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The 1995 Assessment of Pollock (*Pollachius virens*) in NAFO Divisions 4VWX and Subdivision 5Zc

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Abstract

Landings of pollock in the management unit 4VWX5Zc were 9795 t in 1995, considerably less than the TAC of 14,500 t. Most gear sectors were unable to catch their allocations. However, reports from the fishery almost unanimously indicate that pollock have increased in abundance in the western half of the management unit over the past several years. Fishermen note that shortfalls against quota reflect market and fishing strategies (such as "banking" pollock to allow continued fishing on cod and haddock), not a lack of abundance. However, reports from the eastern half of the management unit have not yet indicated any recovery of the resource.

The stock status evaluation was based on an analytical assessment employing landings statistics, sampling for size and age composition of the commercial catch and trends in commercial fishery catch rate. If the TAC of 10,000 t is taken in 1996, the resulting fully recruited fishing mortality will be about 0.14. The beginning of year age 5+ biomass will increase from 70582 t in 1996 to 73601 t in 1997. The F_{01} catch in 1997 is 22,159 t, with about 33% contributed by the 1989 year-class. Some of the more important sources of the uncertainty include the large management unit, the small catch weight accounted for by the TC5 catch rate index in recent years, and the schooling semi-pelagic nature of the resource which makes traditional approaches to groundfish stock assessment difficult.

Résumé

En 1995, dans l'unité de gestion 4VWX5Zc, on a débarqué 9 795 t de goberge, ce qui est de beaucoup inférieur au TPA, fixé à 14 500 t. Dans la plupart des catégories d'engins, on n'a pas réussi à faire les captures allouées. Toutefois, les rapports concernant cette pêche indiquent pratiquement tous que, depuis plusieurs années, la goberge est plus abondante dans la moitié ouest de l'unité de gestion. Les pêcheurs signalent que l'écart entre les prises et les quotas alloués reflète les stratégies de commercialisation et de pêche préconisées (on «épargne» la goberge pour continuer à pêcher la morue et l'aiglefin), non une baisse de la ressource. Pour ce qui est de la moitié est de l'unité de gestion, par contre, les rapports ne font pas encore fait état d'un rétablissement de la ressource.

L'évaluation du stock s'est fondée sur l'analyse des valeurs de débarquement, de la composition en fonction de la taille et de l'âge d'échantillons des captures de la pêche commerciale et des tendances du taux de capture de la pêche commerciale. Si le TPA de 1996 (10 000 t) est atteint, il s'ensuivra une mortalité par pêche des groupes d'âge entièrement recrutés d'environ 0,14. La biomasse de la classe d'âge 5 + en début d'année passera de 70 582 t, en 1996, à 73 601 t, en 1997. Pour 1997, le F_{01} se chiffre à 22 159 t, dont environ 33 % est attribuable à la classe de 1989. Parmi les principaux facteurs d'incertitude, signalons la grande étendue de l'unité de gestion, le faible poids des prises considéré pour de l'indice de capture TC5 ces dernières années et enfin, le caractère semi-pélagique de l'espèce et son mode de déplacement en bancs, deux caractéristiques qui rendent difficile l'application des approches classiques de l'évaluation des stocks de poissons de fonds.

Introduction

Management Unit

The management unit for the pollock resource in Maritime waters includes NAFO Divs. 4VWX and Subdiv. 5Zc. The convention for the Canadian management unit was established following a review in 1989 (Annand et al. 1990), which involved examination of results of egg and larval surveys, meristic and morphometric studies, and tagging work. Prior to this, the convention for the management unit was NAFO Divs. 4VWX and Subarea 5.

History and Description of the Fishery

Landings and TACs since 1974 are shown on Fig. 1 and Table 1. Landings from 1974 to 1980 averaged about 28,000, rose through the early 1980s to 45000 in 1987. Since then, landings have sharply decreased. The TAC rarely constrained overall fishery landings, although for a period of five consecutive years in the late 1980s, the TAC was either met or exceeded. The 1995 total allowable catch (TAC) for 4VWX5Zc pollock was 14,500 t. Overall landings (9795 t) are less than the quota, and are the lowest recorded since 1974 (Fig. 1, Table 1).

The 1995 landings continue the recent trend of comparatively small contributions to total landings in the eastern portion (4VW) of the management unit (Table 2, Figs. 2 and 3). 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. Further dissagregation of landings by area (Fig. 4) indicate that landings in 4X have declined since 1991. While landings from 4V were significant through the late 1980s', they have dropped markedly until 1993, when they recovered slightly. Landings from 5Zc (Georges Bank) peaked in 1993, but declined thereafter.

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). The landings in 1995 compared with 1994 were 56, 67 and 58%, for large draggers, small draggers and fixed gear, respectively. As indicated in Fig. 5, there have been significant changes in the relative importance of gear types over time. The relative contribution of larger draggers has been much diminished, whereas the contribution of smaller draggers and fixed gear has been steadily increasing.

Under the 1995 management plan, there were 14 gear components which receive quota allocation. The quotas and catch to date (December 31, 1995, as obtained from the the Preliminary Final Canadian Atlantic Quota Report) are given in Table 4. Of those, only one (4X5Y <45' gillnet) met or exceeded their quota. In contrast, mobile vessels greater than 100' caught only 37% of their

[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), longline, jigger, troller lines, mechanized squid jigger, handline (baited),trap, pot, weir and miscellaneous.

quota. In recent years, however, fishermen from many gear sectors have noted that they often do not direct for pollock and quota shortfalls should not be viewed as a lack of abundance.

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, all of which was landed in Canada in 1995. There was also a small quantity taken by foreign vessels which was not landed in Canada (1.2 t). Pollock landings in the 1995 silver hake fishery remain comparatively small (58 t, Table 2). Pollock bycatch in the silver hake fishery can be attributed, in part, to the mandatory use of grates (which commenced in 1994). 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) are also thought to have reduced the bycatch of pollock.

In summary, the fishery can be described as dynamic, with significant changes in areas fished and gear used. The industry perception of the resource is summarized in Appendix One.

Catch at Length and Age

In 1995/96, new age readers took over responsibility for pollock age determinations. The training, evaluation and progress of the new age readers was documented (Neilson et al. 1996) for commercial fishery samples from NAFO Div. 4X, the area contributing the bulk of the commercial fishery samples and landings (Table 5). The main conclusions are summarized in Appendix Two. Also, a similar evaluation was made of the progress of the age readers using commercial fishery samples from the eastern shelf, and the results are also provided in Appendix Two. As indicated in the Appendix, the performance of the age readers for the 4X samples has been good. Age determinations from 4V, however, are not at the same standard. Otoliths used for age determination from 4V comprised 313 of the 1804 otoliths aged, representing 11% of the total catch in 1995. Therefore, given the relatively small contribution of the 4V material to the total catch at age and the observation that the overall mean lengths at age derived from the 1995 catch at age were comparable to those obtained with the previous reader (see text table below), we decided to include all aged material in the assessment.

	Mean Weight		Mean Length	
AGE	1994	1995	1994	1995
2	0.864	0.611	41.92	37.295
3	1.283	1.065	47.817	45.289
4	1.541	1.646	50.683	52.365
5	1.902	2.082	54.149	56.557
6	3.064	2.577	63.893	60.433
7	3.779	3.635	68.616	68.006
8	4.177	4.349	70.96	72.356
9	4.74	4.663	73.923	73.914
10	5.588	4.884	78.157	74.399
11	5.999	5.512	79.867	77.623
12	6.184	7.574	80.503	86.713

In the previous assessment, 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, sufficient samples exist to stratify by area 4VW and 4X+5 and by trimester for the OTB TC 1-3 vessels. Stratifying on such a basis is important because there are considerable differences in growth rate between areas and among trimesters. 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. Last year, the catch at age was redone using the new approach from 1991 to 1994. This year, we added 1989 and 1990, as well as adding 1995.

As indicated, 79 samples were collected in 1995. The distribution of sampling with respect to landings by area and gear type is indicated in Table 5. Overall, most gear/area combinations were sampled adequately.

Supplemental 'B' landings accounted for 7.6 t in 1995, and all came from 4VW. For the purposes of constructing the catch at age, it was assumed that the supplemental 'B' landings could be attributed to the small mobile gear category (OTB TC 1-3).

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. An age-length key derived from the 1995 survey (4VW strata only) was applied to the length-frequency samples available from the Observer Program.

As in the past assessment, length-weight parameters were calculated as the average *a* and *b* parameter values over the past five years. Since we do not have recent spring or fall surveys that cover the entire management unit, we used the summer values for the 1st and 3rd trimesters as well.

The overall catch composition at length for 1994 and 1995 is shown in Fig. 6, as are certain important constituents of the overall catch at length. The distribution of lengths in the 1995 landings was less broad than in 1994, with fewer large fish in the catch. This difference was also apparent when the overall catch composition was disaggregated (Fig. 6). These observations are consistent with reports from industry, as noted in Appendix One. Industry has also noted that the length composition of their catchs in 1996 was larger than 1995, and more comparable with their catch in 1994.

Fishermen have noted that particular areas are often associated with pollock of a certain size. Such differences may occur on a relatively small geographic scale and may not be adequately dealt with using the NAFO division level stratification employed in the construction of the caa. To examine whether the observed differences in catch at length could be related to differences in unit area sampled, we first examined the distribution of origin of samples by unit area in 1994 and 1995 (see text table on next page):

1994																	
Count of Area	Area																
	4VNn	4VSc	4VSu	4Wk	4Wl	4Wu	4Xm	4Xn	4Xo	4Xp	4Xq	4Xr	4Xu	5ZEj	Grand Total		
Total	3	8	1	1	2	1	2	17	17	5	7	2	1	23	90		
% Occurrence	3.33	8.89	1.11	1.11	2.22	1.11	2.22	18.9	18.9	5.56	7.78	2.22	1.11	25.6	100		
1995																	
Count of Area	Area																
	4VNn	4VSc	4Wf	4Wh	4Wk	4Wu	4Xm	4Xn	4Xo	4Xp	4Xq	4Xr	4Xs	4Xu	5Yb	5ZEj	Grand Total
Total	4	10	1	1	1	2	7	9	4	8	18	1	1	1	1	10	79
% Occurrence	5.06	12.7	1.27	1.27	1.27	2.53	8.86	11.4	5.06	10.1	22.8	1.27	1.27	1.27	1.27	12.7	100

Comparing years, the distribution of samples is roughly similar, except for 4Xq, which accounted for a considerably larger fraction of all samples in 1995, and 4Xn and 4Xo, which were sampled less intensively than in 1994. The length frequency distributions by unit area is shown on Fig. 7 for TC 1-3 otter trawlers. Comparatively large fish were found in 4Xq in both 1993 and 1994. While 4Xq was sampled almost three times as intensively in 1995 compared with 1994, the landings attributed to that area doubled. While this might have caused a slight distortion of the overall length composition, we concluded that in general, differences in unit areas sampled had minor impacts on the length compositions for 1994 and 1995.

The resulting catch at age and weight at age matrices are reported in Tables 6 and 7, respectively. The age composition of the landings in 1995 is shown with respect to the 10 year mean and 1994 in Fig. 8. The catch was comprised of somewhat younger fish than was the case in 1994. Age six fish (the 1989 year-class) were abundant compared with the 10 year average age composition. The weights at age have been stable since 1989 (Fig. 9). Prior to that, the weights at age for some older ages have declined since about 1982.

Distribution and Abundance

Research Surveys

Fig. 10 shows the distribution of sets where pollock were caught in 1995 compared with the three past years. The most recent sets from the 1996 survey are also shown. Inspection of the plots indicates that there has not been a dramatic shift in the distribution of pollock in 1995 compared with the three years preceding. In 1996, very few catches of pollock were made on the eastern shelf compared with 1992-1995. Some good catches of pollock were made in 1996 along the shelf edge at "non-traditional" locations selected as part of the redfish initiative.

The density of pollock is shown by research vessel survey stratum in Table 8 and Fig. 11. Comparison of the catch rate by stratum in 1995 to the longer-term average over the duration of survey indicates that most strata where pollock have occurred in the past were also associated with pollock catches in 1995. Therefore, the distribution of pollock in 1995 did not appear anomolous.

The overall trend in catch per tow is shown in Fig. 12, and have increased for the past two years. 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 (Fig. 13). This year, we began more in-depth

analyses of the survey information to determine whether alternative approaches might yield more reliable results. We selected a subset of 4X strata which corresponded with preferred fishing areas, according to discussions with experienced pollock fishermen. The abundance trends by age for the selected strata are also shown on Fig. 13. Some of the interannual variation is reduced by this approach, but year effects remain pronounced. Given such observations, we elected not to include the survey information in the VPA.

The length composition of the landings from the 1995 and 1996 surveys are compared with previous years in Fig. 14. In 1995, there are modes at about 30 and 55 cm which is consistent with the 1985-1994 average length composition. However, larger fish were less abundant than the average. The 1996 length composition shows a pronounced mode at 55 cm and more larger fish than 1994, but still the numbers of fish greater than about 65 cm is less than the long term average. The 1996 length composition also indicates few fish less than 45 cm compared with the long term average.

Industry Survey

A collaborative survey with ITQ vessels has been ongoing for the past two years. While it is too early to use the information as an index of abundance, it does provide important information on distribution and the catches can be compared qualitatively. The catch rates experienced by the ITQ vessels participating in the survey are shown on Fig. 15, and are standardized for tow duration only. In both years, pollock catches were distributed generally throughout the 4X area, with many of the larger catches made in the lower Bay of Fundy.

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 assessments completed for the last two years have employed commercial fishery catch rates for TC5 mobile gear as an index of abundance for the stock. The use of catch rates have been criticized by some members of industry, 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. Most importantly, however, there is a concern that the utility of the TC 5 catch rate series is rapidly diminishing, as the contribution of this component of the fishery has been declining in recent years.

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 in the past two years, data from the International Observer Program (IOP).

Nominal IOP catch rates[2] were generated by using the International Observer Program database for the years 1982 to 1995, for 4VWX5Zc. Data were selected for OTB TC5 where the main species caught was pollock. Months included in the analyses were, as before, April through November.

The second approach to developing a catch rate series was to use catch-effort data from Regional analytical data for the years 1982 - 1988 and from ZIFF for the years 1989 - 1995. The source of the catch and effort information was a set of "core" vessels for Tonnage Classes 1 - 3 in NAFO Divs. 4X5 which we identified in collaboration with industry. Any vessel that was active in the pollock fishery for the years 1991-1994 was initially selected. We then selected trips which had directed pollock catches (when pollock landings were equal to or greater than 50% the total landings by weight) and where effort and catch are both greater than zero and grouped to the sub trip level from 1982 to 1995. A sub trip prior to 1989 constituted any change in date caught, unit area, gear, depth zone or main species caught. After 1989, set level information was included; thus more sub trips per trip. After the catch data have been extracted and grouped to the sub trip level, it was then grouped by trip. The series extends back to 1982 (see text table on the next page, showing number of trips made per year, by vessel). Vessels that had fewer than 10 trips with a directed pollock catch were excluded from the data. Factors in the catch rate standardization included vessel, year, month, tonnage class, NAFO unit area and mesh type (square vs diamond). In instances prior to and including 1993 where the mesh type field was blank, it was assumed to be diamond. In 1994, all such records were deleted. In 1995, if the mesh type field was blank, it was assumed to be square mesh. The results of the catch standardization are given in Appendix Three. The spatial distribution of the sets included in the index is shown in Fig. 16. As indicated, the distribution of sets comprising the index has not changed appreciably over the period when set location data are available.

[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 code 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)

	Year														
Vessel	82	83	84	85	86	87	88	89	90	91	92	93	94	95	Grand Total
1	2	5	6	2	2	7	0	2	0	7	29	18	5	2	87
2	0	2	1	1	7	5	0	7	5	9	9	0	2	2	50
3	3	0	1	9	1	7	5	0	0	6	4	1	0	1	38
4	2	6	1	3	3	2	1	1	3	5	4	1	3	3	38
5	0	1	0	5	0	4	0	2	0	4	0	0	0	0	16
6	1	0	1	3	10	2	0	0	1	16	24	24	21	12	115
7	1	4	3	6	1	4	7	2	6	4	9	7	2	2	58
8	4	7	7	14	4	6	3	3	3	8	3	6	1	5	74
9	0	0	0	0	0	0	0	3	4	1	4	4	0	0	16
10	0	0	4	3	6	3	1	6	4	1	3	2	0	0	33
11	0	0	1	4	1	3	1	0	11	31	18	21	8	9	108
12	3	5	8	2	2	1	1	2	1	1	5	1	6	1	39
13	4	5	13	5	3	8	3	0	0	6	13	15	7	3	85
14	2	3	7	6	3	0	0	0	3	12	8	10	13	10	77
15	8	8	19	5	3	3	13	3	0	33	31	32	31	26	215
16	0	0	0	3	0	3	0	1	1	1	40	21	0	2	72
17	10	9	11	7	0	2	0	1	4	3	8	4	0	18	77
18	3	4	5	9	0	0	0	0	0	23	19	21	27	15	126
19	0	0	8	0	1	0	0	0	1	2	14	7	20	0	53
20	0	0	0	0	0	0	0	0	2	23	27	18	22	6	98
21	0	0	0	0	1	2	2	4	4	2	1	3	0	1	20
22	0	1	1	0	0	1	0	0	3	6	0	1	1	1	15
23	1	2	0	6	0	6	6	0	1	6	1	0	0	1	30
24	0	9	3	9	2	5	0	2	5	9	2	3	1	0	50
25	0	0	0	0	1	2	1	2	0	3	0	1	0	2	12
26	0	0	0	0	0	4	5	3	3	4	1	1	1	1	23
Total	44	71	100	102	51	80	49	44	65	226	277	222	171	123	1625

The two catch rate series are shown on Fig. 17 and Table 9. The series track each other well, with the exception of the 1989 value for TC 1-3. This year appears anomolous, and was also the year in which management of cod, haddock and pollock was done through a combined quota.

The comparative strengths and weaknesses of the two catch rate series is summarized in the text table on the next page:

	TC 5 Domestic Catch Rates from IOP	TC 1-3
Strengths	Tracks strong yearclasses. Index includes whole management unit. Observed trips. Possibly fewer changes in fishing practices.	Tracks strong yearclasses. Covers a significant fraction of landings by an important fleet component.
Weaknesses	Index based on a rapidly diminishing proportion of total landings.	Includes 4X5 area only. Has large unexplained peak in 1989 (may be due to the cod/haddock/pollock combined management approach tried in 4X that year)
Observations	Industry has claimed that changes in management and fishing practices limits utility. Includes change to square mesh (in part of the management unit) NOT standardized for.	General trend matches that of TC 5 catch rate series. Industry has noted that logbook information may be less reliable before 1990. Change to square mesh occurred in 1992 (included in standardization)

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. The age disaggregated catch rates shown in Table 9 were obtained by dividing the catch at age by standardized effort.

Sequential Population Analyses

Partial Recruitment

In light of the changing nature of the fishery, we felt it appropriate to re-examine the basis for the partial recruitment vector. We calculated the average F on partially recruited ages (taken to be age 6 and younger) relative to the population-weighted F's of fully recruited ages over the period 1992-1995, a period when much of the mobile gear fishery was making changes to a different mesh type. The resulting partial recruitment vector is compared with the old one below:

Age	Old PR	New PR
2	0.01	0.01
3	0.10	0.10
4	0.30	0.40
5	0.50	0.80
6	0.80	0.90

7	1.00	1.00
8	1.00	1.00
9	1.00	1.00
10	1.00	1.00
11	1.00	1.00
12	1.00	1.00

The new partial recruitment vector was used for the current ADAPT runs and for the projections.

Yield per Recruit

Given that a new partial recruitment vector was adopted this year, we determined whether this change affected yield per recruit. The calculations are shown below, with weight at age averaged from 1979 to 1995, a period of stability in weight at age (Fig. 9).

```
                NATURAL MORTALITY RATE :  0.2
F0.1  COMPUTED AS  0.3042  AT  Y/R  OF   1.0156
FMAX  COMPUTED AS  0.7284  AT  Y/R  OF   1.1179
```

YIELD PER RECRUIT ANALYSIS

	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
	0.1000	0.181	0.599	3.310	1.796
	0.2000	0.288	0.880	3.054	1.318
	0.3000	0.356	1.012	2.842	1.010
F0.1---	0.3042	0.358	1.016	2.834	1.000
	0.4000	0.402	1.074	2.669	0.804
	0.5000	0.436	1.102	2.528	0.660
	0.6000	0.462	1.114	2.413	0.556
	0.7000	0.482	1.118	2.317	0.478
FMAX---	0.7284	0.488	1.118	2.293	0.460
	0.8000	0.499	1.117	2.237	0.418
	0.9000	0.514	1.114	2.169	0.371
	1.0000	0.526	1.111	2.111	0.333
	1.1000	0.537	1.106	2.060	0.301
	1.2000	0.547	1.102	2.015	0.275
	1.3000	0.555	1.097	1.975	0.253
	1.4000	0.563	1.092	1.940	0.234
	1.5000	0.570	1.088	1.908	0.217

Thus, the $F_{0.1}$ fishing mortality was taken to be 0.30, as was the case in previous assessments.

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 9, using the following data:

C_{ay} = catch a= 2 to 12, y = 1974 to 1995
I_{ay}= TC5 catch rates

and/or TC1-3 catch rates a= 3 to 9, y = 1982 to 1995

where a is age, and y is year. The model provided estimates of the abundances of ages 4 to 12. Last year's formulation provided estimates of ages 5 through 12.

Both available commercial fishery indices were considered midyear indices 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.

Assessment Results

Several possible combinations of abundance indices were considered. The table below summarizes differences in overall model fit and projected catch in 1997.

ADAPT Input	Mean Square Residual	Projected F0.1 Catch in 1997 (t)	Comments
1. Catch at age to 1994, last year's formulation (index TC5, ages 4 to 10)	0.2755		
2. As above, plus 1995 CAA + index	0.3247	19808	Comparatively poor overall fit.
3. Revised CAA, index TC5, ages 4-9, new PR.	0.2336	22159	Some runs of positive and negative residuals, but residual magnitude is comparatively small
4. Revised CAA, indices TC5+TC1-3, ages 4-9, new PR.	0.2553	29077	Pronounced runs of positive and negative residuals. 1989 residuals marked at ages 3 and 4.
5. As in 4, but drop 1989 year for TC 1-3	0.2336	30450	Deletion of 1989 year had little impact on overall model fit.

On the basis of the above, we identified run 3 as the best scenario. Age by age plots showing the relationship between the population and the index along with residuals are provided in Fig. 18. For each cohort, the terminal population abundance estimates from ADAPT were adjusted for bias and used to construct the history of stock status (Tables 10, 11). The assessment results are summarized in Figs. 19-21. Recruitment after the strong 1979 yearclass has been close to the longterm average of 28 million fish. The 1989 yearclass is now estimated to be the second strongest in the series and is driving a recovery in population biomass. However, all year classes subsequent to 1989 appear to be comparatively weak. The exploitation rate has been increasing since 1984 and reached a peak in 1992. It has since declined, and with the current level of exploitation, has fallen below $F_{0.1}$.

Prognosis

If the TAC of 10,000 t is taken in 1996, the resulting fully recruited fishing mortality will be about 0.14 (Table 12). The beginning of year biomass will increase from 70582 t in 1996 to 73601 t in 1997. The $F_{0.1}$ catch in 1996 is 22,159 t. The relationship between 5+ biomass and yield with varying exploitation rates is shown in Fig. 21.

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Table 1. Pollock landings[1] (t round fresh) by country for NAFO Divs. 4VWX and Subdiv. 5Zc
(Source: Neilson and Perley 1995, DFO ZIFF & IOP Data)

	Canada	Japan	France[2]	Fed. Rep. Germany	German Dem. Rep.	Cuba	USSR (Russia)	USA	Spain	Other	Total
1974	24975	40		149			2301	435	1500	61	29461
1975	26548			236	95		2004	403	708	124	30118
1976	23565			994	24		1466	443	303	385	27180
1977	24653	1		368			182	325		53	25582
1978	26801	110	33			141	502	451			28038
1979	29967	19	23			50	1025	391		7	31482
1980	35986	81	99			32	950	443			37591
1981	40270	15	90				358	918			41651
1982	38029	3	44			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	40864	1				99	1782				42746
1990	36348					261	1040				37649
1991	37931	38				459	1177				39605
1992	32002	72	9			1015	1006				34104
1993	20253					644	176				21073
1994	15240					10					15250
1995	9737					58					9795

[1] Data from 1992 to 1995 are provisional.
[2] Includes mainland France and St. Pierre and Miquelon

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	4032	7541	4270	15843	6773	12414	5832	25019
1990	4831	4522	2916	12269	3151	13850	7077	24078
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
1995	430	649	613	1692	1131	4271	2643	8045

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								
1995								

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

Other Foreign Countries

	4VW				4X + 5Zc			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1974	176	196	173	545	746	605	289	1640
1975	421	57	263	741	145	253	427	825
1976	254	318	162	734	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		378		118		118
1992	259	361		620	12	464		476
1993	85	213		298	4	343		347
1994		9		9		1		1
1995	11	43		54	1	3		4

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	2990	4932	3614	11536	1498	2428	2419	6345
1990	4180	2832	1836	8848	1654	1850	1314	4818
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
1995	384	463	417	1264	215	400	391	1006

	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	4562	2372	49	6983
1990	455	594	496	1545	558	3985	1999	6542
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
1995	39	26	8	73	701	2016	809	3526

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

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	1312	597	2019	712	7614	3364	11690
1990	196	1095	584	1875	939	8015	3763	12717
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
1995	7	159	188	354	216	1854	1443	3513

Table 4. 1995 pollock fishing activity by gear sector, 4VWX5Zc pollock.

Gear Sector	Quota	Catch	% of Quota
4VW Fixed <45'	518	409	79
4X,5Y Fixed <45' ENS Gillnet/Handline	40	24	60
4X,5Y Fixed <45' ENS Longline	41	35	85
4X,5Y Fixed <45' Gillnet	2555	2778	109
4X,5Y Fixed <45' 4X Handline	631	404	64
4X,5Y Fixed <45' 4X Longline Group A	84	66	79
4X,5Y Fixed <45' 4X Longline Group B	86	52	60
4X,5Y Fixed <45' 4X Longline Group B1	52	49	94
4X5Y Fixed <45'	13	12	92
4VWX Fixed 45-64'	156	127	81
4XVX5Zc Mobile <65' (ITQ)	3292	2737	83
4XVX5Zc Mobile <65' (Generalists)	26	19	73
4XVX5Zc Mobile 65-100'	983	927	94
4XVX5Zc Vessels > 100'	6023	2205	37
Totals	14500	9844	68

Table 5. Summary of commercial fishery sampling for 4VWX5Zc pollock in 1995, and how the sampling data were used to construct the catch at age.

Area	4VW			4X5		
Trimester	TR1	TR2	TR3	TR1	TR2	TR3
No. of San	7	4	4	9	19	14
No. Aged	205	94	119	312	680	397
Landings (	430	649	613	1131	4271	2643

Gear	Tonnage Class	Trimester	Area	a	b	Number of Samples	Number Measured	Landings(t)	ALK Used
OTB	small mobile	TR1	4VW	0.00001017	3.02997	0	)TB TC 1-3 TR2	39	4VWTR1
	Large mobile	TR1				8	1617	384	
	small mobile	TR2				2	323	26	4VWTR2
	Large mobile	TR2				2	406	463	
	small mobile	TR3				1	274	8	4VWTR3
	Large mobile	TR3				4	796	417	
	small mobile	TR1	4X5	0.00001053	3.01437	6	1303	701	4XTR1
	Large mobile	TR1				4	882	215	
	small mobile	TR2				12	3116	2016	4XTR2
	Large mobile	TR2				3	803	400	
	small mobile	TR3				13	3019	809	4XTR3
	Large mobile	TR3				3	577	391	
GN		TR1,2,3	4VW	0.00001017	3.02997	1	290	277	4VW**
		TR1,2,3	4X5	0.00001053	3.01437	14	3298	2825	4X**
LL		TR1,2,3	4VW	0.00001017	3.02997	1	150	73	4VW**
		TR1,2,3	4X5	0.00001053	3.01437	5	736	684	4X**
Misc		TR1,2,3	4VWX	0.00001152	3.01036	0	***	8	4VWX

* Used samples from TR2

** Combination of all samples by area to construct the ALK

*** Used all LF samples

Table 6. Catch at age (numbers in thousands), revised method of aggregation.

Total Catch at Age

	1974	1975	1976	1977	1978	1979	1980
1	-	-	-	-	-	8	-
2	197	175	178	36	23	98	171
3	5603	1058	1361	1476	835	2763	291
4	2662	4023	1974	2873	3119	5786	1864
5	2356	2090	3649	1785	3084	3482	5306
6	1088	1904	1089	2181	1276	1705	3169
7	317	835	1089	732	1167	528	1075
8	164	196	207	417	257	249	277
9	80	55	36	108	143	47	168
10	83	57	14	19	17	15	32
11	74	35	18	25	19	14	9
12	40	31	49	80	18	-	2

	1981	1982	1983	1984	1985	1986	1987
1	10	-	1	1	1	1 -	
2	171	134	56	87	37	60	10
3	291	4018	1999	803	493	635	467
4	1864	1589	9514	3493	2190	3062	2259
5	5306	563	1256	7155	4160	3562	4908
6	3169	1873	238	639	6183	3595	3538
7	1075	2295	524	92	1105	3306	2404
8	277	1069	835	217	131	299	1736
9	168	389	428	210	139	82	177
10	32	172	163	92	230	117	39
11	9	87	50	18	85	171	48
12	2	22	58	23	59	116	98

	1988	1989	1990	1991	1992	1993	1994	1995
1	1 -		8 -	-	-	-		
2	27	61	49	45	24	56	50	32
3	683	670	803	1308	2037	903	273	465
4	2669	4104	1777	3310	5395	3543	693	793
5	3290	3832	3598	3257	3798	3087	2184	1252
6	3390	2424	2727	3543	1980	1412	1396	1230
7	1860	2170	1563	1651	1116	553	709	399
8	1181	970	986	808	449	279	338	95
9	1005	702	641	400	314	104	172	37
10	43	434	308	300	169	38	44	17
11	19	31	120	141	68	21	18	5
12	97	14	47	91	54	13	7	1

Table 6.(Cont.) Catch at age (numbers in thousands), new method of aggregation.

	1974	1975	1976	1977	1978	1979	1980
1	-	-	-	-	-	-	-
2	185	167	126	36	23	8	128
3	4784	986	1207	1433	786	98	244
4	2364	3567	1738	2855	3070	2752	1733
5	2125	1852	3170	1760	3022	5582	5035
6	954	1660	939	2128	1222	3341	3113
7	273	795	1001	710	1142	1645	1047
8	144	132	194	395	246	495	269
9	64	45	35	90	134	248	165
10	51	56	12	19	17	47	32
11	33	34	16	25	19	15	9
12	10	30	42	80	18	14	2

	1981	1982	1983	1984	1985	1986	1987
1	-	-	-	-	-	-	-
2	42	132	54	22	24	4	8
3	1333	3516	1857	720	477	217	428
4	672	1584	9309	3491	2179	2868	2231
5	2043	563	1248	7152	4162	3519	4859
6	4019	1872	237	639	6178	3575	3489
7	2432	2294	523	91	1102	3291	2372
8	712	1067	833	215	126	298	1672
9	207	389	428	207	134	82	175
10	148	172	163	148	221	113	35
11	31	87	50	31	78	165	44
12	24	22	58	24	57	113	95

	1988	1989	1990	1991	1992	1993	1994	1995	1986-1995
1	-	-	-	-	-	-	-		-
2	27	34	4	45	24	56	50	23	28
3	618	580	595	1024	2008	901	272	405	705
4	2493	3424	1578	2571	4508	3521	691	779	2466
5	3235	3652	3276	2774	3041	2824	2179	1247	3061
6	3345	2381	2662	3427	1853	1282	1395	1229	2464
7	1784	2104	1543	1592	1036	498	709	399	1533
8	1146	931	970	793	427	271	338	95	694
9	991	677	631	390	306	100	172	37	356
10	43	414	308	288	167	37	44	17	147
11	17	28	118	138	66	21	18	5	62
12	93	10	41	87	53	13	7	1	51

Table 6.(Cont.) Catch at age (numbers in thousands), new method of aggregation.

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	-

Small Mesh Gear Catch at Age

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

	1981	1982	1983	1984	1985	1986	1987
1	10	-	-	1	1	1	-
2	829	2	2	65	13	56	2
3	1	502	142	83	16	318	39
4	1	5	205	2	11	194	28
5	1	-	8	3	34	43	49
6	-	1	1	-	5	20	49
7	-	1	1	1	3	15	32
8	1	2	2	2	5	1	64
9	1	-	-	3	5	-	2
10	-	-	-	-	9	4	4
11	-	-	-	0	7	6	4
12	-	-	-	2	2	3	3

Table 6.(Cont.) Catch at age (numbers in thousands), new method of aggregation.

	1988	1989	1990	1991	1992	1993	1994	1995
1	1	-	8	-	-	-	-	
2	-	27	45	284	29	2	-	9
3	65	90	208	739	887	22	1	60
4	176	680	199	483	757	263	2	14
5	55	180	322	116	127	130	5	5
6	45	43	65	59	80	55	1	1
7	76	66	20	15	22	8	-	
8	35	39	16	10	8	4	-	
9	14	25	10	12	2	1	-	
10	-	20	-	3	2	-	-	
11	2	3	2	4	1	-	-	
12	4	4	6	1	1	-	-	

Table 7. Mean weights at age (kg) for pollock in 4VWX5Zc.

Total Weight at Age

	1974	1975	1976	1977	1978	1979	1980
1	-	-	-	-	-	0.19	-
2	0.82	0.86	0.59	0.79	1.14	0.77	1.03
3	1.38	1.26	1.21	1.1	1.23	1.18	1.68
4	1.94	1.95	1.92	1.52	1.8	1.55	2.08
5	3	3.06	2.81	2.48	2.6	2.62	2.77
6	4.09	3.81	3.71	3.5	3.9	3.4	3.46
7	5.08	5.06	4.67	4.52	4.59	4.34	4.12
8	6.16	6.52	5.64	5.47	6.02	5.55	5.58
9	6.68	7.49	7.02	6.62	6.91	6.61	6.5
10	7.39	7.49	7.8	7.25	7.37	7.14	9.07
11	8.58	8.22	8.76	10.02	8.38	8.79	8.4
12	10.03	9.59	9.11	11.3	10.03	-	11.65

	1981	1982	1983	1984	1985	1986	1987
1	-	-	0.63	0.36	-	0.1	-
2	0.68	0.76	0.83	0.73	0.74	0.35	0.64
3	1.74	1.19	1.25	1.64	1.49	1.13	1.32
4	2.54	2.69	1.66	2.36	1.96	2	1.96
5	2.91	3.51	3.12	2.67	2.73	2.52	2.5
6	3.34	4.18	4.12	3.84	3.12	3.29	2.94
7	4.32	4.45	4.83	5.41	3.42	3.61	3.71
8	5.93	5.19	5.08	5.97	4.39	4.2	4.03
9	6.9	6.12	5.84	5.9	6.1	5.66	4.55
10	7.77	7.64	6.48	6.32	5.86	6.09	6.26
11	7.54	8	8	7.69	6.17	6.11	6.15
12	9.22	8.65	8.72	8.53	7.52	6.68	7.57

	1988	1989	1990	1991	1992	1993	1994	1995
1	-	-	0.25	0.14	-	-	-	
2	1.17	0.60	0.48	0.53	0.75	0.97	0.87	0.61
3	1.37	1.23	1.30	1.09	1.08	1.19	1.28	1.07
4	1.88	1.71	2.04	1.93	1.62	1.54	1.54	1.65
5	2.64	2.43	2.56	2.63	2.41	2.17	1.90	2.08
6	3.21	3.16	2.96	3.07	3.03	2.95	3.06	2.58
7	3.51	3.69	3.78	3.42	3.49	3.33	3.78	3.64
8	4.23	4.03	4.21	4.16	4.18	3.88	4.18	4.35
9	4.41	4.68	4.97	4.63	4.96	4.70	4.74	4.66
10	5.26	4.79	5.24	5.00	5.60	5.35	5.59	4.88
11	7.18	6.41	6.06	5.77	5.88	5.97	6.00	5.51
12	8.46	7.25	7.09	5.90	6.43	6.81	6.18	7.57

Table 7.(Cont.) Mean weights at age (kg) for pollock in 4VWX5Zc.

Canadian Weight at Age

	1974	1975	1976	1977	1978	1979	1980
1	-	-	-	-	-	0.19	-
2	0.83	0.86	0.63	0.79	1.14	0.77	1.12
3	1.43	1.27	1.23	1.11	1.26	1.18	1.77
4	1.98	1.99	1.94	1.52	1.81	1.54	2.1
5	3.02	3.1	2.8	2.48	2.59	2.63	2.8
6	4.05	3.87	3.73	3.49	3.88	3.38	3.47
7	5.03	5.07	4.65	4.5	4.59	4.33	4.14
8	6.06	6.51	5.62	5.45	6	5.54	5.56
9	6.62	7.47	7.04	6.55	6.84	6.61	6.51
10	7.22	7.69	7.71	7.25	7.37	7.14	9.07
11	8.12	8.47	8.67	10.02	8.38	8.79	8.4
12	9.37	9.89	9.19	11.3	10.03	-	11.65

	1981	1982	1983	1984	1985	1986	1987
1	-	-	-	-	-	-	-
2	1.01	0.76	0.84	1.46	0.94	0.83	0.72
3	1.74	1.24	1.25	1.68	1.52	1.39	1.37
4	2.54	2.7	1.67	2.36	1.96	2.02	1.97
5	2.91	3.51	3.13	2.67	2.74	2.52	2.51
6	3.34	4.18	4.11	3.84	3.12	3.29	2.95
7	4.32	4.45	4.83	5.41	3.43	3.61	3.72
8	5.93	5.19	5.08	5.97	4.39	4.2	4.04
9	6.9	6.12	5.84	5.9	6.13	5.66	4.55
10	7.77	7.64	6.48	6.34	5.89	6.09	6.32
11	7.54	8	8	7.69	6.19	6.11	6.27
12	9.22	8.65	8.72	8.76	7.56	6.86	7.62

	1988	1989	1990	1991	1992	1993	1994	1995
1	-	-	-	-	-	-	-	
2	1.17	0.746	0.815	0.88	1.10	0.99	0.865	0.734
3	1.46	1.258	1.453	1.30	1.26	1.20	1.285	1.137
4	1.92	1.819	2.064	2.06	1.69	1.56	1.543	1.661
5	2.64	2.446	2.553	2.67	2.43	2.19	1.903	2.086
6	3.22	3.17	2.969	3.08	3.06	2.97	3.065	2.578
7	3.51	3.709	3.779	3.42	3.51	3.33	3.779	3.635
8	4.23	4.048	4.221	4.16	4.20	3.88	4.177	4.349
9	4.41	4.709	4.982	4.63	4.96	4.70	4.74	4.663
10	5.26	4.807	5.241	4.99	5.61	5.35	5.588	4.884
11	8.03	6.644	6.057	5.77	5.88	5.97	5.999	5.512
12	8.52	7.253	7.189	5.87	6.42	6.81	6.182	7.574

Table 7.(Cont.) Mean weights at age (kg) for pollock in 4VWX5Zc.

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	-

Small Mesh Gear Weight at Age

	1974	1975	1976	1977	1978	1979	1980
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	0.77
3	1.02	1.11	0.92	0.74	0.83	1.23	1.25
4	1.47	1.74	1.45	1.65	1.66	1.81	1.86
5	2.71	3.04	2.91	2.8	2.88	2.49	2.19
6	4.9	3.47	3.68	3.9	4.32	3.93	2.72
7	5.5	5.62	5.13	4.99	4.45	4.48	3.14
8	7.01	6.64	-	5.9	6.45	5.98	6.32
9	7.01	8	-	6.92	8.01	-	6.37
10	7.73	-	-	-	-	-	-
11	8.99	-	-	-	-	-	-
12	10.2	-	-	-	-	-	-

	1981	1982	1983	1984	1985	1986	1987
1	-	-	-	0.36	-	-	-
2	0.66	0.62	0.43	0.48	0.37	0.32	0.32
3	1.52	0.84	1.15	1.29	0.62	0.87	0.79
4	1.74	2.15	1.28	2.5	1.39	1.68	1.4
5	2.96	-	2.52	2.82	2.35	2.48	1.92
6	3.63	3.54	4.38	3.77	2.92	3.24	2.65
7	4.28	4.97	4.62	4.97	3.04	3.2	2.94
8	5.41	6.3	4.35	5.6	4.29	3.85	3.61
9	7.36	8.82	5.03	5.87	5.4	-	4.78
10	8.87	7.43	7.08	5.96	5.35	6.14	5.74
11	-	-	7.61	7.25	5.94	6.04	4.84
12	-	8.5	8.39	6.19	6.46	-	5.96

Table 7.(Cont.) Mean weights at age (kg) for pollock in 4VWX5Zc.

	1988	1989	1990	1991	1992	1993	1994	1995
1	-	-	0.25	0.14	-	-		
2	0.26	0.42	0.45	0.47	0.46	0.5	0.36	0.29
3	0.5	1.08	0.86	0.79	0.7	1	0.60	0.58
4	1.22	1.19	1.85	1.29	1.23	1.35	0.76	0.80
5	2.39	2.04	2.59	1.85	1.9	1.93	1.24	1.22
6	2.7	2.82	2.8	2.69	2.16	2.59	1.67	1.94
7	3.36	3.08	3.68	3.4	2.77	3.35	-	
8	4.33	3.69	3.77	3.89	3.46	3.95	-	
9	4.3	3.99	4.32	4.54	4.31	5.1	-	
10	-	4.45	5.74	6.02	4.6	6.1	-	
11	-	4.19	6.12	5.86	5.85	6.8	-	
12	7.04	7.24	6.45	8.25	6.8	7.8	-	

Table 8. 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	1995	1996	Mean	SD	CV
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	0.25	0.48	2.43	9.36	385.13
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	3.23	0	4.10	8.26	201.73
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	0.96	0.10	0.20	206.69
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	0	0.02	0.06	331.69
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	0	0.24	0.65	266.61
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	0	0	1.20	4.62	384.01
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	0.66	0.33	1.79	4.25	237.00
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	0	0.12	0.22	181.50
48	0	0	0	0	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		4.08	0	0	0	0	5.35	0	0.52	0	0	0	0	0	0	112.9	0	0	0	5.58	24.00	429.96
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	81.13	0	5.80	17.98	310.25
51	0	0	0	0.55	0.49	3.13	25.93	0	2.92	571.5	0	0	96.76	1.09	133	22.13	6.09	21.23	0	9.26	378.5	0	555.6	6.5	79.49	173.48	218.25
52	0	0	0	0	0.55	0.49	3.6	0	0	5.05	3.6	113.8	6.69	60.03	0.34	0.55	0.52	0.65	7.29	1.49	0.51	8.7	26.22	1.52	10.44	26.07	249.82
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	0	58.17	0	13.42	47.82	356.28
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	0	0.15	0.38	256.25
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	0.3	1.3	0.73	1.78	244.69
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	6.07	1.78	1.74	4.13	236.59
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	0	0.04	0.14	323.67
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	0.25	0	0.65	2.32	355.73
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	0.33	0.75	2.26	4.37	193.56
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	337.2	10.49	40.88	111	35.08	4.37	34.71	33.29	4.37	13.2	47.28	97.16	205.52
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	2.53	1.53	3.14	4.53	144.19
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	1.28	0.48	9.15	16.15	176.50
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	4.42	2.43	3.25	2.70	83.06
64	0	0	0	0.32	1.79	3.52	0.97	0	0	0	41.22	0.62	2.96	0.28	4.57	1.58	23.77	1.37	6	17.78	2.65	2.58	6.41	2	5.15	9.80	190.38
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	14.43	38.84	4.36	6.47	148.40
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	178.5	0	0	33.87	8.04	37.18	462.42
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	364.4	41.63	75.35	5.35	7.47	2.49	10.87	44.72	76.10	170.18
71	0.55	0	0	0	6.35	3.04	0	4.86	1.37	0	0.97	1.63	27.79	4.63	108.6	6.85	1.03	4.03	6.02	6.81	157.5	1.5	5		15.15	38.35	253.10
72	1.09	2.57	0	2.13	1.74	0.46	0.34	16.42	5.83	0.49	5.47	1.75	377.2	6.18	3.6	8.51	14.41	0.98	2.07	19.93	8.25	7.49	49.77	1.66	23.33	77.89	333.78
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	4.53	7.68	0.97	2.74	283.36
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	1.31	0.16	0.43	264.32
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	0.5	1.47	0.20	0.33	169.27
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	439.2	2.44	4.13	9.52	33.05	18	1.25	29.69	90.31	304.17
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	1.14	1.25	2.62	6.96	266.11
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	82.2	79.74	9.55	21.28	222.76
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	20.37	2.57	4.01	8.32	207.33
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	104.5	18.36	2.17	76	3.27	2.71	1.23	10.34	25.88	250.34
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	4.35	3.15	6.01	10.33	171.93
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	0	0	3.36	10.49	311.71
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	10.52	168.1	5.44	5.94	109.09
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	127.2	23.64	6.56	9.28	2.04	200.5	14.38	6.11	2.99	35.63	51.88	145.60
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	1.28	6.46	9.60	20.00	208.43
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	6.57	3.7	4.23	3.89	9.46	10.15	6	6.89	9.14	15.82	173.19
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	1.51	3.84	2.73	2.86	104.86
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	0	0	3.05	9.66	316.29
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	0	0.29	0.52	182.32
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	0.5	0.47	0.51	0.76	148.98

Table 9. Age disaggregated catch rates for TC 5 and
TC 1-3 stern trawlers fishing pollock in 4VWX5Zc and 4X, respectively.

TC5

	1982	1983	1984	1985	1986	1987	1988
3	0.2715	0.0736	0.0450	0.0297	0.0105	0.0100	0.0257
4	0.0764	0.4786	0.2043	0.1556	0.1052	0.0553	0.0827
5	0.0205	0.0304	0.5629	0.1794	0.1564	0.1102	0.0872
6	0.0751	0.0050	0.0246	0.3537	0.1476	0.0966	0.0888
7	0.1044	0.0180	0.0026	0.0663	0.1578	0.0598	0.0624
8	0.0477	0.0405	0.0098	0.0058	0.0165	0.0432	0.0311
9	0.0179	0.0206	0.0106	0.0072	0.0021	0.0060	0.0339

	1989	1990	1991	1992	1993	1994	1995
3	0.0132	0.0274	0.0195	0.0669	0.0223	0.0098	0.0126
4	0.1025	0.0564	0.0393	0.1367	0.1438	0.0249	0.0589
5	0.1095	0.1102	0.0361	0.0736	0.1354	0.1569	0.1182
6	0.0627	0.0956	0.0555	0.0451	0.0620	0.0764	0.1931
7	0.0573	0.0520	0.0324	0.0326	0.0282	0.0322	0.0320
8	0.0278	0.0401	0.0159	0.0142	0.0187	0.0144	0.0069
9	0.0191	0.0223	0.0086	0.0091	0.0064	0.0052	0.0056

TC 1-3

	1982	1983	1984	1985	1986	1987	1988
3	0.0299	0.0238	0.0103	0.0052	0.0040	0.0045	0.0033
4	0.0286	0.0758	0.0432	0.0148	0.0235	0.0177	0.0175
5	0.0114	0.0105	0.0669	0.0358	0.0214	0.0310	0.0237
6	0.0241	0.0013	0.0081	0.0388	0.0212	0.0196	0.0227
7	0.0177	0.0025	0.0011	0.0066	0.0169	0.0146	0.0094
8	0.0075	0.0020	0.0021	0.0012	0.0017	0.0075	0.0067
9	0.0034	0.0012	0.0021	0.0011	0.0005	0.0012	0.0038
9	0.0179	0.0206	0.0106	0.0072	0.0021	0.0060	0.0339

	1989	1990	1991	1992	1993	1994	1995
3	0.0205	0.0098	0.0090	0.0161	0.0144	0.0069	0.0246
4	0.0705	0.0276	0.0242	0.0357	0.0476	0.0174	0.0354
5	0.0425	0.0398	0.0223	0.0195	0.0315	0.0393	0.0436
6	0.0214	0.0182	0.0194	0.0072	0.0089	0.0188	0.0223
7	0.0134	0.0058	0.0053	0.0018	0.0022	0.0067	0.0066
8	0.0043	0.0016	0.0021	0.0005	0.0005	0.0028	0.0014
9	0.0024	0.0011	0.0009	0.0003	0.0002	0.0010	0.0004

Table 10. Estimated beginning of year population numbers(000's), bias adjusted, for pollock

	2	3	4	5	6	7	8	9	10	11	12	13
1974	17301	27819	10152	8182	2956	825	405	484	337	173	130	0
1975	25390	13987	17736	5921	4584	1445	392	185	324	201	75	71
1976	34785	20629	10497	10904	2975	2050	441	146	102	214	133	34
1977	44129	28319	15662	6818	5656	1460	709	176	87	71	159	65
1978	27870	36097	21853	10237	3979	2678	543	210	49	54	36	59
1979	6926	22797	28800	15083	5614	2113	1150	215	45	24	27	13
1980	13559	5582	16175	18374	9218	3067	1256	717	134	24	8	22
1981	75444	10946	4308	11563	10281	4707	1547	779	436	81	11	4
1982	43446	61614	8699	1861	4728	5574	2887	1018	487	328	58	7
1983	34684	35449	46820	5692	1018	2195	2511	1407	485	244	191	28
1984	36768	28346	27220	29775	3531	620	1326	1307	768	251	155	104
1985	26351	30025	22483	19138	17947	2316	425	890	881	546	189	106
1986	27540	21541	24137	16433	11928	9152	910	230	604	515	370	102
1987	29699	22494	17063	17002	10251	6540	4531	477	115	389	268	199
1988	19617	24307	17995	11935	9515	5222	3201	2156	232	59	275	132
1989	21983	16036	19284	12329	6817	4753	2609	1563	868	151	31	138
1990	28656	17943	12525	12097	6656	3409	1953	1267	653	323	96	13
1991	44219	23417	13969	8665	6702	3035	1411	731	473	263	158	37
1992	15884	36162	17992	8462	4177	2331	1015	437	243	121	90	49
1993	12186	12983	27769	9889	3535	1653	913	430	81	49	39	26
1994	11357	9926	9815	19543	5327	1631	857	497	259	32	22	20
1995	28035	9254	7880	7411	14032	3108	701	400	253	172	10	11
1996	28000	22924	7156	5737	4940	10379	2185	489	294	192	136	8

Table 11. Estimated fishing mortality (bias adjusted). Pollock in 4VWX5Zc.

	2	3	4	5	6	7	8	9	10	11	12
1974	0.013	0.25	0.339	0.379	0.515	0.545	0.584	0.201	0.315	0.63	0.411
1975	0.008	0.087	0.286	0.488	0.605	0.987	0.788	0.394	0.215	0.212	0.596
1976	0.006	0.075	0.232	0.456	0.512	0.862	0.717	0.316	0.164	0.097	0.515
1977	0.001	0.059	0.225	0.339	0.548	0.79	1.017	1.091	0.274	0.487	0.793
1978	0.001	0.026	0.171	0.401	0.433	0.646	0.726	1.332	0.484	0.484	0.797
1979	0.016	0.143	0.249	0.292	0.405	0.321	0.272	0.275	0.45	0.97	0
1980	0.014	0.059	0.136	0.381	0.472	0.484	0.277	0.297	0.305	0.537	0.341
1981	0.003	0.03	0.639	0.694	0.412	0.289	0.219	0.27	0.084	0.131	0.216
1982	0.003	0.075	0.224	0.403	0.567	0.598	0.519	0.541	0.489	0.343	0.537
1983	0.002	0.064	0.253	0.277	0.297	0.304	0.453	0.406	0.459	0.255	0.405
1984	0.003	0.032	0.152	0.306	0.222	0.178	0.198	0.194	0.141	0.082	0.178
1985	0.002	0.018	0.113	0.273	0.473	0.734	0.413	0.188	0.337	0.188	0.418
1986	0.002	0.033	0.15	0.272	0.401	0.503	0.446	0.494	0.239	0.452	0.421
1987	0	0.023	0.157	0.381	0.475	0.514	0.543	0.521	0.465	0.146	0.511
1988	0.002	0.031	0.178	0.36	0.494	0.494	0.517	0.71	0.228	0.434	0.487
1989	0.003	0.047	0.266	0.416	0.493	0.689	0.522	0.673	0.787	0.255	0.668
1990	0.002	0.05	0.168	0.391	0.585	0.682	0.782	0.785	0.709	0.515	0.74
1991	0.001	0.064	0.301	0.53	0.856	0.895	0.972	0.903	1.161	0.875	0.98
1992	0.002	0.064	0.398	0.673	0.727	0.738	0.659	1.488	1.391	0.939	1.057
1993	0.005	0.08	0.151	0.419	0.574	0.456	0.408	0.309	0.719	0.624	0.456
1994	0.005	0.031	0.081	0.131	0.339	0.644	0.564	0.476	0.207	0.932	0.436
1995	0.001	0.057	0.117	0.206	0.102	0.152	0.161	0.108	0.077	0.033	0.112

Table 12. Projected population and catch, for pollock in 4VWX5Zc, 1996-8.

Projected Population Numbers

	2	3	4	5	6	7	8	9	10	11	12	13
1996	28000	22924	7156	5737	4940	10379	2185	489	294	192	136	8
1997	28000	22892	18508	5541	4201	3567	7391	1556	348	209	136	97
1998	28000	22856	18189	13440	3569	2625	2164	4483	944	211	127	83

Projected Fishing Mortality

	2	3	4	5	6	7	8	9	10	11	12
1996	0.001	0.014	0.056	0.112	0.126	0.14	0.14	0.14	0.14	0.14	0.14
1997	0.003	0.03	0.12	0.24	0.27	0.3	0.3	0.3	0.3	0.3	0.3

Projected Beginning Weight

	2	3	4	5	6	7	8	9	10	11	12	13
1996	0.78	1.02	1.37	1.79	2.49	3.28	3.82	4.38	5.03	5.66	6.36	6.76
1997	0.6	0.95	1.44	1.98	2.64	3.31	3.84	4.42	4.97	5.6	6.43	7.18
1998	0.6	0.95	1.44	1.98	2.64	3.31	3.84	4.42	4.97	5.6	6.43	7.18

Projected Population Biomass

	2	3	4	5	6	7	8	9	10	11	12	13	2+	3+	4+	5+
1996	21840	23382	9804	10269	12302	34044	8346	2141	1477	1085	867	51	125609	103769	80387	70582
1997	16800	21748	26652	10971	11090	11808	28380	6876	1730	1171	877	697	138801	122001	100253	73601
1998	16800	21713	26192	26611	9421	8690	8308	19813	4690	1182	816	594	144831	128031	106318	80126

Projected Catch Numbers

	2	3	4	5	6	7	8	9	10	11	12
1996	35	288	353	550	530	1229	259	58	35	23	16
1997	76	614	1901	1076	905	842	1745	367	82	49	32

Projected Average Weight

	2	3	4	5	6	7	8	9	10	11	12
1996	0.7	1.19	1.72	2.31	2.97	3.59	4.14	4.76	5.21	5.94	6.73
1997	0.7	1.19	1.72	2.31	2.97	3.59	4.14	4.76	5.21	5.94	6.73

Projected Catch Biomass

	2	3	4	5	6	7	8	9	10	11	12	2+	3+	4+	5+
1996	25	343	606	1272	1573	4410	1071	275	181	135	109	10000	9975	9632	9026
1997	53	730	3269	2485	2688	3023	7223	1748	428	293	217	22159	22105	21375	18106

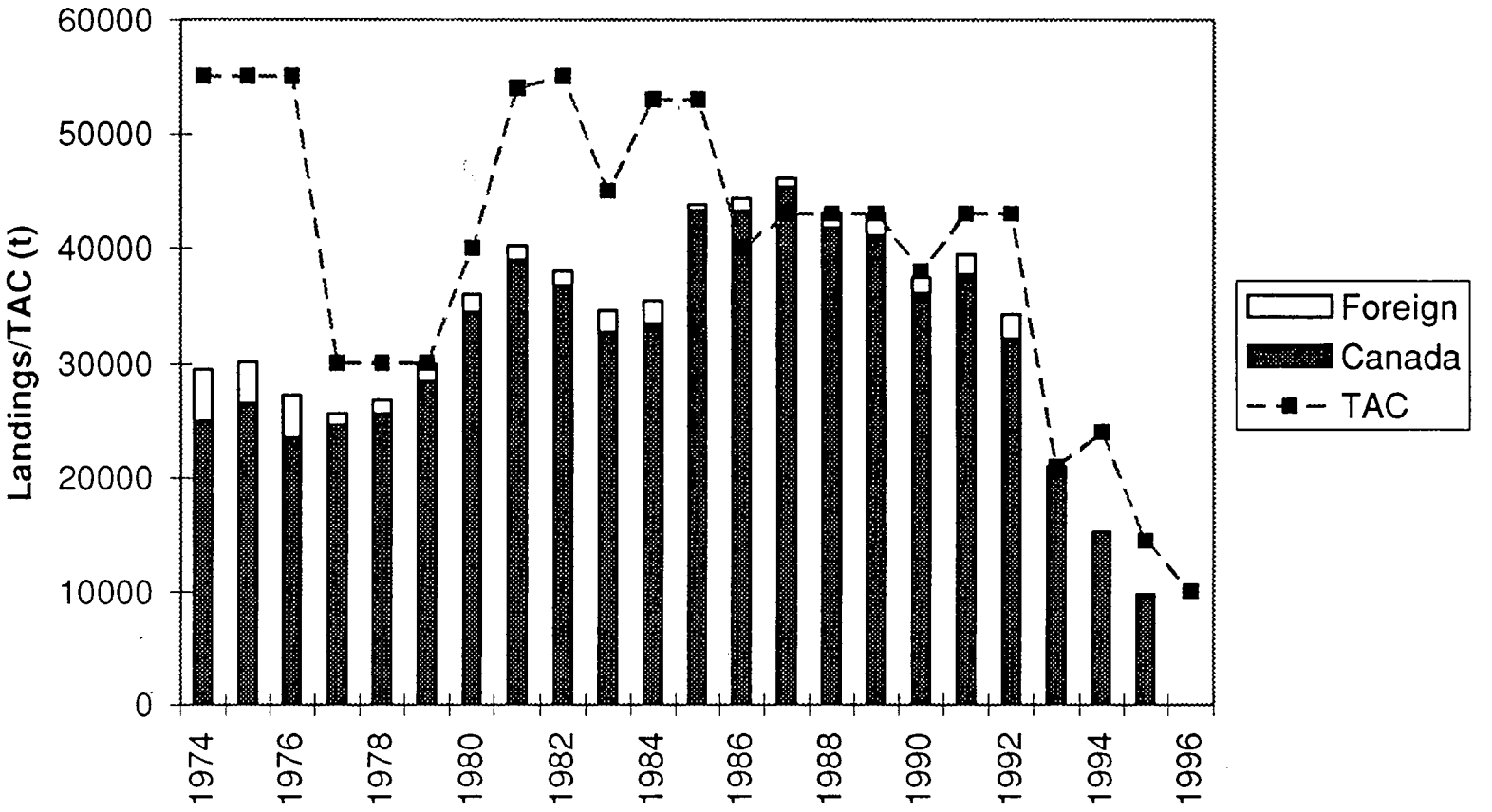


Fig. 1. Landings of 4VWX5Zc pollock by Canada and Foreign countries, shown with respect to the TAC

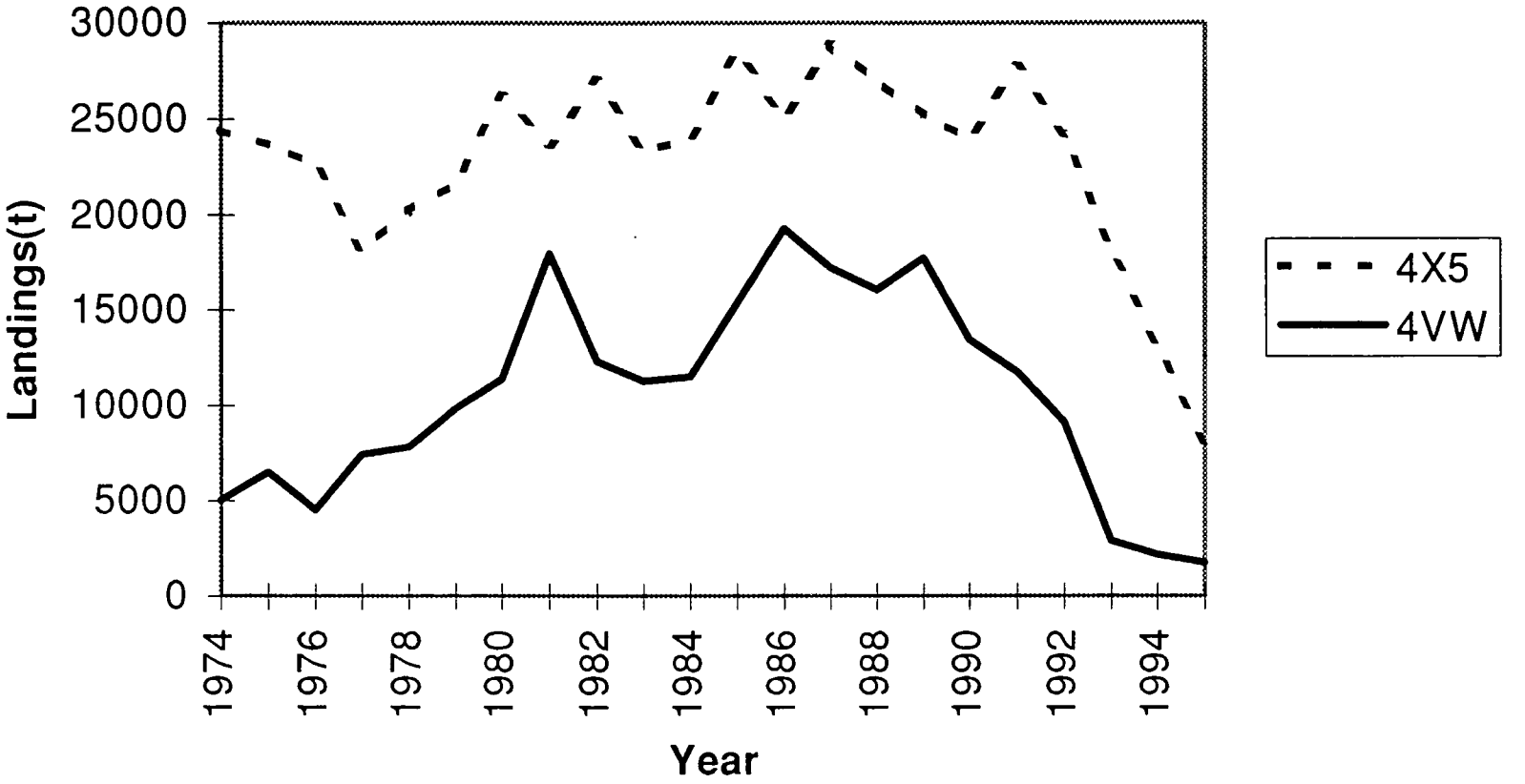


Fig. 2. Landings of 4VWX5Zc pollock, split into eastern and western halves of the management unit.

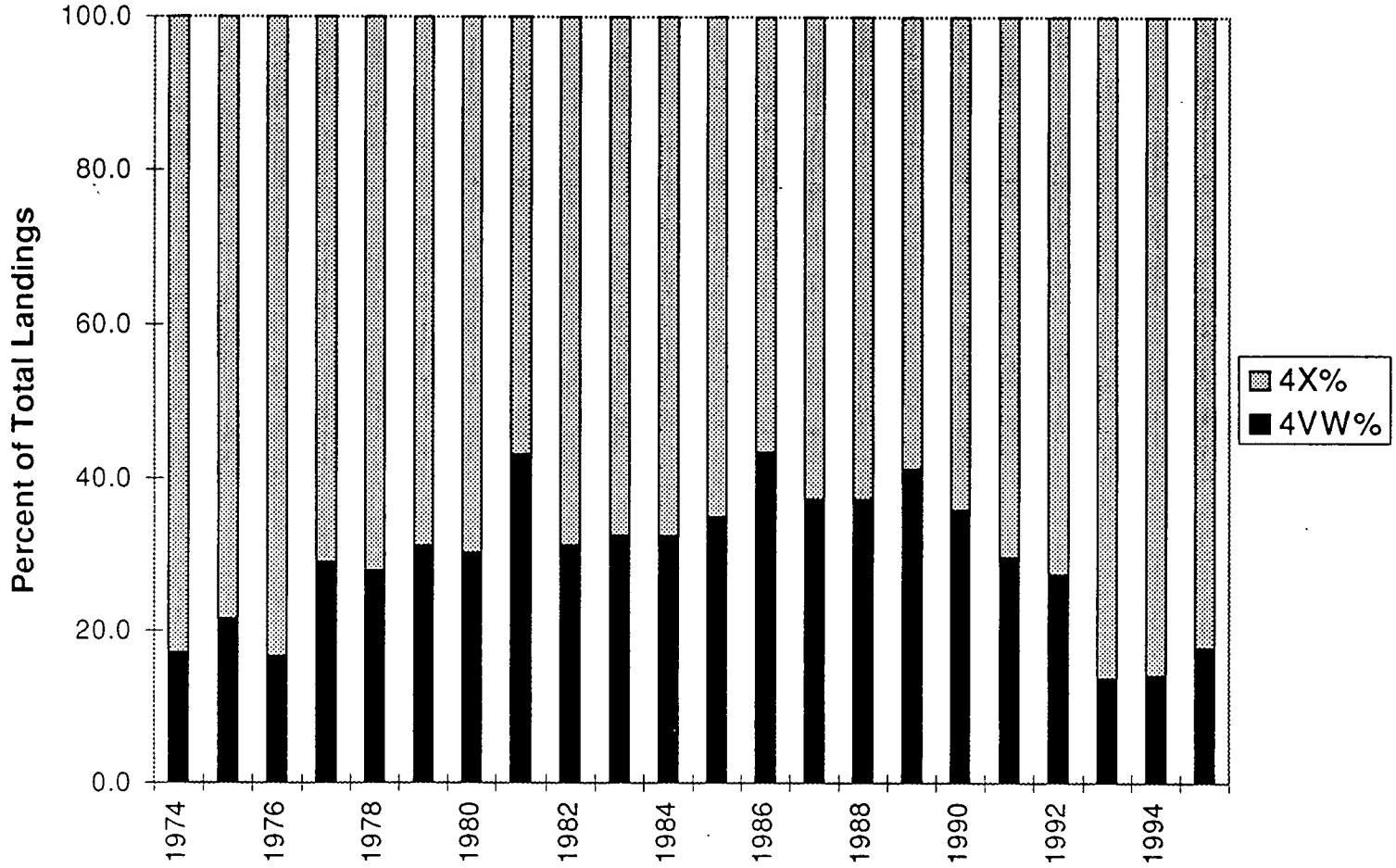


Fig. 3. Landings of 4VWX5Zc pollock, split into eastern and western halves of the management unit by proportion.

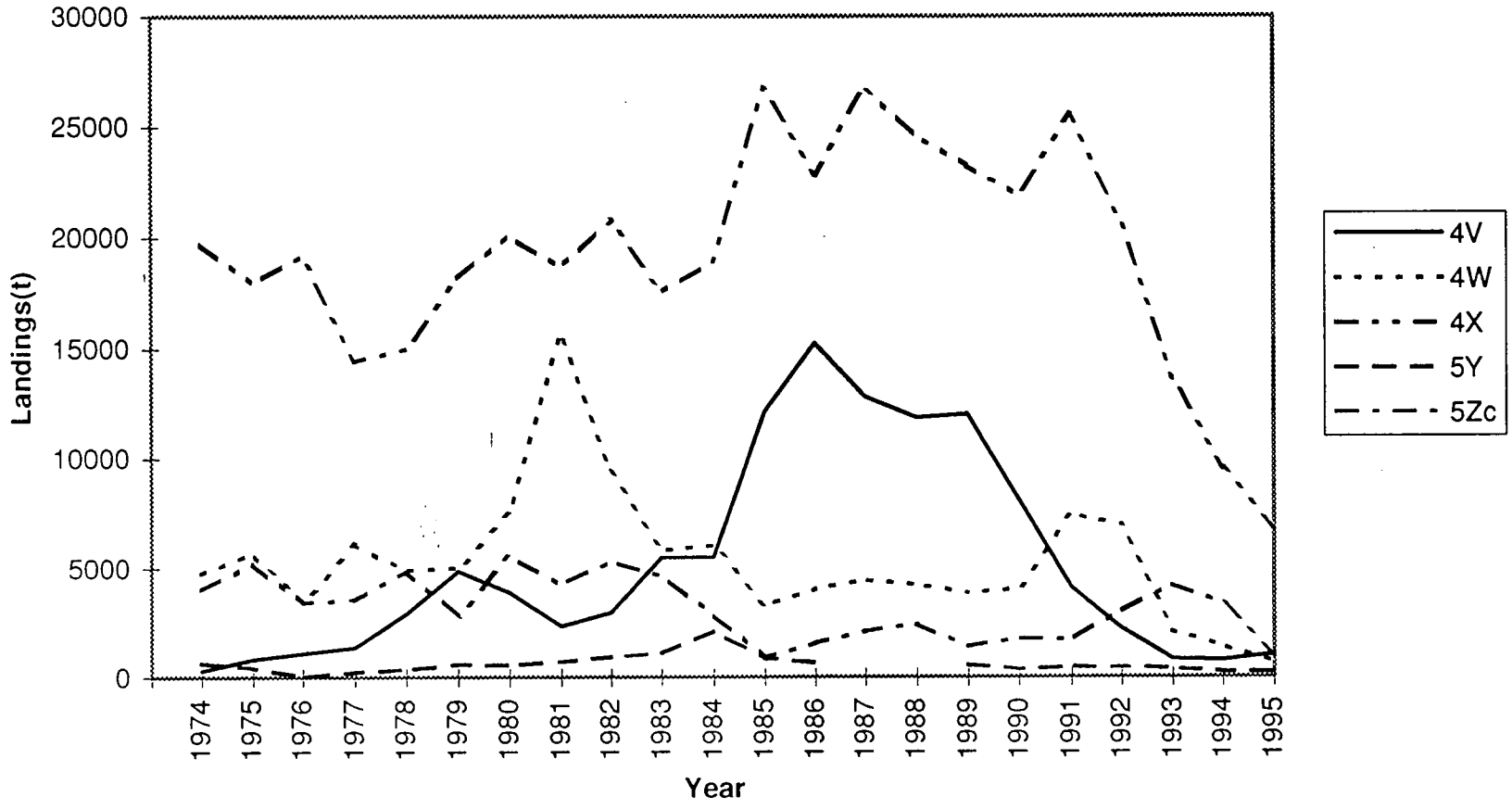


Fig. 4. Landings of 4VWX5Zc pollock by NAFO subdivision.

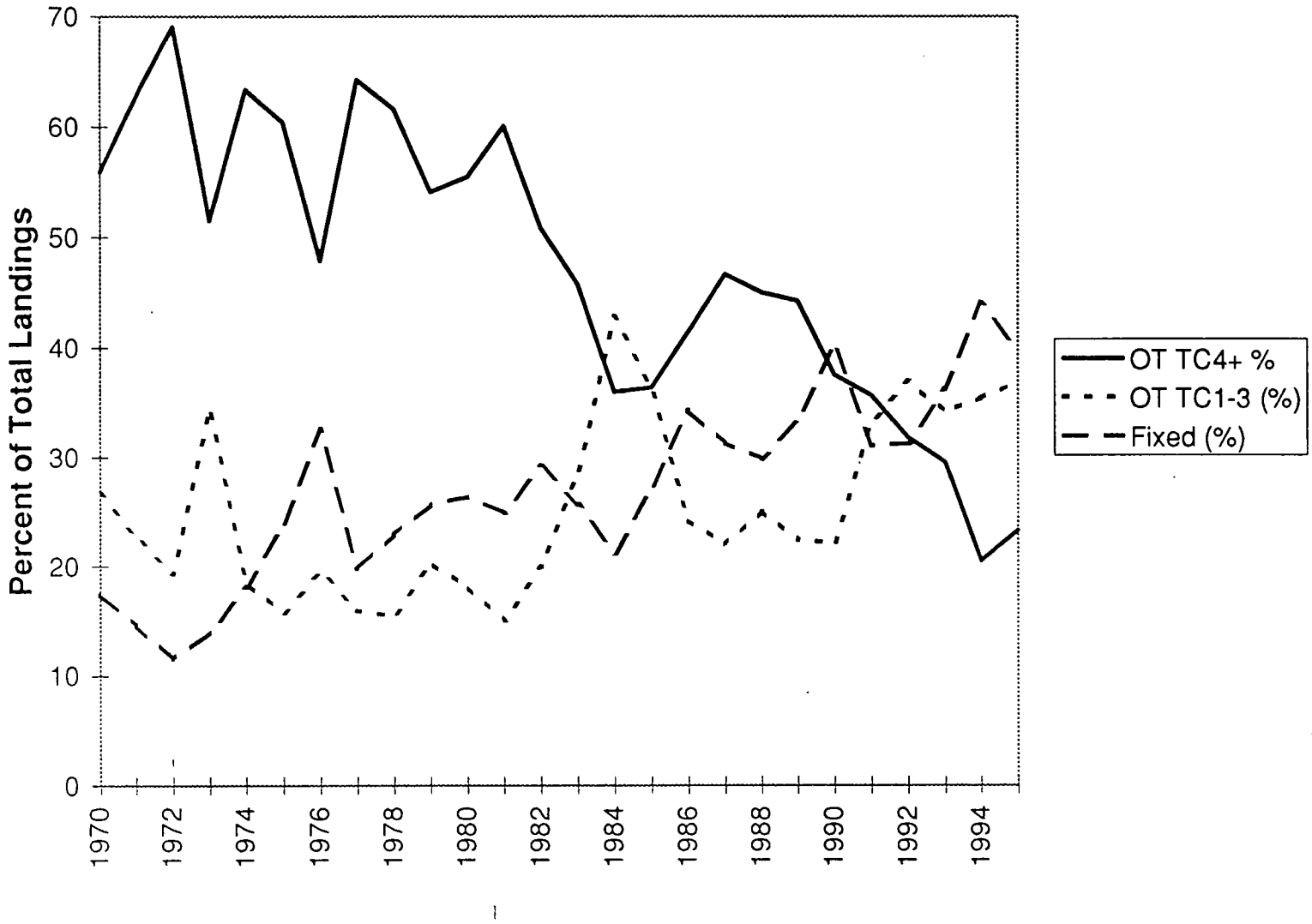


Fig. 5. Landings of 4VWX5Zc pollock by major gear type.

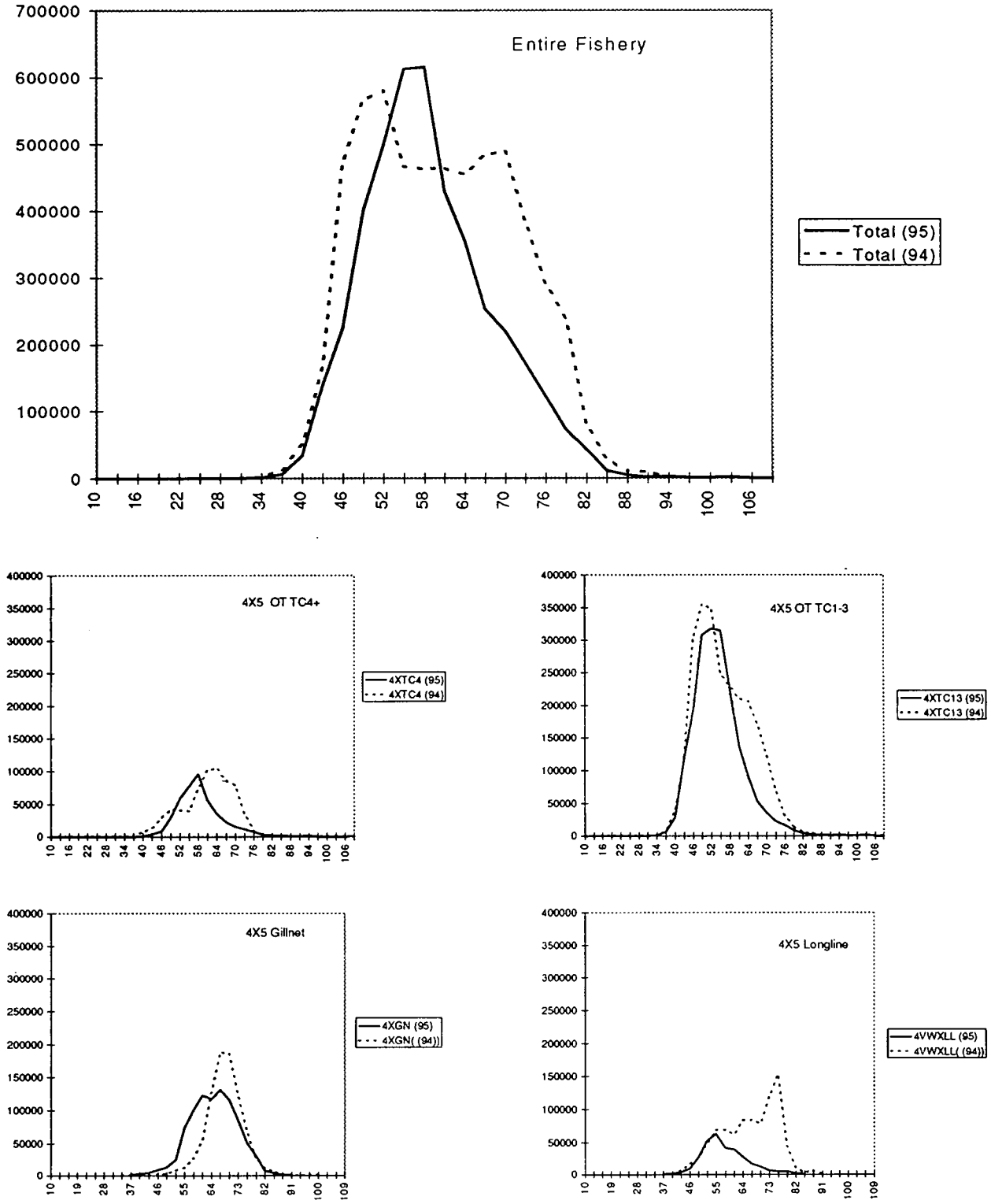


Fig. 6. The 1995 length composition of the landings of pollock compared with 1994. Some major constituents of the catch at age are also shown

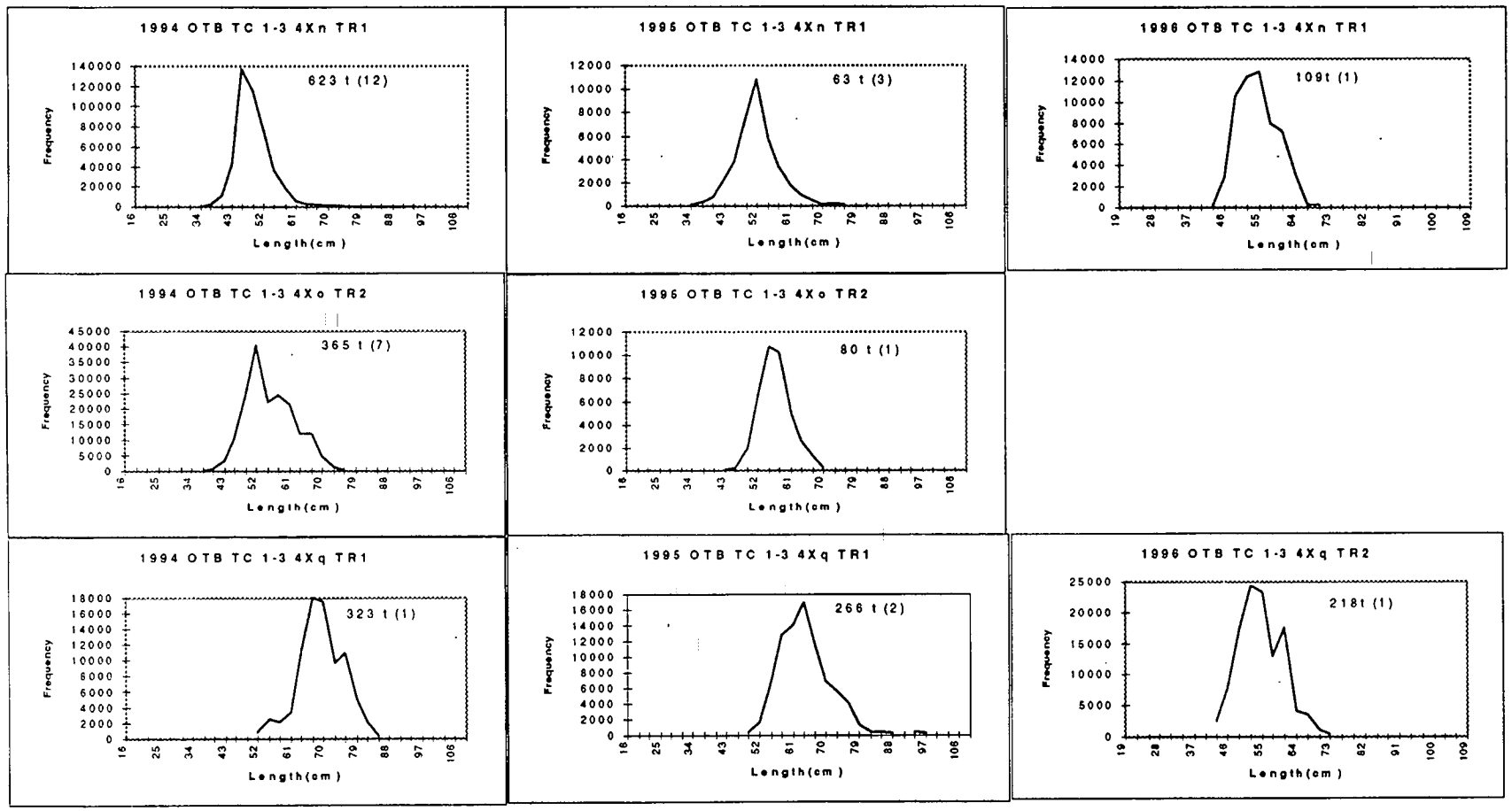


Fig. 7. Comparison of length composition of pollock from commercial samples taken in the TC 1-3 fishing in 1994 to 1996. Tonnage landed by that sector is shown(as is number of samples in brackets)

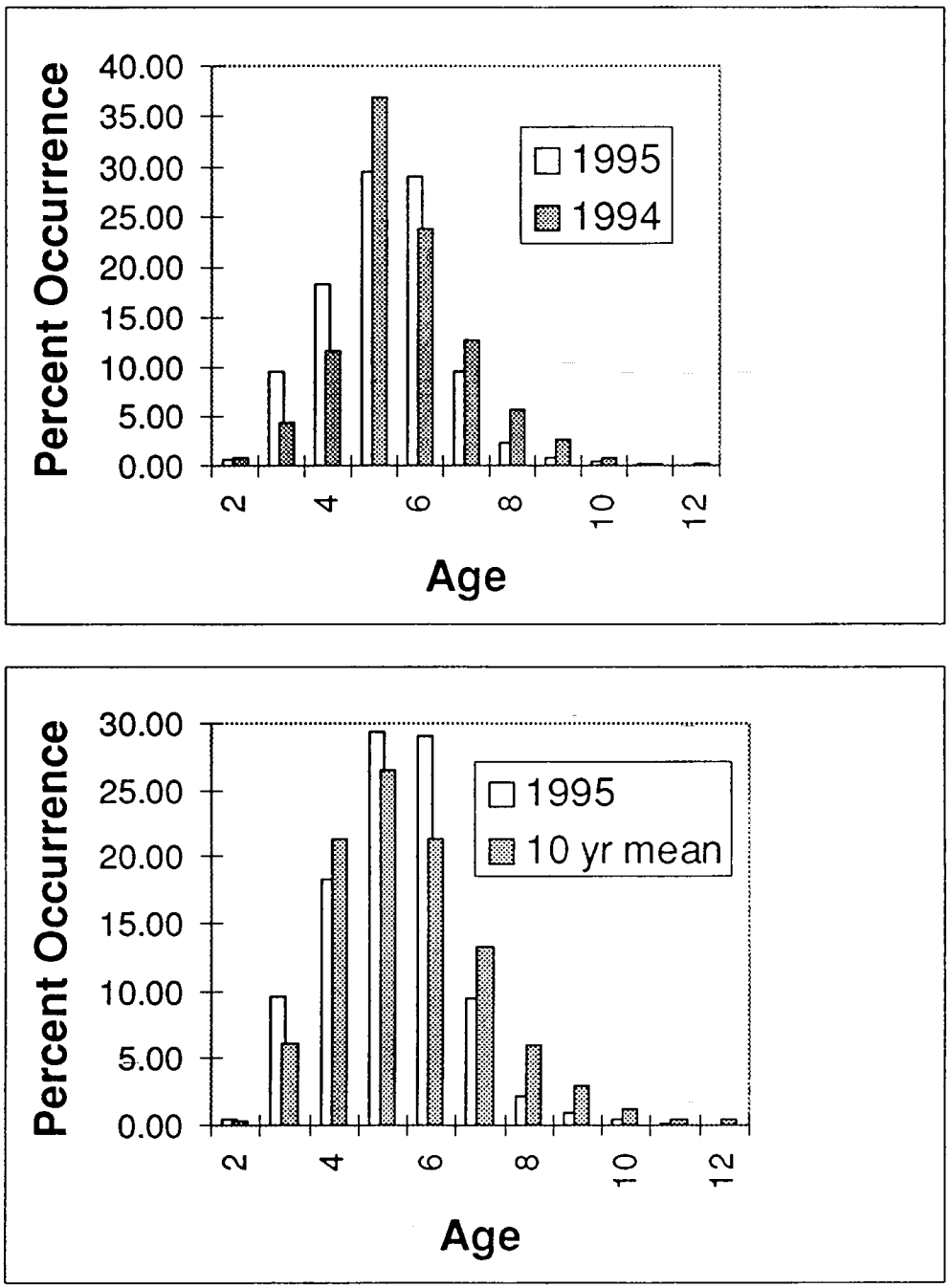


Fig. 8. The 1995 age composition of pollock landings in 4VWX5Zc, shown with respect to 1994 (top panel) and the mean over the previous ten years.

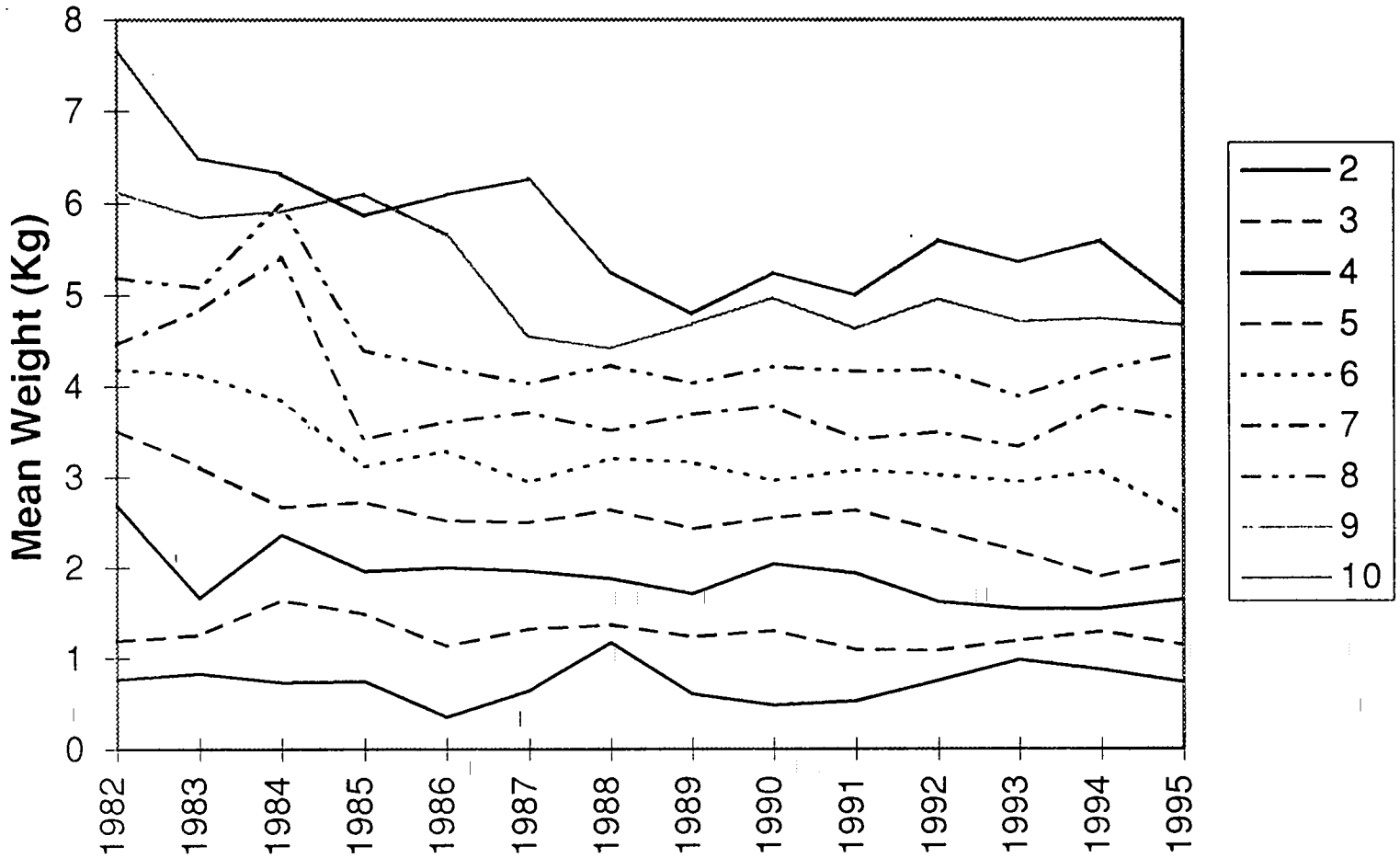
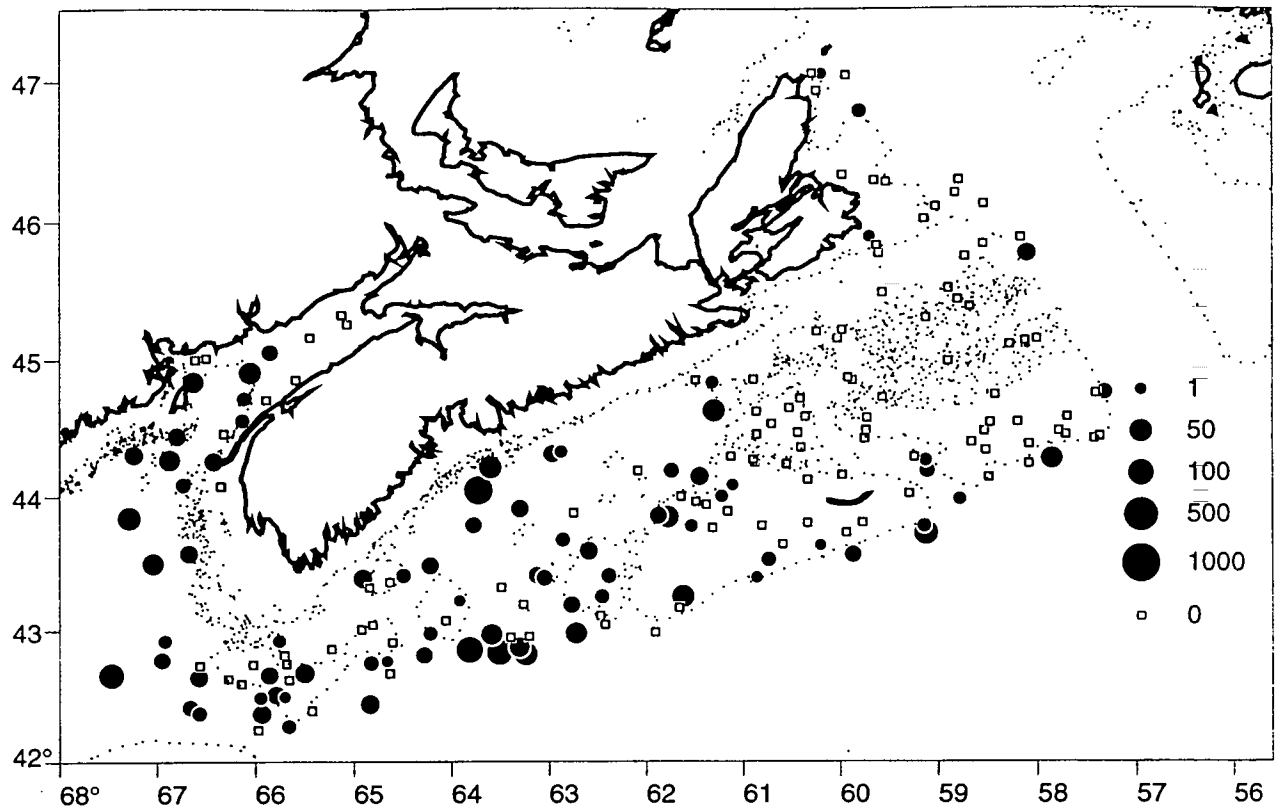


Fig. 9. Mean weight at age from the 4VWX5Zc pollock fishery, 1982 to 1995.



Summer Groundfish Survey 4VWX Pollock Biomass (kg/tow) July 1992

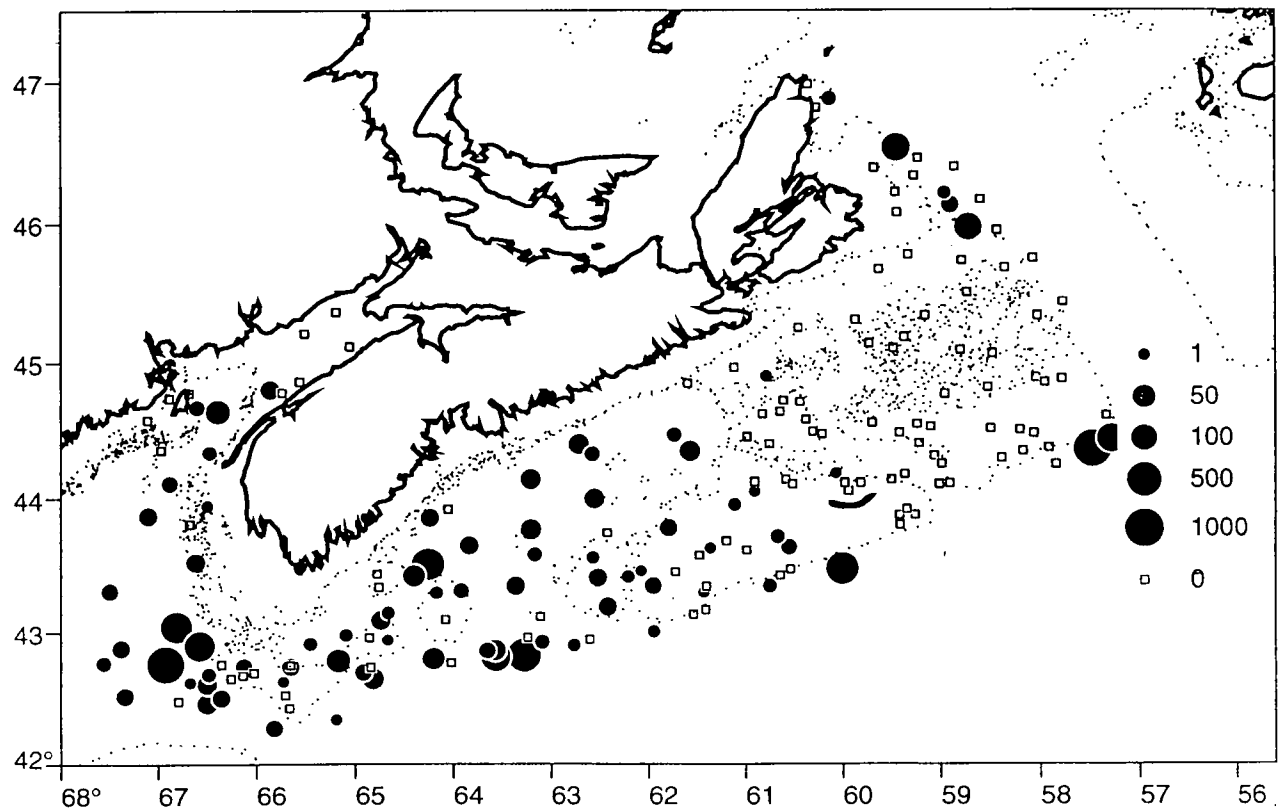
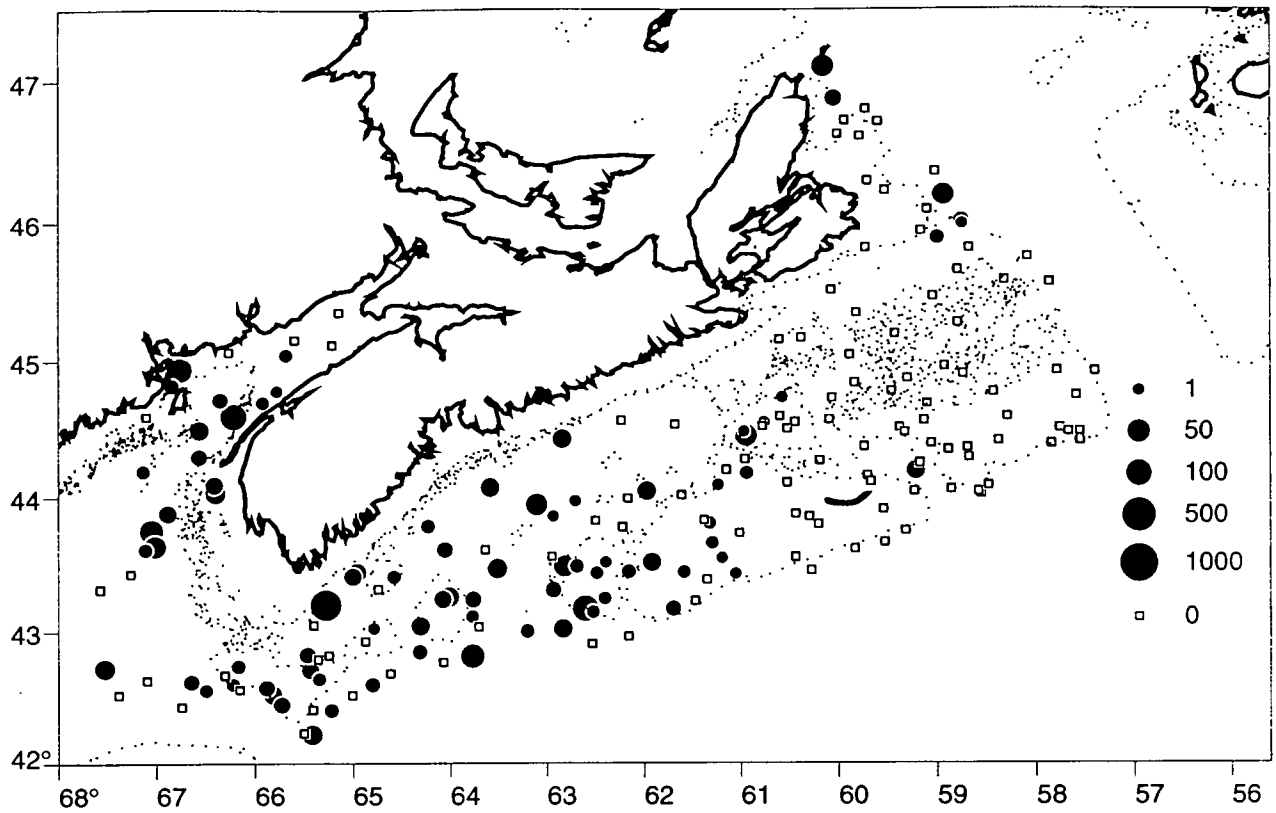


Fig. (10 Cont.) Summer Groundfish Survey 4VWX Pollock Biomass (kg/tow) July 1993



Summer Groundfish Survey 4VWX Pollock Biomass (kg/tow) July 1994

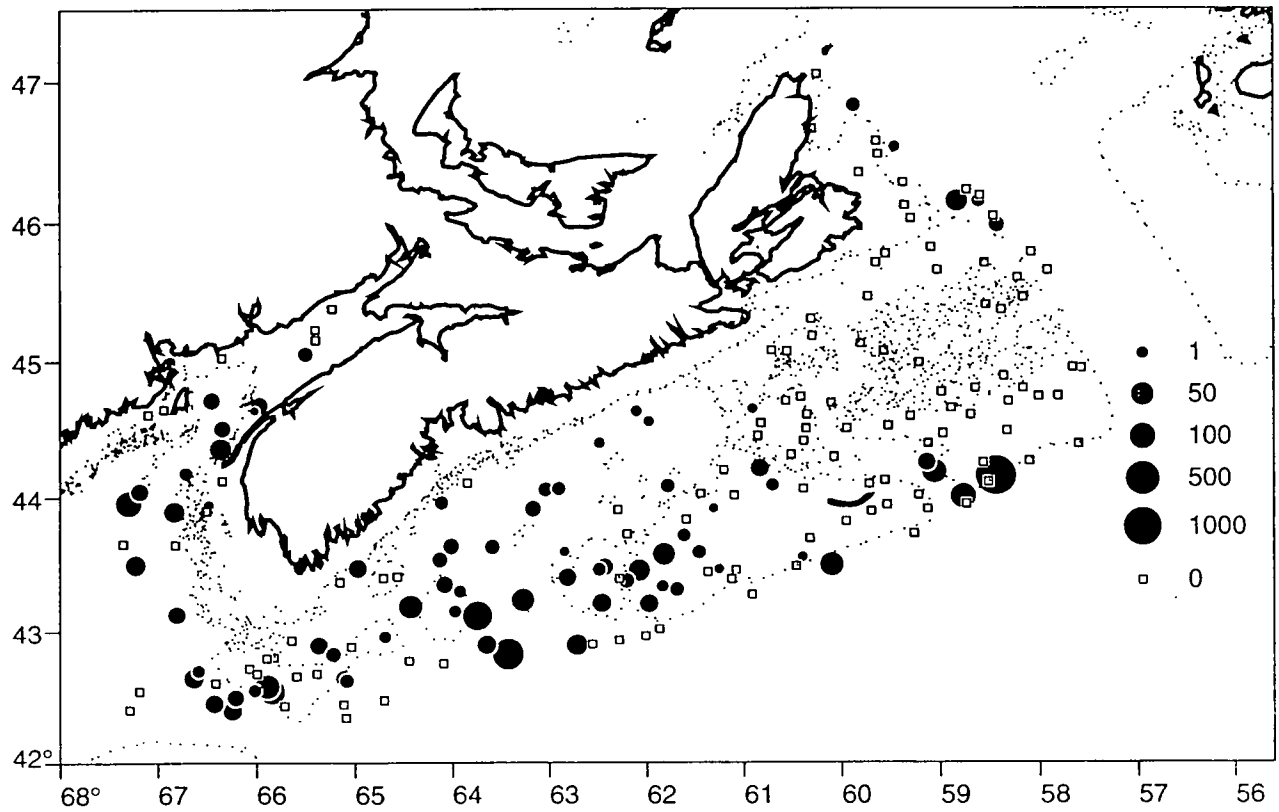


Fig. (10 Cont.) Summer Groundfish Survey 4VWX Pollock Biomass (kg/tow) July 1995

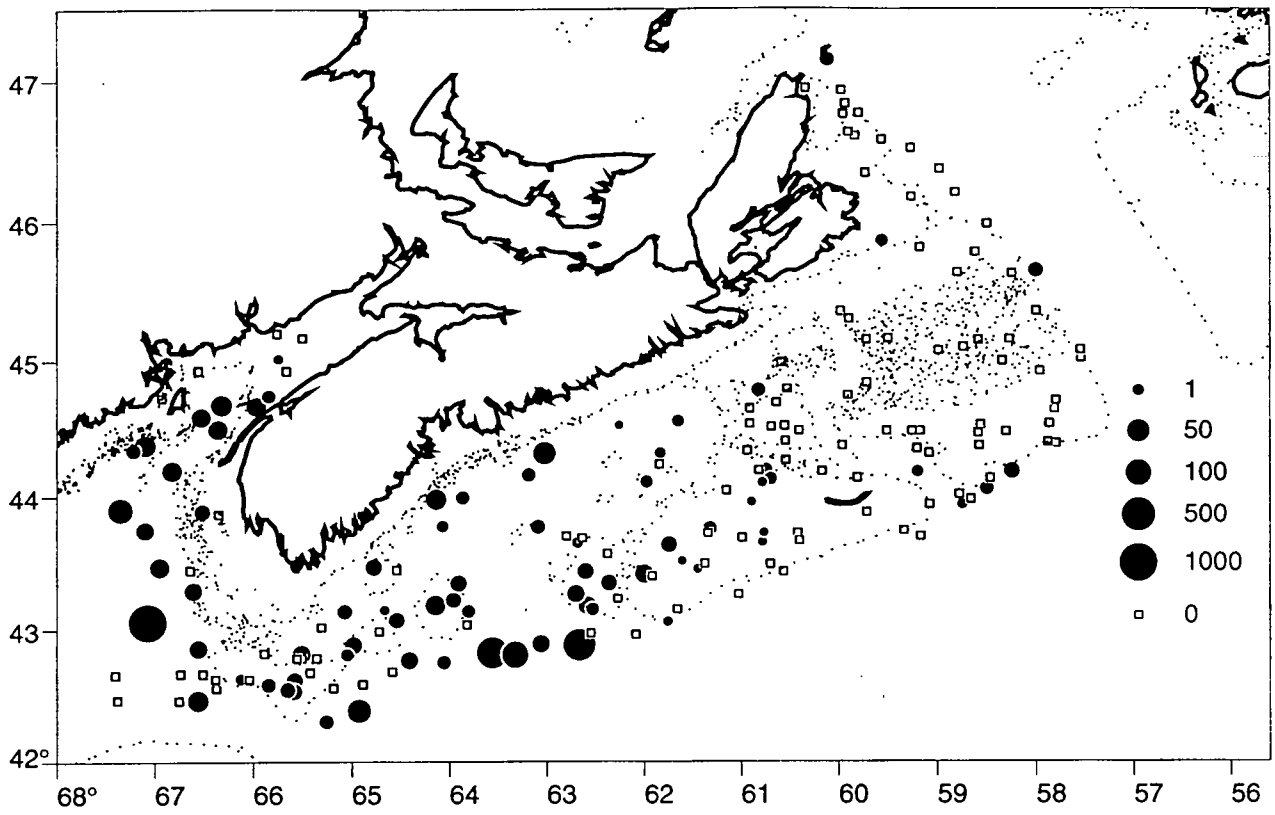


Fig. 10(Cont.)Summer Groundfish Survey 4VWX Pollock Biomass (kg/tow) July 1996

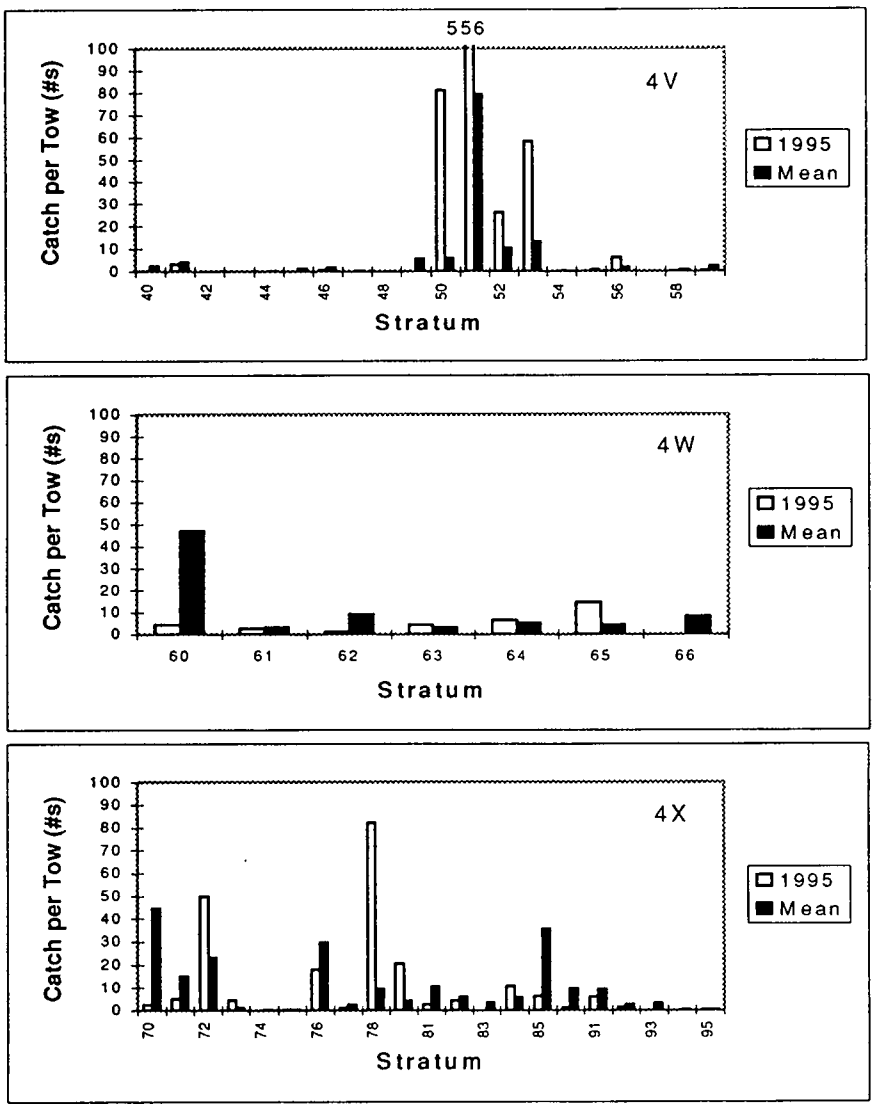


Fig. 11. Comparison of catch rates by stratum for the 1995 survey and the mean over the survey duration, shown for NAFO Divs. 4V, 4W and 4X.

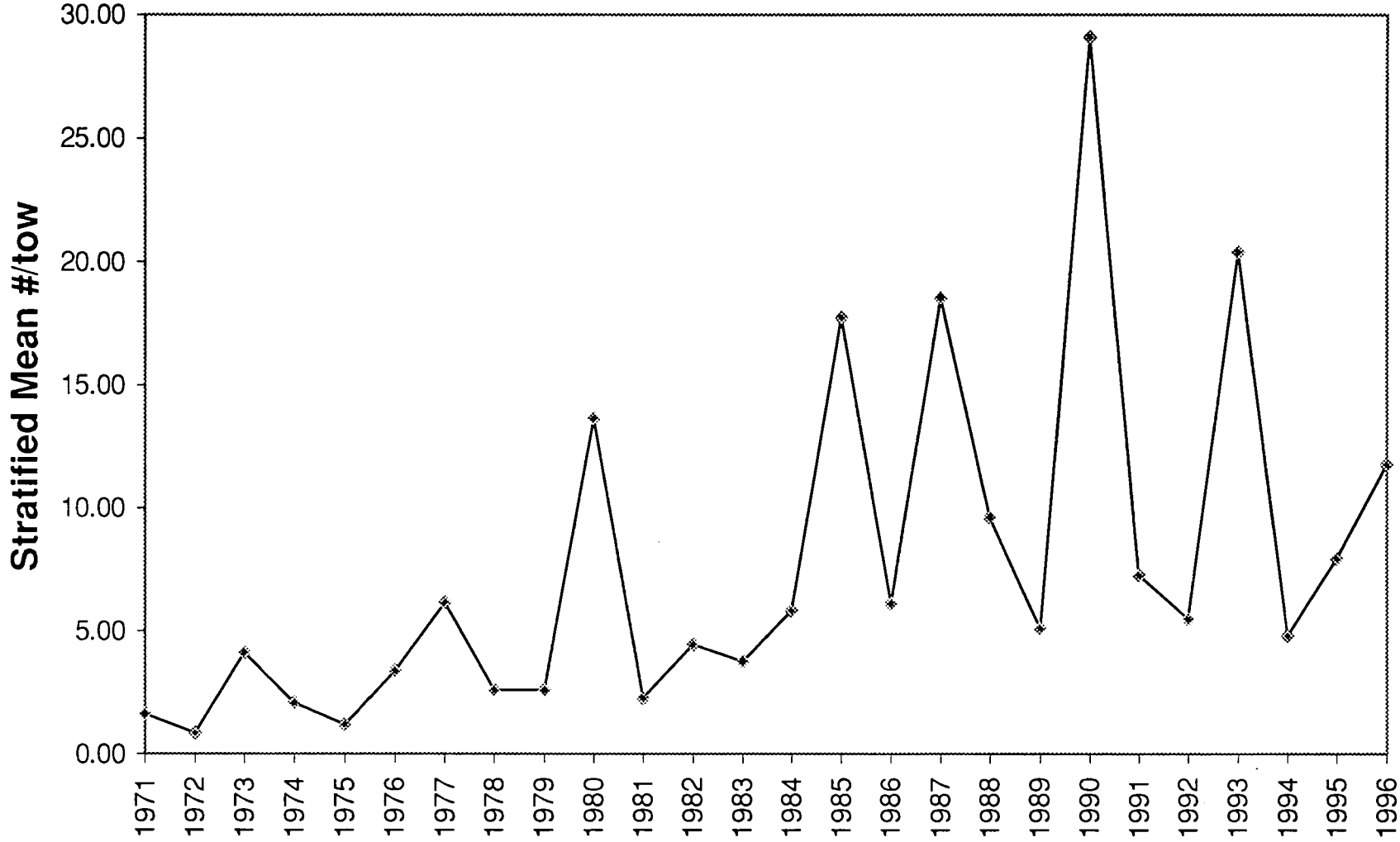


Fig. 12. Pollock catch per tow from summer RV surveys, 4VWX. Strata included were 440-495.

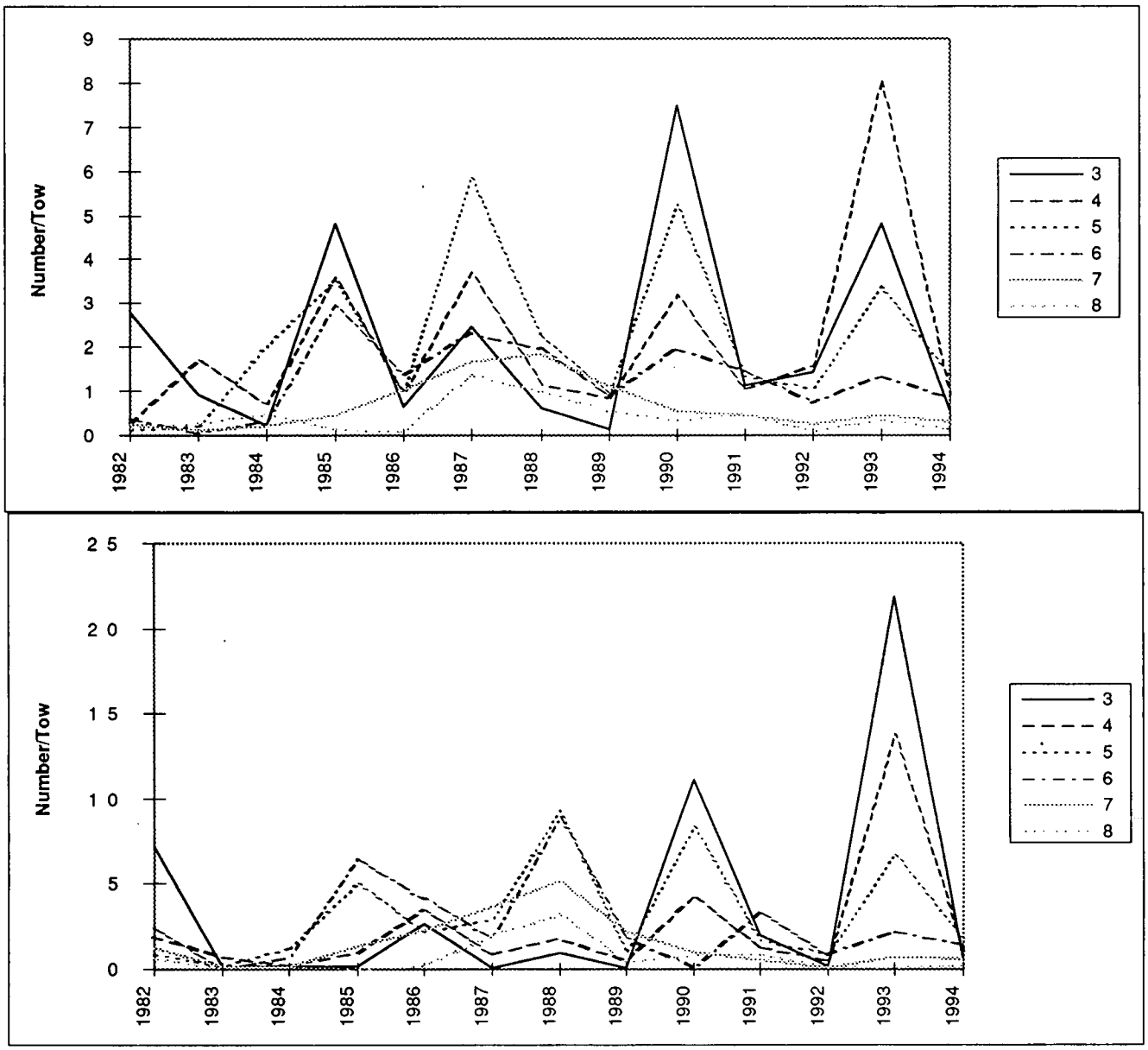


Fig. 13. Pollock number caught at age per tow for strata 440/495 in the summer RV survey (top panel) and for selected 4X strata (480,481,485,490,491,492,493 -- bottom panel).

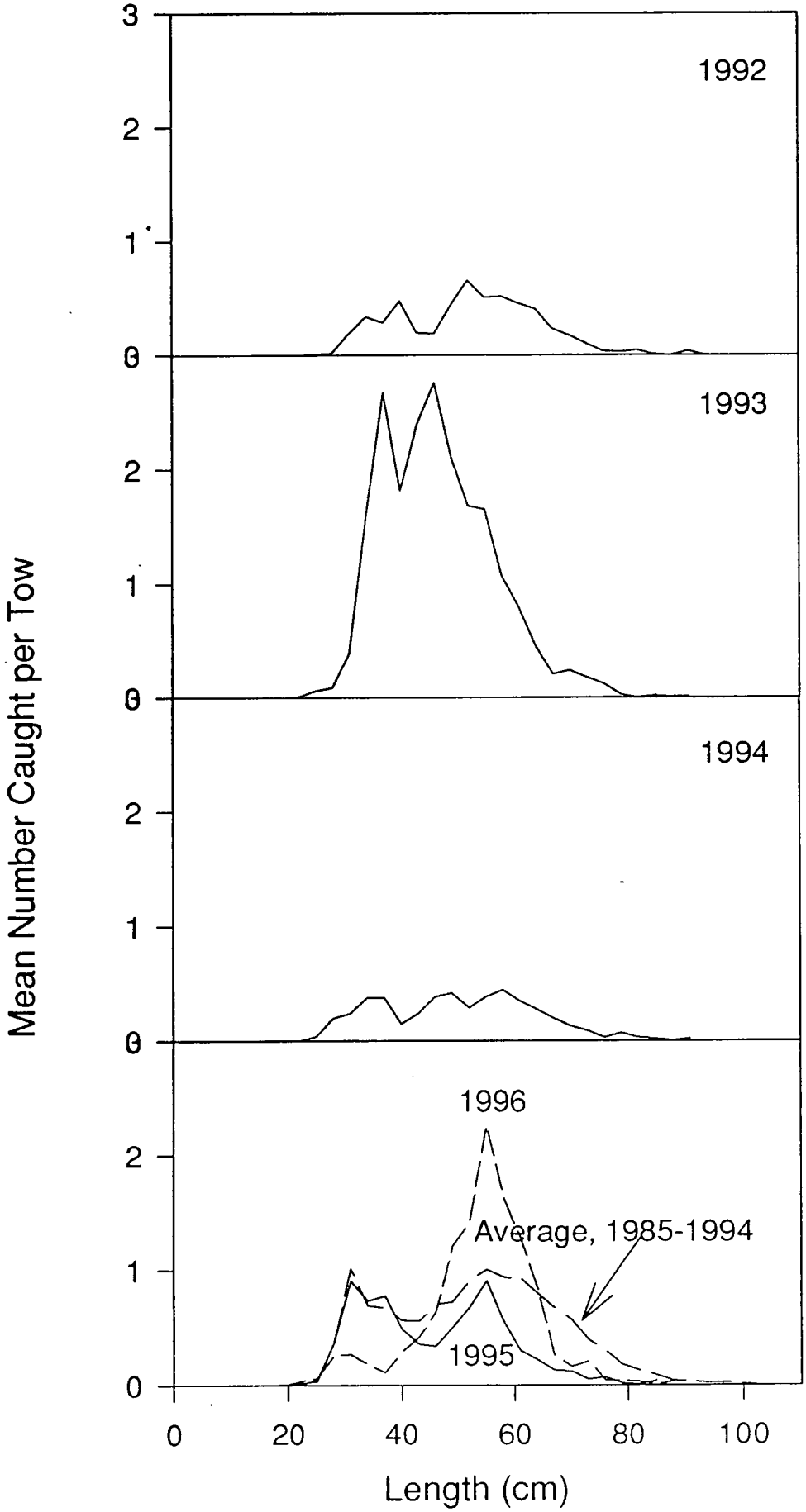


Fig. 14. Pollock length frequency distributions from summer groundfish surveys, 1992-1996. The average from surveys conducted from 1985 to 1994 is compared with the 1995 and 1996 data, bottom panel.

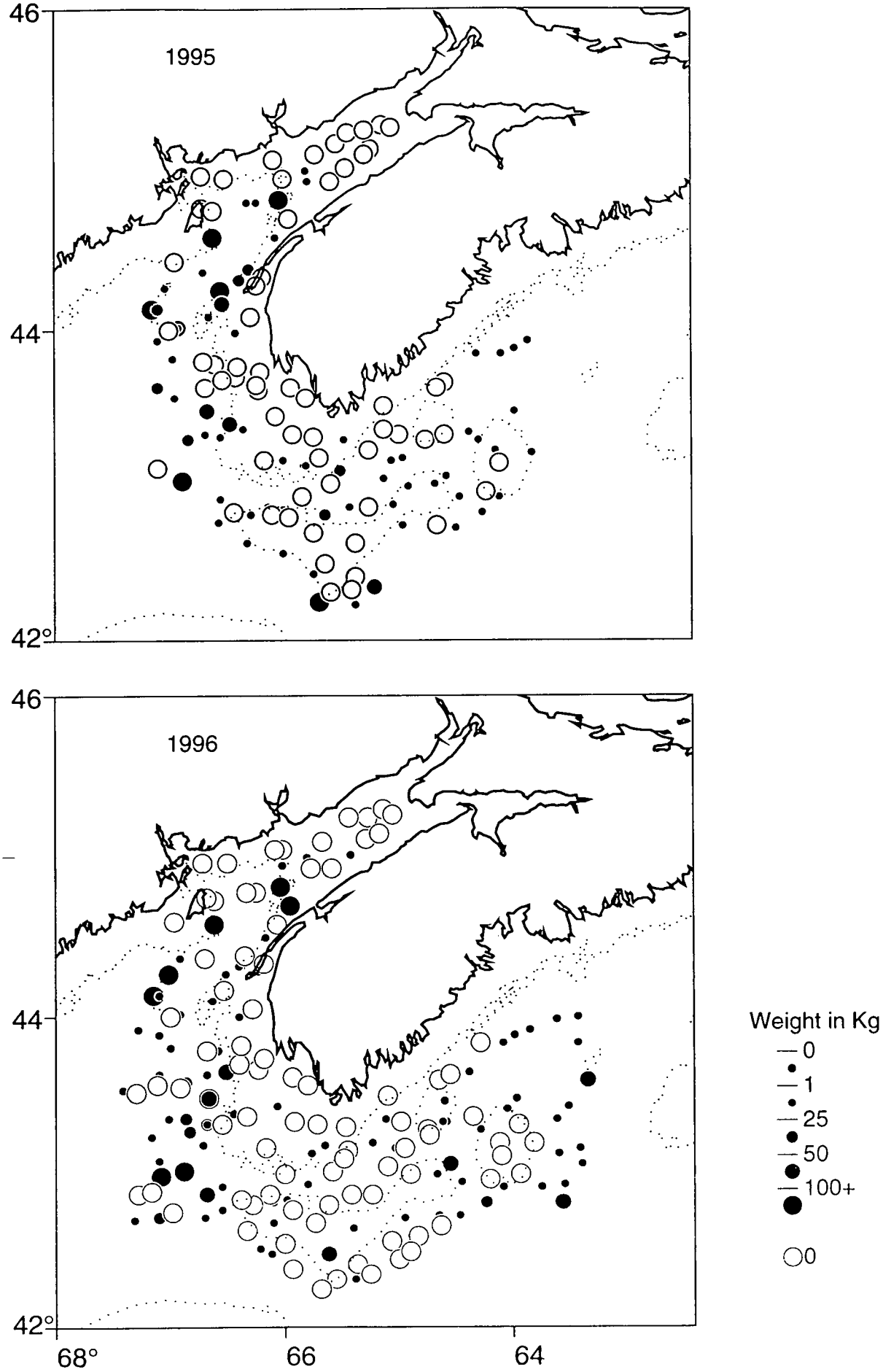


Fig.15 4X POLLOCK FROM 1995/1996 ITQ SURVEY

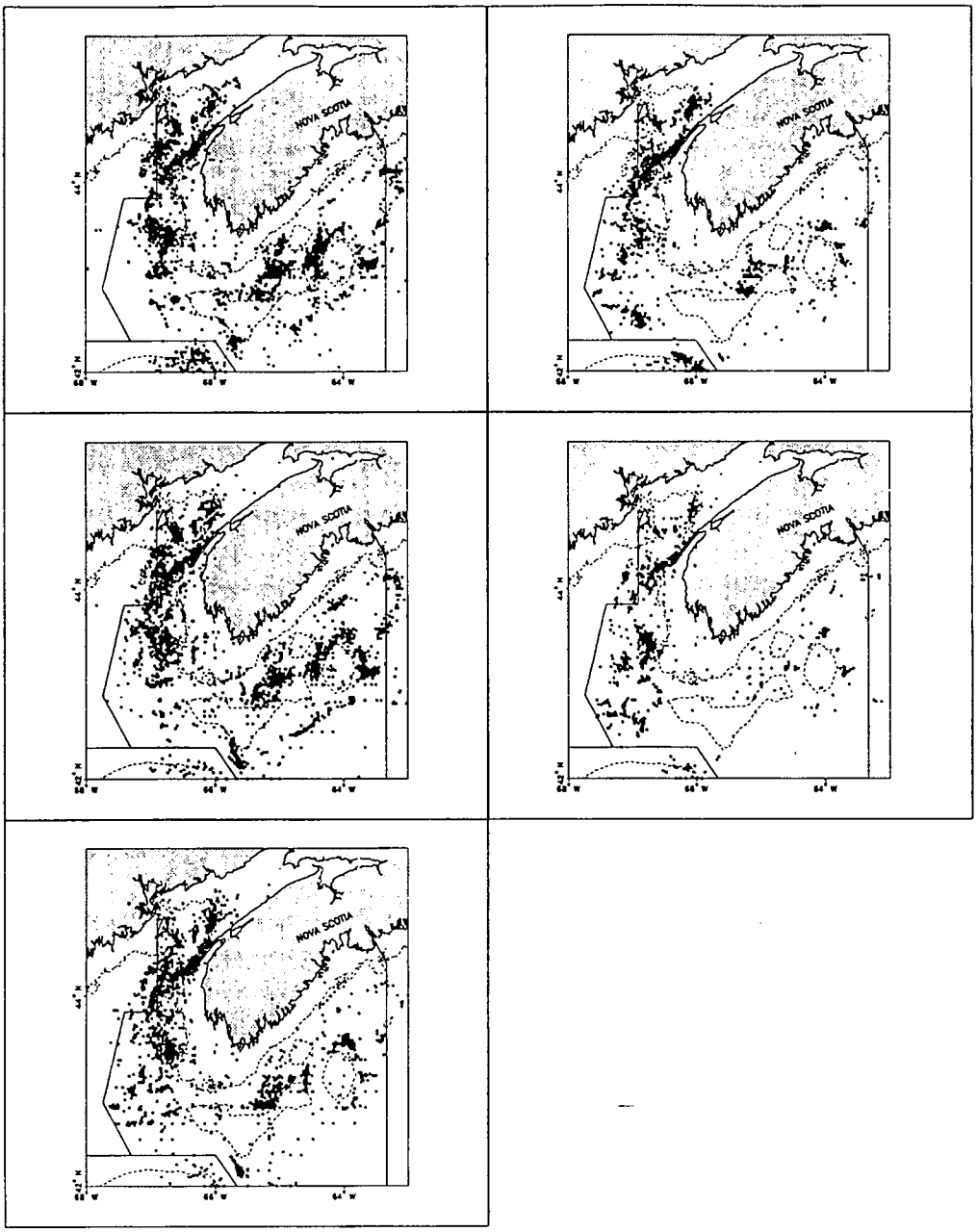


Fig. 16 Distribution of sets by core vessels used in catch standardization, 1991 - 1995

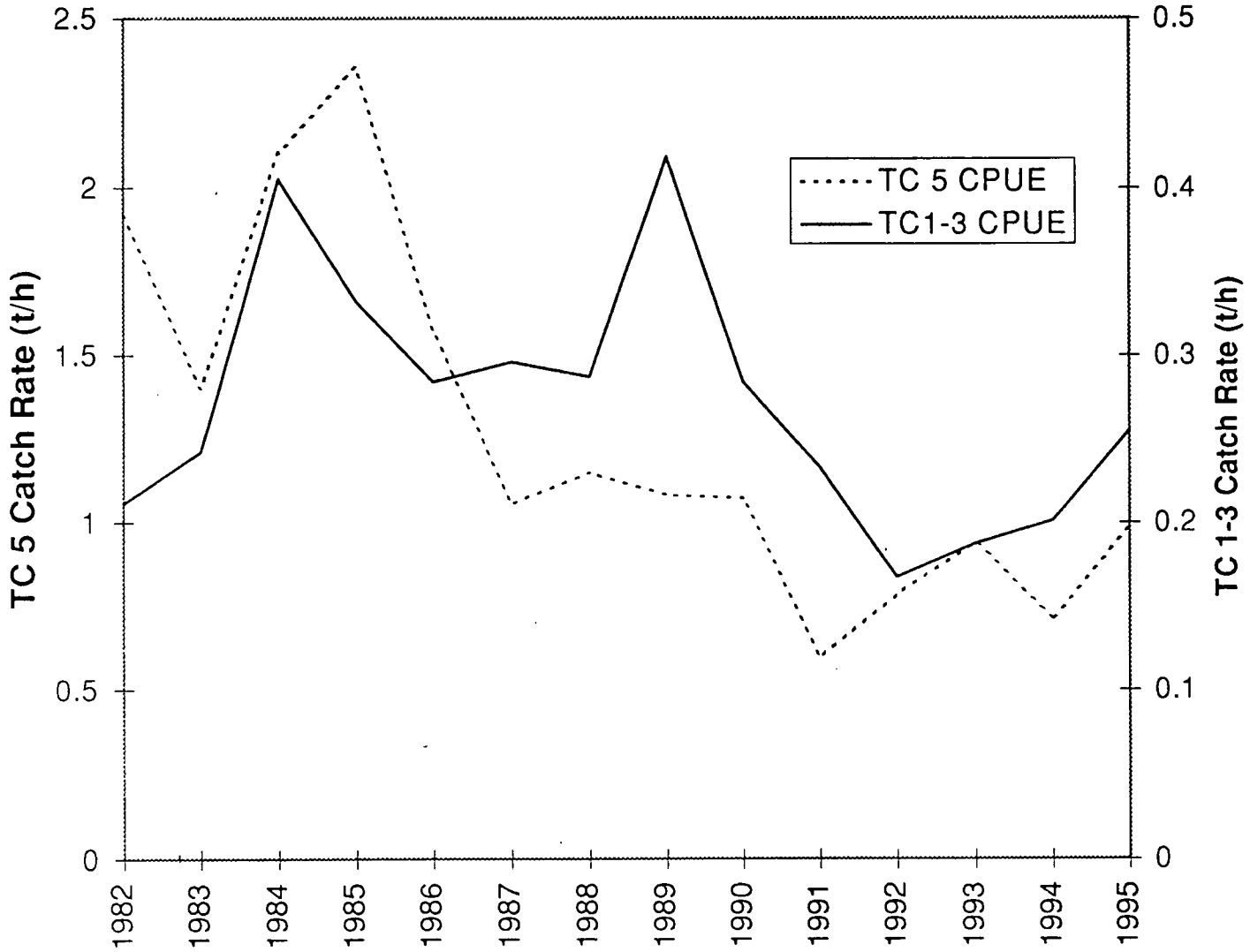


Fig. 17. Catch rate series for TC 5 and TC 1-3 stern trawlers fishing pollock in 4VWX5Zc and 4X, respectively.

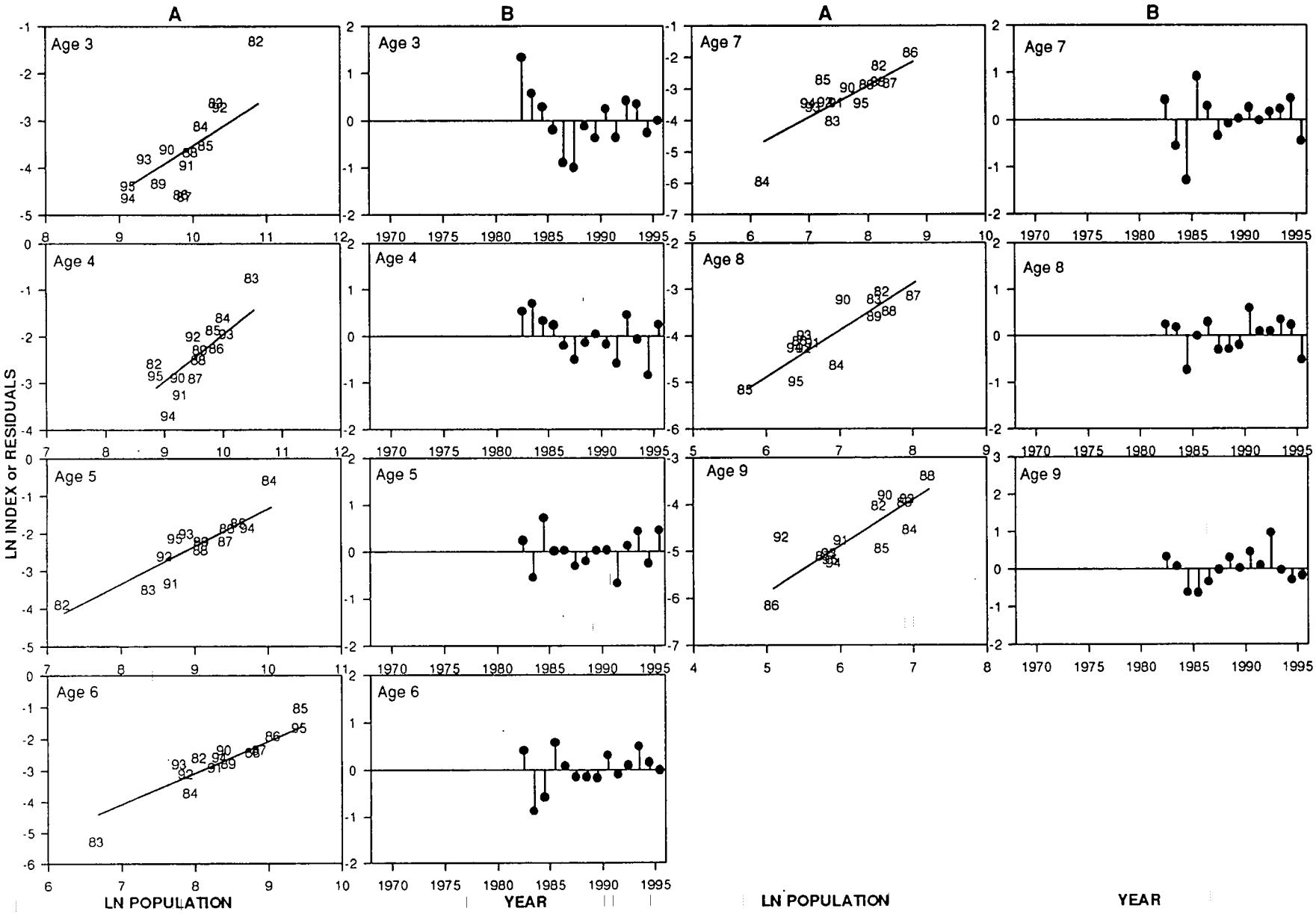


Fig. 18 a. Age by age plots of A) the observed and predicted ln abundance index versus ln population numbers, and B) residuals plotted against year for pollock in 4VWX5Zc. The index used was OT TC 5 only.

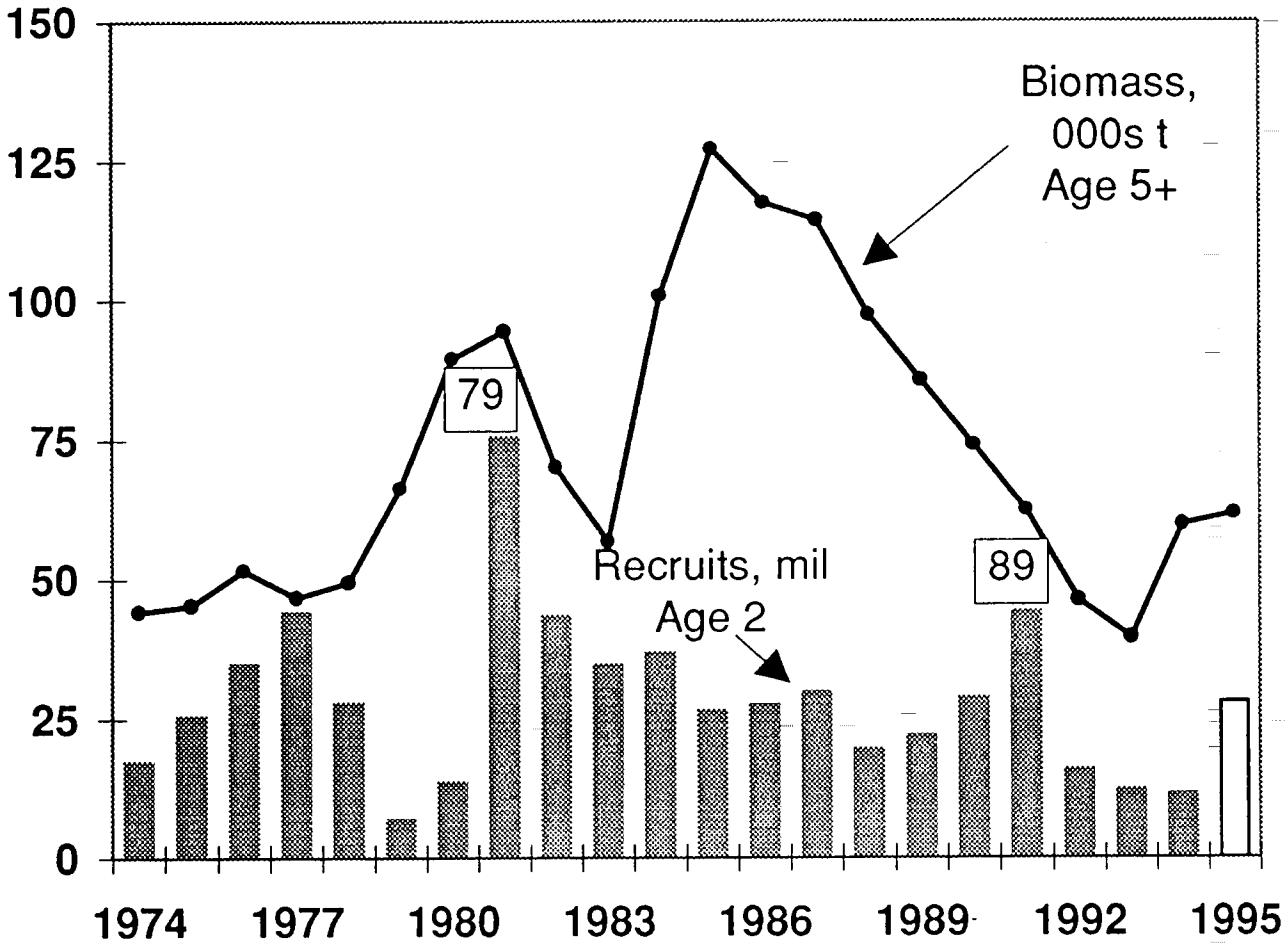


Fig. 19. Age 2 recruitment and adult biomass for pollock in 4VWX5Zc.

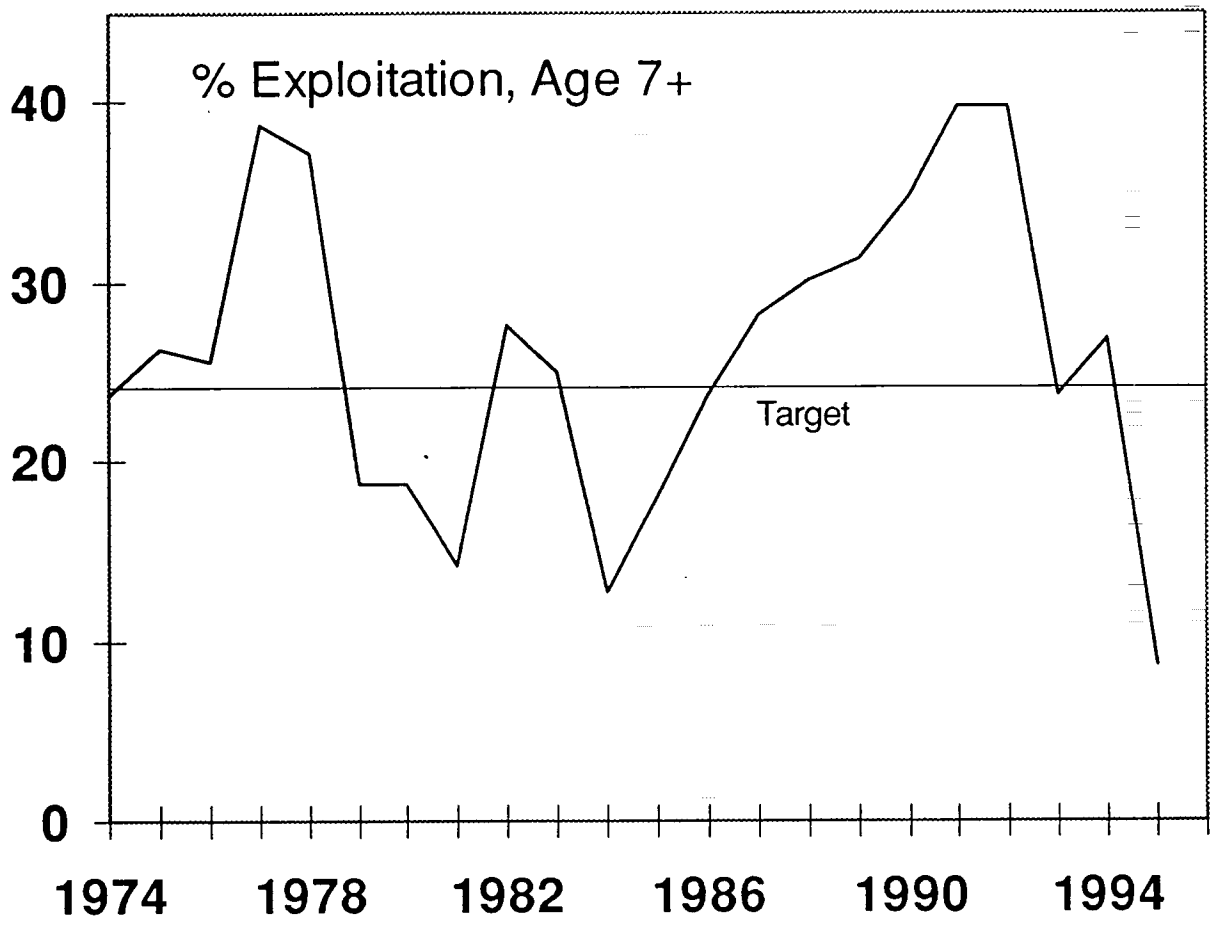


Fig. 20. Exploitation rate for fully recruited pollock in 4VWX5Zc.

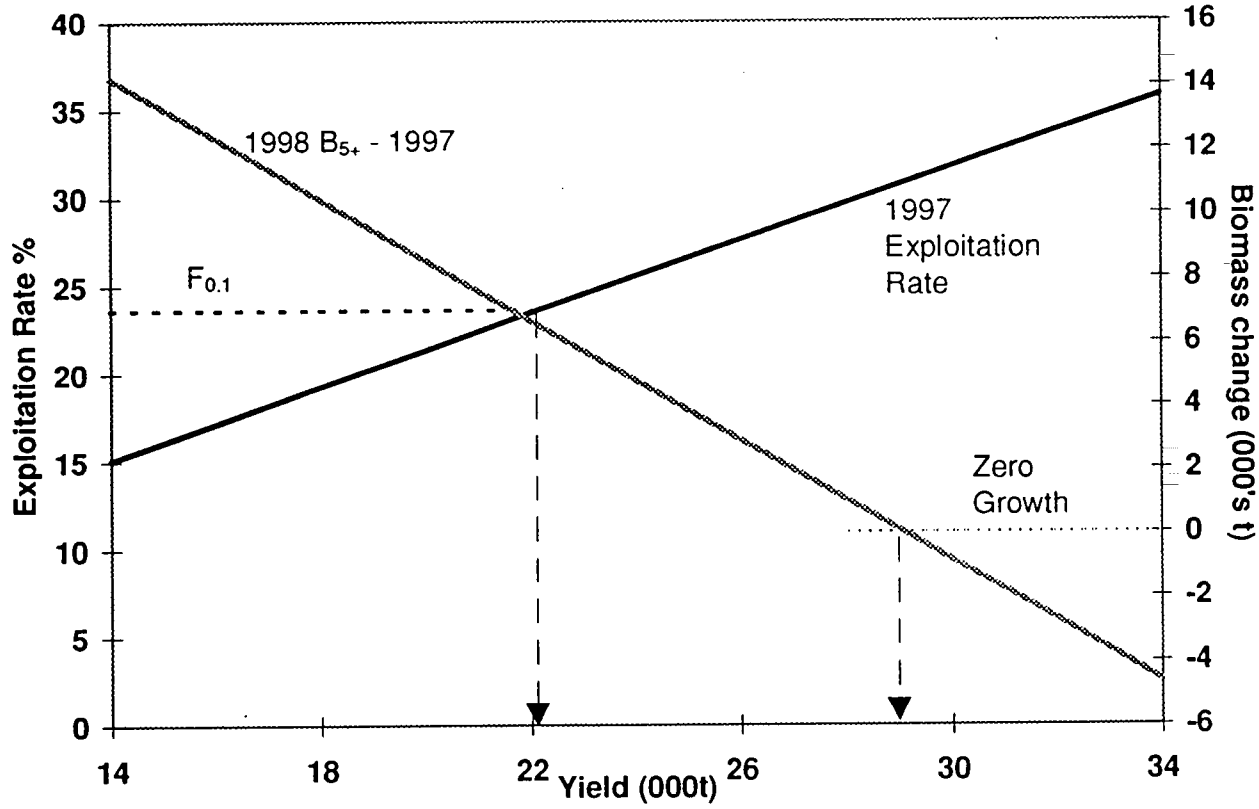


Fig. 21. Relationship between 5+ biomass and yield at varying levels of exploitation for 4VWX5Zc pollock.

APPENDIX ONE

Yarmouth Data Input Review Meeting, August 28

The purpose of the meeting was to review the data to be used in the 1996 stock assessment of 4VWX5Zc pollock and 4X cod. The meeting was well attended by a good cross section of representatives from most gear sectors, as well as members of the FRCC, the Provinces of Nova Scotia and New Brunswick and news media.

The main conclusions regarding pollock are summarized below:

- General consensus on length frequencies shown for 1994 and 1995. Participants agreed that fewer large fish seen in 1995, but small fish were comparatively abundant. In 1996, however, participants noted that fish were larger than in 1995.
- Most participants commented negatively on the use of catch rates as an index of abundance. However, after considerable discussion, there was consensus that some of the sources of concern could be addressed by careful data analysis and by careful interpretation of the trends. All participants agreed that new indices are required, and supported the joint Industry/DFO Science's initiatives to begin an acoustic survey and collect gillnet catch rate information.
- In general, most participants felt that pollock were more abundant than indicated in the 1994 stock assessment, particularly in the Bay of Fundy area and Georges Bank. A couple of participants including one representing the offshore, noted that pollock were not so abundant on the eastern shelf. The offshore representative noted in a later written submission that his perception of the pollock resource was more consistent with the stock assessment than others at the meeting.
- Most participants noted that they were "running away from pollock". Discrepancy between landings and TAC should be interpreted in that light.
- One participant noted that when small fish are abundant (referred to as "school fish"), larger fish are not usually caught. This observation from industry seems to support the idea of gear competition or targetting of a strong year class.
- The use of subtrip aggregations in the construction of the new catch rate series was discussed. Subtrips change when fishermen move from one area to another. Fishermen participants noted that logbooks might not a change in position, because a slight change may be very important for catch rates.. If you move a mile one way or another you will move in or out of the pollock. You can fish all day for groundfish, then move a mile and get a big catch of pollock.

The main recommendations are:

- Examine 1996 length frequency samples to corroborate observations of larger fish. Move towards a full half year stock assessment.
- Ensure that observers are measuring pollock as well as cod and haddock. Apparently observers monitoring small fish protocol compliance on fixed gear vessels have not been routinely measuring pollock.

- Examine areas sampled in 1994 vs 1995. Pollock are distributed by size very markedly, thus a different pattern of sampling may lead to a different perception of the population size structure. Related to this, one small dragger fisherman noted that small fish were found in shoal water this year, an opposite pattern to what is normally seen.
- Examine vessels participating in the TCRP program which transferred offshore allocation to smaller draggers. These vessels might provide a useful index of pollock.

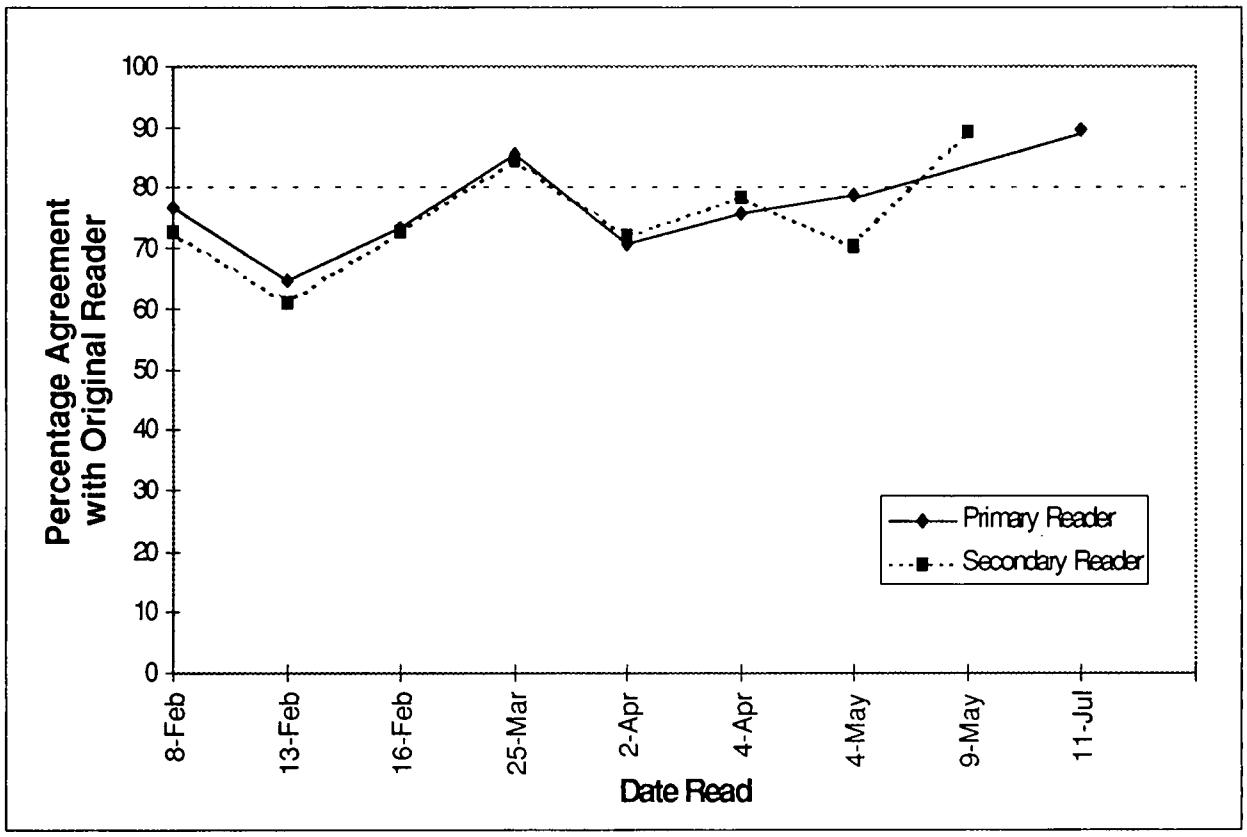
Points of discussion included:

- Considerable interest in the management unit and the basis for it. Participants asked if the stock complex be leading to problems? If pollock are now all in 4X, then vessels which fish only in that area in a mixed fishery may be seeing good pollock when there is not much further east. Their proportion of the pollock quota may then not be in line with the abundance of pollock in 4X, and its relative abundance compared to cod and haddock.
- Differences in catch rates between TC1-3 and offshore were discussed. It was agreed that the differences required checking.
- Alternative methods of assessment that recognized the imprecision of the information for this resource.
- Discussion of the adequacy of surveys for this resource.

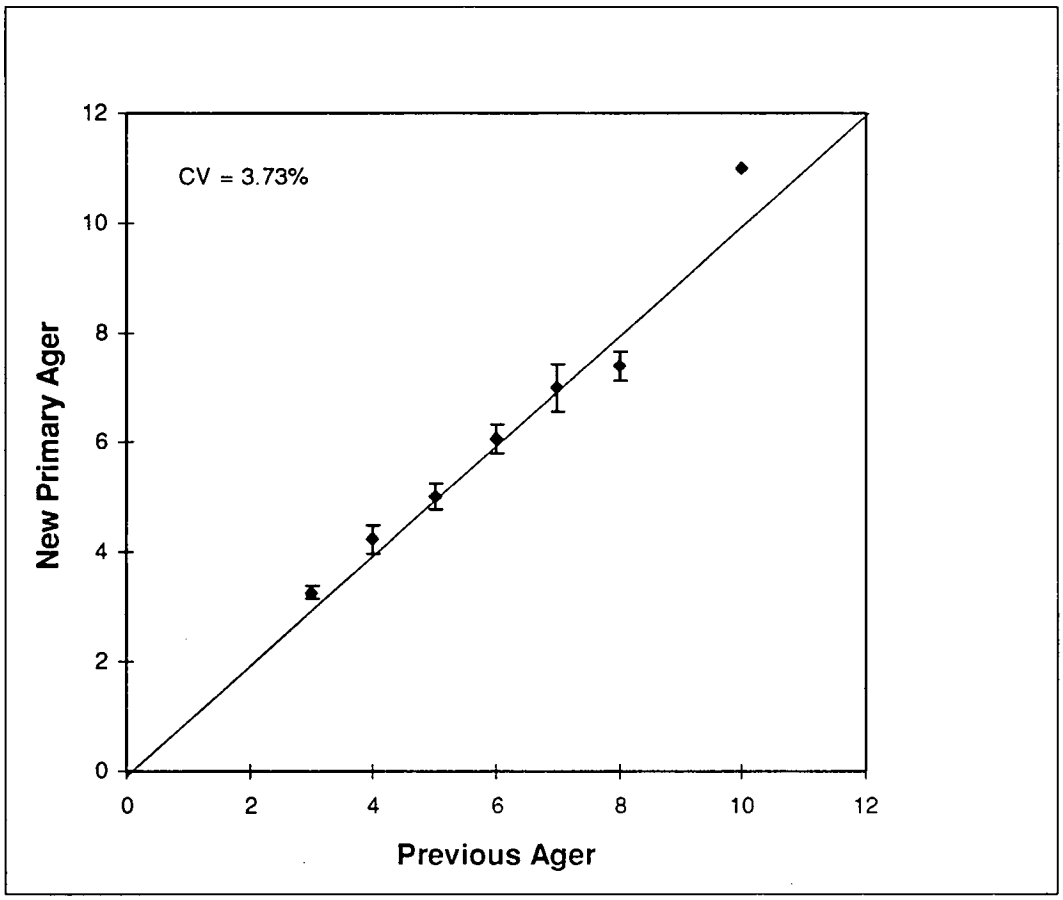
APPENDIX TWO

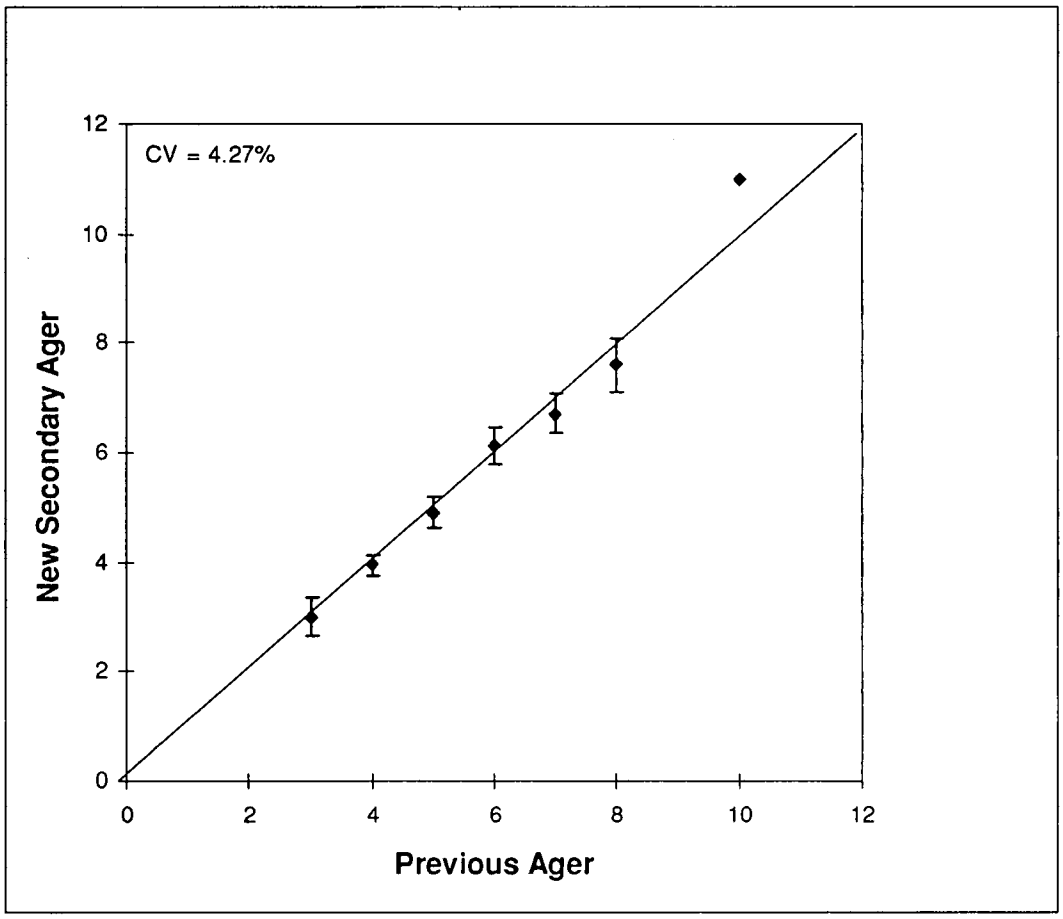
Performance of New Age Readers for 4VWX5Zc Pollock

The progress of the age readers on samples originating from 4X was evaluated in the spring 1996 meeting of the Gulf of Maine Subcommittee of RAP. Subject to regular review and monitoring, it was concluded that production age reading should proceed and training and evaluation in the more difficult samples from the eastern shelf should commence immediately. The main results from the 4X evaluations are shown below. The figure below represents the trend in percent agreement with samples re-aged by new age readers when compared with ages obtained by previous age reader. Each point is an average of three samples (n = 30-45 for each sample) aged on the same day.

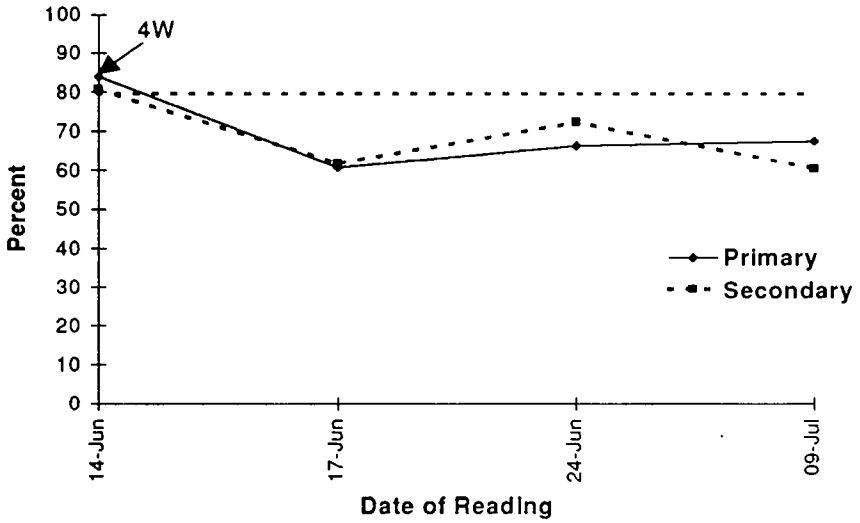


On the next page, we show so-called age bias graphs for a sample of pollock otoliths aged February 8, 1996 (n = 77). The mean age (with the 95% confidence interval) obtained by the new age readers is shown relative to all ages 3 to 11, as determined by the previous age reader.


CV = 3.73%
New Primary Ager
Previous Ager
0
2
4
6
8
10
12


CV = 4.27%
New Secondary Ager
Previous Ager
0
2
4
6
8
10
12

Progress with 4VW age samples requires improvement, as indicated below. While the age readers have shown comparable test scores with 4W samples, 4V samples are proving more difficult (the last three points in the series below correspond to 4V samples, again showing the average of means of three samples.



Two examples of the results by sample are shown below.

Sample 930190 4Vsb												
Count of Harry	Primary											
Previous Ager	4	5	6	7	8	9	10	11	12	13	(blank)	Grand Total
4	10	0	1	0	0	0	0	0	0	0	0	11
5	0	7	0	0	0	0	0	0	0	0	0	7
6	0	0	4	0	0	0	0	0	0	0	0	4
7	0	0	0	0	0	0	0	0	0	0	1	1
8	0	0	0	1	6	1	0	0	0	0	0	8
9	0	0	0	0	1	3	2	0	0	0	0	6
10	0	0	0	0	0	0	0	0	0	0	1	1
11	0	0	0	0	0	0	0	1	0	1	0	2
12	0	0	0	0	0	0	0	0	1	1	0	2
(blank)	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	10	7	5	1	7	4	2	1	1	2	2	42
												76%
Count of Harry	Secondary											
Previous Ager	4	5	6	7	8	9	10	11	12	13	(blank)	Grand Total
4	11	0	0	0	0	0	0	0	0	0	0	11
5	2	5	0	0	0	0	0	0	0	0	0	7
6	0	2	2	0	0	0	0	0	0	0	0	4
7	0	0	0	0	0	0	0	0	0	0	1	1
8	0	0	0	1	7	0	0	0	0	0	0	8
9	0	0	0	0	2	4	0	0	0	0	0	6
10	0	0	0	0	0	0	0	0	0	0	1	1
11	0	0	0	0	0	0	1	0	1	0	0	2
12	0	0	0	0	0	0	0	0	0	2	0	2
(blank)	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	13	7	2	1	9	4	1	0	1	2	2	42
												69%

Sample 940415 4Vsc

Count of Harry	Primary								
Previous Ager	4	5	6	7	8	9	10	11	Grand Total
5	1	11	0	0	0	0	0	0	12
6	0	1	5	0	0	0	0	0	6
7	0	0	1	1	1	0	0	0	3
8	0	0	0	1	0	0	0	0	1
9	0	0	0	0	0	3	0	0	3
10	0	0	0	0	0	1	0	0	1
11	0	0	0	0	0	0	2	1	3
Grand Total	1	12	6	2	1	4	2	1	29

72%

Count of Harry	Secondary								
Previous Ager	4	5	6	7	8	9	10	11	Grand Total
5	1	11	0	0	0	0	0	0	12
6	0	0	3	3	0	0	0	0	6
7	0	0	1	0	1	1	0	0	3
8	0	0	0	0	1	0	0	0	1
9	0	0	0	0	0	3	0	0	3
10	0	0	0	0	1	0	0	0	1
11	0	0	0	0	0	0	2	1	3
Grand Total	1	11	4	3	3	4	2	1	29

66%

APPENDIX THREE
Results of Standardized Catch Rate Analysis

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.508
MULTIPLE R SQUARED..... 0.258

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.536E3	2.536E3	
REGRESSION	57	4.519E2	7.928E0	9.548
Vessel	25	1.247E2	4.989E0	6.009
Year	13	8.505E1	6.542E0	7.879
Month	7	5.012E1	7.160E0	8.624
Tonnage Class	1	1.048E⁻1	1.048E⁻1	0.126
Area	10	2.659E1	2.659E0	3.202
Mesh Type	1	3.581E0	3.581E0	4.313
RESIDUALS	1567	1.301E3	8.303E⁻1	
TOTAL	1625	4.289E3		

REGRESSION COEFFICIENTS

CATEGORY	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
3488	INTERCEPT	⁻1.914	0.343	1625
82				
7				
3				
4Xq				
D				
554	1	1.150	0.327	87
2017	2	0.672	0.184	38
2149	3	0.574	0.189	38
2769	4	0.698	0.166	115
3292	5	0.768	0.167	58
5615	6	1.573	0.343	39
5650	7	1.033	0.327	85
5656	8	0.891	0.328	77
5660	9	1.125	0.319	215
5694	10	0.903	0.327	77
5715	11	1.371	0.323	126
7904	12	⁻0.130	0.201	30

1065	13	0.180	0.260	50
2668	14	¯0.728	0.254	16
7172	15	¯0.045	0.263	15
18107	16	0.088	0.168	50
3961	17	0.199	0.195	33
5591	18	0.796	0.321	108
5754	19	1.073	0.338	53
5682	20	0.745	0.328	72
6864	21	¯0.108	0.246	20
19885	22	¯0.161	0.287	12
100278	23	0.682	0.224	23
3629	24	¯0.124	0.264	16
5761	25	1.506	0.329	98
83	26	0.136	0.178	71
84	27	0.648	0.168	100
85	28	0.448	0.169	102
86	29	0.305	0.198	51
87	30	0.340	0.179	80
88	31	0.309	0.197	49
89	32	0.681	0.206	44
90	33	0.294	0.190	65
91	34	0.090	0.159	226
92	35	¯0.242	0.156	277
93	36	¯0.118	0.199	222
94	37	¯0.042	0.224	171
95	38	0.194	0.227	123
6	39	¯0.031	0.076	327
5	40	¯0.418	0.079	345
8	41	¯0.275	0.090	173
4	42	¯0.346	0.095	191
10	43	¯0.097	0.118	85
9	44	¯0.487	0.097	137
11	45	¯0.458	0.133	64
2	46	0.104	0.292	554
4Xo	47	0.021	0.091	364
4Xn	48	0.220	0.097	297
4Xr	49	¯0.169	0.105	333
4Xm	50	0.316	0.279	12
ZEj	51	0.167	0.127	77
4Xp	52	¯0.136	0.130	71
5Yb	53	¯0.224	0.162	40
ZEJ	54	0.975	0.552	3
ZEm	55	0.235	0.357	7
4Xs	56	0.178	0.125	125
S	57	¯0.322	0.155	464

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
82	¯1.9137	0.1174	0.211	0.070	566	2686
83	¯1.7782	0.1117	0.242	0.079	806	3330
84	¯1.2658	0.1088	0.405	0.130	1762	4355
85	¯1.4662	0.1056	0.332	0.105	1298	3914
86	¯1.6089	0.1328	0.284	0.100	488	1720
87	¯1.5742	0.1195	0.296	0.099	518	1752
88	¯1.6047	0.1160	0.287	0.095	294	1023
89	¯1.2323	0.1108	0.418	0.135	272	651
90	¯1.6196	0.1069	0.284	0.091	373	1312
91	¯1.8242	0.1000	0.233	0.072	1064	4576
92	¯2.1559	0.1008	0.167	0.052	1264	7577
93	¯2.0321	0.1162	0.187	0.062	975	5204
94	¯1.9562	0.1256	0.201	0.069	644	3201
95	¯1.7196	0.1265	0.255	0.088	680	2669