4.23	4.1	4.11	4.16	4.18	3.88	4.22
9	5.9	6.1	5.66	4.55	4.41	4.81	4.92	4.63	4.96	4.70	4.77
10	6.32	5.86	6.09	6.26	5.26	5.16	5.1	5.00	5.60	5.35	5.57
11	7.69	6.17	6.11	6.15	7.18	7.77	5.94	5.77	5.88	5.97	5.99
12	8.53	7.52	6.68	7.57	8.46	7.39	7.22	5.90	6.43	6.81	6.09

Canadian Weight at Age

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	-	-	-	-	-	0.19	-	-	-	-
2	0.83	0.86	0.63	0.79	1.14	0.77	1.12	1.01	0.76	0.84
3	1.43	1.27	1.23	1.11	1.26	1.18	1.77	1.74	1.24	1.25
4	1.98	1.99	1.94	1.52	1.81	1.54	2.1	2.54	2.7	1.67
5	3.02	3.1	2.8	2.48	2.59	2.63	2.8	2.91	3.51	3.13
6	4.05	3.87	3.73	3.49	3.88	3.38	3.47	3.34	4.18	4.11
7	5.03	5.07	4.65	4.5	4.59	4.33	4.14	4.32	4.45	4.83
8	6.06	6.51	5.62	5.45	6	5.54	5.56	5.93	5.19	5.08
9	6.62	7.47	7.04	6.55	6.84	6.61	6.51	6.9	6.12	5.84
10	7.22	7.69	7.71	7.25	7.37	7.14	9.07	7.77	7.64	6.48
11	8.12	8.47	8.67	10.02	8.38	8.79	8.4	7.54	8	8
12	9.37	9.89	9.19	11.3	10.03	-	11.65	9.22	8.65	8.72

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	-	-	-	-	-	-	-	-	-	-	-
2	1.46	0.94	0.83	0.72	1.17	0.83	0.76	0.88	1.10	0.99	0.87
3	1.68	1.52	1.39	1.37	1.46	1.26	1.45	1.30	1.26	1.20	1.29
4	2.36	1.96	2.02	1.97	1.92	1.88	2.05	2.06	1.69	1.56	1.54
5	2.67	2.74	2.52	2.51	2.64	2.51	2.55	2.67	2.43	2.19	1.90
6	3.84	3.12	3.29	2.95	3.22	3.26	2.96	3.08	3.06	2.97	3.08
7	5.41	3.43	3.61	3.72	3.51	3.83	3.84	3.42	3.51	3.33	3.79
8	5.97	4.39	4.2	4.04	4.23	4.12	4.12	4.16	4.20	3.88	4.22
9	5.9	6.13	5.66	4.55	4.41	4.84	4.94	4.63	4.96	4.70	4.77
10	6.34	5.89	6.09	6.32	5.26	5.19	5.1	4.99	5.61	5.35	5.57
11	7.69	6.19	6.11	6.27	8.03	8.66	5.94	5.77	5.88	5.97	5.99
12	8.76	7.56	6.86	7.62	8.52	7.44	7.39	5.87	6.42	6.81	6.09

Foreign Fishery Weight at Age

	1974	1975	1976	1977-93
1	-	-	-	-
2	0.59	0.84	0.63	-
3	1.24	1.13	1.04	-
4	1.81	1.68	1.88	-
5	2.89	2.32	2.83	-
6	3.97	3.25	3.52	-
7	5.23	4.33	4.83	-
8	6.7	5.13	5.9	-
9	6.72	5.13	6.7	-
10	7	-	8.26	-
11	8.43	-	9.46	-
12	13	-	8.68	-

Table 8. (Cont.) Mean weights at age (kg) for pollock in 4VWX5Zc

Small Mesh Gear Weight at Age

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	0.77	0.66	0.62	0.43
3	1.02	1.11	0.92	0.74	0.83	1.23	1.25	1.52	0.84	1.15
4	1.47	1.74	1.45	1.65	1.66	1.81	1.86	1.74	2.15	1.28
5	2.71	3.04	2.91	2.8	2.88	2.49	2.19	2.96	-	2.52
6	4.9	3.47	3.68	3.9	4.32	3.93	2.72	3.63	3.54	4.38
7	5.5	5.62	5.13	4.99	4.45	4.48	3.14	4.28	4.97	4.62
8	7.01	6.64	-	5.9	6.45	5.98	6.32	5.41	6.3	4.35
9	7.01	8	-	6.92	8.01	-	6.37	7.36	8.82	5.03
10	7.73	-	-	-	-	-	-	8.87	7.43	7.08
11	8.99	-	-	-	-	-	-	-	-	7.61
12	10.2	-	-	-	-	-	-	-	8.5	8.39

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.36	-	-	-	-	-	0.25	0.14	-	-	
2	0.48	0.37	0.32	0.32	0.26	0.42	0.45	0.47	0.46	0.5	0.36
3	1.29	0.62	0.87	0.79	0.5	1.08	0.86	0.79	0.7	1	0.60
4	2.5	1.39	1.68	1.4	1.22	1.19	1.85	1.29	1.23	1.35	0.76
5	2.82	2.35	2.48	1.92	2.39	2.04	2.59	1.85	1.9	1.93	1.24
6	3.77	2.92	3.24	2.65	2.7	2.82	2.8	2.69	2.16	2.59	1.67
7	4.97	3.04	3.2	2.94	3.36	3.08	3.68	3.4	2.77	3.35	-
8	5.6	4.29	3.85	3.61	4.33	3.69	3.77	3.89	3.46	3.95	-
9	5.87	5.4	-	4.78	4.3	3.99	4.32	4.54	4.31	5.1	-
10	5.96	5.35	6.14	5.74	-	4.45	5.74	6.02	4.6	6.1	-
11	7.25	5.94	6.04	4.84	-	4.19	6.12	5.86	5.85	6.8	-
12	6.19	6.46	-	5.96	7.04	7.24	6.45	8.25	6.8	7.8	-

Table 9. Mean number/tow for 4VWX + 5 Pollock in Canadian summer bottom trawl surveys (strata 40-95).

Stratum	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Mean
40	0	0	0	0	0	0	0	0	0	0	0	0	0.26	0.41	45.11	0.34	0.51	3.09	2.83	0	0	3.09	2.53
41	0	0	0	0	0	0.31	0	0	1.46	0.65	1.3	0.29	1.03	0.21	37.43	9.14	14.1	3.89	4.32	0.78	11.54	4.51	4.13
42	0	0	0	0	0	0	0	0	0	0	0	0	0.34	0	0.16	0.33	0	0.39	0.22	0.83	0	0	0.10
43	0	0	0	0	0	0	0	0	0	0.21	0.23	0	0	0	0	0	0	0	0	0	0	0	0.02
44	0	0	0	0	0.17	0	0	0	0	0	0	0	0.26	0.83	0.34	0	0	0	0.26	0.12	3.06	0.57	0.26
45	0	0	0	0	0	0	0	0	0	0	0	0	21.63	0.17	5.85	0	0	0	0	0	0	0	1.26
46	0	0	0	0	0.34	0	0	0	0	0.97	16.47	0	3.09	0.69	0	0.97	13.35	2.07	0.34	2.31	0	0	1.85
47	0.37	0	0.44	0	0	0	0.61	0	0	0.51	0.26	0	0	0	0	0	0.66	0	0	0	0	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	0.00
49	0	0	0	0	0		4.08	0	0	0	0	5.35	0	0.52	0	0	0	0	0	0	112.86	0	5.85
50	0	0	0.36	0	0	0	1.56	0	15.1	1.09	0	0	0	0.34	0.34	0	0	32.73	0	0.65	0	0	2.37
51	0	0	0	0.55	0.49	3.13	25.93	0	2.92	571.5	0	0	96.76	1.09	133.02	22.13	6.09	21.23	0	9.26	378.45	0	57.84
52	0	0	0	0	0.55	0.49	3.6	0	0	5.05	3.6	113.75	6.69	60.03	0.34	0.55	0.52	0.65	7.29	1.49	0.51	8.7	9.72
53	0	0	0	0	0.34	0	0	0	0	0	0	0	0	0.34	0	0.58	0	0	3.83	20.42	225.02	0	11.39
54	0	0	0	0	0	0.39	0	0	0	0	0	0	1.05	0	0	0	0	0	0	1.46	0.48	0	0.15
55	0	0	0	0	0	0	0	0	0.29	1.42	0.26	0	0	0.13	0.12	0	0.15	0.68	8.36	1.12	2.32	1.57	0.75
56	0.18	0	0	0	0.34	0	0	0	0	0	0.16	2.97	1.94	0.17	0.7	4.73	0.35	1.4	19.19	0.28	0.36	1.28	1.55
57	0	0	0	0	0		0	0	0	0.49	0	0	0	0	0	0	0	0	0	0	0.49	0	0.05
58	0	0	0	0	0	0	0	0	0	0	2.27	0	0	0.21	0	1.03	0	0.2	0	0	0	11.03	0.67
59	0.58	0	0	0.2	0.63	0.24	0	0	0	0	0.58	17.06	2.34	10.47	3.94	9.43	0.78	0	0	4.86	0.25	0.18	2.34
60	4.12	0	5.07	0	0.97	14.72	2.89	353.5	0.97	6.55	29.17	36.66	12.4	8.92	337.21	10.49	40.88	111.02	35.08	4.37	34.71	33.29	49.23
61	0.51	0	20.26	0	2.78	0	0	0	0	2.76	1.46	1.61	5.06	3.78	11.67	3.28	3.28	3.09	4.52	0.97	3.09	1.57	3.17
62	0	5.1	2.73	0.51	0	3.82	1.22	55.19	6.87	0.78	0	1.29	60.12	14.78	3.98	6.85	2.8	13.68	1.51	6.08	19.58	2.31	9.51
63	0	0	3.31	6.13	1.17	0	5.83	0.51	5.41	0.31	4.86	0	1.46	2.57	6.69	0.55	8.23	5.14	4.09	5.58	6.93	1.52	3.20
64	0	0	0	0.32	1.79	3.52	0.97	0	0	0	41.22	0.62	2.86	0.28	4.57	1.58	23.77	1.37	6	17.78	2.65	2.58	5.09
65	0	25.03	1.17	2.33	1.95	0.41	0.21	0	0.85	0.15	0.51	1.29	2.72	0.19	5.65	1.88	3.31	0.82	13.27	7.11	2	14.97	3.90
66	0	0	0	0	0	0	0	0	0	0	0	0	3.24	0.39	0.55	0	2.19	0	0	0	178.54	0	8.41
70	27.47	2.4	0.49	96.62	18.47	74.79	9.3	1.09	16.4	0	42.41	6.56	60.82	19.56	72.06	74.27	9.07	364.41	41.63	75.35	5.35	7.47	46.64
71	0.55	0	0	0	6.35	3.04	0	4.86	1.37	0	0.97	1.63	27.79	4.63	108.57	6.85	1.03	4.03	6.02	6.81	157.46	1.5	15.61
72	1.09	2.57	0	2.13	1.74	0.46	0.34	16.42	5.83	0.49	5.47	1.75	377.22	6.18	3.6	8.51	14.41	0.98	2.07	19.93	8.25	7.49	22.13
73	0	0	0	0	0.55	0	0	0.38	0	0	0	0	0.49	2.13	0.51	0	0	0	0	0.49	0.49	12.63	0.80
74	0	0	0	0	0	0	0	0.52	0	0	0		0	1.88	0.55	0	0	0	0	0	0	0.66	0.17
75	0	0	0	0	0	0	0	0	0	0	0	0.51	0	1.03	0	0	1.03	0	0	0.49	0.49	0.49	0.18
76	9.24	8.07	7.7	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	4.13	9.52	33.05	30.22
77	1.84	0	0	0	0	0	0.58	0	0	0	1.03	0	0	0	23.5	0	0	0.22	0.56	2.29	25.42	3.57	2.68
78	0.97	0	1.09	0	0	1.75	1.72	0	0	0	0	0	3.89	0.36	0	4.12	0	20.78	0	22.21	63.68	16.99	6.25
80	0.46	0	0	0.23	34.81	0.55	0	0.97	0	0.51	1.46	0	1.84	3.25	14.67	0.22	1.42	1.35	2.99	3.11	0.94	3.14	3.27
81	6	1.3	0	0.29	0	2.11	0	2.42	1.46	1.8	2.73	0.26	0.46	8.14	0.68	2.36	0.73	104.49	18.36	2.17	76	3.27	10.68
82	0	0	0	0.32	0.73	1.02	13.64	1.35	4.04	1.41	1	0.88	0.49	1.03	4.25	3.62	38.11	2.98	34.58	14.25	6.46	3.64	6.08
83	0	0	0	1.95	0.49	0	0.58	0.78	0	0.52	0.51	1.54	0.49	0	1.64	1.03	0	12.43	49.97	1.85	3.6	0	3.52
84	1.78	1.34	1.58	21.52	2.38	0.49	9.82	0.25	16.54	0.26	0	3.43	3.56	2.4	4.72	14.68	0.74	5.6	9.39	10.21	2.28	1.73	5.21
85	83.38	2.17	0	1.99	127.1	1.59	19.79	32.42	3.57	58.78	1.7	23.7	13.35	46.03	14.24	127.16	23.64	6.56	9.28	2.04	200.51	14.38	36.97
90	0	3.98	1.19	8.17	0.78	8.61	3.28	1.35	15.75	2.6	8.2	0	90.55	2.94	0.23	1.98	1.56	17.39	43.42	1.29	2.43	3.73	9.97
91	5.64	1.13	0.65	2.52	1.53	0	46.03	1.92	0.53	0.6	1.88	3.09	6.06	26.08	64.8	3.65	8.57	3.7	4.23	3.89	9.48	10.15	9.28
92	1.63	3.19	2.02	2.1	3.68	2.27	0	0	0.29	11.08	1.03	0.36	0.65	8.43	3.47	5.93	0.51	2.06	1.23	6.54	0.65	4.11	2.78
93	1.54	0	0.46	0.58	1.16	0	0.69	1.32	0	4.25	1.94	0	46.94	0.65	4.12	0	0.34	0.92	0.92	0.65	0	3.73	3.19
94	0	0.42	0.46	2.17	0	0	1.03	0.51	0	0	0	0.55	0.49	0	0	0	0	0	0.94	0	0	0	0.30
95	0	1.54	0.7	0	0	0	1.06	1.21	2.92	0	0.67	0	0.92	0	0	0	1.64	0	0	0	0	0.5	0.51

Table 10 . Stratified average numbers per tow in Canadian summer bottom trawl surveys (strata 40 - 95) .

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.10	0.04	0.01	0.05	0.00	0.02	0.01	0.15	0.02	0.00	0.01	0.00
2	0.73	0.02	0.39	0.04	0.01	0.03	0.26	0.01	0.00	1.14	0.16	0.20	0.12	0.47	1.58	0.61	0.59	0.03	0.06	9.76	1.08	0.25	1.84	0.48
3	0.61	0.01	0.48	0.94	0.02	0.22	0.77	0.15	0.11	1.26	0.18	2.79	0.92	0.23	4.82	0.85	2.45	0.60	0.14	7.49	1.14	1.43	4.82	0.56
4	0.17	0.15	2.15	0.23	0.32	0.67	0.99	0.61	0.63	3.33	0.05	0.27	1.70	0.70	3.57	0.97	3.68	1.16	0.85	3.16	1.02	1.58	8.04	0.92
5	0.04	0.32	0.82	0.28	0.28	1.24	2.03	0.94	0.80	5.28	0.51	0.12	0.20	2.01	3.48	1.01	5.84	2.20	0.97	5.23	1.33	1.04	3.34	1.33
6	0.02	0.14	0.08	0.13	0.37	0.31	1.42	0.35	0.58	1.40	0.51	0.37	0.05	0.31	2.91	1.38	2.30	1.95	0.89	1.96	1.48	0.72	1.37	0.85
7	0.03	0.04	0.05	0.15	0.06	0.54	0.18	0.33	0.24	0.80	0.35	0.25	0.09	0.21	0.44	1.02	1.67	1.83	1.13	0.52	0.44	0.24	0.45	0.30
8	0.01	0.07	0.05	0.09	0.09	0.20	0.31	0.10	0.17	0.25	0.24	0.15	0.26	0.46	0.12	0.07	1.37	1.01	0.54	0.34	0.46	0.10	0.34	0.13
9	0.01	0.05	0.06	0.07	0.04	0.04	0.11	0.05	0.01	0.10	0.11	0.13	0.17	0.69	0.22	0.01	0.05	0.58	0.31	0.22	0.20	0.04	0.12	0.14
10	0.02	0.02	0.00	0.04	0.01	0.04	0.05	0.02	0.04	0.06	0.08	0.07	0.06	0.43	0.35	0.10	0.12	0.04	0.11	0.07	0.06	0.04	0.03	0.05
11	0.00	0.01	0.02	0.09	0.01	0.02	0.03	0.00	0.00	0.00	0.03	0.01	0.06	0.07	0.12	0.14	0.09	0.04	0.03	0.03	0.04	0.01	0.01	0.00
12+	0.00	0.03	0.01	0.03	0.00	0.05	0.01	0.02	0.00	0.00	0.01	0.05	0.02	0.16	0.11	0.09	0.35	0.16	0.05	0.12	0.01	0.03	0.01	0.03
UK	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.02	0.03	0.05	0.03	0.03	0.04	0.00	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Total	1.64	0.86	4.12	2.09	1.21	3.37	6.16	2.60	2.61	13.65	2.27	4.43	3.76	5.82	17.73	6.10	18.55	9.62	5.09	29.07	7.27	5.47	20.38	4.79
4+	0.30	0.82	3.24	1.10	1.18	3.11	5.12	2.42	2.47	11.21	1.88	1.42	2.60	5.04	11.32	4.78	15.48	8.97	4.88	11.66	5.04	3.80	13.71	3.75
5+	0.13	0.68	1.09	0.87	0.86	2.44	4.14	1.82	1.83	7.88	1.83	1.15	0.90	4.34	7.76	3.82	11.80	7.82	4.03	8.50	4.02	2.22	5.67	2.83
6+	0.09	0.357	0.27	0.588	0.579	1.2	2.109	0.876	1.034	2.603	1.324	1.032	0.702	2.323	4.276	2.81	5.955	5.621	3.062	3.265	2.685	1.178	2.33	1.5

Table 11. Stratified numbers at age (x 10^3) in Canadian summer bottom trawl surveys (strata 40 - 95).

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0	0	30	0	0	0	0	0	49	29	0	426	148	30	216	0	86	55	645	83	0	54	0
2	82	1649	179	37	122	1108	29	0	4842	673	832	504	1989	6694	2570	2504	122	231	41392	4568	1047	7786	2033
3	55	2021	3989	77	928	3266	610	462	5328	744	11816	3884	966	20433	2770	10375	2541	588	31771	4824	6046	20415	2395
4	618	9117	975	1375	2826	4177	2525	2676	14106	215	1129	7218	2965	15116	4090	15614	4896	3597	13403	4324	6707	34098	3887
5	1361	3467	1183	1182	5264	8604	3915	3389	22393	2142	502	830	8509	14751	4273	24762	9311	4090	22173	5653	4411	14184	5654
6	595	347	549	1587	1328	5999	1459	2462	5947	2140	1558	203	1297	12336	5865	9752	8285	3784	8323	6253	3038	5806	3605
7	157	213	643	252	2289	779	1372	1007	3378	1491	1070	383	892	1865	4304	7099	7738	4768	2221	1850	1036	1907	1271
8	288	197	365	389	836	1308	424	715	1052	1028	628	1113	1934	527	309	5802	4284	2290	1457	1959	411	1434	556
9	209	248	278	151	183	458	198	44	412	461	553	703	2920	951	47	221	2477	1319	911	858	188	499	614
10	100	10	158	35	188	219	91	155	245	321	306	239	1811	1475	438	502	169	484	280	269	147	138	206
11	52	83	368	40	62	129	0	0	0	121	50	250	301	497	575	379	184	119	130	147	51	54	0
12+	111	48	131	0	203	49	98	0	0	54	208	86	662	477	377	1490	696	218	516	42	122	32	108
UK	17	59	0	0	45	15	71	99	122	195	143	116	186	15	31	129	0	55	0	0	0	0	0
Total	3646	17459	8848	5125	14275	26110	10792	11009	57875	9612	18796	15954	24578	75167	25866	78630	40789	21597	123222	30830	23204	86386	20329
4+	3491	13730	4651	5010	13179	21721	10083	10450	47534	7972	6006	11024	21290	47996	20279	65622	38039	20668	49414	21355	16111	72500	15901
5+	2873	4613	3676	3636	10353	17544	7558	7773	33428	7756	4877	3806	18324	32879	16189	50008	33143	17072	36011	17031	9404	24003	12014
6+	1512	1147	2493	2454	5089	8940	3642	4384	11035	5615	4375	2976	9815	18129	11915	25246	23832	12982	13838	11378	4993	9869	6360
1,2,3	137	3670	4198	114	1050	4374	639	462	10219	1446	12648	4814	3103	27157	5556	12879	2749	874	73808	9475	7093	28255	4428
4,5,6,7,8,9	3228	13589	3993	4936	12726	21325	9893	10293	47288	7477	5440	10450	18517	45548	18888	63250	36991	19848	48488	20897	15791	57908	15587

As obtained using STRAP (STRatified Analysis Package)

Table 12. Age disaggregated catch rates for IOP TC 5 OTB (tonnes/hr)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4	0.0787	0.4919	0.2059	0.1779	0.117	0.0732	0.0901	0.0984	0.0646	0.0367	0.1423	0.1053	0.0223
5	0.0212	0.0311	0.5722	0.2031	0.1739	0.1274	0.0887	0.1046	0.1169	0.0506	0.0918	0.161	0.1466
6	0.0789	0.0052	0.0247	0.4034	0.1641	0.0951	0.0973	0.0659	0.0897	0.0642	0.0473	0.119	0.0881
7	0.1105	0.0185	0.0026	0.0755	0.1754	0.049	0.0539	0.0548	0.0556	0.0424	0.034	0.0431	0.0315
8	0.0509	0.0415	0.0099	0.0066	0.0184	0.0438	0.0342	0.0306	0.042	0.0246	0.0154	0.0182	0.0094
9	0.0191	0.0211	0.0109	0.008	0.0024	0.0036	0.0321	0.0213	0.0231	0.0085	0.0104	0.0056	0.0036
10	0.0125	0.0084	0.0051	0.0153	0.0056	0.0005	0.001	0.0125	0.0112	0.0089	0.0051	0.0024	0.0002

Table 13. Statistical properties of population abundance and commercial catch rate calibration constants for pollock in 4VWX5Zc.

Age	Par. Est.	Std. Err.	Rel.Err.	Bias	Rel. Bias.
2 [1]	28000	0	0	0	0
3 [2]	8302	2068	0.25	-320	-0.04
4 [2]	4290	1096	0.26	-169	-0.04
5	2577	1649	0.64	492	0.19
6	8949	4408	0.49	967	0.11
7	5252	2419	0.46	494	0.09
8	1369	727	0.53	161	0.12
9	301	195	0.65	52	0.17
10	107	77	0.72	23	0.21
11	55	18	0.32	-3	-0.05
12	22	7	0.32	-1	-0.05
13	8	3	0.36	0	-0.04

[1] Geometric Mean

[2] Calculated based on partial recruitment

Table 14. Estimated beginniing of year population numbers(000's), bias adjusted, for pollock

Population Numbers (Bias Adjusted)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
2	17385	25523	34907	44357	27962	6986	13405	75646	43306	34253
3	28013	14056	20738	28419	36284	22872	5631	10820	61779	35335
4	10247	17865	10550	15747	21932	28951	16226	4347	8595	46945
5	8284	5981	10987	6852	10293	15134	18468	11598	1873	5600
6	2997	4651	3005	5693	3995	5637	9240	10319	4695	1024
7	760	1469	2085	1475	2688	2116	3072	4698	5581	2149
8	408	335	448	722	545	1145	1255	1543	2873	2493
9	467	185	97	179	214	214	712	777	1012	1385
10	324	310	102	47	49	45	133	431	484	477
11	167	190	202	71	21	25	24	80	324	240
12	124	70	124	149	35	0	8	11	57	186
13	0	65	29	57	51	13	0	4	7	27
2+	69176	70700	83274	103768	104069	83138	68174	120274	130586	130114
3+	51791	45177	48367	59411	76107	76152	54769	44628	87280	95861
4+	23778	31121	27629	30992	39823	53280	49138	33808	25501	60526
5+	13531	13256	17079	15245	17891	24329	32912	29461	16906	13581

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	36090	26622	26970	30539	19881	25072	34638	32897	7067	6820
3	27994	29470	21763	22027	24994	16252	20463	28313	26893	5765
4	27121	22193	23682	17243	17612	19846	12777	15644	21997	20175
5	29827	19044	16188	16618	12074	12004	12293	8525	9813	13128
6	3448	17946	11828	10031	9165	6908	6252	6449	4033	4598
7	623	2245	9098	6431	5011	4436	3504	2813	2074	1510
8	1285	427	838	4458	3090	2420	1843	1466	809	688
9	1286	856	231	416	2079	1461	1179	739	469	256
10	747	862	575	115	180	793	586	473	243	100
11	243	528	498	365	59	109	285	260	115	46
12	152	183	356	253	255	31	75	154	85	33
13	101	103	97	187	119	122	13	31	45	22
2+	128917	120479	112124	108683	94519	89454	93908	97764	73643	53141
3+	92827	93857	85154	78144	74638	64382	59270	64867	66576	46321
4+	64833	64387	63391	56117	49644	48130	38807	36554	39683	40556
5+	37712	42194	39709	38874	32032	28284	26030	20910	17686	20381

	1994	1995
2	10196	28000
3	5533	8302
4	3903	4290
5	13312	2577
6	7955	8949
7	2487	5252
8	736	1369
9	311	301
10	115	107
11	47	55
12	19	22
13	15	8
2+	44629	59232
3+	34433	31232
4+	28900	22930
5+	24997	18640

Table 15. Estimated beginning of year population biomass (000 t), bias adjusted, for pollock in 4VWX5Zc.

Population Biomass (Bias Adjusted)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
2	11501	18508	15087	28089	31341	3643	10626	38892	25669	20225
3	29803	14288	21158	22900	35774	26536	6406	14489	55584	34447
4	16768	29311	16411	21360	30869	39983	25430	8982	18601	65994
5	19986	14574	25723	14952	20467	32876	38277	28546	5594	16228
6	10499	15724	10129	17860	12424	16765	27832	31400	16387	3896
7	3462	6685	8795	6044	10779	8707	11505	18174	21530	9670
8	2285	1928	2391	3648	2848	5783	6176	7632	13618	11865
9	3010	1264	656	1094	1313	1353	4282	4820	6106	7638
10	2279	2205	784	334	342	320	1031	3067	3514	3009
11	1334	1485	1650	630	165	199	183	662	2558	1881
12	1151	637	1076	1497	358	0	76	99	463	1561
13	0	709	298	551	652	130	0	58	71	251
2+	102078	107318	104158	118959	147332	136295	131824	156821	169695	176665
3+	90577	88810	89071	90870	115991	132652	121198	117929	144026	156440
4+	60774	74522	67913	67970	80217	106116	114792	103440	88442	121993
5+	44006	45211	51502	46610	49348	66133	89362	94458	69841	55999

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	18443	15947	4864	13310	22443	11581	10938	11415	3674	5949
3	32660	30738	19907	14981	23318	19288	19044	19887	19013	4752
4	46592	39789	40885	25670	27761	30786	19965	24672	28033	24157
5	62810	48352	35977	37164	27474	25939	25986	19430	20530	23231
6	11941	51815	35460	27303	25967	20245	16931	17903	11115	11618
7	2943	8140	30552	22480	16098	15498	12373	8952	6654	4549
8	6916	2082	3180	17019	12252	9180	7288	5859	3076	2408
9	7050	5178	1152	1821	8779	6602	5297	3228	2138	1152
10	4548	5082	3515	685	885	3795	2910	2344	1242	522
11	1720	3308	2989	2242	395	698	1592	1416	626	270
12	1254	1393	2290	1729	1850	226	568	922	525	209
13	915	911	719	1301	1007	1213	96	218	266	147
2+	197792	212735	181490	165705	168229	145051	122988	116246	96892	78964
3+	179349	196788	176626	152395	145786	133470	112050	104831	93218	73015
4+	146689	166050	156719	137414	122468	114182	93006	84944	74205	68263
5+	100097	126261	115834	111744	94707	83396	73041	60272	46172	44106

	1994	1995
2	8905	21258
3	6421	8105
4	4469	5905
5	20750	3990
6	19005	21483
7	7656	15530
8	2520	4513
9	1219	1102
10	607	433
11	275	322
12	116	144
13	112	57
2+	72055	82842
3+	63150	61584
4+	56729	53479
5+	52260	47574

Table 16. Estimated fishing mortality (bias adjusted). Pollock in 4VWX5Zc.

Fishing Mortality (Bias Adjusted)

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	0.01	0.01	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.25	0.09	0.08	0.06	0.03	0.14	0.06	0.03	0.07	0.06	0.03	0.02	0.03	0.02
4	0.34	0.29	0.23	0.23	0.17	0.25	0.14	0.64	0.23	0.25	0.15	0.12	0.15	0.16
5	0.38	0.49	0.46	0.34	0.40	0.29	0.38	0.70	0.40	0.28	0.31	0.28	0.28	0.40
6	0.51	0.60	0.51	0.55	0.44	0.41	0.48	0.41	0.58	0.30	0.23	0.48	0.41	0.49
7	0.62	0.99	0.86	0.79	0.65	0.32	0.49	0.29	0.61	0.31	0.18	0.78	0.51	0.53
8	0.59	1.04	0.72	1.02	0.73	0.27	0.28	0.22	0.53	0.46	0.21	0.41	0.50	0.56
9	0.21	0.40	0.53	1.10	1.35	0.28	0.30	0.27	0.55	0.42	0.20	0.20	0.50	0.63
10	0.33	0.23	0.16	0.59	0.48	0.45	0.31	0.09	0.50	0.47	0.15	0.35	0.25	0.47
11	0.67	0.23	0.10	0.49	4.95	0.99	0.54	0.13	0.35	0.26	0.09	0.20	0.48	0.16
12	0.44	0.67	0.57	0.89	0.81	0.00	0.35	0.22	0.55	0.42	0.18	0.44	0.45	0.56

Age	1988	1989	1990	1991	1992	1993	1994
2	0.00	0.00	0.00	0.00	0.00	0.01	0.01
3	0.03	0.04	0.07	0.05	0.09	0.22	0.05
4	0.18	0.28	0.21	0.27	0.33	0.23	0.26
5	0.36	0.45	0.45	0.56	0.58	0.32	0.22
6	0.53	0.48	0.60	0.95	0.81	0.44	0.24
7	0.53	0.68	0.67	1.04	0.93	0.56	0.44
8	0.55	0.52	0.71	0.94	0.94	0.64	0.79
9	0.76	0.71	0.71	0.91	1.34	0.58	1.01
10	0.30	0.82	0.61	1.21	1.45	0.54	0.53
11	0.44	0.16	0.41	0.91	1.05	0.69	0.53
12	0.54	0.69	0.68	1.04	1.18	0.57	0.61

Table 17. Projected population and catch for 4VWX5Zc pollock, 1995-7

Projected Population Numbers

Age	1995	1996	1997
2	28000	28000	28000
3	8622	22837	22856
4	4460	6796	18145
5	2085	3257	5085
6	7982	1411	2295
7	4757	4819	909
8	1208	2662	2923
9	249	676	1614
10	85	139	410
11	57	47	85
12	23	32	29
13	9	13	19
2+	57536	70689	82369
3+	29536	42689	54369
4+	20914	19851	31513
5+	16454	13056	13368

Projected Population Biomass

Age	1995	1996	1997
2	22787	22787	22787
3	8632	22863	22881
4	5898	8987	23997
5	3822	5971	9322
6	21133	3736	6077
7	15516	15717	2964
8	4495	9905	10878
9	1093	2964	7082
10	434	715	2102
11	326	269	481
12	145	198	177
13	59	91	135
2+	84338	94202	108881
3+	61551	71415	86094
4+	52920	48552	63213
5+	47022	39565	39216

Projected Population Numbers(Mid-Year)

Age	1995	1996
2	25331	25341
3	7673	20401
4	3827	5899
5	1726	2748
6	6268	1141
7	3609	3792
8	916	2094
9	189	532
10	64	110
11	43	37
12	18	25
2+	49663	62121
3+	24332	36780
4+	16660	16379
5+	12833	10480

Projected Population Biomass(Mid-Year)

Age	1995	1996
2	21785	21793
3	9105	24210
4	5995	9242
5	3728	5936
6	18929	3447
7	12762	13411
8	3750	8573
9	909	2558
10	353	604
11	259	221
12	115	163
2+	77689	90158
3+	55904	68365
4+	46799	44155
5+	40804	34913

Projected Fishing Mortality

Age	1995	1996
2	0	0
3	0.04	0.03
4	0.11	0.09
5	0.19	0.15
6	0.3	0.24
7	0.38	0.3
8	0.38	0.3
9	0.38	0.3
10	0.38	0.3
11	0.38	0.3
12	0.38	0.3

Projected Catch Numbers

Age	1995	1996
2	96	76
3	292	612
4	437	531
5	329	412
6	1909	274
7	1374	1138
8	349	628
9	72	160
10	24	33
11	17	11
12	7	8
2+	4906	3882
3+	4810	3806
4+	4517	3194
5+	4080	2663

Table 17. (Cont.) Projected population and catch for 4VWX5Zc pollock, 1995-7.

Projected Catch Biomass

Age	1995	1996
2	83	65
3	347	726
4	685	832
5	710	890
6	5766	827
7	4859	4023
8	1428	2572
9	346	767
10	134	181
11	98	66
12	44	49
2+	14500	11000
3+	14417	10935
4+	14070	10209
5+	13386	9377

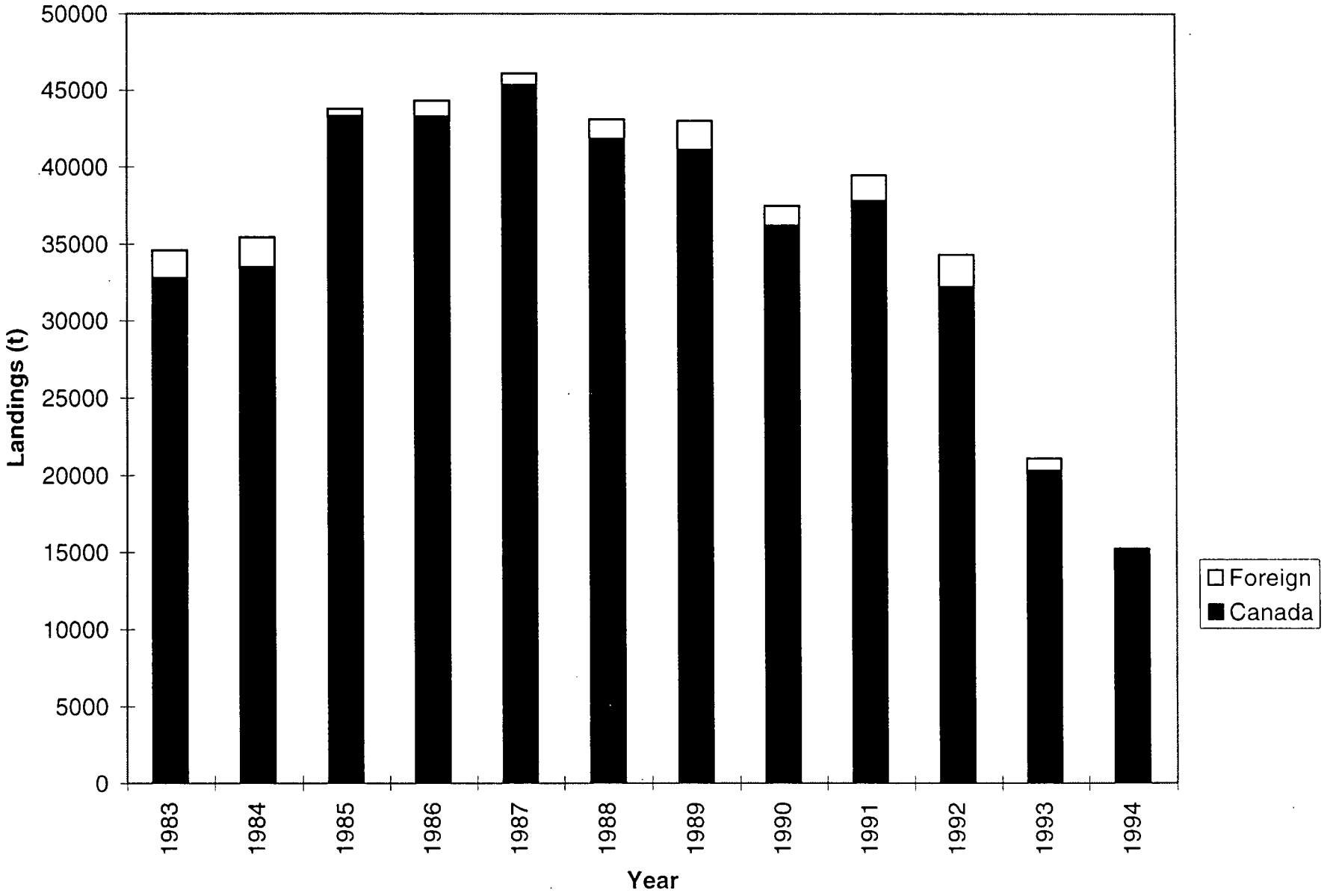


Fig. 1. Landings of 4VWX5Zc pollock by Canada and foreign countries.

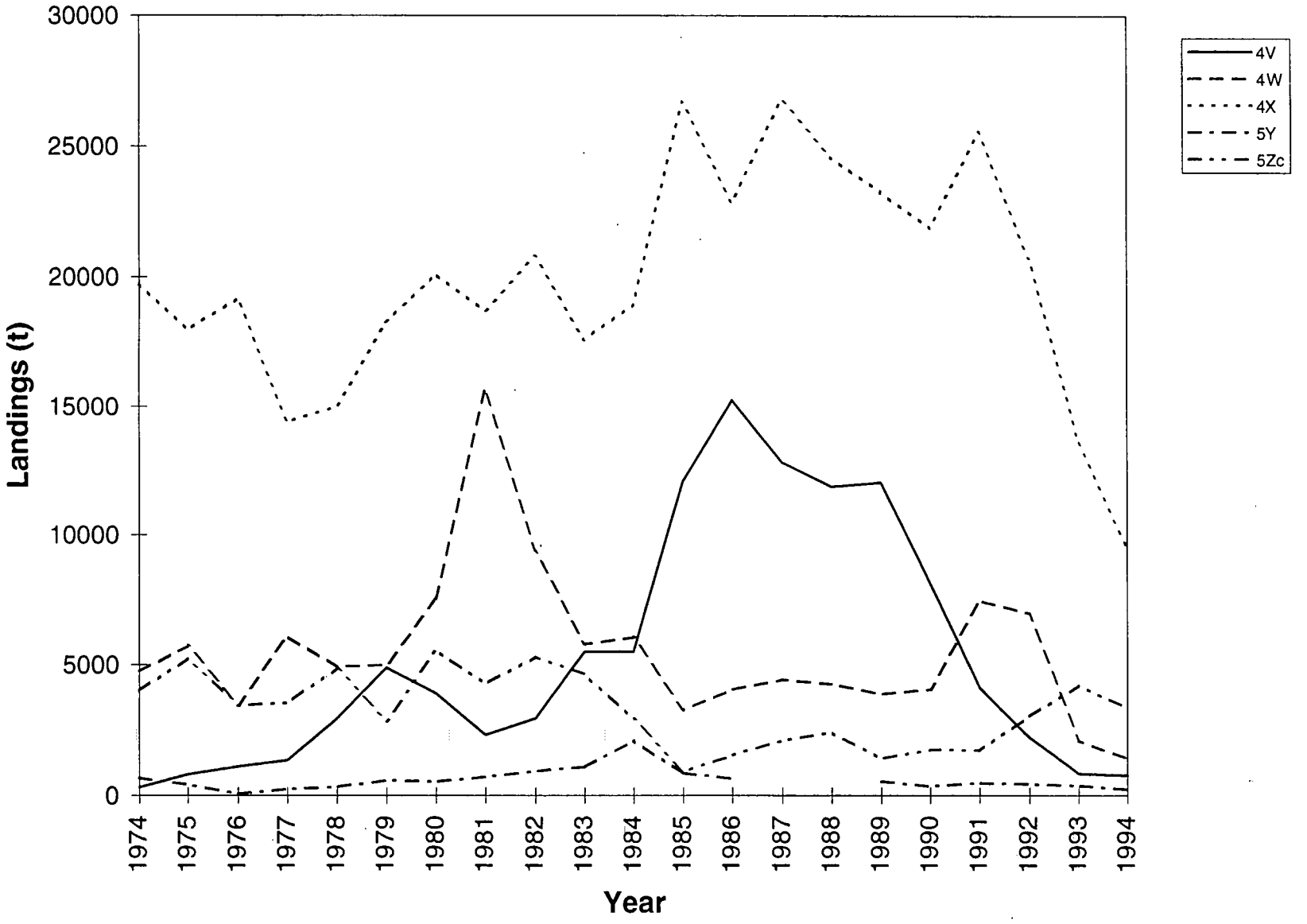


Fig. 2. Landings of Pollock by NAFO Division (includes Canadian and foreign fisheries).

4XS Trimester 1, 1992

Len	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sum
34	1														1
37	3														3
40	10														10
43	13														13
46	10	8													18
49	7	17	2												26
52	2	23	5												30
55		18	15	3											36
58		10	23	3											36
61		5	24	9											38
64		1	22	16	1										40
67			13	23	3	1									40
70			5	18	9	1	1								34
73				14	13	2									29
76				1	19	4									24
79					8	8	3								19
82					2	4	12	3							21
85						3	6	5	1	1					16
88							3	4						1	8
91							3	5		1					9
94							1	2		2	1				5
97										1				1	2
100										1					1
	46	82	109	87	55	23	28	19	1	6	1	0	0	2	459

4VW Trimester 1, 1992

Len	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sum
40	2	2													4
43	3	13													16
46	3	13	3												19
49	1	18	5		1										25
52		11	16	2											29
55		2	14	13	1										30
58			7	17	9										33
61			2	11	17										30
64			1	3	21	6									31
67				4	8	13									25
70				2	3	14	8								27
73					2	8	11	3							24
76						2	8	9	1	1					21
79						1	5	5	7	1					18
82						1	1	3	2	4	1				12
85							1		1	3	2				7
88												1			1
91															0
94															0
97															0
100													1		1
	9	59	48	52	62	44	34	20	11	9	3	1	1	0	353

Fig. 3. Comparison of seasonal and area effects on the growth rate of pollock in 4VWX5Zc.

4X5 Trimester 2, 1992

Len	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sum
40	2	2														4
43		18														18
46		28	7													35
49		19	29	1												49
52		11	47	2												60
55			47	15	1	1										64
58			34	29	7											70
61			16	42	11	1										70
64			1	49	20	2										72
67			1	32	28	3										64
70				10	33	11										54
73				1	24	19	5	2	1							52
76				1	9	22	10	3								45
79						21	16	7	1							45
82						12	11	13	3							39
85						1	7	11	8							27
88								6	12	4	1	1	1			25
91							1		10	7	1	1	1			21
94									1	3	5	3	1	1	1	15
97									1	2	4	1	1		1	10
100											2	2		2		6
103													1	2		3
	2	78	182	182	133	93	50	42	37	16	13	8	5	5	2	848

4X5 Trimester 3, 1992

Len	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sum
40	1	3														4
43	4	15														19
46	4	26	1													31
49	2	27	3													32
52		20	17													37
55		11	23	4												38
58		4	26	11												41
61		1	24	18	1											44
64			13	20	5											38
67			3	19	8											30
70			3	13	10	3	1									30
73				7	13	4	1									25
76				2	9	8	3	1								23
79					4	7	6		2							19
82					2	5	8	1	2							18
85							2	3	2							7
88						1		6	3	2						12
91								1	2	1						4
94									1		1	1				3
97										1	2	1				4
100											1		1			2
	11	107	113	94	52	28	21	12	12	4	4	2	1	0	0	461

Fig. 3(cont.) Comparison of seasonal and area effects on the growth rate of pollock in 4VWX5Zc.

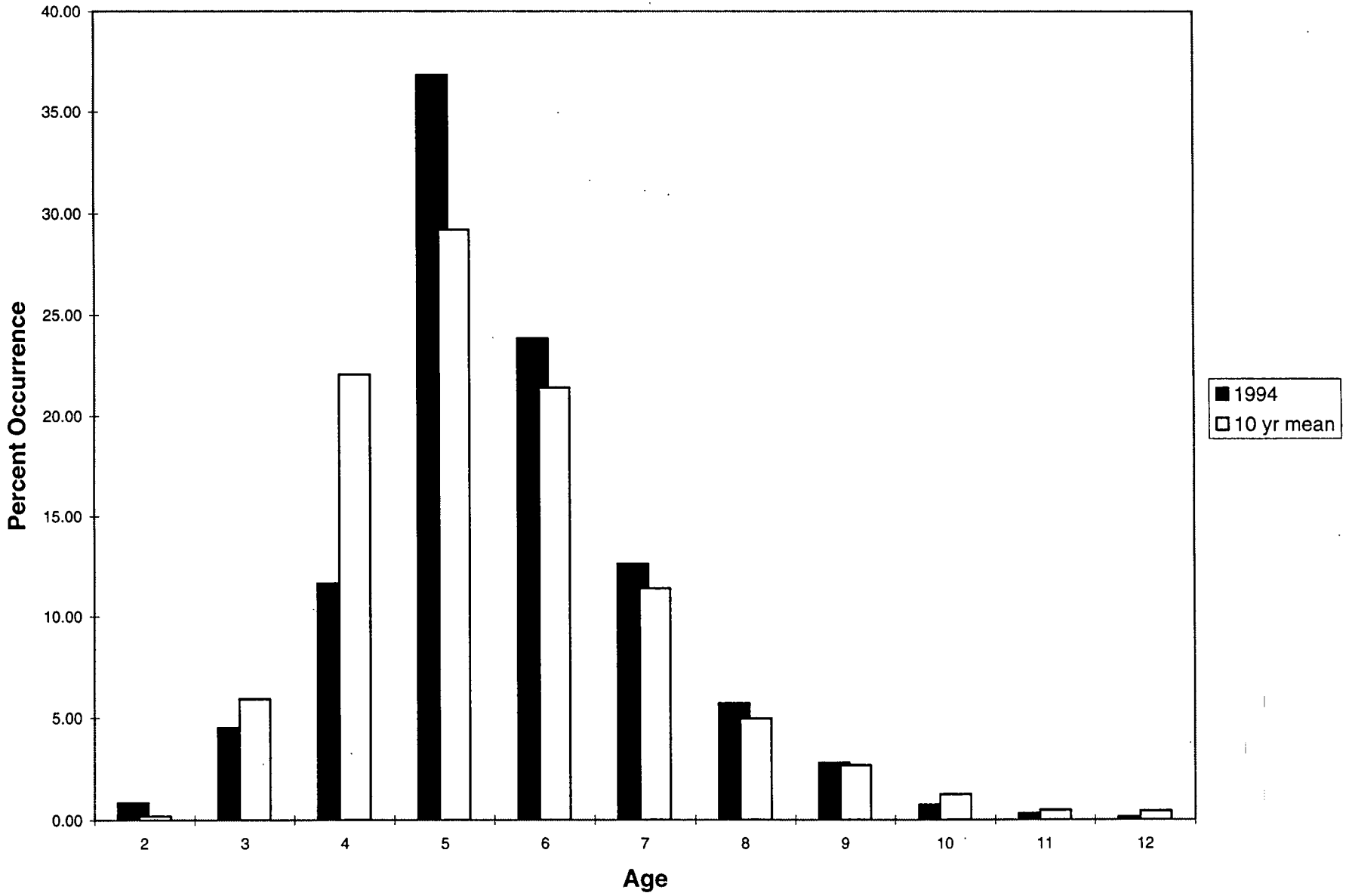


Fig. 4. Comparison of the ages in the 1994 landings with the longterm average (1984 to 1993).

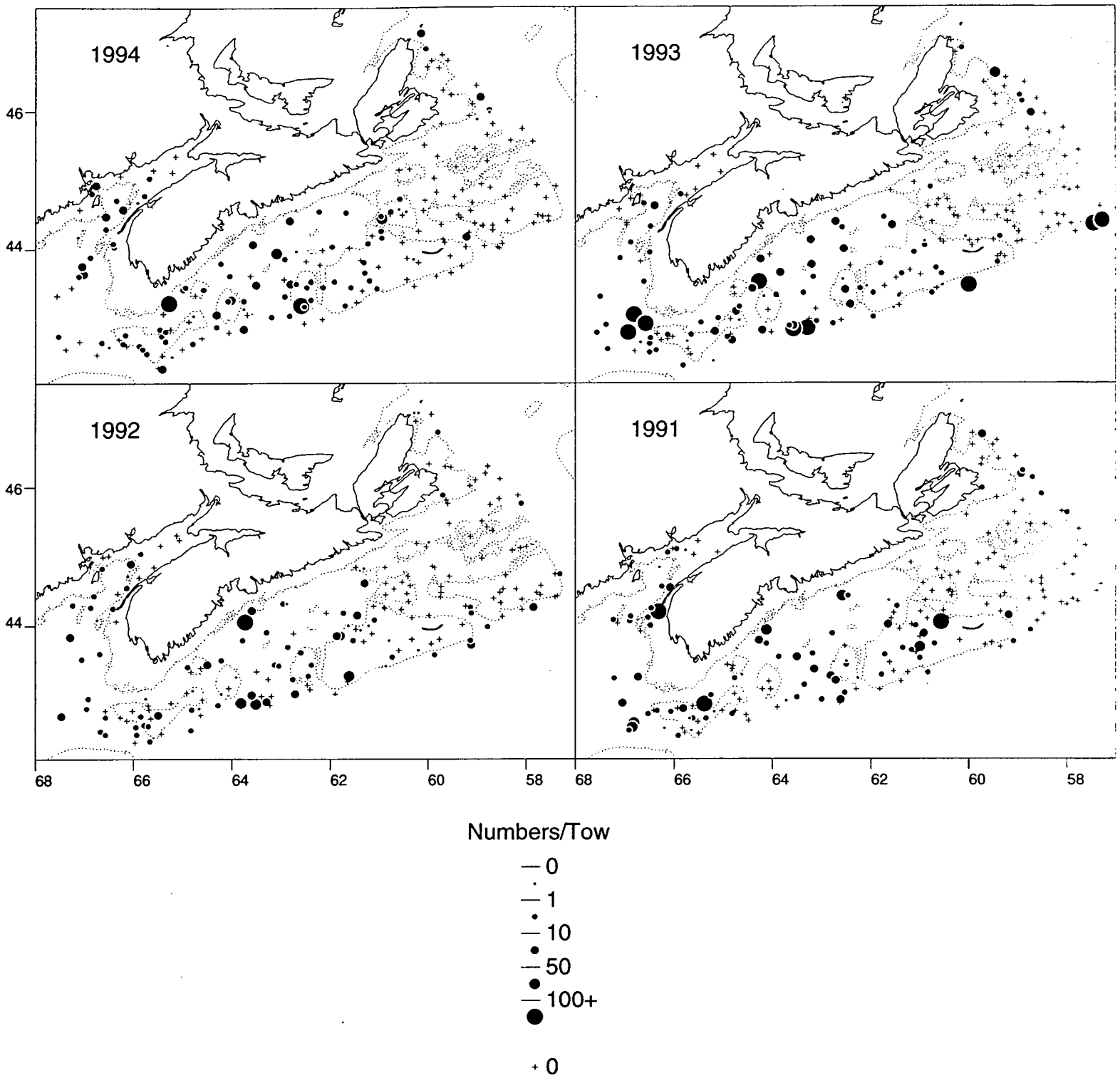


Fig. 5 Numbers/tow for Pollock-Summer Research Surveys 1991-1994

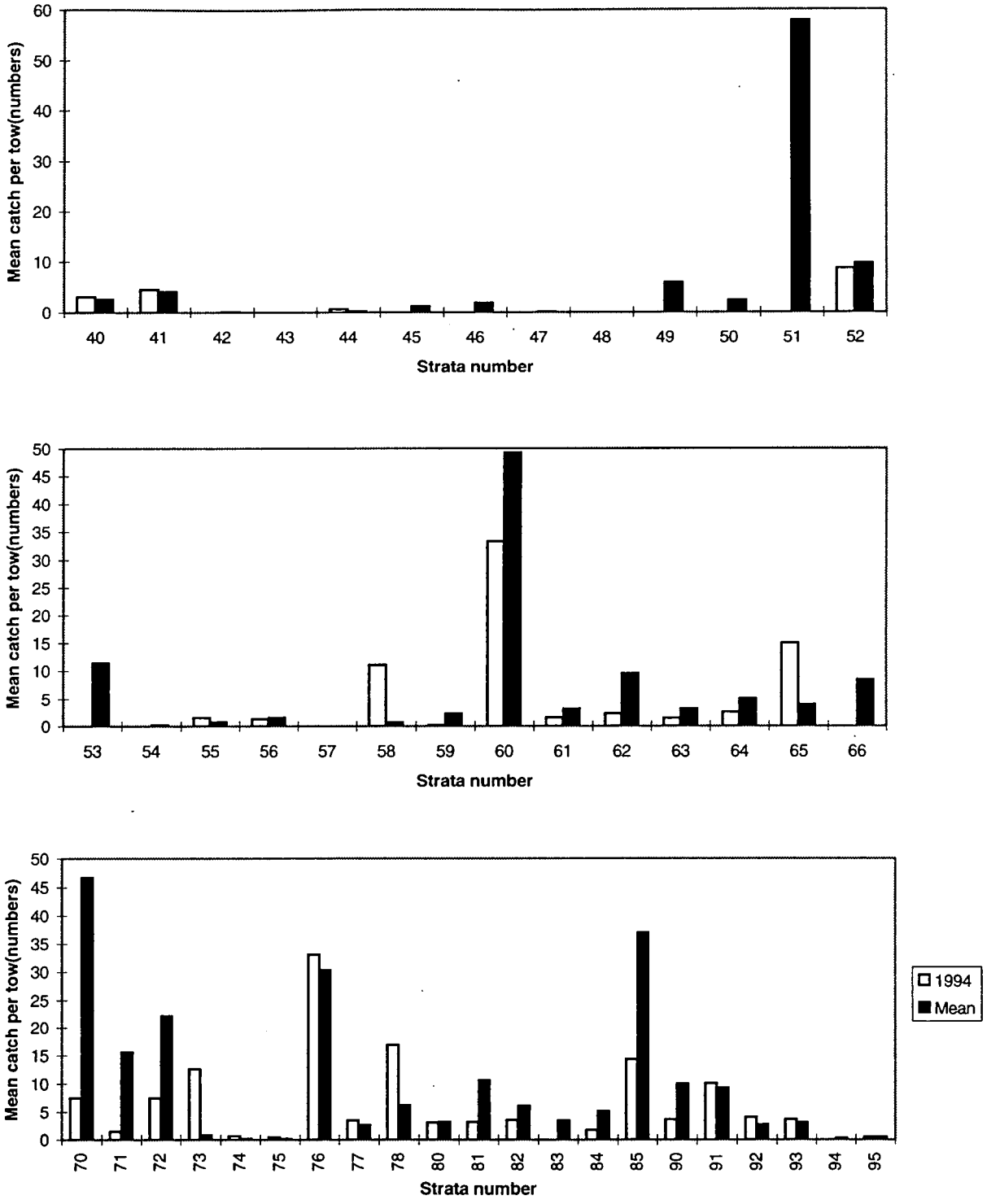


Fig. 6 Comparison of 1994 catch rates with the average over the duration of the survey, by stratum.

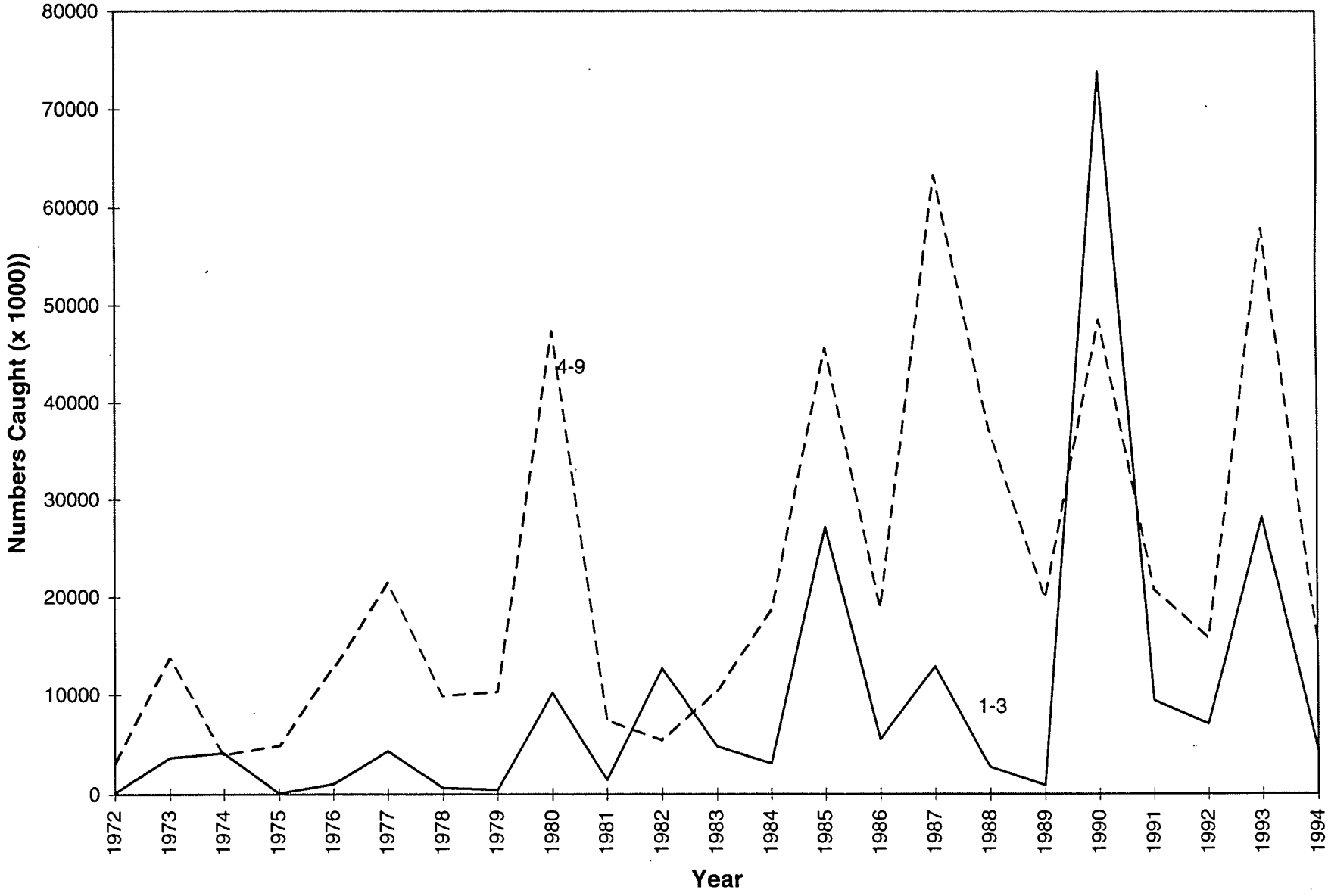


Fig.7. July RV Stratified Numbers Caught (ages 1-3 and 4-9) for Divs. 4VWX5 Pollock, 1974 - 1994.

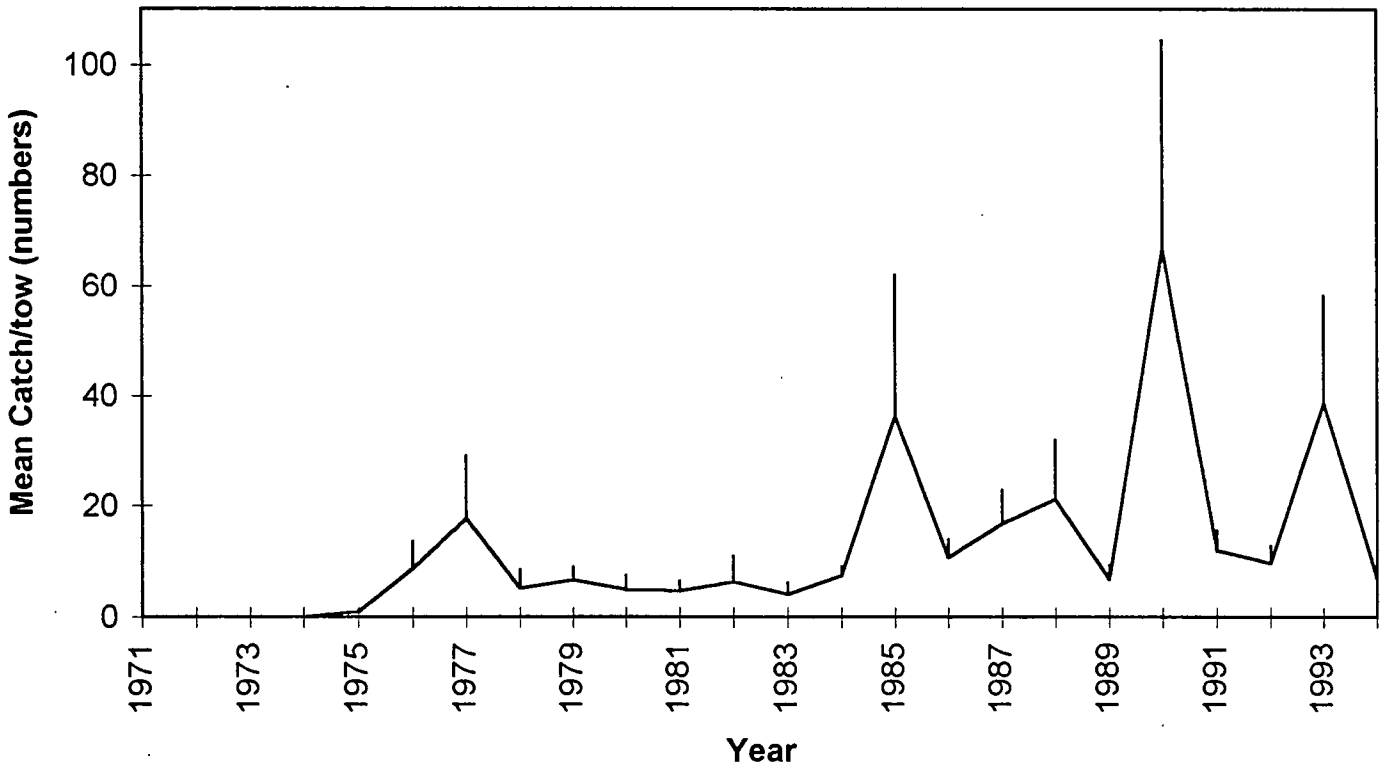


Fig. 8 Stratified mean catch per tow for pollock caught during summer surveys in NAFO Divs. 4VWX. The series shown is for 4X only, ± one standard error.

Fig. 9 Pollock catch rates from tonnage class 5 OTB vessels, from IOP data. Series include the entire management unit and 4X only.

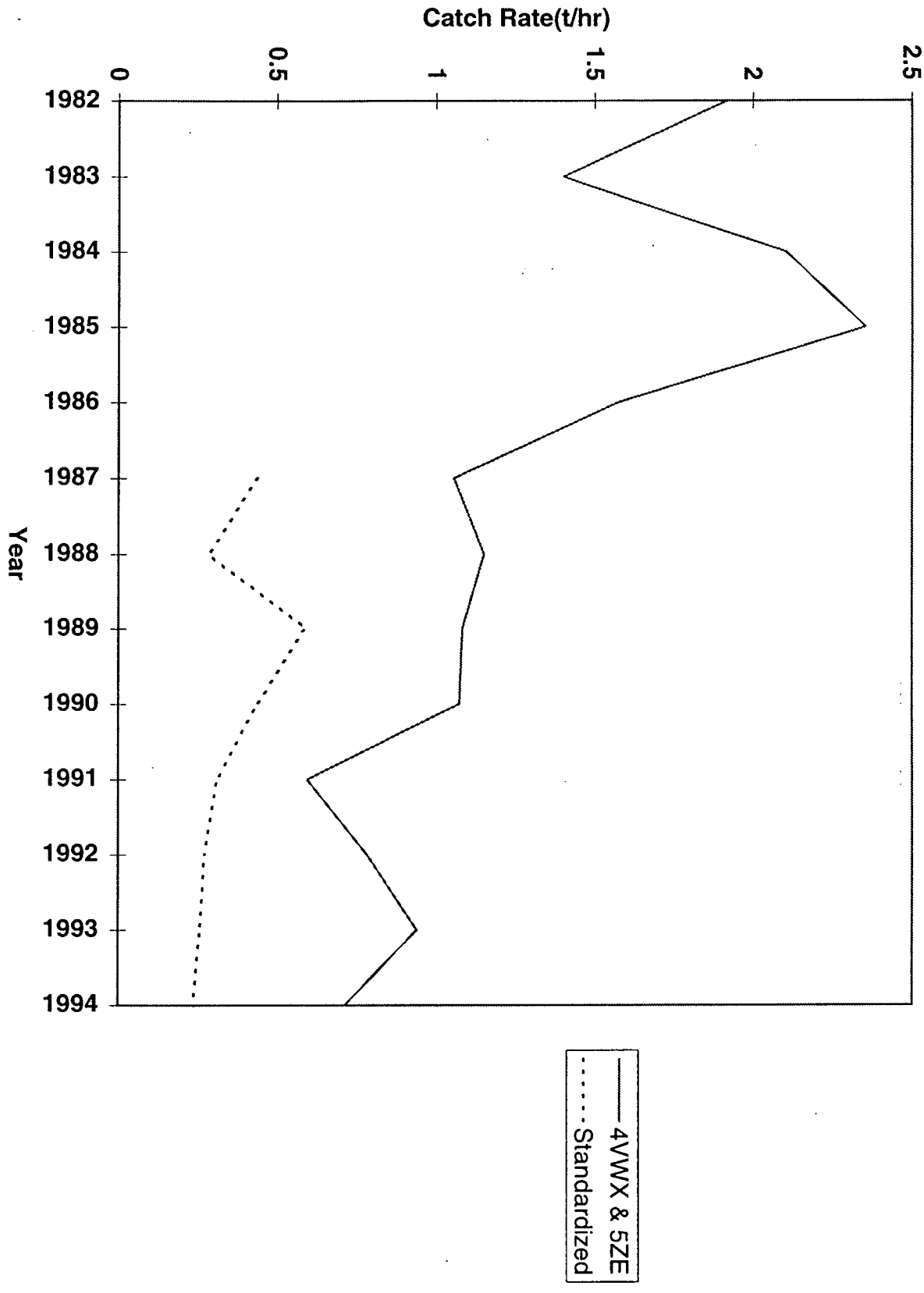
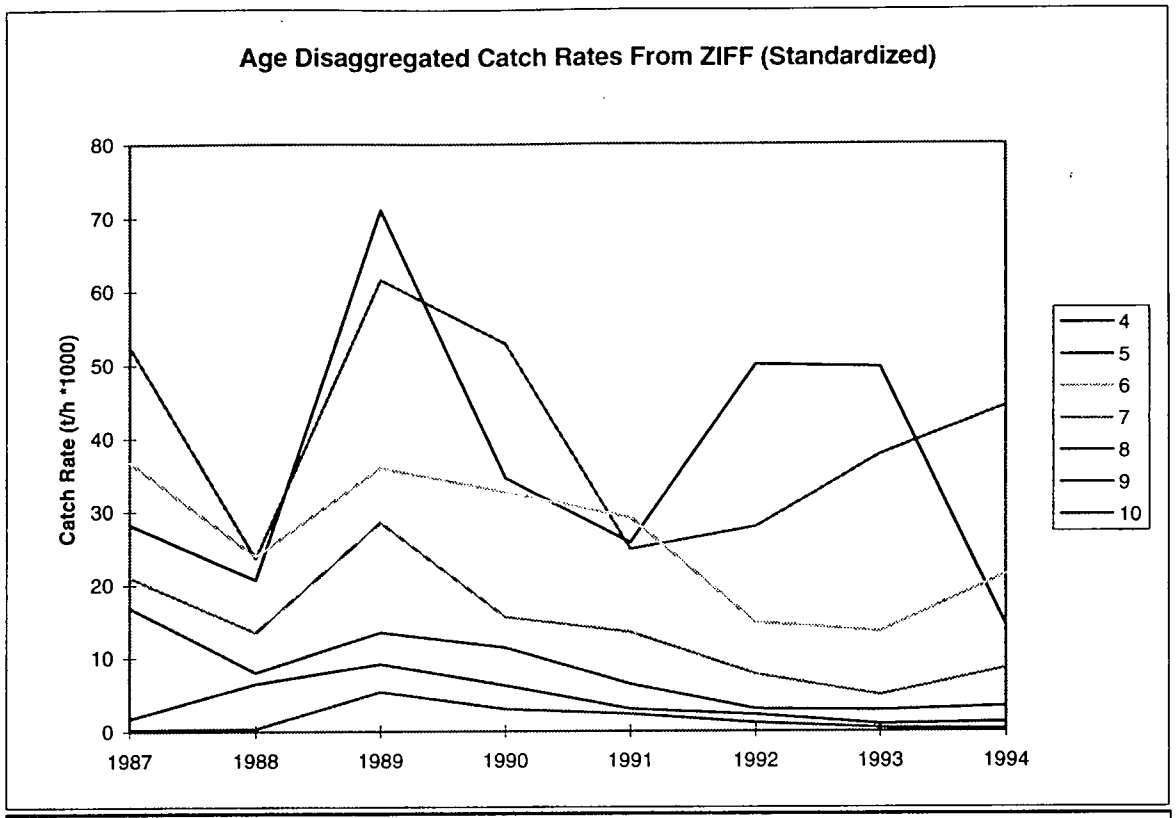


Fig. 10. Pollock catch rates from tonnage class 5 OTB vessels, from IOP data, with standardized series from all OTB vessels shown for comparison.



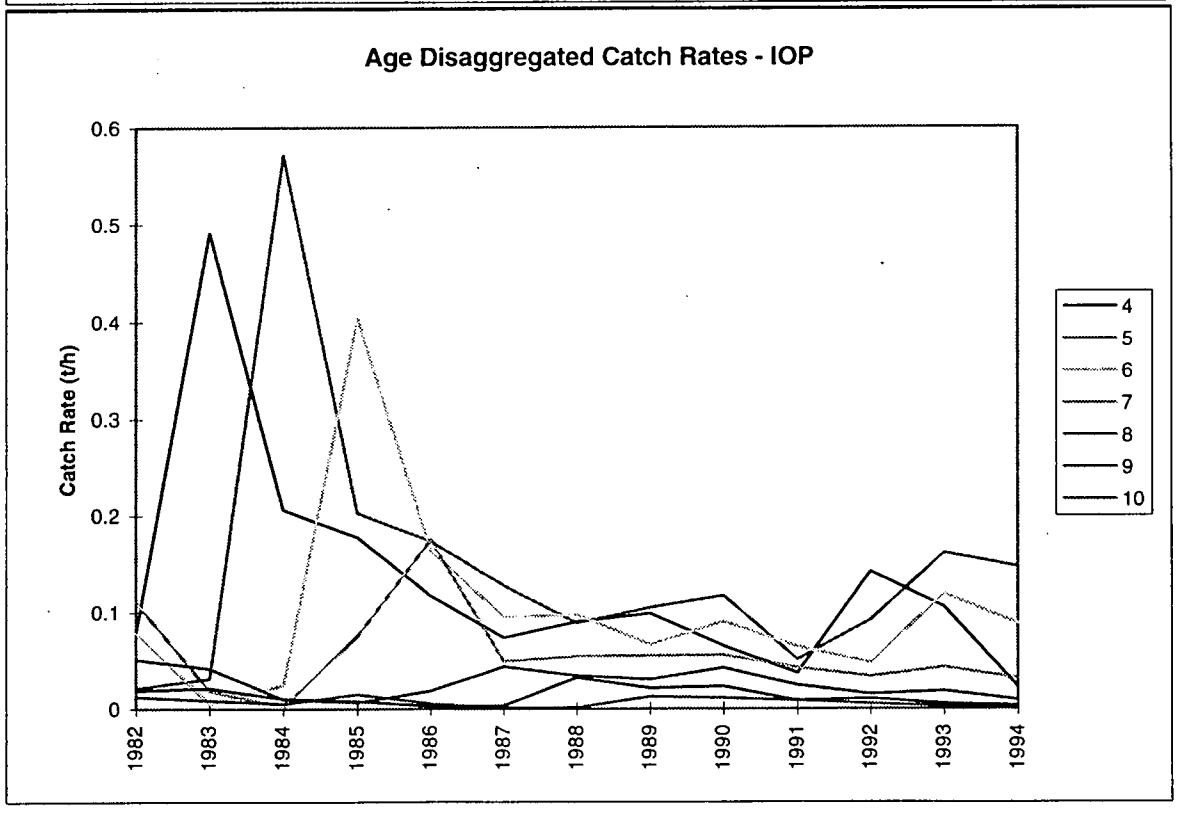


Fig. 11. Comparison of age-disaggregated catch rate series.

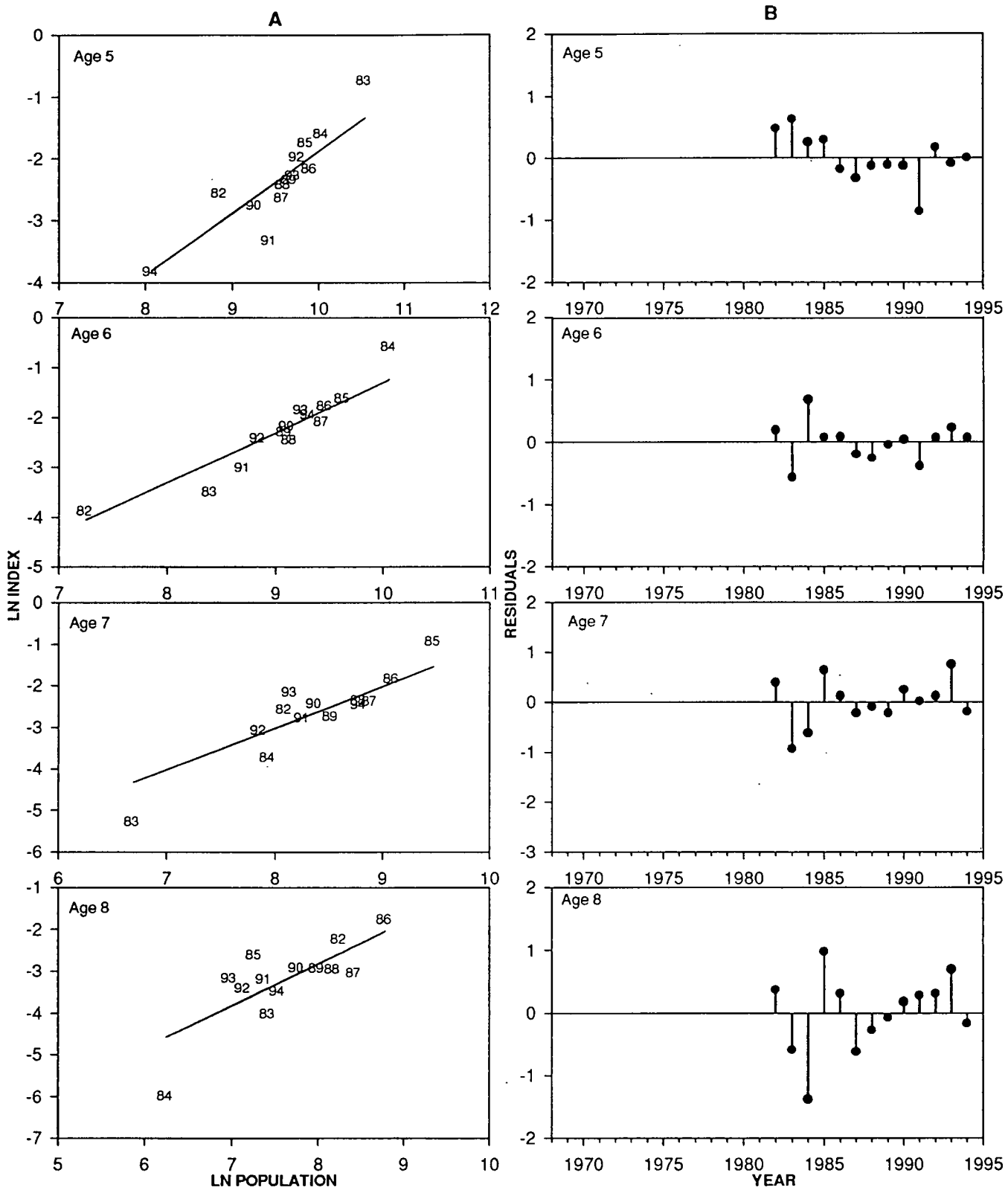


Fig.12a. Age by age plots of A) the observed and predicted ln abundance index versus ln population numbers and B) residuals plotted against year of the otter trawl (TC 4-6) catch rate for pollock.

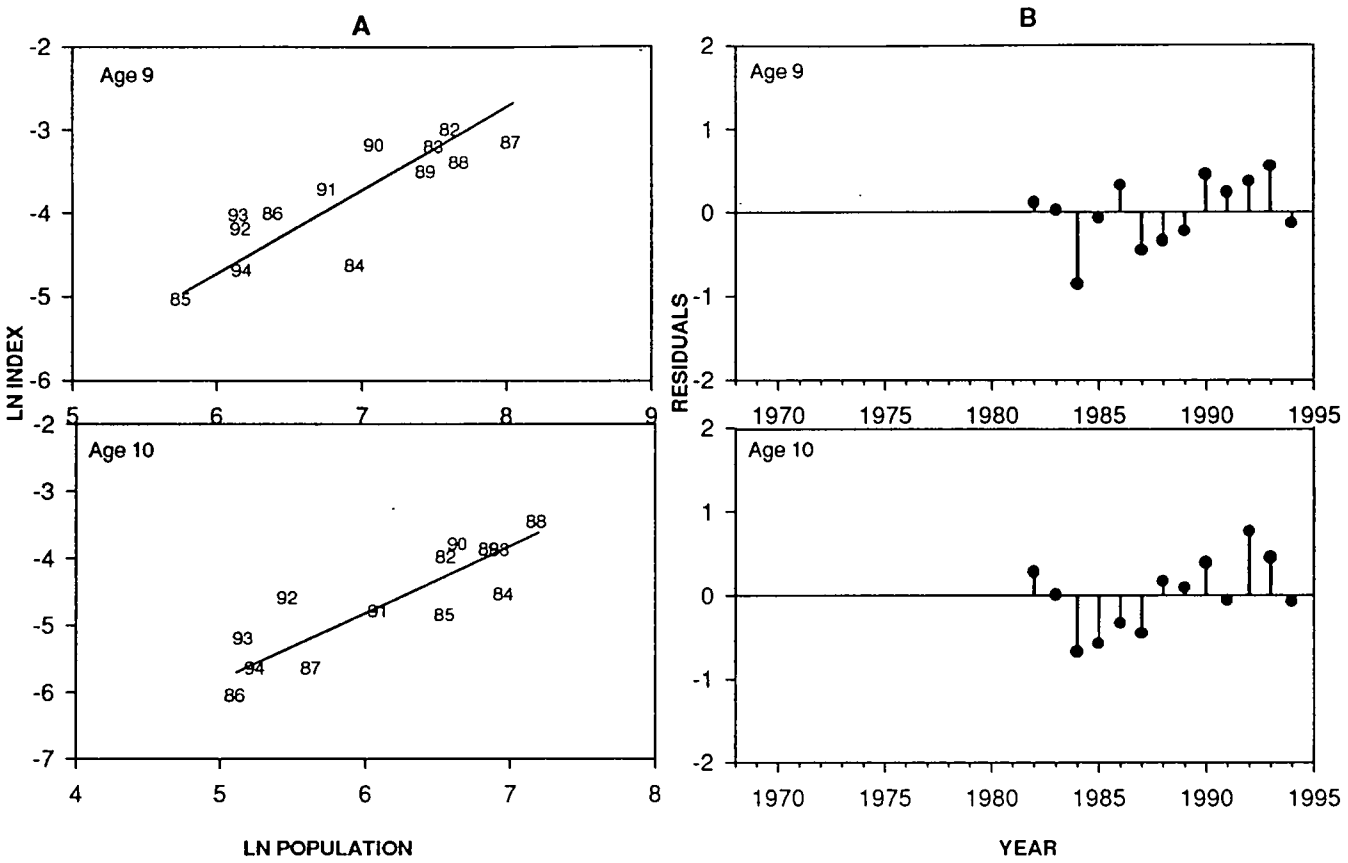


Fig.12b. Age by age plots of A) the observed and predicted ln abundance index versus ln population numbers and B) residuals plotted against year of the otter trawl (TC 4-6) catch rate for pollock.

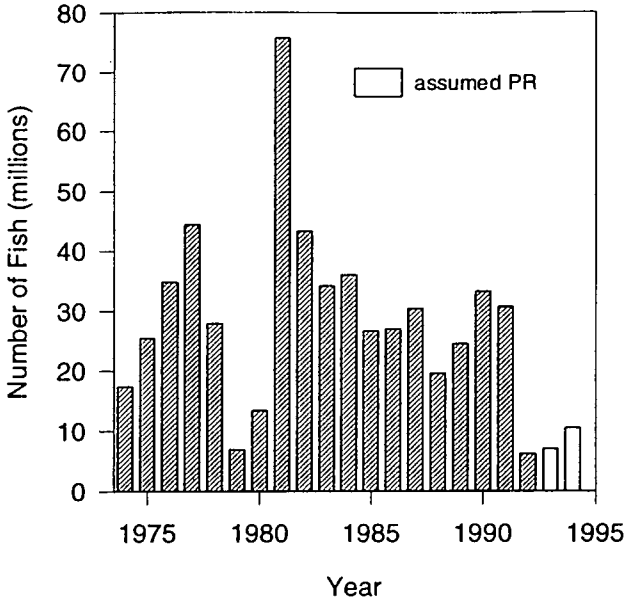


Fig.13 . Recruitment (age 2) for pollock.

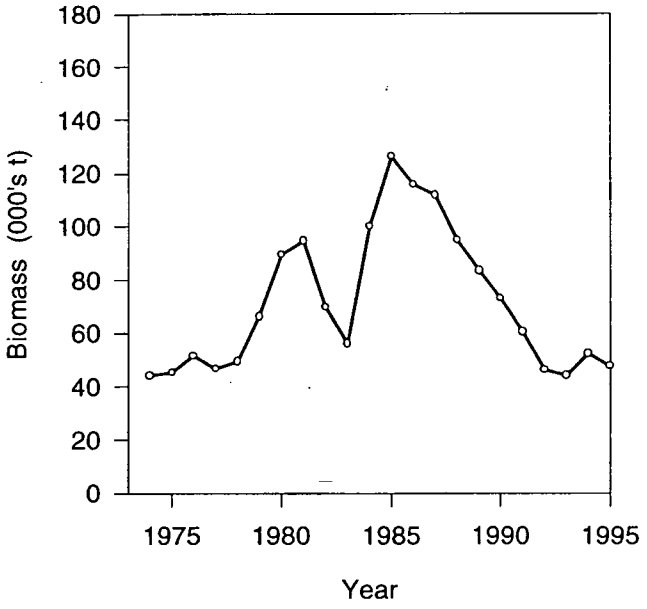


Fig.14 . Beginning of year biomass (5+) for pollock.

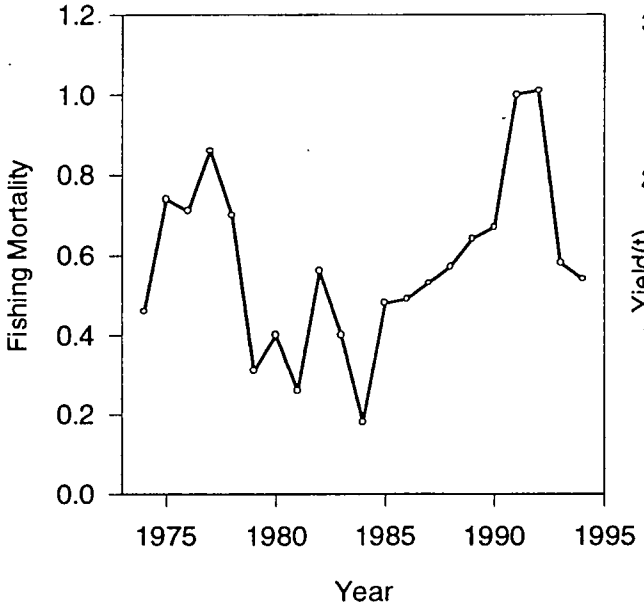


Fig.15 . Fishing mortality (7+) for pollock.

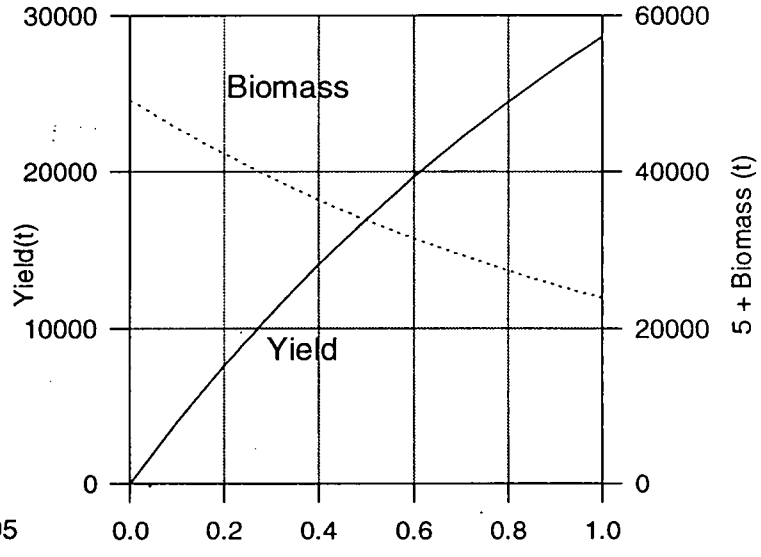


Fig.16 . Projected pollock yield for 1995 and beginning of year biomass in 1996.

Appendix 1. Results of 2nd reading(blind) by pollock age reader.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
0									1							1
1																0
2		3														3
3			18													18
4				11	1		1									13
5			1		31	2										34
6				1	2	13	4									20
7						2	13	1								16
8						1	1	9	3		1					15
9								1	8	1						10
10							1			10						11
11											4					4
12											3	3				6
13													3			3
14													2	2		4
15															1	1
	0	3	19	12	34	18	20	11	12	11	8	3	5	2	1	159

Agreement = 86%

Appendix 2 REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.518
MULTIPLE R SQUARED..... 0.268

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.308E3	2.308E3	
REGRESSION	28	7.762E2	2.772E1	34.255
Division	5	3.307E1	6.615E0	8.174
Tonnage Class	6	3.426E2	5.709E1	70.546
Mesh Type	1	5.644E_1	5.644E_1	0.697
Month	7	1.934E1	2.764E0	3.415
Year	7	1.580E2	2.257E1	27.888
RESIDUALS	2620	2.120E3	8.093E_1	
TOTAL	2649	5.205E3		

REGRESSION COEFFICIENTS

CATEGORY	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
4X	INTERCEPT	_1.223	0.081	2649
2				
D				
06				
87				
4W	1	_0.009	0.052	659
5ZE	2	0.045	0.070	245
4VN	3	_0.351	0.072	239
4VS	4	_0.159	0.063	361
5Y	5	_0.296	0.085	146
4	6	1.078	0.083	254
5	7	1.058	0.058	1122
3	8	0.409	0.052	1330
1	9	_0.935	0.323	8
6	10	1.687	0.641	9
7	11	1.466	0.166	50
	12	0.758	0.908	1
	13	0.397	0.111	161
S	14	_0.034	0.091	269
04	15	_0.015	0.071	271
05	16	_0.146	0.065	377
08	17	_0.071	0.070	293
09	18	_0.084	0.074	252
10	19	_0.097	0.070	304
07	20	0.063	0.063	413
11	21	0.266	0.069	321
88	22	_0.434	0.082	365
89	23	0.289	0.078	452
90	24	_0.002	0.077	474
91	25	_0.340	0.077	538
92	26	_0.476	0.079	454
93	27	_0.597	0.091	410
94	28	_0.703	0.107	316

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
87	_1.2228	0.0066	0.440	0.036	31055	70599
88	_1.6564	0.0061	0.285	0.022	28983	101629
89	_0.9338	0.0052	0.588	0.042	26188	44560
90	_1.2249	0.0049	0.439	0.031	21693	49379
91	_1.5623	0.0053	0.313	0.023	26156	83447
92	_1.6990	0.0058	0.273	0.021	21999	80486
93	_1.8195	0.0077	0.242	0.021	12915	53353
94	_1.9256	0.0115	0.217	0.023	8524	39228