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Haddock in Division 4TVW in 1993

by

K. Zwanenburg, G.A.P. Black, B. Charlton, A.F. Sinclair, and G. Young
Marine Fish Division
Bedford Institute of Oceanography
Dartmouth, N.S. B2Y 4A2

Abstract

From historical landings of as high as 50,000t and up to 20,000t from 1979 to 1987, this resource yielded only 1,300t in 1993. The significant reductions in landings from 1992 to 1993 (5,000 to 1,300t) and the exclusion of all fishing from the Emerald/Western closed area probably reduced exploitation significantly. Most of the recent landings have been made in Division 4W by fixed gear vessels at appreciably smaller modal lengths than their mobile gear counterparts. The size composition of this population shows both a narrower range of length-classes and a concentration at a single mode probably representing the 1988 year-class. Assuming that maturity schedules have not shifted, the present spawning stock biomass may be as low as 4,000-8,000t. There are some indications that the 1993 and 1992 year-classes may be of above average abundance, however estimates of abundances at these size classes are highly variable. At present both the fishery and the reproductive potential of the resource appear to depend on the 1988 year-class.

Résumé

Après avoir produit des débarquements historiques culminant à 50 000 t et atteignant jusqu'à 20 000 t de 1979 à 1987, le stock considéré n'a fourni que 1 300 t de prises en 1993. La chute importante des débarquements de 1992 à 1993 (de 5 000 à 1 300 t) et la cessation totale de la pêche dans la zone de fermeture des bancs Émeraude et Western ont probablement réduit considérablement l'exploitation. La plupart des débarquements récents provenaient de la pêche pratiquée dans la division 4W par des bateaux à engins fixes, dont la longueur typique est notablement inférieure à celle des bateaux de pêche aux engins mobiles. La composition de la population selon les tailles révèle une plus petite fourchette de classes de longueur et une concentration dans un même groupe qui correspond très probablement à la classe d'âge de 1988. En supposant qu'il n'y ait pas eu de changement dans les régimes de maturation, la biomasse actuelle du stock reproducteur pourrait ne pas dépasser les 4 000 à 8 000 t. Selon certaines indications, les classes d'âge de 1992 et 1993 seraient d'abondance moyenne, mais les estimations d'abondance concernant de telles classes de longueur sont très variables. À l'heure actuelle, la pêche et le potentiel de reproduction de la ressource semblent dépendre de la classe d'âge de 1988.

Description of the Fishery to 1993

Landings averaged 26,500t per year from 1950 to 1969, 5,000t from 1970 to 1979, and ranged between 8,000 and 20,000t until 1987. The nominal catches for 1987 through 1992 have been taken exclusively as by-catch in other groundfish fisheries operating in divisions 4T, 4V and 4W, and totalled approximately 1,300t in 1993 (Table 1). The 1989 nominal catch has been left as provisional due to a large discrepancy between the haddock by-catches reported to NAFO by the then USSR and those reported by the International Observer Program (IOP). The IOP observed all Soviet and Cuban vessels fishing in Canadian waters and reported a total haddock by-catch of 683t while the catches reported to NAFO by those nations were 1,931t. Since these fleets were restricted to a maximum cumulative haddock by-catch of 1% and the total silver hake catch in 1989 was 91,000t; this would have allowed a maximum by-catch of 910 t and not the 1931 t reported. In the absence of a satisfactory explanation for this discrepancy, the IOP reported catch of 683t will be used.

In 1987 the combination of reduced recruitment over several successive years (1983-1985), low levels of spawning stock biomass and the concentration of the fishery on the only two remaining year-classes of any appreciable size (1981, 1982), resulted in the restriction of the fishery to a 5% by-catch. In 1988 this by-catch limit this was increased to 15% and remained in effect through 1990. Since then the fishery has been regulated through a combination of by-catch restrictions and trip limits. In 1993, catches were regulated through by-catch restrictions ranging from 2,500kg trip limits to closure (Table 2). The year-round nursery ground closure (mainly Emerald and Western banks) imposed in 1987 remains in effect to the present. Throughout the 1987 to 1992 period fixed gear vessels had been allowed to fish inside the closed area. In 1993 the closed area was closed to all fishing.

Until 1984, most of the catch from this stock was taken from Division 4W by large otter tralwers (OTBs, TC4 and TC5) in the spring. In 1984, Division 4W was closed to trawlers from May to December to prevent the capture of the abundant early 1980s year-classes. This caused a shift in the fishery to 4Vs. From 1984 to 1986, favourable catch rates resulted in an increase in 4Vs landings to the point where they represented 40-60% of total landings. Following the exclusion of mobile gear from much of Division 4W (as a result of the imposition of the closed area in 1987) landings in 4Vs ranged from 1,500 to 2,500t annually, however, since 1990 landings in this area have declined to 433t. Since 1987, landings in 4W increased five-fold (from 994 to 5,164t) mainly due to the development of the fixed gear fishery inside the closed area. In 1993, following the exclusion of all gears from the closed area, landings in 4W fell to a total of 770t. Landings in Division 4T and Subdivision 4Vn have been negligible since 1989 (Tables 1 and 3).

From 1987 to 1992 the proportion of landings taken by trawlers has decreased from 60 to 37%. In 1993 trawler landings represent 30% of the total. Longline landings have ranged from 21 to 63% over the period 1987 to 1992. Longline landings in 1993 accounted for 64% of total landings. Seiner landings represented approximately 4% of the total landings in 1993 (Table 4). The most significant change in the distribution of landings from 1992 to 1993 is the sharp decline in overall landings mainly due to the severe restrictions on fishing activities during the last year. Most of the decline occurred in the first, second, and fourth quarters of the year (Table 5).

Sources of Uncertainty

The preceding estimates of landings do not incorporate estimates of misreporting by area, or non-reporting of catches as a result of dumping or discarding. Unquantified, anecdotal information suggests that practises have been significant sources of error at a number of times in the past. Some of these reports indicate that the amount of dumping and discarding had represented a significant portion of the total reported landings. The effects of these potential errors on catch estimates for the assessment of the status of this resource cannot presently be evaluated.

Consultation with inshore fishermen in 4W indicated that the inshore haddock landings have declined significantly in recent years. Although a steady decline in landings has been noted over the past 15 to 25 years, declines in the past 3-7 years have been relatively precipitous. In addition to this decline in landings, many independent sources report a change in the 'migratory pattern' of the inshore haddock. In past years the haddock would 'come ashore' in waters westward of Country Harbour, Nova Socita. These fish would then 'migrate' westward throughout the remainder of the summer and fall until the fishermen in the area stopped fishing when the fishery reached Halifax Harbour and approaches. More recently it is reported that the haddock are coming onshore further westward each year, and that the numbers caught has declined substantially. All respondents indicated that these 'inshore haddock' are different from offshore haddock by virtue of colour, shape, taste, and general size composition (larger). We presently have no information by which to judge these observations, but it illustrates our general lack of understanding of inshore resources in general. Plans for cooperative work with the inshore industry to determine the relationship between inshore and offshore haddock are being developed.

See also the results of the survey of members of the Fishermen Scientists Research Society presented at this meeting.

None of the foregoing discussion is based on recorded information but rather comes from the memories of the fishermen participants.

Composition of the Catch

The age composition of the 1993 landings is not available. Over the past year serious concerns have been raised concerning the accuracy of the ages determined for haddock. A significant bias in the ageing of haddock was introduced in the early 1980s. This bias may have resulted in over-ageing of young fish in the early 1980s and a subsequent under-ageing of older fish in the late 1980s and early 1990s. The full extent of the bias has not yet been determined. Resolution of this problem will require age validation studies and the establishment and implementation of consistent ageing criteria. It may also require the re-examination of historical otoliths to determine the extent of bias in previous estimates of catch at age. Work is presently underway to resolve this issue

In the absence of estimates of catch at age, estimates of catch at length were developed for the years 1970-1993 (Table 6). Catch at length for removals by the domestic fisheries were developed using commercial groundfish samples stratified as for the estimation of catch at age outlined in previous documents (see Zwanenburg 1989). The catch at length for domestic landings from 1970 to 1978 were estimated as outlined in Mahon et al. (1984) using ALSYS. All keys were re-unstructed with the length-weight parameters as outlined in Mahon et al. (1984). The sampling information available for the 1993 domestic removals are given in Table 7. Catch at length for the haddock by-catch from the foreign small mesh gear fishery were estimated from IOP data. For catches realized prior to 1977 no IOP estimates of length-frequencies were available. In the absence of these data it was assumed that the length frequencies of these catches were similar to that observed in the July research surveys conducted in 4W in the same years. The numbers measured at each length class were converted to weights using the length/weight relationship determined for all haddock caught on the survey. These weights at length values were then converted to proportion of the summed weight. These proportions at weight were then used to allocate the total small mesh gear catch for that year into length bins. The weights at length were finally converted to numbers at length by dividing by the average weight of a fish at that length (using the length-weight parameters from the survey).

The catch at length for 1993 shows a unimodal distribution with a mode at 42.5 cm (Figure 1), smaller than the long-term average (46.5 cm). Catches of fish in all length classes were far below the long-term average (1970-1992). A comparison of the length frequencies of haddock caught by longline gear versus those caught by mobile gear show clearly that the fixed gear in 1993 landed more fish in the smaller length classes than did the mobile gear sector (Figure 2).

Sources of Uncertainty

These estimates of catch composition of domestic landings do not take into account any at-sea modification of the size composition. There have been reports of discarding and high-grading that cannot be quantified with presently available information. Dumping would tend to result in underestimation of total landings while selective discarding is likely to result in underestimation of removals at the smaller length classes. The overall effects of these potential sources of error cannot at present be quantified.

Commercial Catch Rates

The restrictive nature of this fishery since 1987 does not allow for a comparison of present catch rates to those of earlier years from directed fisheries. We do not consider that by-catch catch rates are not considered to be representative of the abundance of this stock.

Research Vessel Survey Results

For the same reasons outlined above for the commercial catches, the age structure of the surveys are not presented. Catch rates at length for the July RV survey times series are given in Table 8.

Summer Surveys

Research survey catch rates show a decline in overall abundance from 1983 to 1987 with a subsequent increase or stability (Figure 3). This resource is now centred in Division 4W with catch rates in subdivisions 4Vn and 4Vs presently negligible (Figure 4).

Estimates of the 1988 year-class at ages 1, 2 and 3 indicated that this is one of the largest year-classes to enter the population since 1970. The CVs of between 27 and 40% associated with estimates of the mean catch per tow at ages 0-3 for this year-class show that this is a relatively reliable estimate. Although haddock ageing is being questioned it is unlikely that the very youngest ages will be greatly affected. The modal lengths of the large 1988 year-class are sufficiently clear to allow for the determination of its growth rate for the first three years.

The long-term average length composition (1990-1992) of Subdivision 4Vn shows modes at 20.5, 32.5, and 50.5 cm (Figure 5). Subdivision 4Vn also has the largest mean modal length of the three areas comprising the stock area. It is likely that the 20.5 cm mode represents age 1 fish although we cannot rule out a significantly different growth rate for the haddock in 4Vn relative to other parts of the stock area. If growth rates are similar throughout the stock areas, the interpretation of these fish being age 1 would be consistent with the age structured analysis presented in previous assessments. This indicated that the 4Vn population is composed mainly of fish aged 4+ and that age 0 fish have never been observed in the survey of this area. There are anecdotal reports of haddock spawning in inshore areas of 4Vn in years past, however, we have no observations with which to judge these reports. There is no evidence of the large 1988 year-class in 4Vn. The overall catch rates at length in 4Vn in 1993 are well below the long-term mean.

The long-term mean catch at length in 4Vs shows modes at 16.5, 28.5 and 42.5 cm (Figure 6). These modes are smaller in all cases than those observed in 4Vn. The modes at 16.5 and 28.5 cm probably represent fish aged 1 and 2, respectively. Overall catch rates at age were well below the long-term average in 1993, however, there is some evidence of fish at a modal length of 10.5 cm. This is significantly smaller than the smallest fish usually detected in 4Vs. Since the abundance of these small size classes does not appear to be well estimated by our summer surveys it is premature to comment on the relative size of the year-class these fish may represent.

Division 4W has traditionally been the centre of distribution of this resource as evidenced by the significantly higher catch rates observed there. Analysis of the catch at length for 4W shows clear modes at 8.5, 20.5, and 32.5 cm (Figure 7). The large peak at 38.5 cm in 1993 represents mainly the 1988 year-class at age 5. It is likely that the modal length of 38.5 cm in the 4W population represents the modal length of the survivors of the 1988 year-class. However, it is also possible that this represents the true mode of the population that is experiencing depressed growth due to density dependent effects. In addition to the 1988 year-class, the 1993 catch rate at length also shows slightly above average modes at 8.5 cm and at 22.5 and 24.5 cm. These would likely represent the 1993 and 1992 year-classes.

The overall distribution of catch rates at length are given on Figure 8. One of the notable features of these data are the relatively small modal length (38.5cm) of what is assumed to be the 1988 year-class at age 5. Figure 9 shows the modal length of the 1988 year-class relative to the mean length at age for all haddock aged in the survey series. This may represent an explanation of some of the results of the length based VPA outlined later in the paper.

Distribution of Haddock from Summer Surveys

Figure 10 shows the long-term distribution of haddock over the entire Scotian Shelf as estimated for July survey data. The data from 1970 to 1990 were aggregated to 0.1 degree squares and contoured. The 1990-1993 data are plotted expanding symbols on the contoured data. This presentation allows for a comparison of long-term versus present distributional patterns. The most obvious feature of these presentations is the relative absence of haddock in 4V in the last few years. Looking at the rest of the shelf it appears that the areas of concentration in the recent period are no different from the areas of concentration over the long-term. Note that the lack of haddock catches on Georges Bank in recent years is due to the absence of any sets there in the past few years.

Spring Surveys

Spring surveys have been conducted on the Eastern Scotian Shelf during March of each year since 1979 (except for 1985) (Table 9). Catch rates in 4VW peaked in 1981 and declined thereafter (Figure 11). The results of the 1993 and 1994 surveys indicate some increase over 1992. Survey catch rates in Subdivision 4V declined for 1984-1993 and increased slightly in 1994. In Division 4W survey catch rates peaked in 1981 and declined to 1992, catch rates have increased in each of the subsequent years. The maximum in both the 4W and 4V catch rates is likely due to the presence of the large early 1980s year-classes. The abrupt decline in 4Vs in the post-1987 period is probably, in part, related to the cooling trend in the bottom water shown to have occurred from 1984 through 1992, with the lowest temperatures being measured in 1989-1992 Smith and Page (1994).

The long-term spring survey catch rate at length in Division 4W shows modes at 14.5 and 26.5 cm (Figure 12). It is probable that the mode at 14.5 cm represents age 1 fish since the July survey catches age 0 fish at 8.5 cm in the previous year. The fish caught at 26.5 cm probably represent early age 2 fish which are caught later in the year by the July survey at a modal length of 32.5 cm. The 1994 results shows the 1988 year-class at a modal length of 38.5 cm, these fish had a modal length of 38.5 cm in the July survey indicating either no growth over the year or high mortality for those fish growing fast enough to reach fishable sizes. As was the case in 1993, the 1994 results again show the presence of a somewhat above average catch at 18.5 cm, however, this has not translated into an above average catch rate at larger size classes in the next year. However, in 1994 it was preceded by a somewhat above average catch at 8.5 cm in July of 1993.

The long-term mean catch at length for 4Vs shows prominent modes at 14.5 and 24.5 cm (Figure 13). The 1994 results show catches at all lengths, except 18.5 cm, well below the mean. The peak at 18.5 cm as in 4W was preceded by an above average catch rate at 8.5 cm in the July 1993 survey.

Much of industries' view of the status of this resource is consistent with the groundfish survey results. Catches of haddock in 4T and 4Vn are presently negligible, while catches in 4Vs are poor and catch rates are generally low. Catches in 4W increased from 1987 to 1991 when they were considered relatively good. Although catch rates were relatively good, the average size of fish in the catches was very low due to the presence of the abundant 1988 year-class (modal length 34.5 cm in 4W in 1991, 36.5 cm in 1992, and 38.5 cm in 1993). In 1992 large trawlers increased their fishing effort on Sable Island Bank and areas adjacent to the closed area resulting in the large increase in trawler landings during the first quarter of 1992 in 4W. The exclusion of all gears from the closed area and the closure of the fishery in 1993 has resulted in much reduced catches and also in reduced the quantity of anecdotal information.

Estimation of Stock Parameters

Fishing Mortality and Stock Abundance

In the absence of reliable age-structured information on either the removals from the stock, or from the stock in general, fishing mortalities, are presently more difficult to estimate than has been the case in the past. The results of both the summer and spring surveys indicate that haddock are at low abundance relative to the long-term mean and in particular, larger (presumably older fish) are relatively rare at present. The bulk of the stock is concentrated in Division 4W and appears to be largely comprised of a single (1988) year-class.

An examination of the commercial catch at length for 1993 shows that significant numbers of fish were caught at sizes less than 42 cm; however with the reduction in overall landings, these landings were well below the long-term average (Figure 1). A comparison of the length composition of removals to the overall length composition of the population estimated from July surveys (Figure 14) shows that the fishery is exploiting the least abundant length classes in the population.

The catches at length presented in Table 6 were converted to estimates of catch at age using a method developed by Mohn (1991) and using as input the mean lengths at age from all available July RV aged haddock. The method assigns fish in length classes to age classes whose mean lengths are provided. All fish at the mean length and all fish in length bins halfway to the next lower and higher limit are included in the age. The resultant catch at 'pseudoage' is presented in Table 9. If these results are compared to the catch at age previously estimated for this resource, some notable differences in the distribution of fish over age-classes are apparent (Figure 15). This could be to some extent related to the apparent changes in mean length at age observed over the time series (Figure 16 a-c).

In spite of these differences the estimated catch at length and the survey catch rates at length were used as input to two minimization models, one using NLLS and the other using a partitioned search algorithm. The model formulation were as follows for each run.

Parameters

Terminal F estimates F_i, 1993, i = 3-6
Calibration coefficients $K_{1,i}$ = i = 3-6 for July RV survey

Structure Imposed

Error in catch assumed neglibile 1, 2 and 7
Partial selection fixed for ages 1, 2, and 7 in 1993
F for oldest age (7) set as average of "ages" 3-6
No intercept was fitted
M = 0.2 for all ages

Input
$C_{i,t}$ (i = 1,...,7; t = 1977,...,1993) = full catch at age
$J_{i,t}$ (i = 3...,6; t = 1977 to 1993) = July RV index

Objective Function

Minimize $\sum$ $(\ln J_{i,t} - K_i N_i)^2$ overall i, t

Summary

Number of observations = 68 for July RV (4 ages by 17 years)
Number of parameters = 4 q's and 4 K's

Results

Using the partitioned search algorithm we noted that using the entire data set (RV and Commercial Catch 1970 -1993) resulted in the relationship between the RV and estimated populations as shown on Figure 17. Removing years successively from 1970 to 1984 results in the decline in the sum of residuals as shown in Figure 18, with apparently abrupt changes in the rate of change in the reduction of the sum of squared residuals in 1974 and 1977. Estimates of q at age for these successive runs are given on Figure 19 and show a monotonic increase over the time series.

We made a decision to use only those data from 1977 to 1993, both because this is where the change in the sum of squared residuals from the models appears to level off and it is the year where the composition of the fishing fleet changed significantly due to the exclusion of the foreign fleet.

The results of the partitioned search using this data series are given on Table 10. These indicate a fishing mortality of about 0.2 on fully recruited ages in 1993. These analyses used an iterated partial selection vector which shows a decline in partial selection at ages beyond 5 as shown below.

Age 1	2	3	4	5	6	7
.01	.05	.28	.82	1.00	.52	.38

These results, although, giving reasonable estimates of F in 1993 do not result, however, in a satisfactory distribution of fish at pseudoages in the estimated population particularly in that it does not track the 1988 year-class. The overall fit of the model is shown in Figure 20.

Results of theses analyses using NLLS depend to some extent on the starting estimates of terminal F provided to the model (Figure 21) which may indicate that the Marquardt search algorithm is being trapped in local minima. The results iterate to approximately the same values as those determined through partitioned search only for an starting value of $F = 0.3$ (Table 11). Overall model fit does not differ significantly from that of partitioned search (Figure 22). Retrospective analysis using NLLS shows the pattern given on Figure 23 and indicates that F in the current year are underestimated relative to the retrospective view.

A second length-based approach to estimating F was attempted using the method outlined in Sinclair et al. (1993). This method estimates relative fishing mortality (R) as

$$R = \frac{C}{A}$$

where C is the catch at length and A is the estimates of population size from the July survey. It is relative fishing mortality because it assumes that catchability from the survey is unity such that A is equal to N (the mid-year population abundance at length).

The results of this analysis indicate a significant decline in relative F from 1992 to 1993 with values less than 0.1 at length-classes under 40 cm and slightly over 0.1 at 50 cm. These results although reasonable assume a catchability of 1.0 which the preceding analyses using the gradient and partitioned search length-based VPAs (LVPA) call into question. The results also appear to indicate a constant increase in partial selection with increasing length again contrary to the LVPA analyses.

Spawning Stock Biomass

Earlier assessments of this resource indicated that the probability of producing a large year-class is related to the general level of spawning stock biomass. At a spawning stock biomass below 16,000t the probability of producing an above average year-class is considered low. At present, female spawning stock biomass estimated from surveys is on the order of 4,000 - 8,000t. This estimate was derived from survey catch rates at length converted to weight and assumed knife-edged maturity at 42.5 - 46.5 cm (Figure 24).

Recruitment

The 1993 summer survey caught an above average number of fish at 8.5 cm which may indicate an above average 1993 year-class, but the abundance at these size classes are generally not well estimated. It also detected above average catch rates at 22.5 and 24.5 cm. The 1994 spring survey detected fish at slightly above average catch rate at a modal length of 18.5 cm (probably age 1), but it is uncertain whether or not it will be estimated as above average in subsequent surveys.

Prognosis

The absence of reliable age-structured data makes it difficult to estimate the rate at which this resource is presently being exploited. There are, however, a number of indicators which would lead to the conclusion that this stock has been heavily exploited, that environmental conditions over a significant portion of the stocks range have been unfavourable, and that recruitment over the past 4 years appears to have been below average.

The length-based VPAs shown above indicate that present exploitation (1993) was about 0.2 with landings of 1,200 t. However, the distribution of fish into age classes does not obviously reflect the known population structure and therefore these estimates must remain questionable.

Although the presence of the strong 1988 year-class is encouraging, indications are that the post-1988 year-classes are not large. At present, both the fishery and the reproductive potential of the stock is dependent on the 1988 year-class.

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Table 1. Nominal catches (t) of eastern Scotian Shelf haddock (4TVW) by NAFO Division and country as reported to NAFO (from NAFO Statistical Bulletin).

	4T					4Vn*					4Vs					4W						
Year	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Total	TAC
1954	5918	1044			40	5549	405		1058	24						12323	1956		17		28334	
1955	3101	31				3339	450		1183	13						12777	1217				22111	
1956	2861					4899	147		1350	12						18273	1661		354		29557	
1957	1740	1				5869	120		747	9						19960	1533		132		30111	
1958	2599			151		3166	71		1343	6						17572	427		1593		26928	
1959	2996	1		64		1594	159		69		3456	111		2870		21156	4804		640		37920	
1960	2041					1317	6		97		1187	18		3926	1	20093	127		1024		29837	
1961	1297			273	2	1055	1		47	1	846			1526	7	22277	23	151	1441	16	28963	
1962	1132			10		1097	1		5	2	1235			1076		15566	51	2567	3224		25966	
1963	1019			46		1213	1	6	64		1061	1		2828	195	11002	60	3295	4915	866	26572	
1964	461			1		958			59	52	677	11		2057	2	9810	42	4391	2884	1889	23294	
1965	432			3	3	402			53	84	1201			1806	47	7007	8	42876	1500	96	55518	
1966	149			1		311		516	30		1494			940	9	8259	19	9985	1885	51	23649	
1967	112			9		203		95	26	31	898			839	9	7180	5	459	1046		10912	
1968	144				4	127			70	6	1128		59	1702	23	8392		195	1458	10	13318	
1969	167				3	245				112	726			631	66	8270		235	864	1	11320	
1970	160					395	2		75	1	620		34	830	16	4754	574	636	1332		9429	
1971	151					466			215	1	1133		11	1114		7940	497	464	1477		13469	
1972	60					362	3		136	19	421		3	599	37	2096	70	103	737	102	4748	
1973	21				2	286			76	164	233			431	9	2830	173	76	95	18	4414	
1974	17				14	161			3	1	147		30	174	196	907	6	102	521	78	2357	0
1975	35				2	67			15	4	107	1		48	3	1393	20	52	63	59	1868	0
1976	12					40				1	52	1	9		1	1198	31	15			1360	2000
1977	8					189				8	144				1	2845	1	14		38	3248	2000
1978	18					119				3	441		3		38	4949	82	139		109	5901	2000
1979	59					194				11	650				2	2339		104		73	3433	2000

Table 1. (Continued)

	4T					4Vn+					4Vs					4W						
Year	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Total	TAC
1980	81					188				42	1841					12448		209		31	14840	15000
1981	177					119				25	1796					17684		187		21	20009	23000
1982	47					183				23	2373					12498		53		49	15226	23000
1983	30					206				17	1542					7302		149		166	9412	15000
1984	120					299				11	3195		2		1	3992		168		233	8021	15000
1985	498					598				59	7291				2	2862		275		79	11664	15000
1986	531					904				17	8798				4	6277		312		78	16921	17000
1987	438					484				13	1587					994		207		154	3877	0
1988	369					507					2057					1176		332		99	4540	0
*1989	80					425				2	3108					3582		1754		177	9128	6700
1990	33					108					2429					4077		265		97	7009	6000
*1991	18					51					978					3740		575		59	5421	0
*1992	9					27					781					5118		63		115	6113	
1993	4					3					433					770					1210	

+ = Between 1954 and 1958 catches for 4Vn and 4Vs were combined as 4V.
* = Provisional data.

Table 2. Summary of license conditions and variation orders relating to 4TVW haddock issued by Fisheries and Habitat Management, Scotia-Fundy Region in 1993.

	Gear Category	Date	Reported Catch	Trip Limits
Fixed Gear <45' - Scotia-Fundy				
4VW - all groundfish	FG < 65'	Sept 23		CHP 220 kg each or 10% by-catch while directing for cusk, hake, halibut; gillnets can direct for pollock
4VsW - all groundfish	FG < 65'	Oct 1		CHP - 10% each while directing for cusk, hake, and halibut
	A 2993	Oct 16		Fishing prohibited
	A 2994	Oct 16		Fishing prohibited
4Vs only	FG < 65'	Dec 9		Large hook fishery only - 10% each CHP - 15 day trip limit
Cod 4VsW		Aug 16		1) haddock 2500 kg, or 2) 2500 kg - 3 trips until 30 September 1993
Haddock 4VsW	all FG < 45'	Jan 26		1500 kg
	all FG < 65'	May 1		2500 kg
		May 14		2500 kg
Haddock 4Vn	all FG < 45'			1500 kg
	all FG < 65'	May 1		1500 kg
Halibut 4VWX	all FG < 65'	Apr 8		1500 kg haddock
		June 1		450 kg haddock
		July 12		100 kg haddock
		Sept 2		100 kg haddock
		Oct 1		CHP - each 10%
Halibut 4VsW	A 2993 (longline and handline)	Oct 1		10% by-catch CHP
	A 2994 (gillnet)	Oct 1		10% by-catch CH, unlimited pollock
4VsW	A 2993 (longline and handline)	Oct 16		Fishing prohibited
	A 2994 (gillnet)	Oct 16		Fishing prohibited

Table 2. (Continued)

	Gear Category	Date	Reported Catch	Trip Limits
Fixed Gear 45'-65' - Scotia-Fundy				
4VW - all groundfish	all FG < 65'	Sept 23		CHP, 250 kg each or 10% by-catch while directing for cusk, hake, halibut - gillnets can direct for pollock
4VsW - all groundfish	all FG < 65'	Oct 1		CHP, 10% each while directing for cusk, hake and halibut
	A 2993	Oct 16		Fishing prohibited
	A 2994	Oct 16		Fishing prohibited
4Vs only	all FG < 65'	Dec 9		Large hook fishery only - 10% each CHP, 15 day trip limit
Haddock 4Vn	FG 45' - 65'	Jan 18		2500 kg, 15% by-catch
	all FG < 65'	May 1		1500 kg
Haddock 4VsW	FG 45' - 65'	Jan 18		2500 kg, 15% by-catch
	all FG < 65'	May 1		2500 kg
		May 14		2500 kg
Halibut 4VWX	all FG < 65'	Apr 8		1500 kg haddock
		June 1		450 kg haddock
		July 12		100 kg haddock
		Sept 2		100 kg haddock
Halibut 4VWX(5) (A24)	all FG < 65'	Oct 1		CHP 10% (in reality, 4VW closed by v/o 1993-090)
Halibut 4Vn	All FG < 65'	Oct 1		Closed until further notice
4VsW	A 2993 (longline and handline)	Oct 1		10% by-catch CHP
	A 2994 (gillnet)	Oct 1		10% by-catch CH, unlimited pollock
4VsW	A 2993	Oct 16		Fishing prohibited
	A 2994	Oct 16		Fishing prohibited
All Fixed Gear			772	

Table 2. (Continued)

	Gear Category	Date	Reported Catch	Trip Limits
Mobile Gear <65' - IQ vessels			96	
4VW - directed CHP	all IQ vessels	Sept 23		5% by-catch of cod while directing for flatfish and redfish
	all IQ vessels	Oct 1		Closed 4Vn cod, 4VsW cod, 4X cod, 4VWX5 pollock and 4VW haddock. Directed flatfish in ENS with 5% by-catch of cod or pollock and 10% for haddock.
		Dec 4		In ENS vessels are only permitted to direct for flatfish with 5% by-catch of cod or pollock and 10% for haddock.
Vessels < 65'			311	
Cod 4Vn, 4VsW	all vessels > 65'	Sept 22		5% cod (maximum 450 kg) by-catch while directing for redfish, by-catch of all other groundfish combined cannot exceed 10%

Table 3. 4TVW haddock landings (t) by division and subdivision (Canadian catches only from inter-regional data).

Area	1986	1987	1988	1989	1990	1991	1992	1993
4T	553	453	383	79	30	12	9	4
4Vn	899	491	506	421	108	52	27	3
4Vs	8719	1547	2041	3114	2427	975	780	433
4W	6170	991	1150	3580	4078	3999	5164	770
TOTAL	16341	3481	4080	7194	6643	5038	5980	1210

Table 4. 4TVW haddock landings by quarter and major gear type 1986-1989 (Canadian landings only).

Gear	1986					1987				
	Q1	**Q2**	**Q3**	**Q4**	**TOTAL**	**Q1**	**Q2**	**Q3**	**Q4**	**TOTAL**
OTB	3072	4158	3661	3060	13952	356	680	608	433	2077
LL	86	203	535	281	1105	34	135	377	190	736
SNU	121	483	349	226	1179	5	370	175	34	585
Other	1	14	65	26	106	0	19	40	24	83
TOTAL	3280	4858	4611	3592	16341	396	1203	1200	682	3481

Gear	1988					1989				
	Q1	**Q2**	**Q3**	**Q4**	**TOTAL**	**Q1**	**Q2**	**Q3**	**Q4**	**TOTAL**
OTB	266	852	777	447	2341	763	2022	1062	487	4332
LL	33	177	721	204	1134	285	522	858	657	2322
SNU	11	199	197	17	424	14	283	150	28	475
Other	7	63	53	57	180	0	16	34	14	64
TOTAL	317	1291	1747	725	4080	1062	2842	2104	1186	7194

Table 4. (Continued)

Gear	1990					1991				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	1092	957	664	258	2971	338	569	396	410	1713
LL	838	474	1341	497	3149	439	668	1413	651	3171
SNU	15	168	223	11	417	3	78	16	6	104
Other	0	7	64	35	106	1	17	34	4	55
TOTAL	1945	1606	2292	800	6643	782	1332	1859	1071	5043

Gear	1992					1993				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	1324	511	173	209	2218	93	140	121	18	372
LL	615	661	1391	826	3494	21	168	563	26	777
SNU	1	114	56	28	199	0	27	20	7	53
Other	0	10	43	17	70	0	0	6	1	7
TOTAL	1940	1296	1663	1081	5980	114	335	709	52	1210

Table 5. 4TVW haddock landings by area, quarter and gear type (Canadian landings only).

Year	4T					
	Gear	Q1	Q2	Q3	Q4	Total
1986	OTB	9	71	85	4	169
	LL	0	2	6	5	12
	SNU	0	261	83	16	359
	Other	0	1	10	1	13
	TOTAL	9	336	184	25	554
1987	OTB	4	78	43	9	134
	LL	0	2	6	4	13
	SNU	0	208	75	5	289
	Other	0	11	6	0	17
	TOTAL	4	300	130	19	453
1988	OTB	1	18	199	5	224
	LL	0	1	2	4	8
	SNU	0	57	69	7	132
	Other	0	9	9	2	20
	TOTAL	1	85	279	18	383
1989	OTB	0	9	2	0	11
	LL	0	0	1	2	3
	SNU	0	39	20	1	60
	Other	0	4	1	0	6
	TOTAL	0	52	24	3	79
1990	OTB	1	2	0	1	5
	LL	0	0	1	0	1
	SNU	0	19	3	0	22
	Other	0	1	1	0	2
	TOTAL	1	22	5	2	30
1991	OTB	0	3	0	0	3
	LL	0	0	0	1	2
	SNU	0	10	2	0	12
	Other	0	0	1	0	1
	TOTAL	0	14	3	2	18
1992	OTB	0	0	0	0	1
	LL	0	0	0	2	2
	SNU	0	5	1	0	6
	Other	0	0	0	0	0
	TOTAL	0	6	1	2	9
1993	OTB	0	0	0	0	0
	LL	0	0	0	1	2
	SNU	0	1	0	0	1
	Other	0	0	0	1	1
	TOTAL	0	1	1	3	4

Table 5. (Continued)

Year	4Vn					
	Gear	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
1986	OTB	67	139	180	18	405
	LL	0	27	87	47	161
	SNU	0	190	134	4	328
	Other	0	1	3	1	6
	TOTAL	67	356	405	71	899
1987	OTB	28	84	32	20	164
	LL	7	28	54	26	115
	SNU	0	142	47	18	207
	Other	0	1	2	3	5
	TOTAL	35	254	135	66	491
1988	OTB	26	113	14	11	164
	LL	0	21	113	52	186
	SNU	0	102	48	3	153
	Other	0	0	2	0	2
	TOTAL	26	236	177	66	506
1989	OTB	24	178	46	1	249
	LL	0	13	32	8	53
	SNU	0	96	17	1	114
	Other	0	1	2	1	4
	TOTAL	25	287	97	12	421
1990	OTB	17	32	12	6	67
	LL	0	6	14	1	21
	SNU	0	15	5	0	20
	Other	0	0	0	0	1
	TOTAL	17	53	31	7	108
1991	OTB	8	8	4	2	21
	LL	0	2	14	3	19
	SNU	0	5	2	0	7
	Other	0	0	3	0	3
	TOTAL	8	14	23	5	50
1992	OTB	8	2	1	1	12
	LL	0	0	9	3	13
	SNU	0	1	0	0	2
	Other	0	0	0	0	0
	TOTAL	8	4	11	4	27
1993	OTB	1	2	0	0	3
	LL	0	0	0	0	0
	SNU	0	0	0	0	0
	Other	0	0	0	0	0
	TOTAL	1	2	0	0	3

Table 5. (Continued)

Year	4Vs					
	Gear	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
1986	OTB	810	3666	3093	917	8485
	LL	4	93	115	0	212
	SNU	0	17	3	0	19
	Other	0	0	2	0	2
	TOTAL	814	3775	3212	917	8719
1987	OTB	252	398	412	291	1353
	LL	2	58	98	16	174
	SNU	0	11	7	1	19
	Other	0	0	0	0	0
	TOTAL	254	468	517	308	1547
1988	OTB	188	596	448	385	1617
	LL	14	67	211	27	319
	SNU	0	24	16	0	40
	Other	7	45	11	2	65
	TOTAL	209	732	685	414	2041
1989	OTB	592	1255	538	209	2594
	LL	11	100	193	95	399
	SNU	5	76	34	2	118
	Other	0	3	0	0	4
	TOTAL	608	1434	765	307	3114
1990	OTB	830	639	370	184	2023
	LL	132	84	54	6	276
	SNU	0	64	62	0	126
	Other	0	3	0	0	3
	TOTAL	961	789	486	190	2427
1991	OTB	185	257	104	129	675
	LL	3	120	133	10	267
	SNU	1	28	2	1	31
	Other	0	0	0	0	0
	TOTAL	189	405	239	140	973
1992	OTB	205	195	60	96	557
	LL	1	68	65	6	140
	SNU	0	76	2	2	80
	Other	0	4	0	0	4
	TOTAL	205	343	128	104	780
1993	OTB	80	126	32	5	242
	LL	7	57	83	0	148
	SNU	0	25	10	7	42
	Other	0	0	0	0	0
	TOTAL	87	208	125	12	433

Table 5 . (Continued)

Year	4W					
	Gear	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
1986	OTB	2186	282	302	2122	4893
	LL	82	81	328	229	719
	SNU	121	16	130	206	472
	Other	1	12	50	23	86
	TOTAL	2391	391	810	2579	6170
1987	OTB	72	120	121	113	427
	LL	26	45	219	144	434
	SNU	5	8	47	10	70
	Other	0	7	32	21	60
	TOTAL	103	181	419	288	991
1988	OTB	51	125	116	45	336
	LL	19	88	394	121	622
	SNU	11	16	64	8	99
	Other	0	9	31	53	93
	TOTAL	81	238	605	226	1150
1989	OTB	146	581	476	276	1479
	LL	274	409	633	551	1867
	SNU	9	72	79	24	184
	Other	0	8	31	12	51
	TOTAL	429	1070	1218	863	3580
1990	OTB	245	284	282	66	877
	LL	706	384	1272	489	2851
	SNU	15	70	153	11	249
	Other	0	3	62	34	100
	TOTAL	966	742	1769	601	4078
1991	OTB	145	301	288	280	1064
	LL	436	546	1266	636	2883
	SNU	3	36	11	5	54
	Other	1	16	30	4	50
	TOTAL	584	900	1594	923	4001
1992	OTB	1112	313	112	111	1648
	LL	615	593	1316	816	3339
	SNU	0	32	53	26	111
	Other	0	6	43	17	66
	TOTAL	1727	943	1524	970	5164
1993	OTB	13	12	89	13	127
	LL	13	111	479	24	627
	SNU	0	1	10	0	10
	Other	0	0	5	0	6
	TOTAL	26	124	582	37	770

Table 6. 4TVW haddock catch at length.

Length (cm)	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.5	2.9	8.5	.0	.0	.0	5.1	.0	.0	.0	.0	.2	.0	.0	.0	.0
8.5	8.7	2.8	.0	.0	.0	1.7	27.8	1.6	.0	.0	6.3	.0	.0	.0	.0
10.5	.0	.0	.0	.0	12.7	1.7	9.3	.8	.0	.0	4.8	2.3	.0	.0	.0
12.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.2	.2	.9	.5	.0
14.5	.0	.0	.0	.0	.0	.0	.0	.4	.3	.0	.8	3.7	62.5	10.2	.0
16.5	2.9	5.6	8.6	.0	.0	.0	11.6	.4	28.0	.1	163.3	44.7	239.6	88.4	.0
18.5	37.6	14.1	56.0	21.6	.0	5.1	25.5	2.0	141.8	.2	286.1	219.4	340.1	498.6	.0
20.5	127.2	53.5	189.5	75.6	.0	17.0	164.3	9.0	249.3	.8	168.2	452.8	204.0	352.5	18.0
22.5	222.5	70.4	168.0	216.0	15.3	37.5	143.5	16.5	157.6	1.8	131.0	286.1	69.3	234.0	796.3
24.5	72.3	39.5	43.1	162.0	10.2	98.8	50.9	14.5	63.0	3.6	97.0	85.8	19.7	141.1	161.1
26.5	34.7	25.4	21.5	86.4	10.2	85.2	20.8	9.0	20.1	13.6	36.5	12.3	61.2	98.3	137.5
28.5	14.5	47.9	21.5	140.4	5.1	29.0	30.1	10.6	45.3	18.4	4.7	15.0	35.3	51.5	62.0
30.5	66.5	159.8	54.9	195.6	17.8	5.1	44.0	12.9	80.4	28.7	2.9	15.7	14.8	17.5	30.0
32.5	76.4	185.8	47.7	413.5	43.3	3.4	148.4	12.6	131.6	35.7	7.3	17.7	19.9	31.1	39.5
34.5	98.8	129.7	64.8	264.8	129.9	6.2	256.6	14.0	126.6	24.8	35.4	25.1	96.6	109.3	160.9
36.5	262.4	173.2	101.1	235.3	158.0	50.2	147.4	33.1	107.7	23.3	153.8	77.1	206.3	190.0	526.8
38.5	322.6	268.9	100.1	287.8	325.4	53.8	40.7	56.7	171.1	63.9	400.6	287.2	452.7	349.7	1101.9
40.5	473.1	431.1	176.0	277.5	225.1	105.4	16.4	113.9	273.3	100.5	751.1	802.6	511.5	742.3	1296.6
42.5	479.3	668.1	210.0	297.5	138.0	123.6	29.6	245.7	387.7	163.3	1227.5	1248.8	639.2	964.2	1169.7
44.5	611.0	732.1	249.0	383.8	84.7	161.7	20.7	283.6	502.4	215.2	1440.7	1690.7	990.0	862.9	951.7
46.5	629.7	920.5	310.4	469.0	132.0	161.2	62.2	324.7	598.7	257.3	1470.7	2130.8	1313.0	842.4	714.1
48.5	669.7	983.7	326.9	351.9	100.7	217.4	108.2	308.1	548.0	321.6	1565.1	2128.6	1629.1	890.7	661.9
50.5	709.2	931.3	332.0	355.2	125.9	170.5	112.3	227.4	470.4	341.8	1266.2	1822.7	1486.0	866.1	421.5
52.5	710.3	950.3	387.7	342.8	158.5	185.3	111.7	186.5	379.2	323.9	1070.8	1533.8	1142.4	653.2	312.0
54.5	480.7	783.4	299.9	313.4	169.9	165.0	133.8	164.6	288.5	181.4	818.3	1143.5	838.5	484.2	276.0
56.5	420.2	724.9	299.0	242.5	127.6	105.6	99.4	151.2	247.0	151.7	578.2	844.1	637.0	317.5	189.7
58.5	343.9	552.9	225.4	268.6	128.2	100.1	84.7	115.6	198.8	98.3	378.1	637.0	459.5	206.2	120.7
60.5	219.4	401.1	178.4	219.3	94.4	68.8	86.2	92.5	169.4	78.8	263.1	376.2	356.0	131.2	81.0
62.5	241.7	381.1	153.4	173.6	85.8	73.1	71.1	55.4	101.4	48.0	167.0	262.7	216.0	93.1	46.0
64.5	132.8	230.2	101.2	87.0	57.1	28.5	46.1	32.1	73.6	31.0	106.0	125.2	124.0	42.3	29.0
66.5	94.8	158.6	55.8	72.6	28.6	24.4	31.7	28.8	33.3	13.0	67.0	93.2	100.0	27.0	19.2
68.5	59.0	85.7	43.8	23.8	25.3	8.5	6.8	16.7	28.9	11.0	19.0	43.0	45.0	11.1	11.0
70.5	26.6	51.6	8.2	20.7	11.7	5.3	4.1	15.9	5.3	3.0	28.0	26.0	44.0	14.2	10.0
72.5	22.9	19.5	13.2	20.4	3.3	5.2	6.4	3.9	3.1	3.0	6.0	10.0	20.0	5.0	3.0
74.5	20.8	14.4	2.5	14.9	2.6	.0	.5	2.2	2.2	1.0	4.0	8.0	5.0	5.0	2.0
76.5	7.8	18.7	1.7	1.5	.7	.0	.3	1.5	3.2	1.0	1.0	2.0	5.0	1.0	.0
78.5	4.2	2.0	2.9	1.1	.0	.9	.0	.4	.2	.0	1.0	2.0	1.0	1.0	.0
80.5	.0	.5	2.9	.0	.0	.0	.0	1.6	.0	.0	.0	1.0	2.0	.0	.0
82.5	3.9	1.7	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
84.5	.5	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Sum	7711.3	10229	4257.2	6037.5	2428.0	2110.1	2153.0	2566.4	5637.4	2559.7	12729.0	16477.0	12387.0	9333.0	9349.0

Table 6. (Continued)

1985	1986	1987	1988	1989	1990	1991	1992	1993
.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
.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
.0	.0	.0	.0	.6	.0	.0	.0	.0
.3	.0	.0	.0	8.7	.4	.0	.0	.0
51.5	.0	.2	.2	119.5	.6	.0	.0	.0
175.7	.4	3.0	4.0	467.3	4.8	.1	.3	.2
354.3	2.9	16.2	33.4	584.7	17.8	.6	.5	1.2
229.7	5.0	25.0	45.8	297.2	36.9	2.2	.7	1.8
66.5	5.5	16.5	20.8	74.6	61.8	5.7	.7	2.4
20.9	4.7	11.4	9.1	101.3	148.2	16.1	.8	1.7
3.5	7.4	20.4	17.3	233.5	189.5	39.2	1.2	4.2
15.3	22.8	41.9	25.5	277.8	118.3	68.8	2.4	6.8
2.4	47.5	47.1	22.7	164.4	58.3	118.0	6.7	6.4
30.3	99.9	40.4	16.6	60.2	70.7	149.5	43.1	7.2
207.5	271.0	33.0	14.7	52.7	67.8	151.1	169.6	22.0
783.5	1060.9	51.3	48.4	122.7	47.5	257.3	448.9	58.3
1748.8	2605.1	124.5	147.2	284.0	129.4	416.7	650.5	125.2
2230.5	3858.8	253.3	384.9	644.4	239.9	504.6	721.6	171.3
1983.0	3983.4	382.5	723.5	939.3	528.6	676.6	772.2	159.1
1567.2	2821.3	610.4	870.8	1175.6	824.7	727.8	757.7	152.3
1049.1	1511.2	611.6	654.2	1105.7	930.1	596.9	693.1	125.4
597.1	848.6	458.3	441.0	799.5	907.8	473.6	478.6	95.8
421.0	460.2	297.3	263.3	539.8	650.5	318.2	314.6	81.5
277.0	258.3	161.0	150.0	321.2	476.2	219.8	209.1	54.6
216.0	144.6	96.5	75.3	195.1	241.2	148.1	156.4	38.3
136.0	90.4	46.2	40.7	104.9	136.5	85.2	101.4	29.9
87.0	67.9	33.1	26.9	66.4	70.0	65.5	69.9	27.5
54.0	32.8	16.6	17.4	27.6	33.7	31.4	45.6	14.7
41.0	24.2	8.4	12.4	18.6	25.3	20.1	31.1	11.0
24.0	13.2	2.2	5.2	9.0	15.2	7.0	20.5	5.1
13.0	2.0	.0	4.2	7.0	11.1	4.1	5.3	1.6
10.0	4.0	1.0	2.0	3.0	8.0	2.0	1.8	1.3
4.0	1.0	1.0	1.1	.0	3.0	1.0	6.6	.1
4.0	1.0	.0	.0	1.0	.0	.0	.3	.0
1.0	.0	1.0	.0	.0	.0	1.0	.3	.0
.0	.0	.0	.0	.0	.0	.0	.0	.2
1.0	.0	.0	.0	.0	1.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0
12406.0	18256.0	3411.1	4078.6	8807.4	6055.0	5108.3	5711.6	1207.0

Table 7. Samples available for the construction of catch at length for 1993.

	Trawlers and Seiners - 4TVW		Longliners - 4TVW	Foreign Small Mesh Fishery
	1st Half 1993	2nd Half 1993	All Year	
No. Samples	14	6	19	
Tons Catch	259.825	165.750	777.073	135
No. Measured	2656	966	3656	

Table 8. July research vessel survey catch rates per tow at length.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0	0
4.5	0	0	0.009	0	0	0	0.005	0	0	0.043	0.036	0.011	0.075	0.015	0	0	0	0	0	0	0	0	0	0.012
6.5	0.025	0.031	0.022	0	0	0.02	0.266	0.05	0	0.43	0.738	3.746	0.319	0.1	0.018	0	0.086	0.017	0.063	0	0	0.022	0	0.282
8.5	0.062	0.021	0.009	0	0.118	0.019	0.209	0.108	0	0.722	0.35	11.929	0.28	0.031	0.258	0.011	0.051	0.061	0.692	0.057	0	0	0	1.13
10.5	0	0	0	0	0.072	0.022	0.037	0.056	0	0.044	0.104	2.783	0.1	0	0	0	0	0.004	0.28	0.043	0	0	0	1.006
12.5	0	0	0	0	0	0	0	0	0	0	0.01	0.157	0.03	0.016	0	0	0	0	0.008	0	0	0	0	0.063
14.5	0	0	0	0	0	0	0	0.02	0.03	0	0.018	0.26	1.361	0.286	0.005	0	0	0	0	0	0.018	0	0	0
16.5	0.022	0.015	0.03	0	0	0.029	0.08	0.02	0.438	0	0.03	1.925	7.78	4.163	0	0.023	0	0.174	0	0.741	0.014	0	0.02	0.007
18.5	0.191	0.125	0.181	0.011	0.023	0.08	0.117	0.071	2.431	0.02	0.494	4.365	5.809	9.825	0.04	0.155	0.061	0.487	0.075	5.296	0.049	0.017	0.008	0.053
20.5	0.66	0.267	0.448	0.066	0.02	0.183	1.053	0.694	3.384	0.029	1.23	3.984	2.548	8.22	0.258	1.286	0.179	0.941	1.043	5.627	0.249	0.061	0.323	0.34
22.5	1.024	0.558	0.411	0.173	0.116	0.318	0.845	1.868	1.426	0.019	0.922	1.743	0.745	3.071	0.339	2.346	0.45	0.871	2.081	1.632	0.387	0.091	0.299	1.06
24.5	0.284	0.398	0.114	0.154	0.084	1.608	0.325	1.847	0.757	0.149	0.328	0.913	1.547	2.256	0.951	0.677	0.483	0.31	1.306	0.574	0.424	0.035	0.137	0.925
26.5	0.125	0.283	0.165	0.129	0.067	1.987	0.371	0.918	0.406	0.426	0.025	0.489	3.612	2.65	1.839	0.226	0.178	0.131	0.27	0.217	1.652	0.068	0.049	0.422
28.5	0.035	0.267	0.126	0.216	0.032	0.419	0.293	0.93	0.266	1.351	0.054	1.474	4.593	4.014	3.119	0.307	0.187	0.211	0.356	0.512	5.874	0.564	0.16	0.217
30.5	0.305	0.794	0.31	0.204	0.109	0.102	0.213	1.682	1.296	1.992	0.015	2.27	3.806	4.201	5.183	0.834	0.912	0.5	2.704	1.735	7.123	1.969	0.435	0.705
32.5	0.328	0.994	0.3	0.466	0.382	0.021	0.455	2.602	2.867	2.446	0.087	2.159	2.329	5.154	4.54	1.803	1.567	0.874	8.208	3.2	2.976	7.544	1.248	0.618
34.5	0.161	0.693	0.22	0.311	0.758	0.036	0.584	2.462	3.546	2.115	0.643	1.38	0.962	5.174	4.238	3.366	2.026	0.888	6.178	1.718	2.035	11.525	4.519	0.981
36.5	0.351	0.325	0.198	0.186	0.627	0.074	0.575	1.736	2.88	1.236	1.569	0.467	1.919	7.836	7.143	4.235	4.271	1.542	2.738	0.943	3.184	10.256	6.059	2.949
38.5	0.392	0.179	0.185	0.171	0.538	0.088	0.247	1.134	2.674	1.726	3.666	0.262	3.427	9.099	9.916	4.598	7.598	2.535	3.639	1.053	3.369	8.137	4.78	5.136
40.5	0.587	0.31	0.239	0.138	0.42	0.373	0.068	1.391	3.952	2.823	4.345	0.581	3.8	5.085	10.563	6.282	9.06	4.557	4.268	1.567	2.489	6.279	3.746	4.535
42.5	0.563	0.524	0.167	0.053	0.574	0.404	0.154	2.044	3.163	3.029	3.698	1.516	2.891	3.309	6.792	6.288	7.812	5.432	5.336	2.945	2.12	5.037	2.364	3.28
44.5	0.656	0.457	0.127	0.144	0.535	0.777	0.097	1.813	2.457	2.888	4.639	1.996	3.269	2.615	3.945	4.122	5.611	4.808	6.121	3.965	2.99	3.945	1.478	1.763
46.5	0.444	0.347	0.209	0.125	0.399	0.458	0.214	1.169	1.895	2.521	4	2.061	2.37	2.152	2.184	2.748	3.655	2.913	4.7	3.694	2.72	3.408	1.111	1.045
48.5	0.377	0.315	0.112	0.039	0.192	0.373	0.334	0.445	1.709	1.851	3.915	2.024	2.196	1.809	1.686	1.595	2.239	1.83	3.012	2.706	1.974	2.487	0.775	0.448
50.5	0.489	0.315	0.282	0.136	0.119	0.365	0.308	0.582	1.058	1.269	3.082	1.475	2.039	1.348	1.039	1.335	1.559	0.769	1.451	1.504	1.438	0.865	0.528	0.432
52.5	0.415	0.21	0.12	0.141	0.201	0.212	0.261	0.594	0.432	0.69	1.452	0.869	1.65	1.177	1.066	0.83	0.76	0.515	0.726	0.827	0.597	0.467	0.306	0.167
54.5	0.176	0.133	0.111	0.127	0.227	0.387	0.267	0.41	0.136	0.521	1.114	0.496	1.173	0.836	0.545	0.425	0.652	0.188	0.318	0.441	0.298	0.095	0.099	0.07
56.5	0.277	0.148	0.072	0.027	0.178	0.209	0.173	0.364	0.138	0.144	0.36	0.452	0.645	0.323	0.464	0.373	0.498	0.167	0.193	0.275	0.254	0.072	0.107	0.03
58.5	0.204	0.072	0.046	0.125	0.142	0.247	0.059	0.26	0.096	0.077	0.289	0.24	0.476	0.258	0.302	0.242	0.305	0.07	0.115	0.07	0.065	0.034	0.011	0.023
60.5	0.089	0.047	0.056	0.04	0.054	0.208	0.021	0.269	0.093	0.129	0.198	0.204	0.185	0.091	0.238	0.093	0.155	0.032	0.13	0.102	0.093	0.007	0.015	0.008
62.5	0.141	0.04	0.076	0.078	0.057	0.11	0.084	0.094	0.089	0.08	0.155	0.075	0.287	0.121	0.126	0.073	0.066	0.002	0.056	0.043	0.016	0	0.015	0
64.5	0.203	0.017	0.03	0	0.074	0.106	0.066	0.07	0.062	0.043	0.088	0.111	0.175	0.083	0.102	0.031	0.038	0.013	0.067	0.019	0.005	0.009	0	0.002
66.5	0.163	0.086	0	0.049	0.008	0.066	0.037	0.014	0	0.051	0.041	0.027	0.076	0.099	0.066	0.093	0.02	0.01	0.016	0.008	0.007	0	0.007	0
68.5	0.026	0.007	0.039	0	0.018	0.025	0.018	0.052	0.026	0.03	0.044	0.027	0	0.042	0.066	0.028	0.007	0.002	0	0.008	0	0.016	0.007	0
70.5	0.037	0.021	0	0	0.004	0.039	0	0	0.025	0.016	0	0	0.018	0.002	0	0.024	0.007	0	0	0	0	0	0	0
72.5	0.036	0	0	0.019	0.013	0.03	0.05	0.027	0.009	0	0	0	0	0.024	0.014	0.004	0	0	0	0	0.005	0	0	0
74.5	0.007	0	0	0.029	0	0	0.003	0	0	0	0	0	0.022	0	0.006	0	0	0	0	0	0	0	0	0
76.5	0.007	0	0	0	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0	0	0	0	0
78.5	0.007	0	0	0	0	0	0	0.025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.003	0.002	0	0.008	0	0	0	0	0	0
82.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUM	8.869	7.999	4.414	3.357	6.161	9.395	7.889	25.821	37.741	28.91	37.739	52.473	62.514	85.485	67.08	44.455	50.493	30.888	56.15	41.522	42.425	63.01	28.606	27.709

Table 9. Spring (March) Research Vessel catch rates per tow at length

length	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0.5	0	0	0	0	0	0		0		0	0	0	0	0	0	0
2.5	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
4.5	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
6.5	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
8.5	0	0	0.02	0	0	0		0	0	0	0	0	0	0	0	0
10.5	0	0	1.88	0.5	0.25	0		0	0.02	0	0.02	0	0	0	0	0
12.5	0	0.69	9.16	9.28	2.49	0.64		0.07	0.05	0.08	1.46	0.03	0.02	0.02	0	0.07
14.5	0.01	3.1	10.33	14.92	6.53	0.97		0.15	1.11	1.5	11.22	0.07	0.01	0.6	0.12	0.17
16.5	0	1.69	4.83	6.95	4.73	0.1		0.29	1.55	4.13	6.93	0.08	0.1	0.36	0.92	1.44
18.5	0.02	0.45	1.38	2.2	1.84	0.3		0.99	0.79	2.27	1.06	0.21	0.04	0.01	1.54	1.51
20.5	0.07	0.17	0.07	2.31	2.62	2.3		0.41	0.11	0.64	0.21	0.09	0	0	0.61	0.68
22.5	0.23	0.02	0.57	4.76	4.33	3.33		0.09	0.05	0.15	0.08	0.77	0.13	0	0	0.1
24.5	0.64	0.03	3.67	9.2	5.52	3.72		0.13	0.29	0.88	1.2	3.39	0.18	0.06	0	0.1
26.5	0.86	0.05	4.45	10	3.49	3.63		0.69	0.7	2.58	4.46	4.77	0.65	0.06	0.04	0.68
28.5	0.61	0.17	2.64	4.94	2.63	4.65		0.68	0.76	3.09	8.03	2.96	0.97	0.02	0	0.81
30.5	0.22	0.54	1.38	2.21	4.65	9.27		0.75	0.69	1.28	4.76	0.59	2.4	0.08	0.06	0.56
32.5	0.43	1.67	0.5	1.46	10.61	15.56		1.45	1.38	0.49	2.18	2.03	3.69	0.32	0.43	0.46
34.5	0.53	2.52	0.12	2.6	13.01	16.26		3.76	2.56	0.94	3.39	3.11	2.4	0.67	1.06	1.44
36.5	1.74	3.23	3.14	3.68	8.23	11.27		7.89	3.96	1.5	3.4	2.58	1.85	1.1	3.56	4.18
38.5	1.29	2.41	11.4	2.57	6.24	10.49		11.51	5.46	2.11	3.06	1.55	1.7	0.79	3.43	9.25
40.5	1.89	1.44	22.09	2.43	7.68	7.28		11.99	8.86	3.5	3.95	2.9	1.28	1.05	2.57	6.75
42.5	2.14	0.94	27.89	1.48	6.41	4.14		11.42	9.16	5.85	4.69	3.75	0.99	0.95	1.24	4.4
44.5	1.97	0.93	21.77	2.62	5.15	4.63		9.35	8.94	5.43	6.07	5.58	0.56	0.78	0.88	2.42
46.5	1.86	1.04	18.37	3.63	3.82	3.28		5.9	7.7	4.88	3.49	5.08	0.9	0.7	0.42	1.43
48.5	1.48	0.7	12.95	2.61	3.36	2.49		3.45	4.71	2.87	2.89	4.52	0.83	0.48	0.24	0.76
50.5	0.85	0.73	9.94	2.59	3.33	2.48		2.27	2.59	1.86	1.76	3.14	0.81	0.48	0.06	0.53
52.5	0.99	0.72	8.28	1.74	2.51	1.58		1.17	1.61	1.24	0.95	1.61	0.46	0.28	0.07	0.26
54.5	0.5	0.3	6.22	1.41	2.07	1.36		1.1	0.76	0.7	1.04	0.71	0.31	0.34	0.04	0.15
56.5	0.51	0.33	3.13	1.29	1.46	0.91		0.52	0.56	0.34	0.58	0.67	0.26	0.11	0.02	0.15
58.5	0.44	0.39	2.87	0.79	0.7	0.61		0.31	0.35	0.23	0.31	0.32	0.11	0.03	0.07	0.16
60.5	0.35	0.3	2.37	0.73	0.48	0.31		0.25	0.18	0.27	0.31	0.15	0.13	0.11	0.01	0.08
62.5	0.2	0.18	1.12	0.64	0.27	0.36		0.08	0.07	0.09	0.08	0.14	0.03	0.05	0.01	0.06
64.5	0.07	0.06	0.37	0.36	0.12	0.22		0.1	0.02	0.1	0.02	0	0.04	0.03	0.01	0.04
66.5	0.2	0.11	0.37	0.11	0.14	0.11		0.03	0	0.03	0.04	0.05	0	0	0	0
68.5	0.04	0.05	0.08	0.1	0.04	0.04		0.03	0	0	0	0	0	0	0	0
70.5	0.02	0.02	0	0.06	0.06	0.13		0.02	0.05	0	0	0	0	0	0	0
72.5	0.05	0	0	0.03	0.01	0.02		0	0	0.01	0	0	0.02	0	0	0.02
74.5	0	0.01	0.02	0.02	0	0.01		0	0	0	0	0	0	0	0	0
76.5	0.01	0	0	0	0.01	0.02		0	0	0	0	0	0	0	0	0
78.5	0	0	0	0.02	0	0.01		0	0	0.01	0	0	0	0	0	0
80.5	0.01	0	0	0	0	0		0	0	0	0	0	0	0	0	0
82.5	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
84.5	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
sum	20.23	24.99	193.38	100.24	114.79	112.48		76.85	65.04	49.05	77.64	50.85	20.87	9.48	17.41	38.66

Table 10. Partitioned search results.

F										
0.002	0.025	0.001	0.07	0.08	0.046	0.049	0.057	0.068	0.001	0.006
0.002	0.018	0.005	0.003	0.007	0.015	0.012	0.013	0.003	0.017	0.013
0.025	0.051	0.018	0.136	0.194	0.229	0.26	0.317	0.269	0.772	0.048
0.079	0.136	0.059	0.371	0.615	0.614	0.687	0.586	0.882	1.427	0.379
0.05	0.126	0.092	0.34	0.738	0.886	0.741	0.593	0.767	0.963	0.531
0.033	0.068	0.053	0.23	0.417	0.649	0.546	0.399	0.697	0.511	0.317
0.034	0.057	0.032	0.155	0.282	0.339	0.32	0.279	0.393	0.546	0.188
0.013	0.16	0.024	0.002	0.001	0.002					
0.009	0.107	0.058	0.043	0.005	0.01					
0.055	0.129	0.083	0.222	0.297	0.04					
0.402	0.563	0.472	0.675	0.828	0.11					
0.41	0.636	0.839	0.428	0.932	0.17					
0.208	0.406	0.556	0.355	0.272	0.19					
0.157	0.252	0.282	0.244	0.338	0.074					
POP										
29606	29666	19734	14385	15894	24475	32833	22235	15150	15571	13036
22926	24192	23691	16139	10978	12013	19137	25594	17197	11591	12732
17459	18725	19460	19299	13168	8922	9685	15479	20690	14033	9329
13099	13943	14568	15652	13786	8878	5812	6115	9232	12947	5309
12153	9909	9960	11244	8840	6103	3934	2393	2785	3130	2544
11180	9469	7155	7438	6552	3461	2060	1535	1083	1059	978
7953	8853	7243	5553	4840	3537	1480	977	844	442	520
9936	12374	12426	14110	3425	4142					
10607	8032	8635	9929	11530	2802					
10288	8610	5910	6674	7789	9391					
7277	7972	6197	4455	4375	4739					
2976	3984	3717	3163	1857	1564					
1225	1617	1727	1315	1689	599					
583	814	882	811	755	1053					
RVpop										
17394	28378	2057	9746	43754	62379	81221	9148	12563	3601	7767
24553	25509	25282	2556	23296	31160	49427	45527	16820	12507	6592
18533	37994	25771	39514	7827	30158	65310	87206	52860	71404	33874
12240	20550	24164	39982	19045	21348	18528	24234	25691	34381	27859
4445	6241	8163	18524	9513	12078	8493	7098	7117	8108	4767
2564	921	1834	4286	3020	4699	2876	2729	2166	3037	914
1801	934	929	1873	1631	2359	1130	1645	848	1097	219
12728	37549	7450	726	2230	7482					
46503	19099	48033	57619	16970	6720					
39042	15385	28359	75885	43632	40196					
38421	27788	20593	27947	10032	10566					
8022	8310	6943	5275	2807	1942					
1303	1708	1360	427	498	251					
828	530	391	88	95	57					

Table 10. (Continued)

Catch										
52	660	20	883	1105	996	1423	1113	899	19	72
50	384	108	50	74	167	209	292	51	178	150
388	843	310	2226	2104	1650	2005	3803	4413	6831	399
901	1609	755	4392	5730	3685	2614	2455	4895	8903	1515
532	1059	791	2933	4175	3245	1863	968	1350	1751	949
332	563	337	1381	2020	1496	784	457	492	384	240
238	444	207	725	1083	926	370	216	250	170	81
113	1653	271	25	3	7					
82	736	437	376	53	25					
499	943	425	1204	1810	334					
2181	3105	2111	1978	2230	448					
905	1696	1910	996	1019	222					
208	488	667	356	364	94					
77	165	197	160	197	68					

Table 11. NLLS results.

fmat

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	0.00	0.02	0.00	0.07	0.08	0.05	0.05	0.06	0.07	0.00	0.01
2	0.00	0.02	0.01	0.00	0.01	0.02	0.01	0.01	0.00	0.02	0.01
3	0.03	0.05	0.02	0.14	0.19	0.23	0.26	0.32	0.27	0.77	0.05
4	0.08	0.14	0.06	0.37	0.61	0.61	0.68	0.58	0.88	1.42	0.37
5	0.05	0.13	0.09	0.34	0.74	0.88	0.73	0.59	0.76	0.95	0.52
6	0.03	0.07	0.05	0.23	0.42	0.65	0.54	0.39	0.68	0.50	0.31
7	0.03	0.06	0.03	0.16	0.28	0.34	0.32	0.27	0.38	0.53	0.18

	1988	1989	1990	1991	1992	1993
1	0.01	0.16	0.02	0.00	0.00	0.00
2	0.01	0.10	0.06	0.04	0.01	0.01
3	0.05	0.13	0.08	0.21	0.25	0.05
4	0.40	0.55	0.45	0.65	0.78	0.09
5	0.40	0.62	0.81	0.40	0.85	0.15
6	0.20	0.40	0.54	0.33	0.25	0.16
7	0.15	0.25	0.27	0.23	0.31	0.07

Population

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	29610	29738	19841	14423	15943	24514	32886	22318	15272	15771	13392
2	22824	24196	23750	16226	11010	12053	19168	25637	17265	11690	12895
3	17363	18642	19463	19348	13240	8948	9718	15504	20725	14089	9410
4	13002	13864	14500	15654	13826	8936	5833	6142	9253	12975	5354
5	12022	9830	9895	11189	8842	6135	3982	2410	2807	3147	2568
6	11397	9361	7090	7385	6507	3462	2087	1575	1097	1077	992
7	9771	9030	7155	5500	4797	3499	1481	999	876	453	535

	1988	1989	1990	1991	1992	1993
1	10165	12710	14412	10475	3785	4579
2	10899	8220	8910	11555	8554	3096
3	10422	8849	6064	6900	9121	6955
4	7344	8082	6392	4581	4560	5829
5	3013	4039	3807	3323	1960	1716
6	1244	1648	1772	1389	1820	683
7	595	830	907	848	815	1161

catch

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	52	660	20	883	1105	996	1423	1113	899	19	72
2	50	384	108	50	74	167	209	292	51	178	150
3	388	843	310	2226	2104	1650	2005	3803	4413	6831	399
4	901	1609	755	4392	5730	3685	2614	2455	4895	8903	1515
5	532	1059	791	2933	4175	3245	1863	968	1350	1751	949
6	332	563	337	1381	2020	1496	784	457	492	384	240
7	238	444	207	725	1083	926	370	216	250	170	81

	1988	1989	1990	1991	1992	1993
1	113	1653	271	25	3	7
2	82	736	437	376	53	25
3	499	943	425	1204	1810	334
4	2181	3105	2111	1978	2230	448
5	905	1696	1910	996	1019	222
6	208	488	667	356	364	94
7	77	165	197	160	197	68

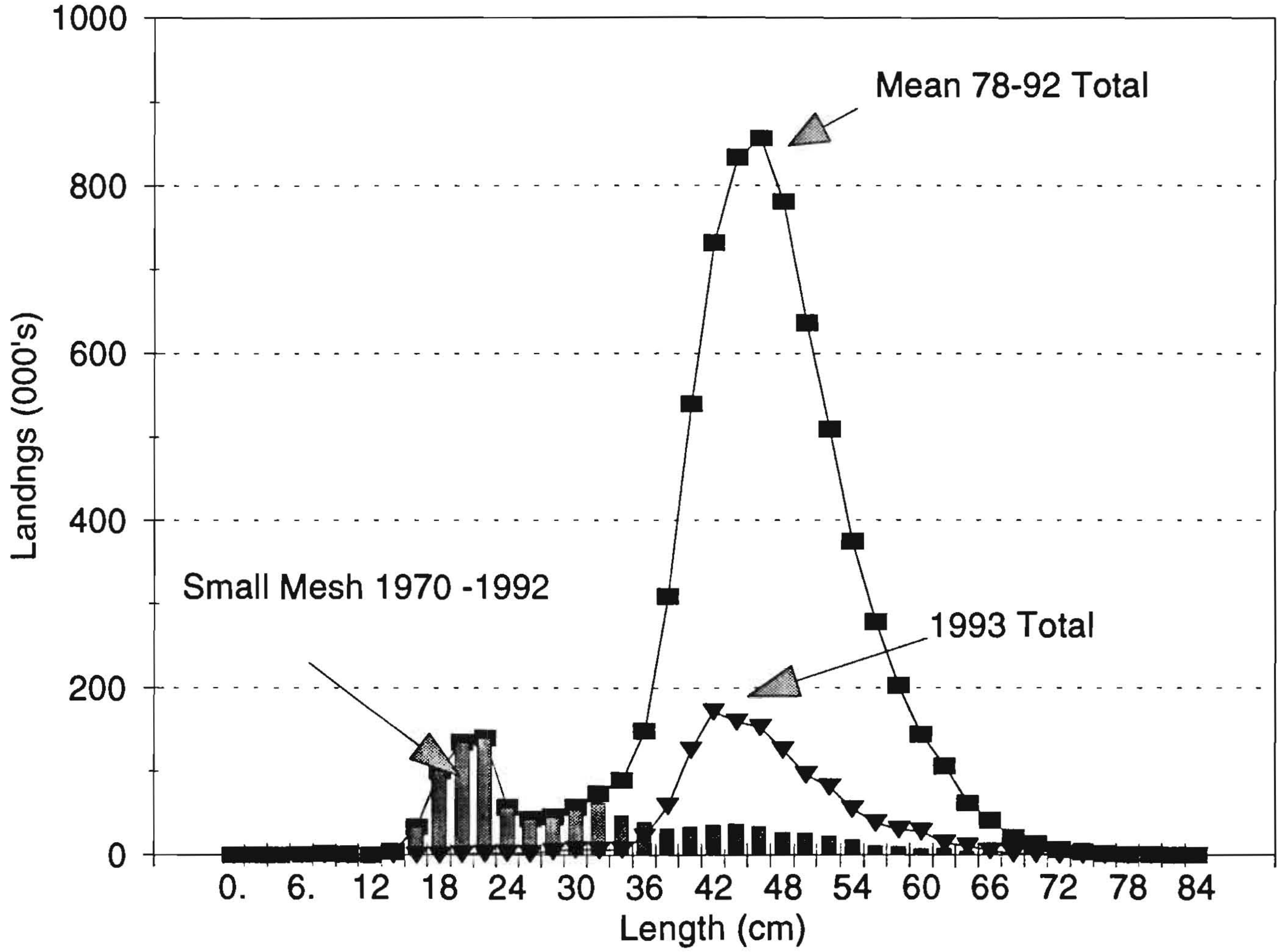


Figure 1. Mean length composition of commercial landings for the period 1978-1992 and for the removals in 1993.

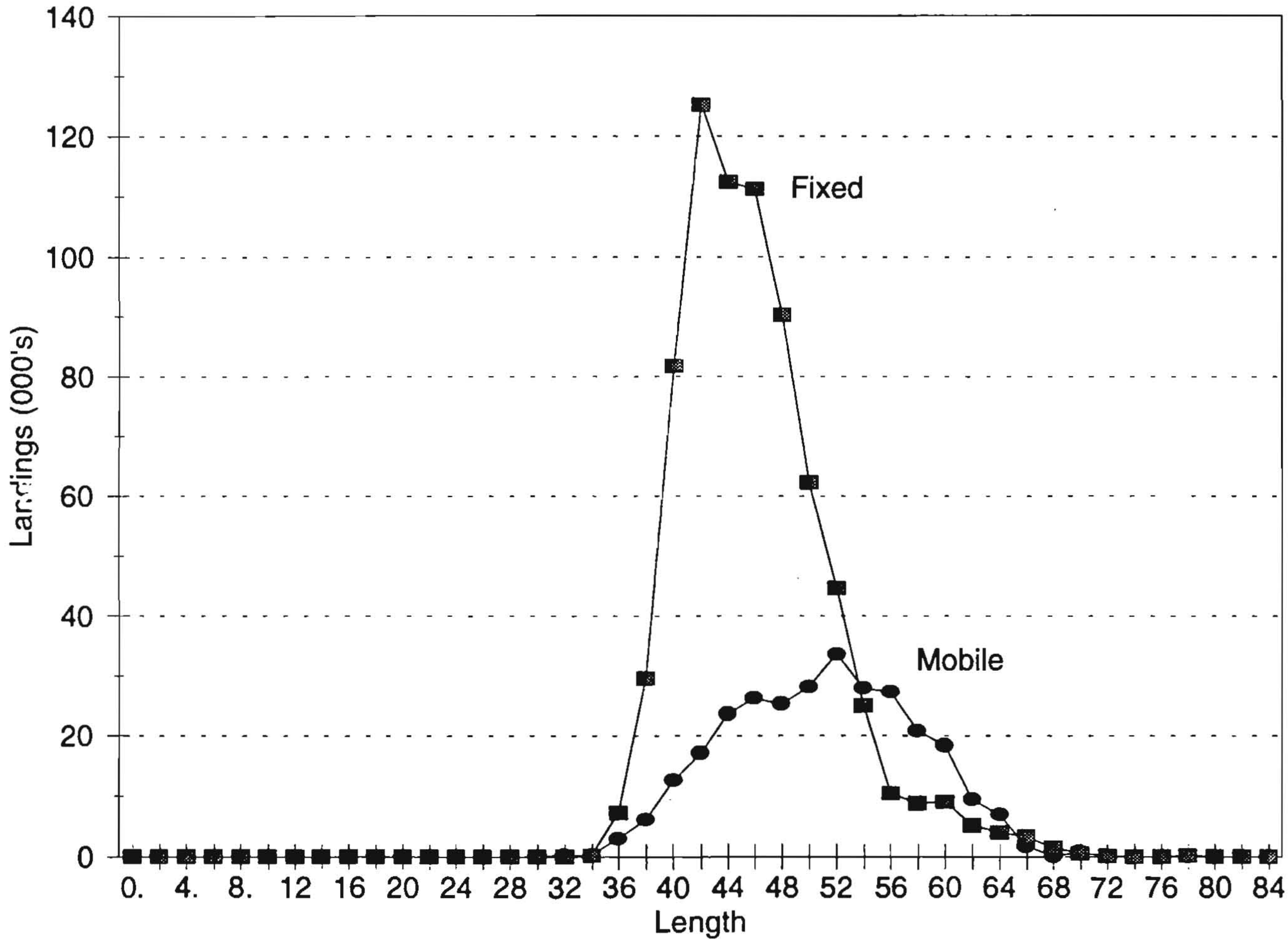


Figure 2. Length composition of landings by mobile and fixed gear vessels in 1993.

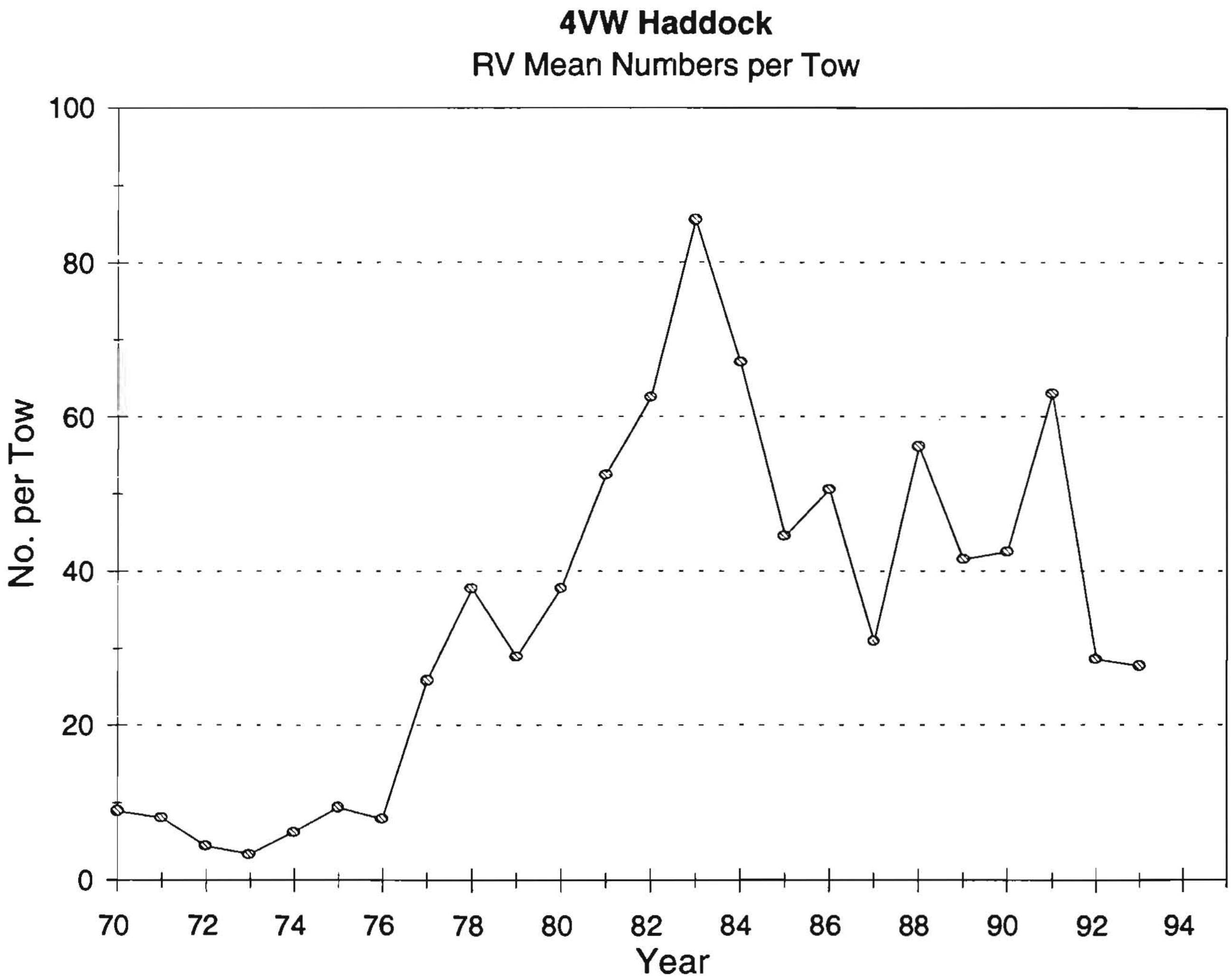


Figure 3. July research vessel catch rates.

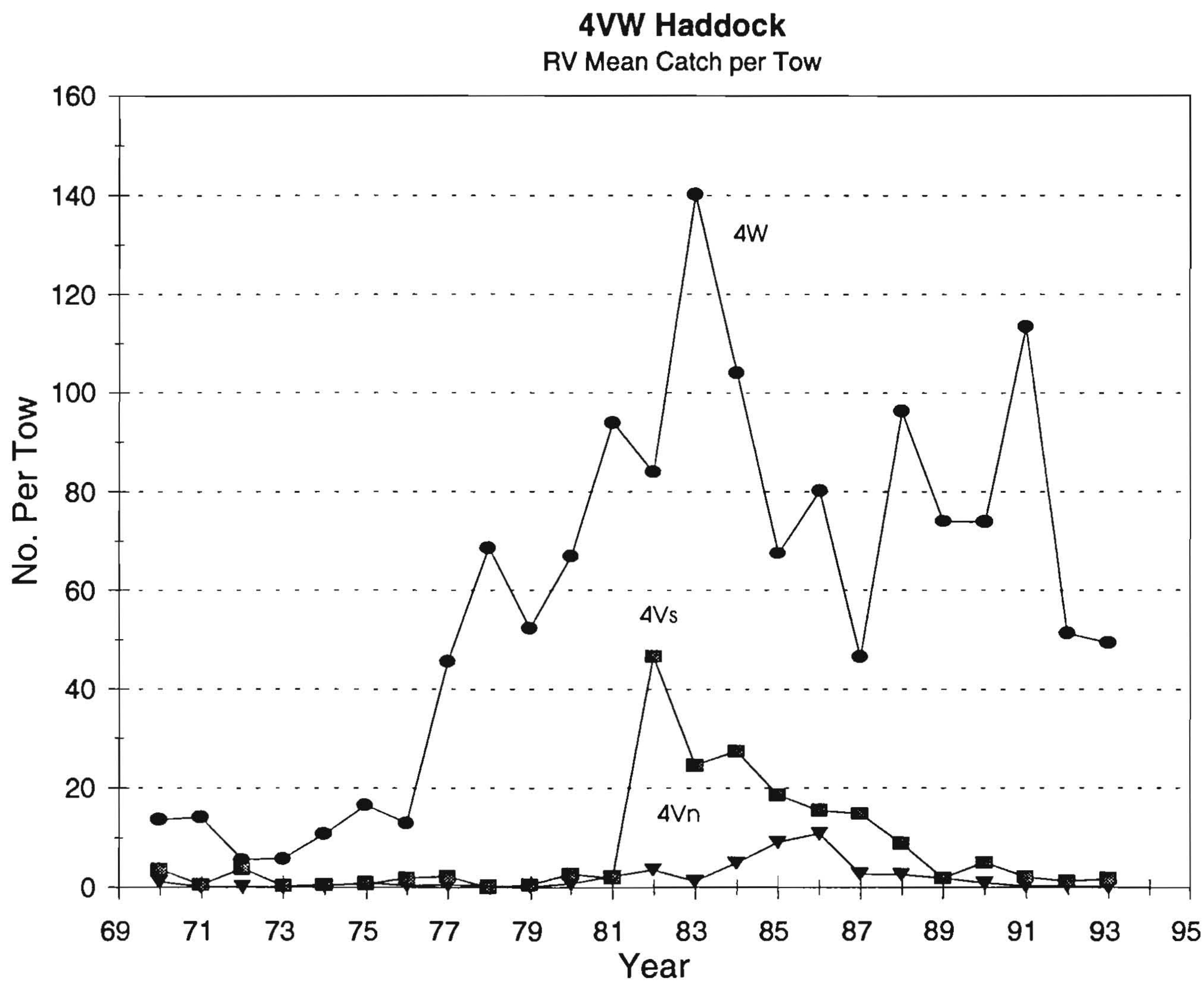


Figure 4. Research vessel catch rates by division and subdivision.

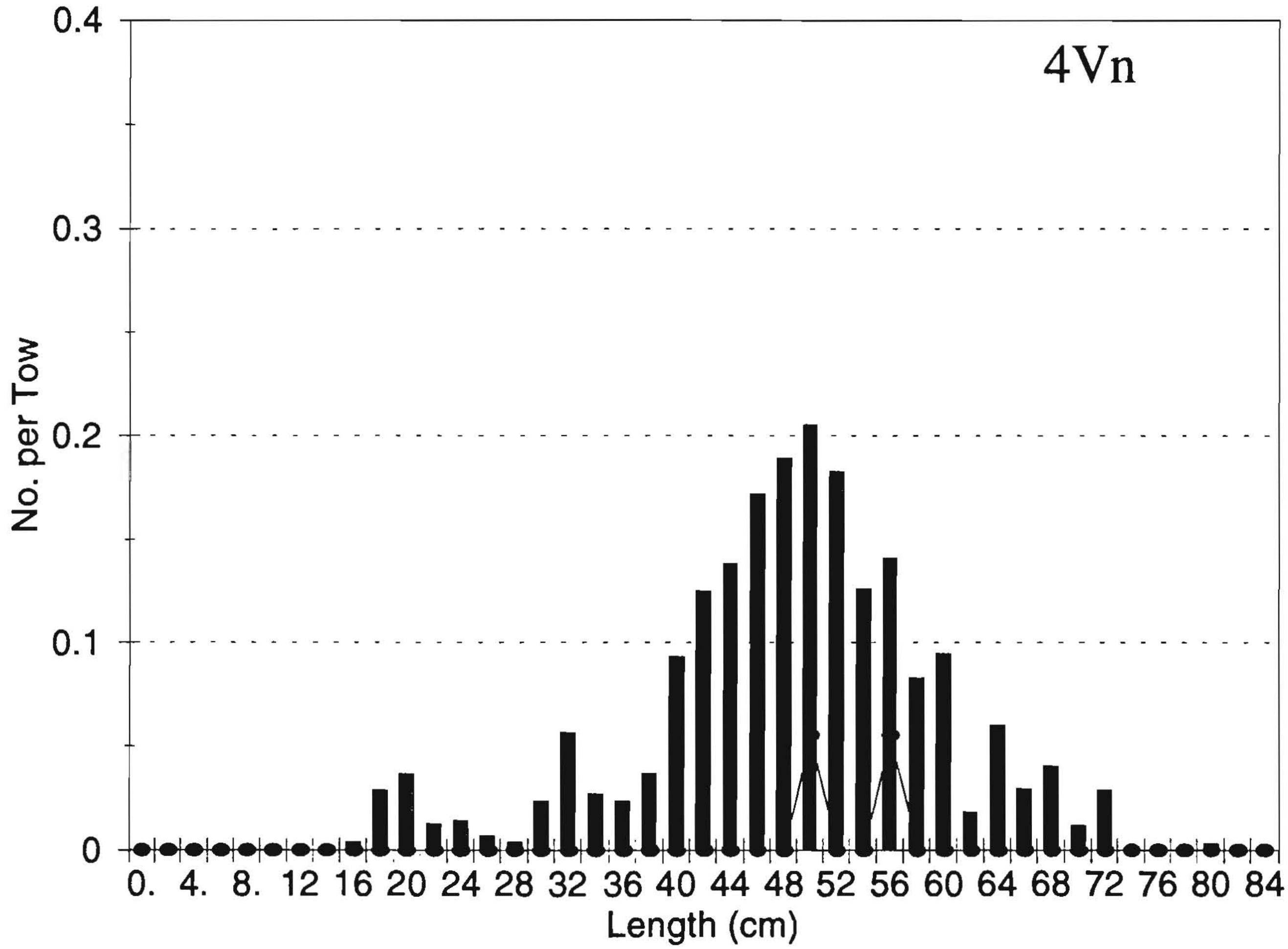


Figure 5. Catch rates at length for Subdivision 4Vn for the period 1970-1992 (bars) and 1993 (line).

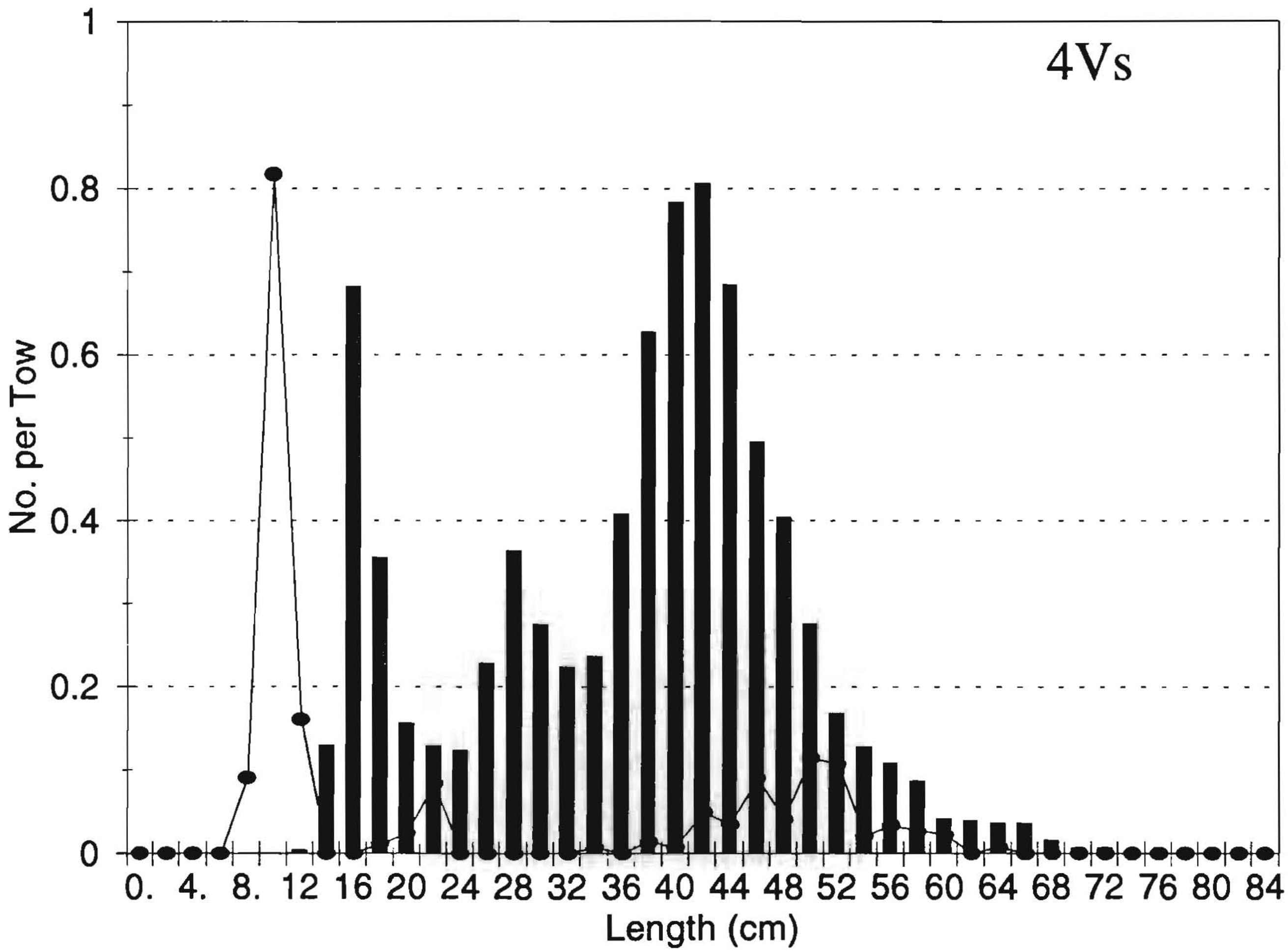


Figure 6. Catch rates at length for Subdivision 4Vs for the period 1970-1992 (bars) and 1993 (line).

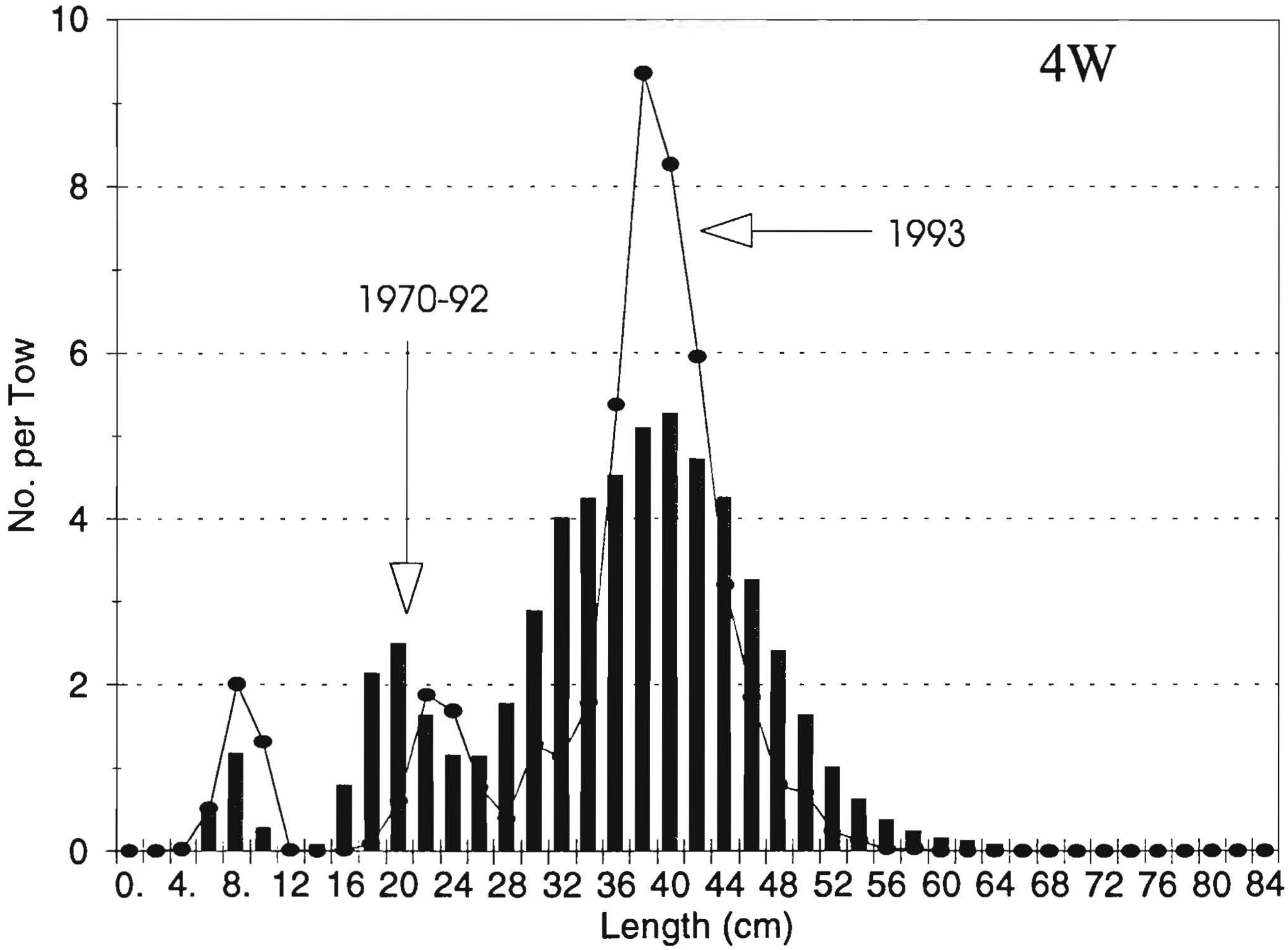


Figure 7. Catch rates at length for Division 4W for the period 1970-1992 (bars) and 1993 (line).

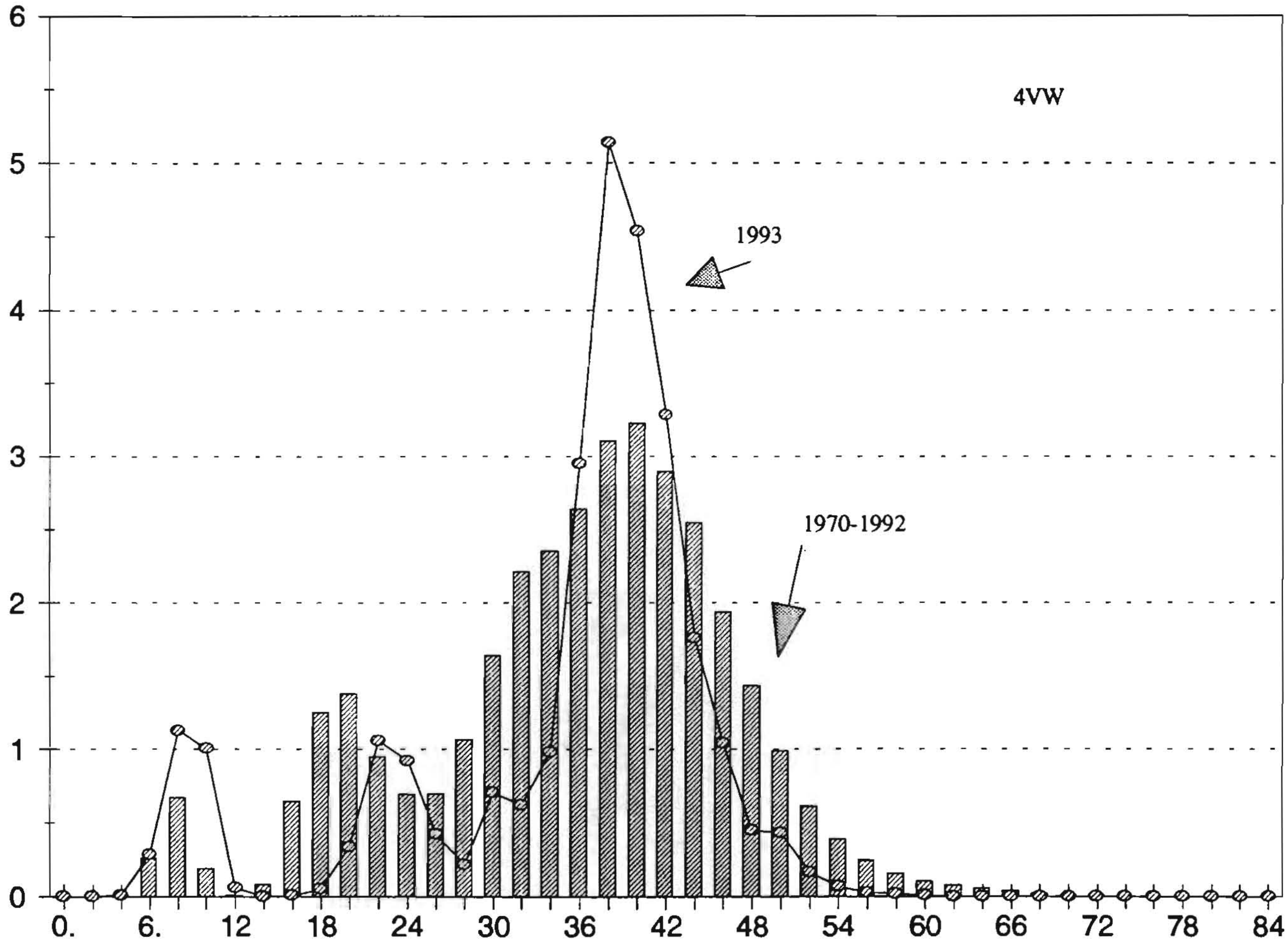


Figure 8. Catch rates at length for Subdivision 4VW stock for the period 1970-1992 (bars) and 1993 (line).

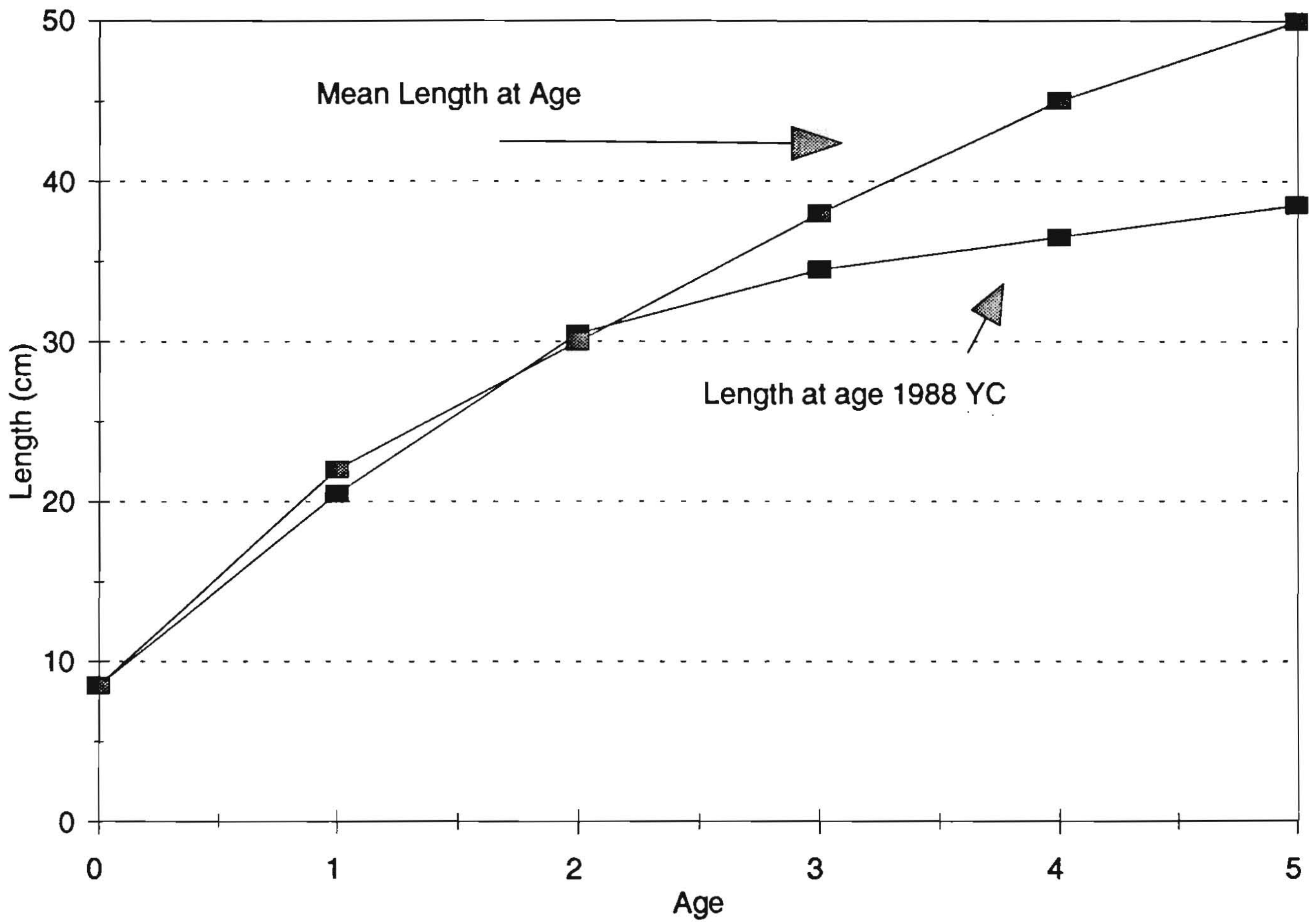


Figure 9. Modal length of the 1988 year-class at "age" vs the mean length at age of other cohorts.

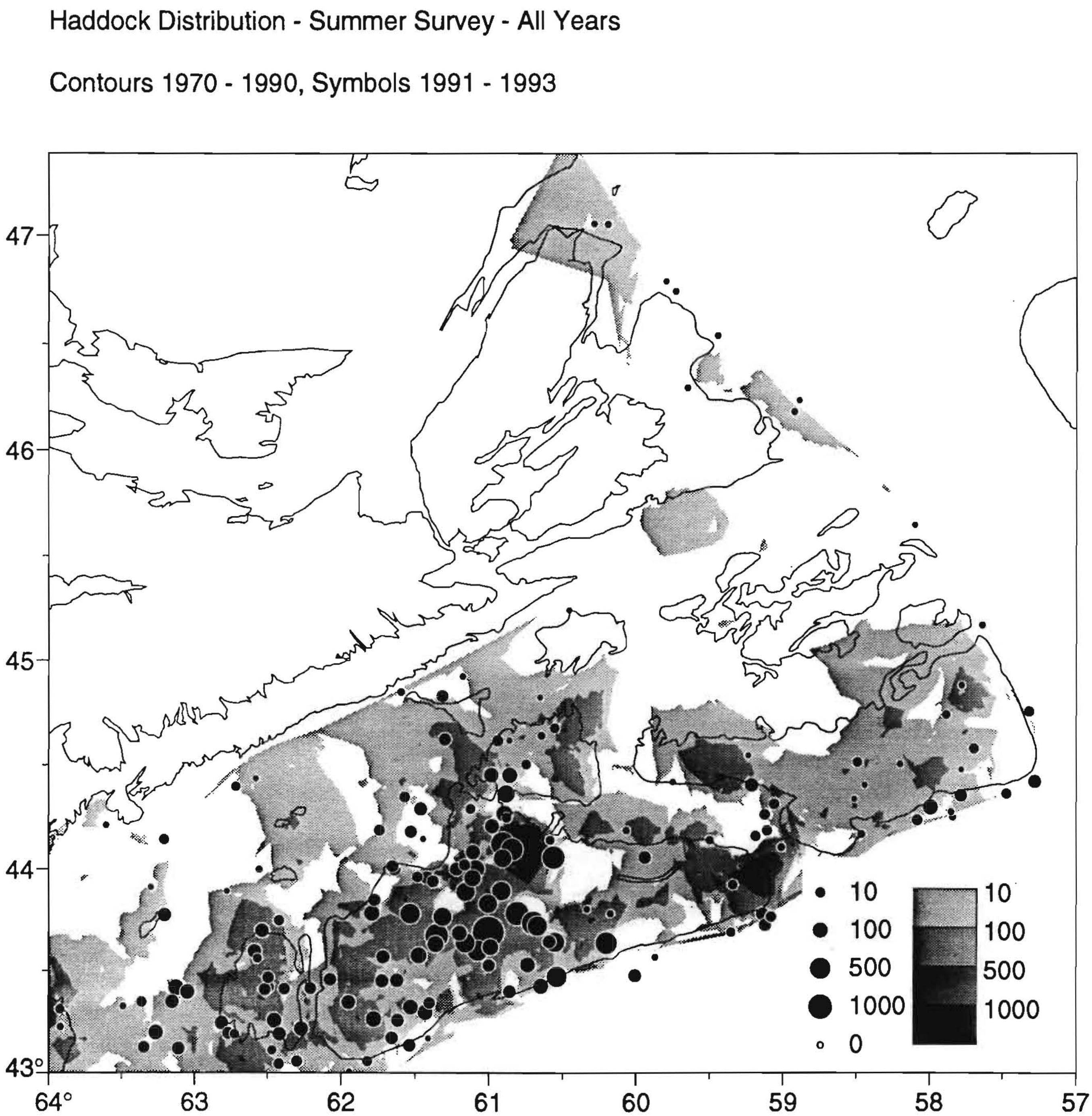


Figure 10. Current vs historical distribution of haddock on the eastern Scotian Shelf.

Haddock Distribution - Summer Survey - All Years

Contours 1970 - 1990, Symbols 1991 - 1993

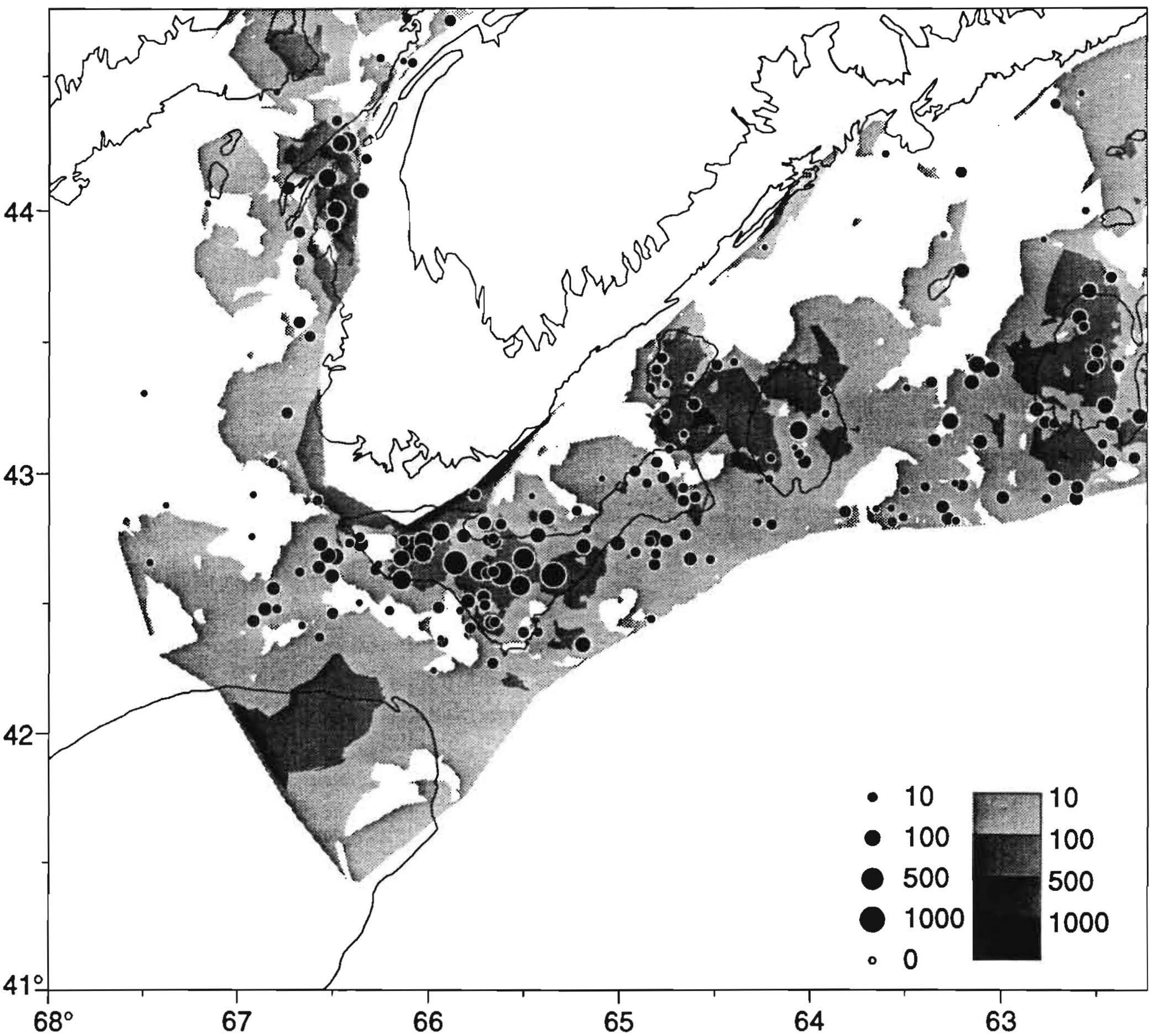


Figure 10. (Continued)

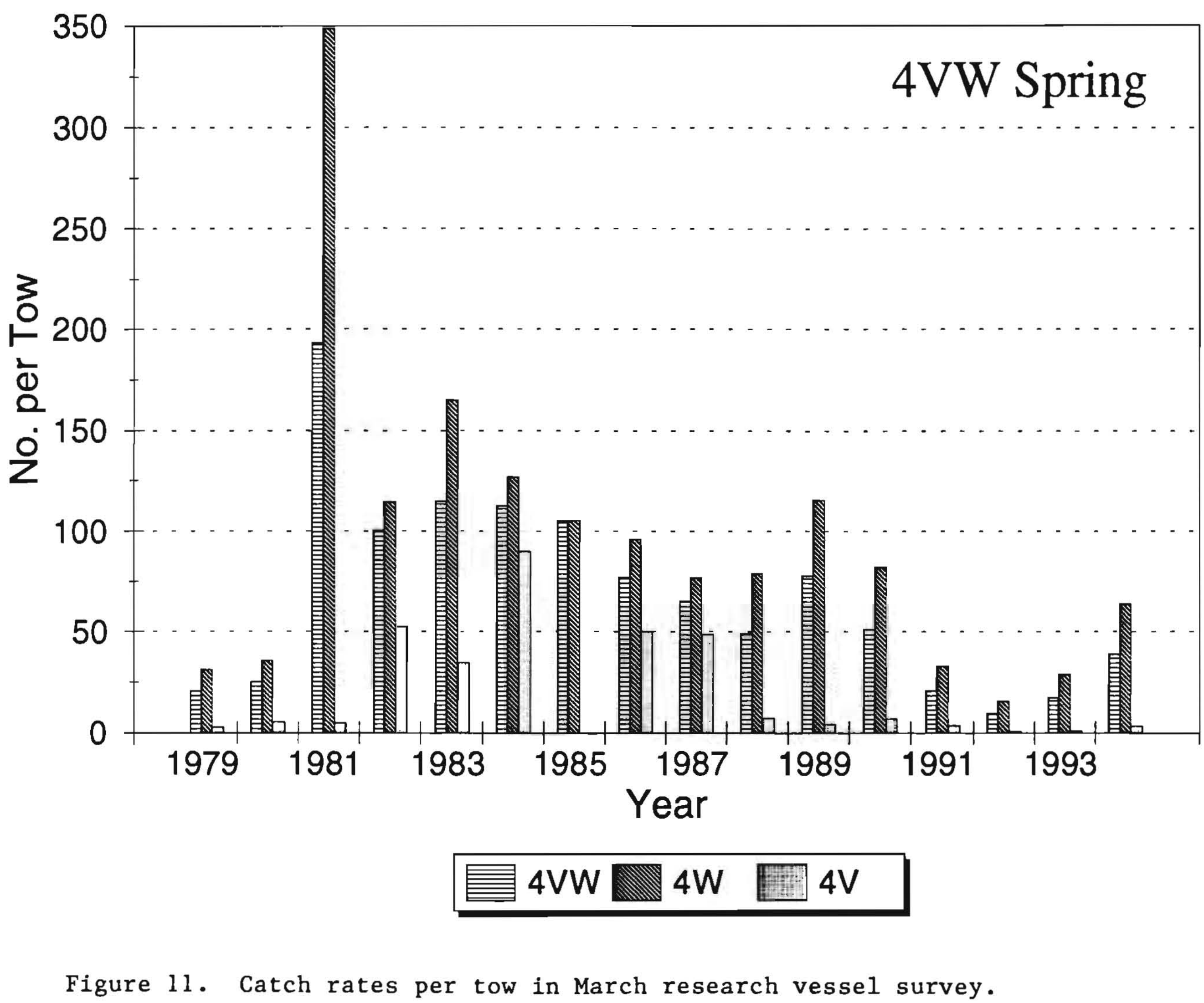


Figure 11. Catch rates per tow in March research vessel survey.

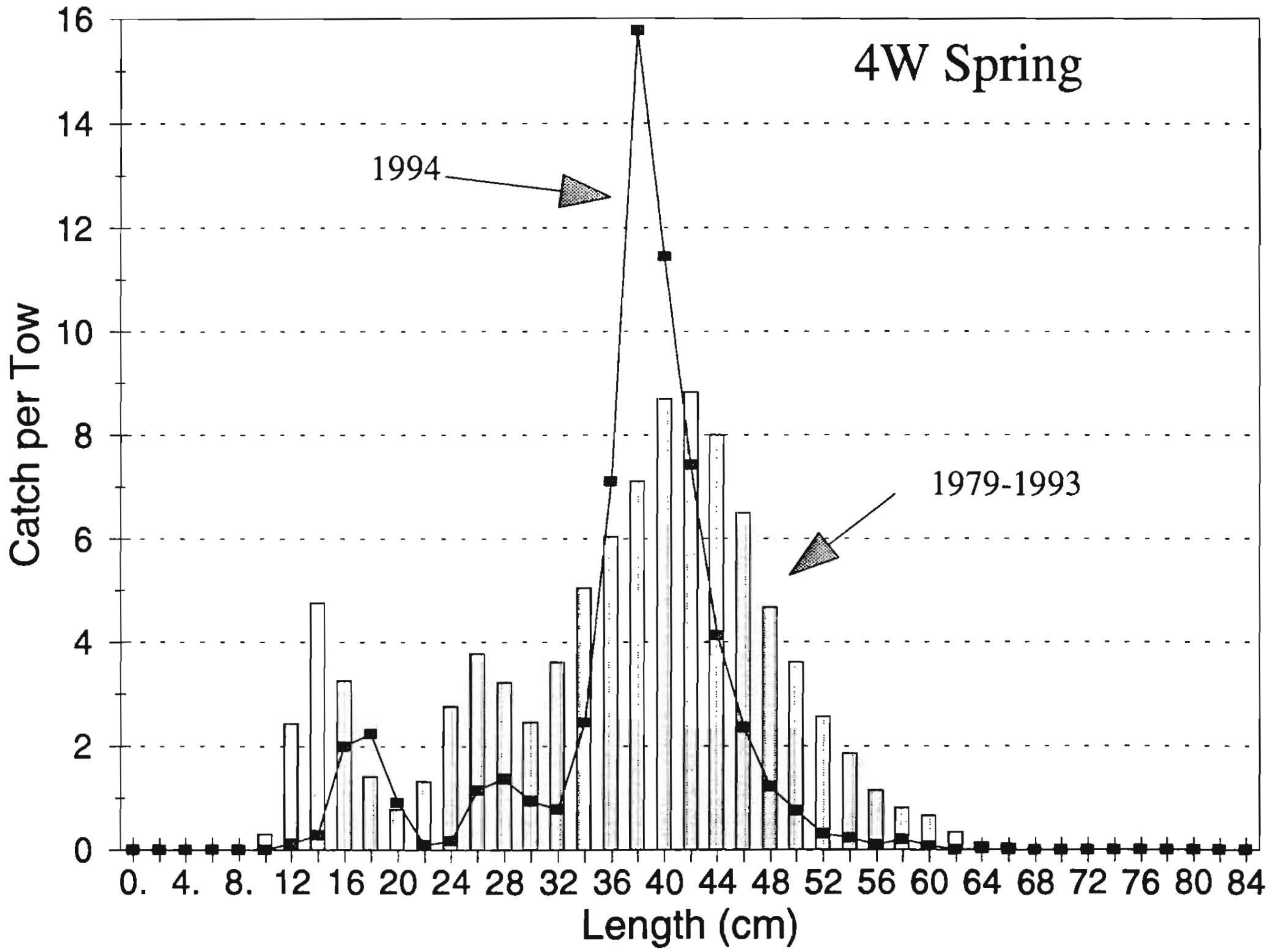


Figure 12. Catch rate at length from the March research vessel surveys in 4W (bars: 1979-1993; line: 1994).

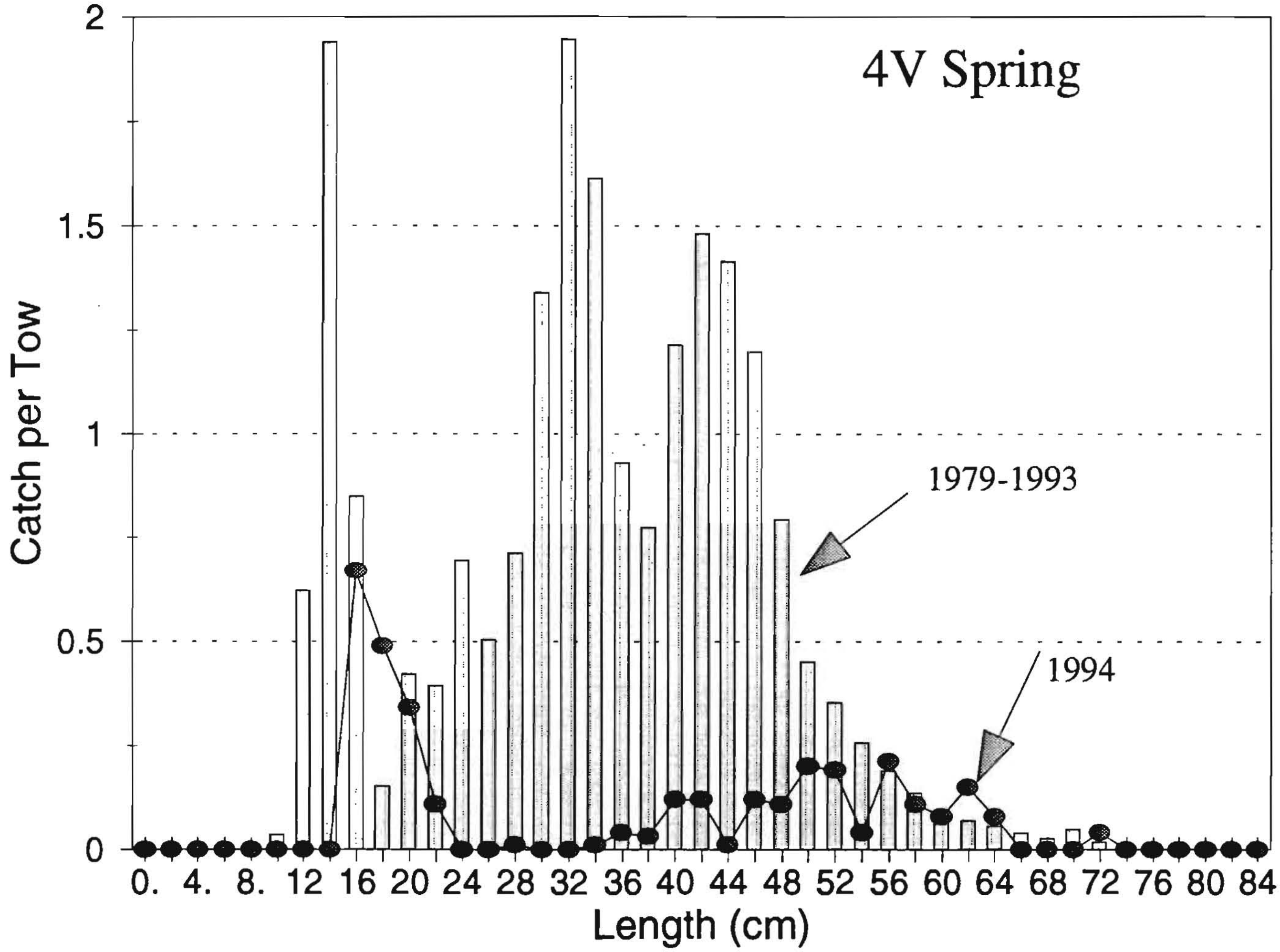


Figure 13. Haddock catch rates at length from March research vessel surveys for 1970-1993 (bars) and 1994 (line).

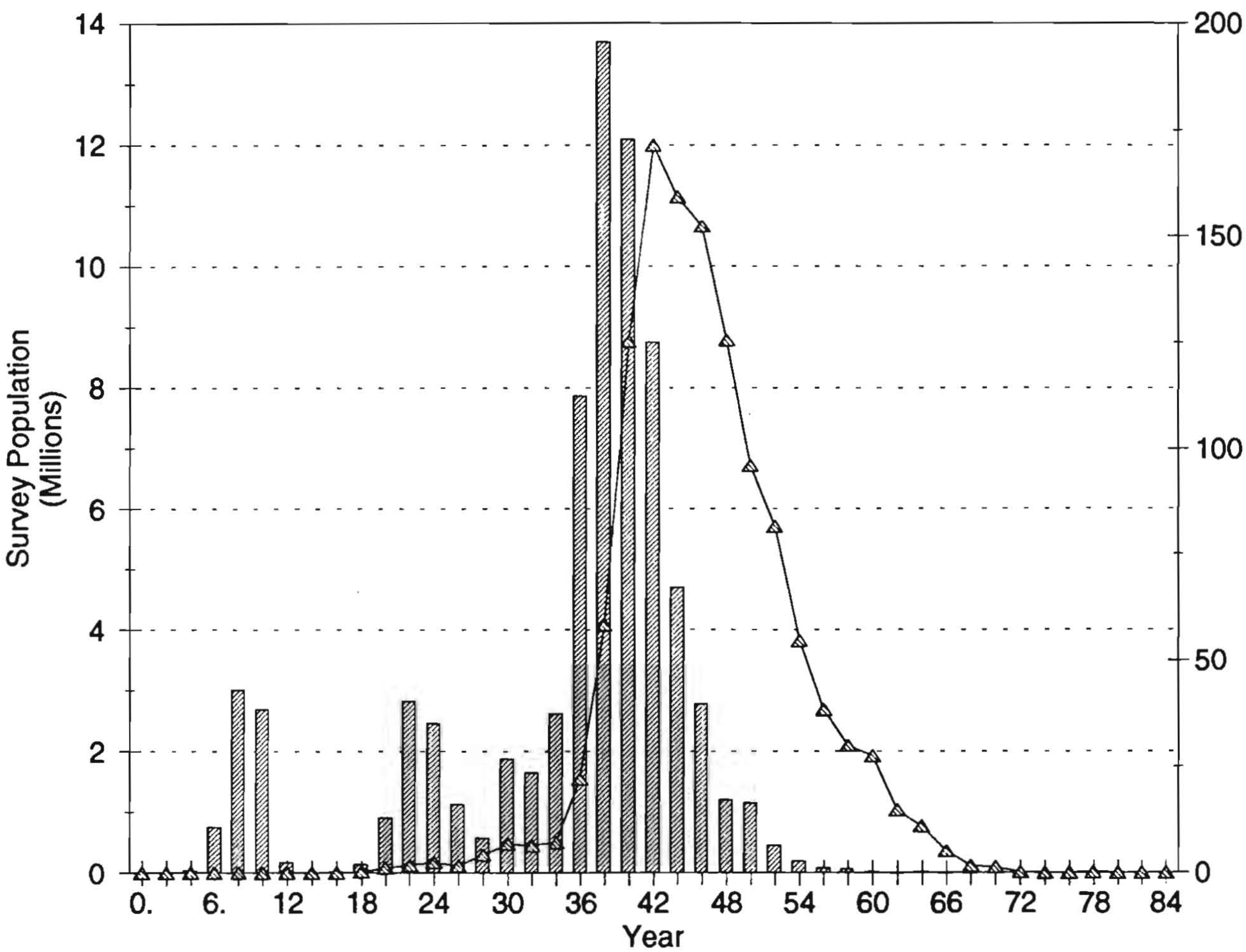
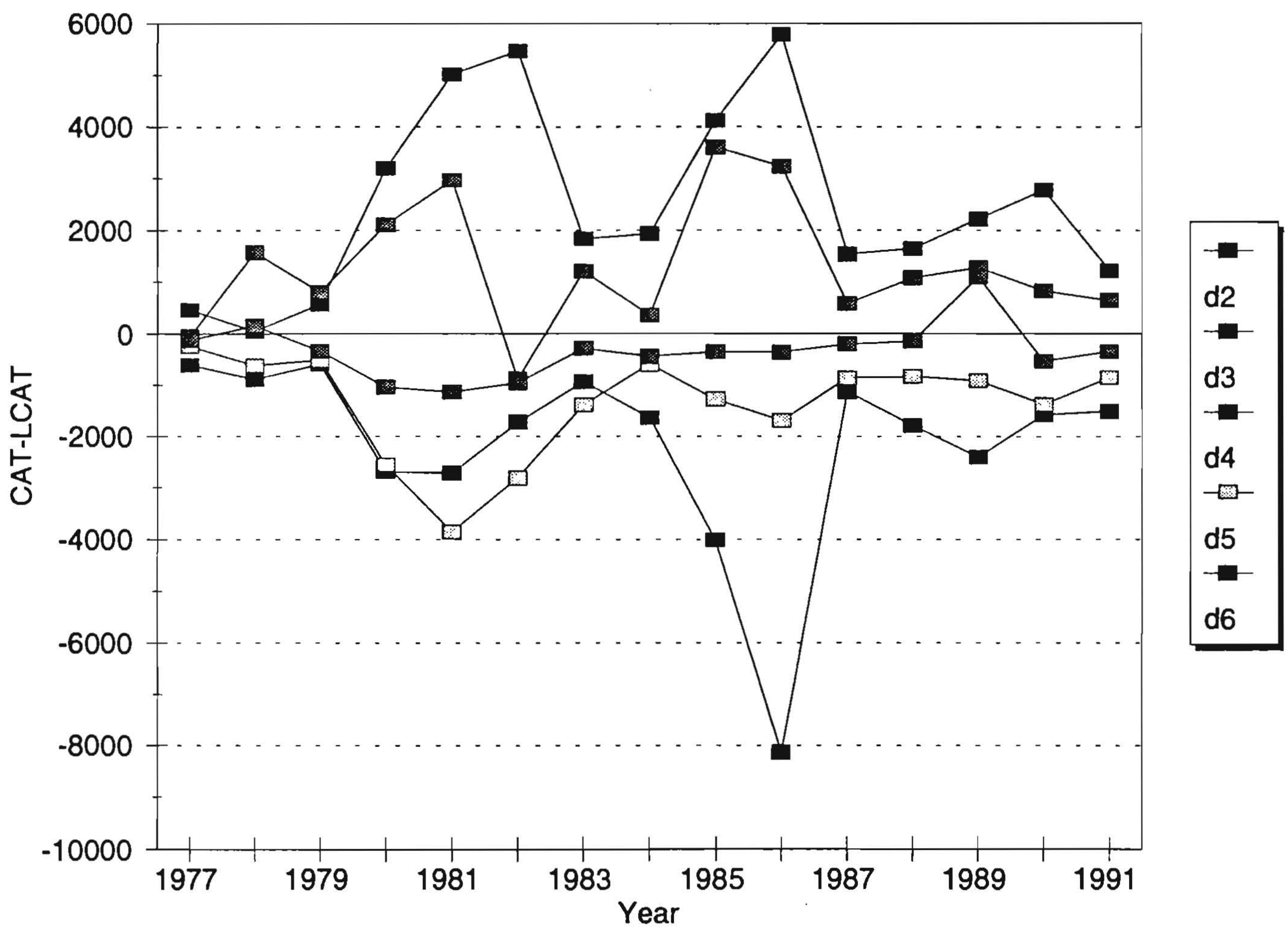


Figure 14. Length distribution of removals vs population estimated from July research vessel surveys (1993).



Fiqure 15. Differences between the catch at aqe qenerated from slices and catch at lenqth and the traditional catch at aqe.

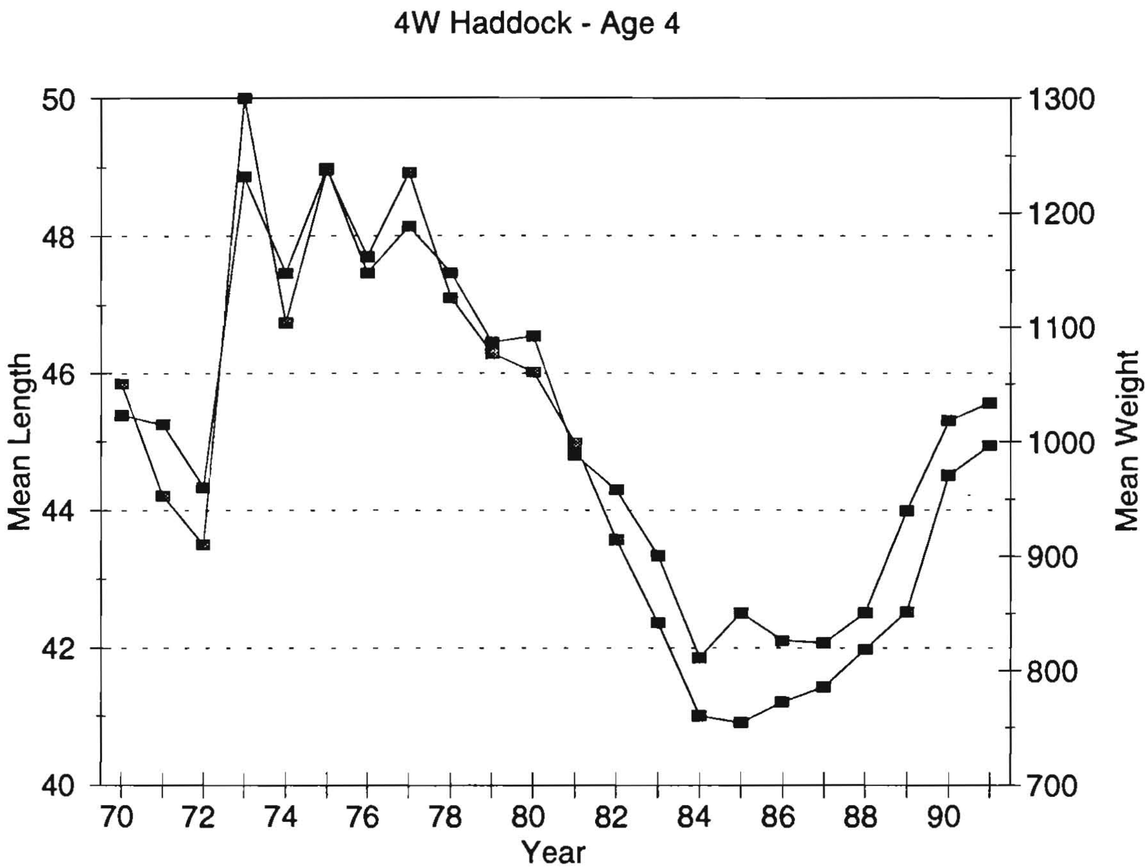


Figure 16a. Mean lengths at age of "age 4" haddock from July research vessel surveys, 1970-1991.

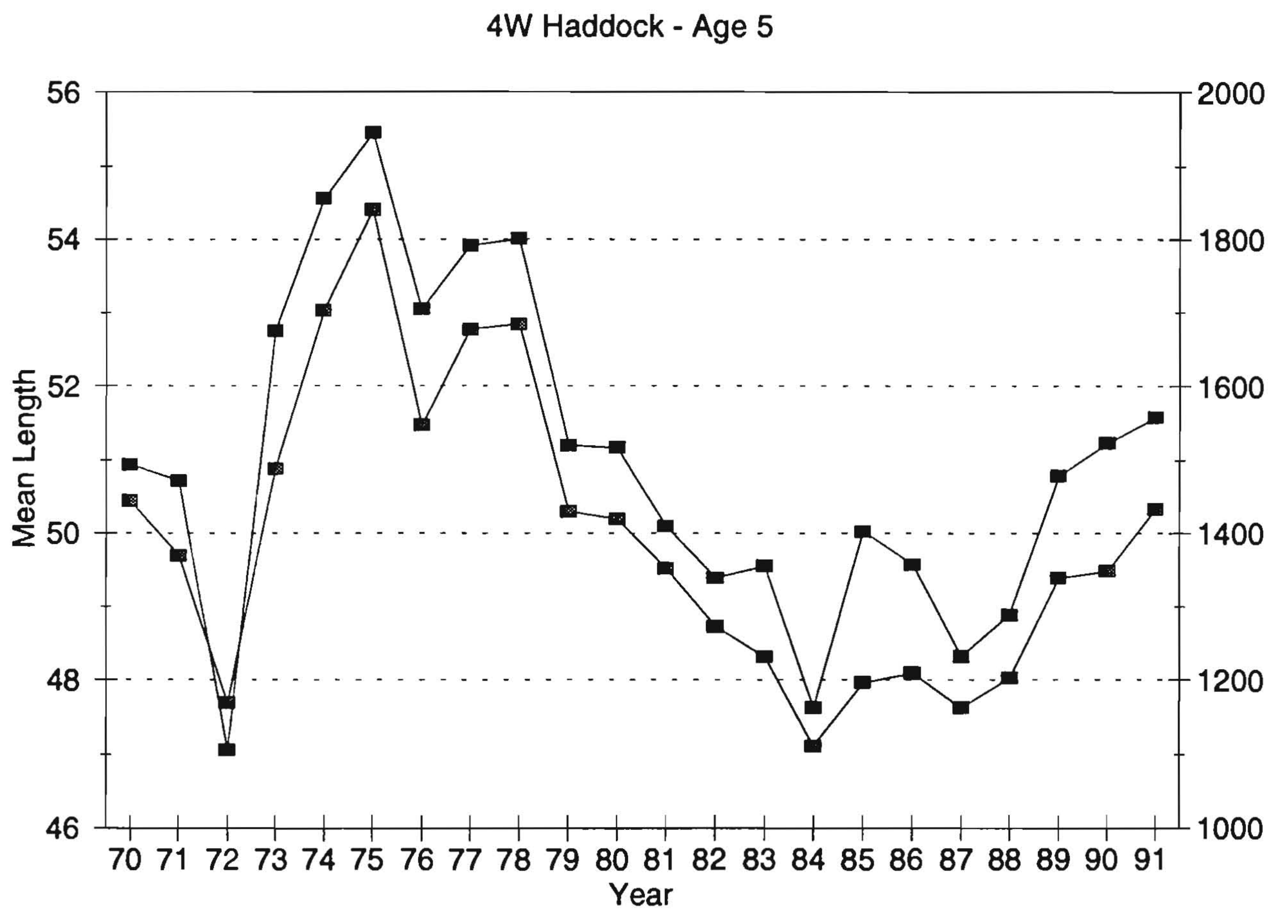


Figure 16b. Mean lengths at age of "age 5" haddock from July research vessel surveys, 1970-1991.

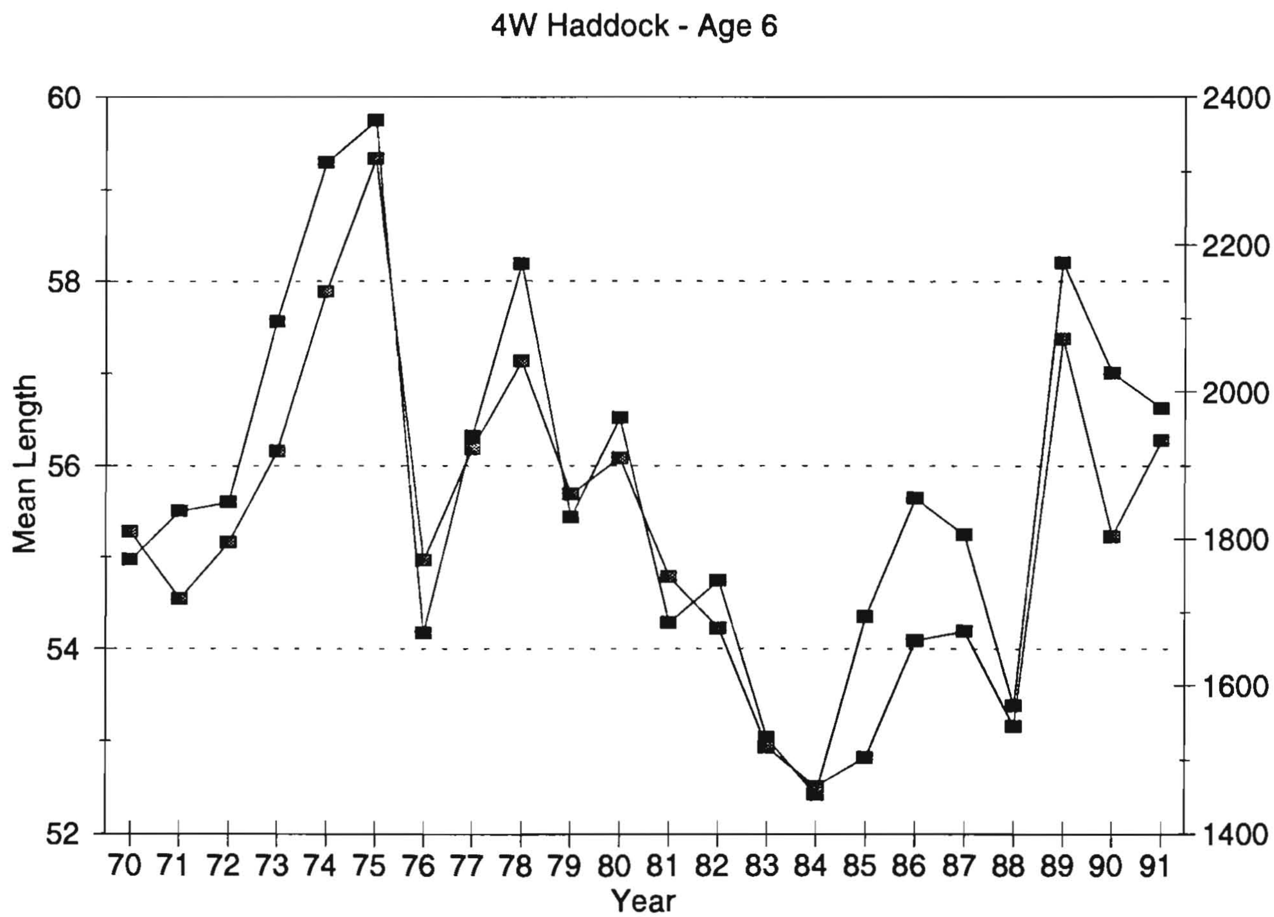


Figure 16c. Mean lengths at age of "age 6" haddock from July research vessel surveys, 1970-1991.

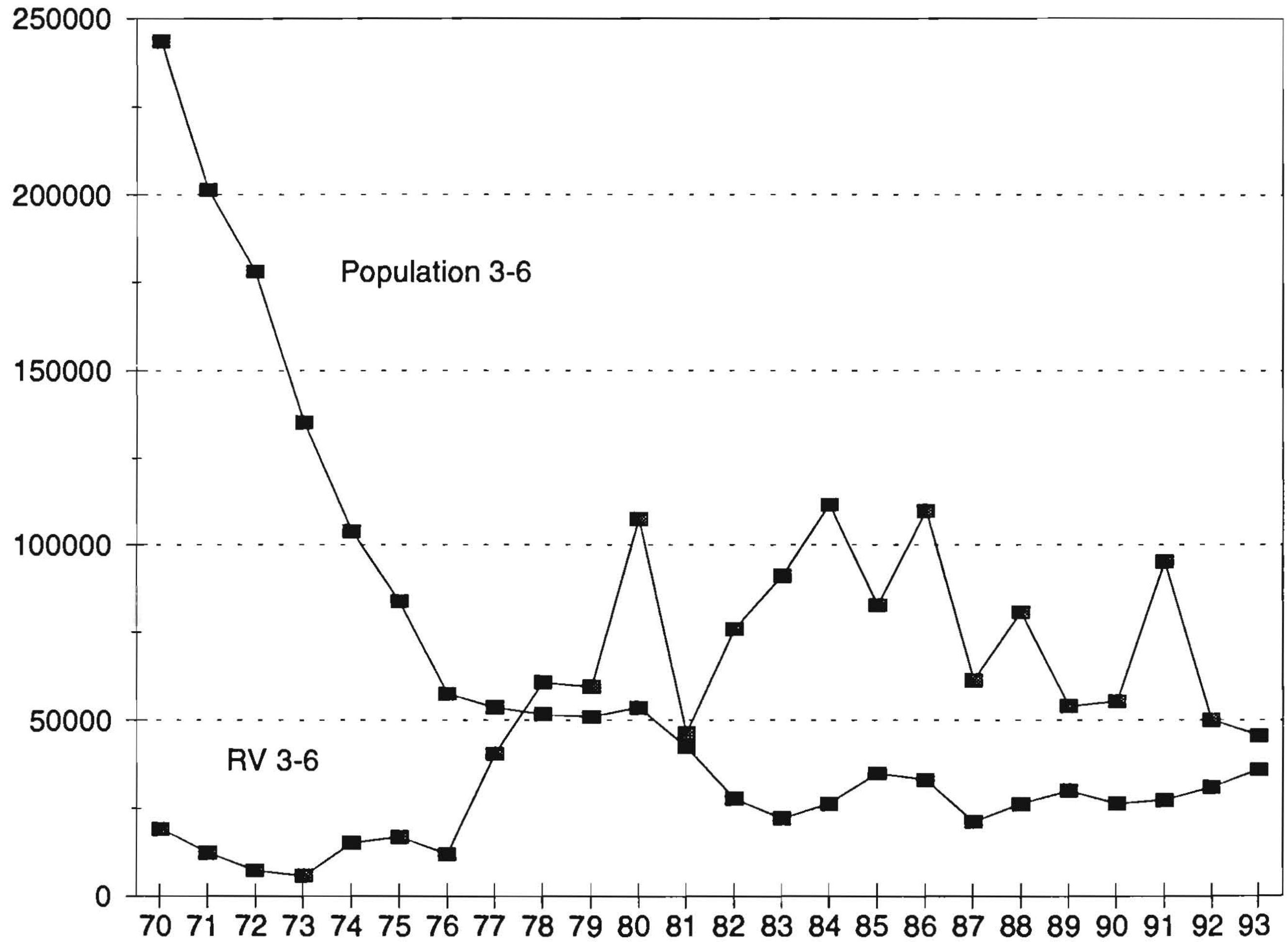


Figure 17. Estimated population and research vessel index for ages 3-6 using partitioned search.

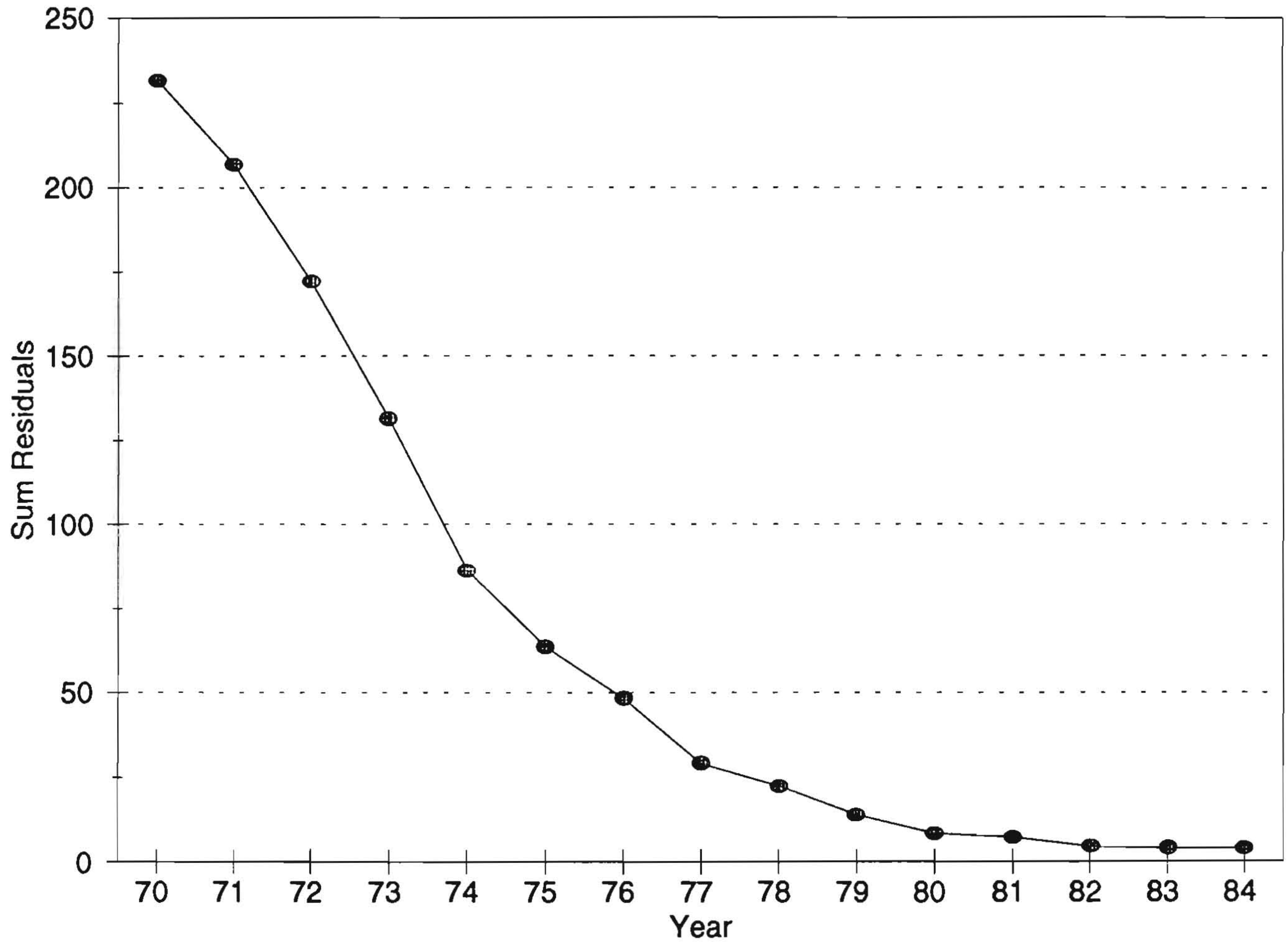
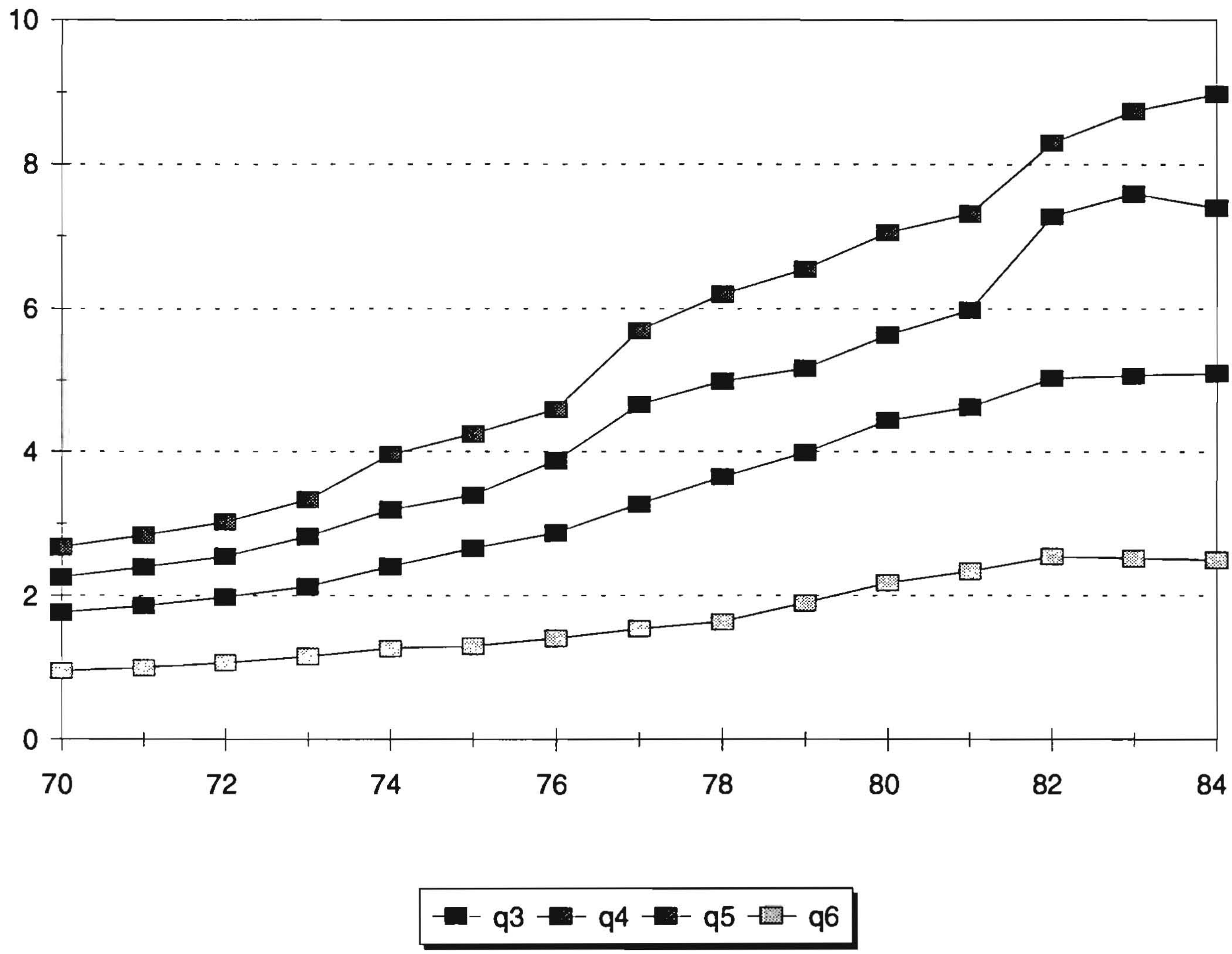


Figure 18. Sum residuals from partitioned search using progressively fewer years of data.



Fiqure 19. Estimates of q resultinq from partitioned analyses as in Fiqure 17.

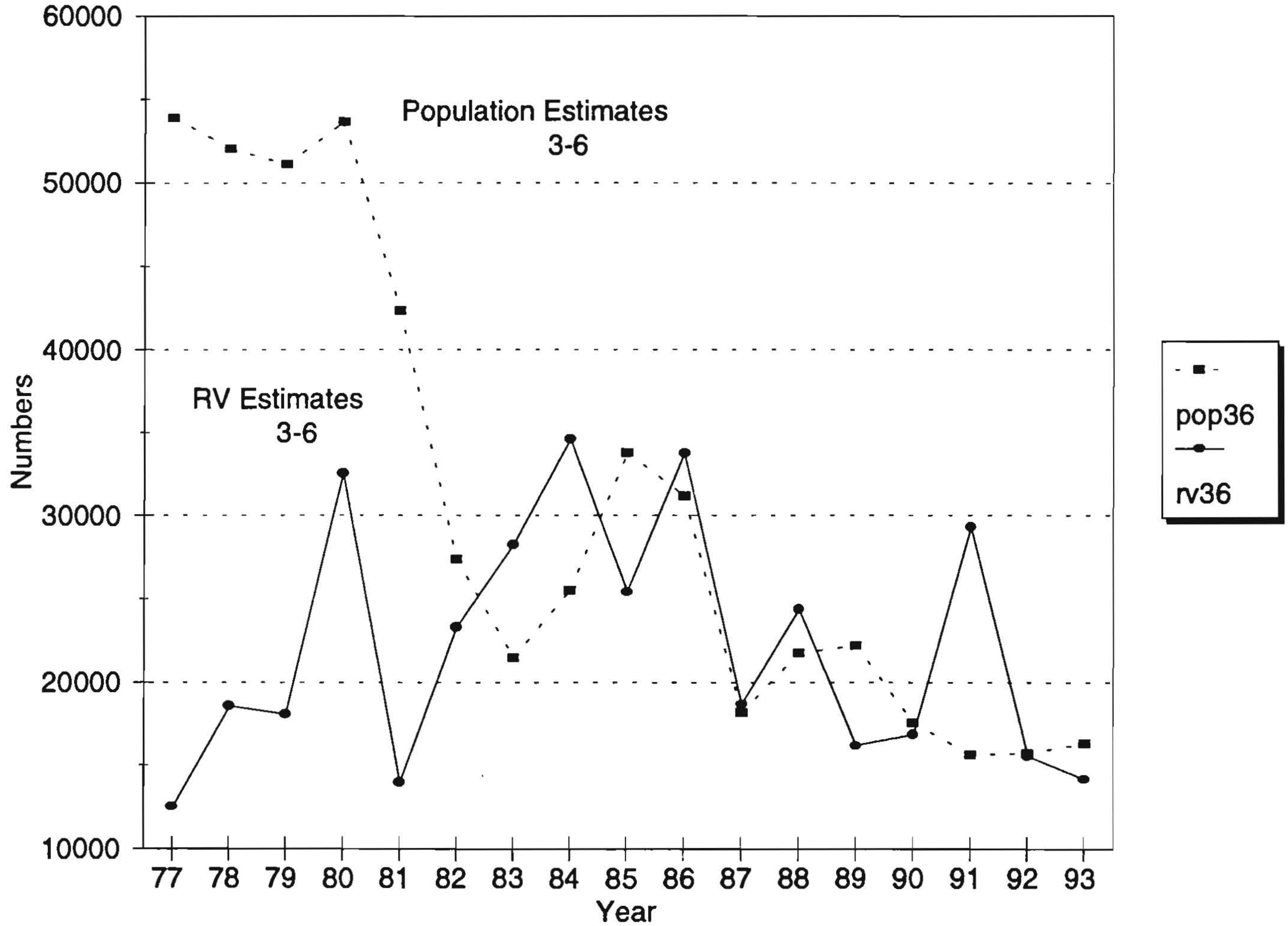


Figure 20. Research vessel index and estimated population numbers at "ages" 3-6 using partitioned search.

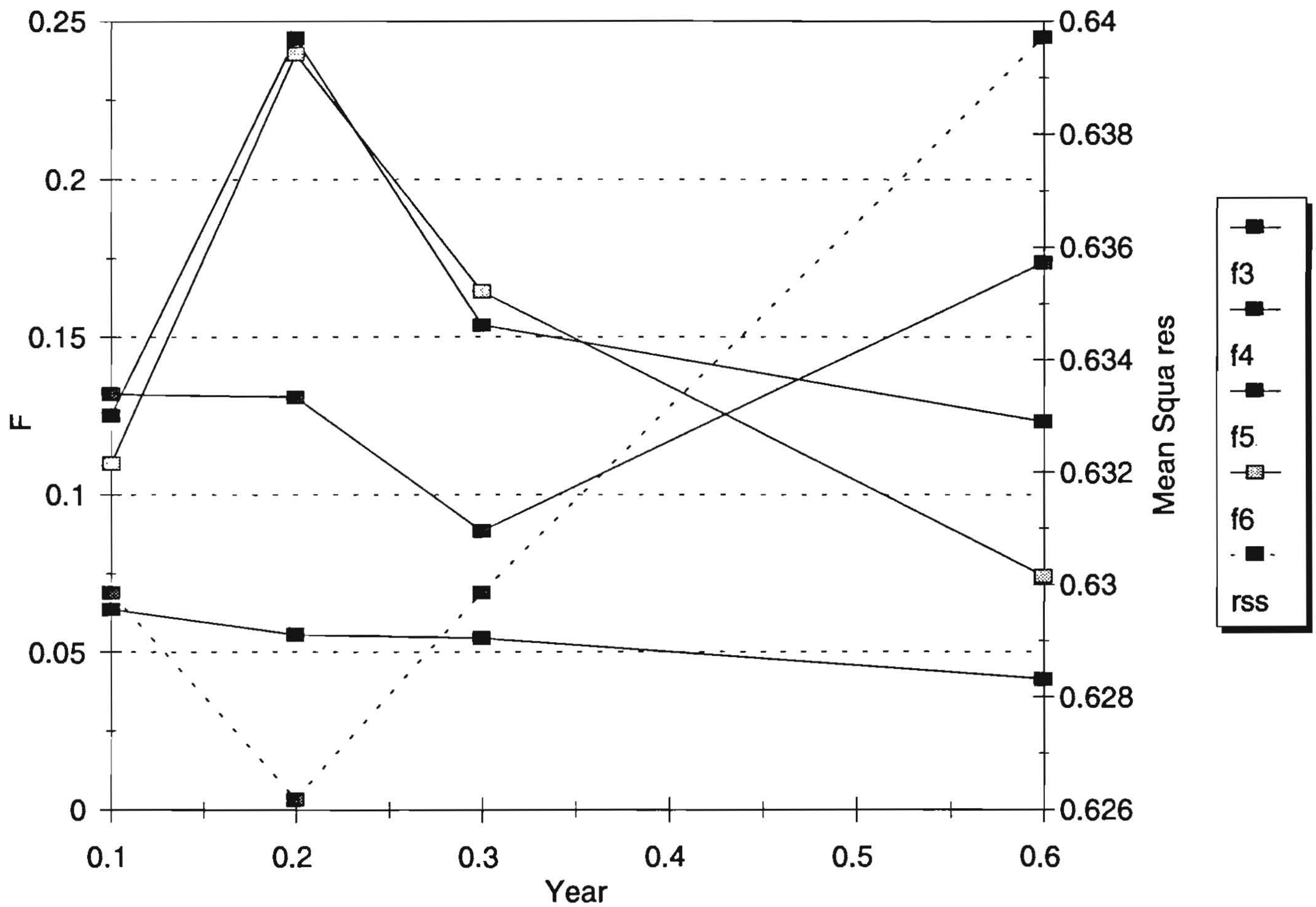


Figure 21. Final estimates of F relative to initial values for NLLS.

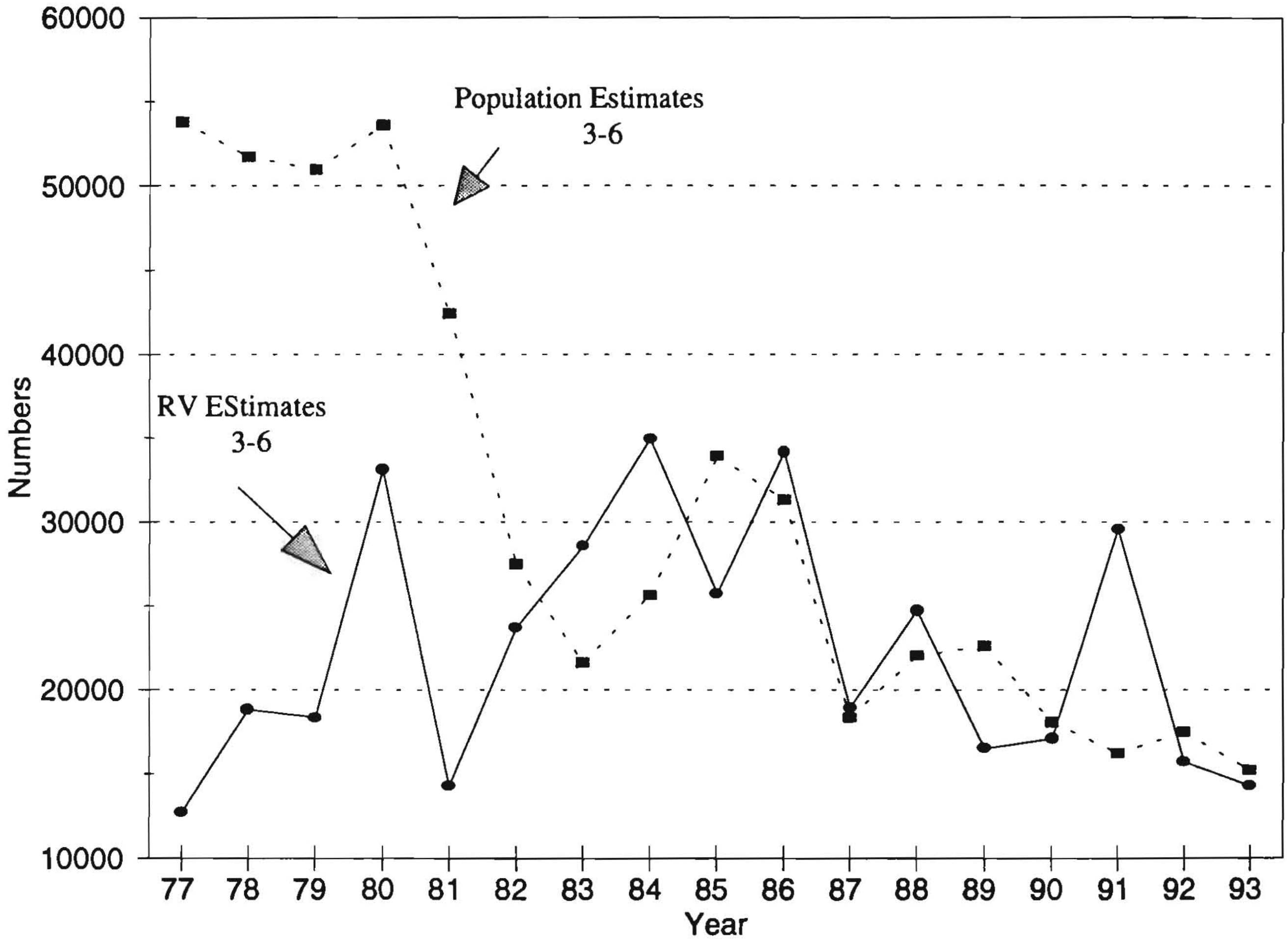


Figure 22. Research vessel index and estimated population numbers at "ages" 3-6 using the NLLS-based analysis.

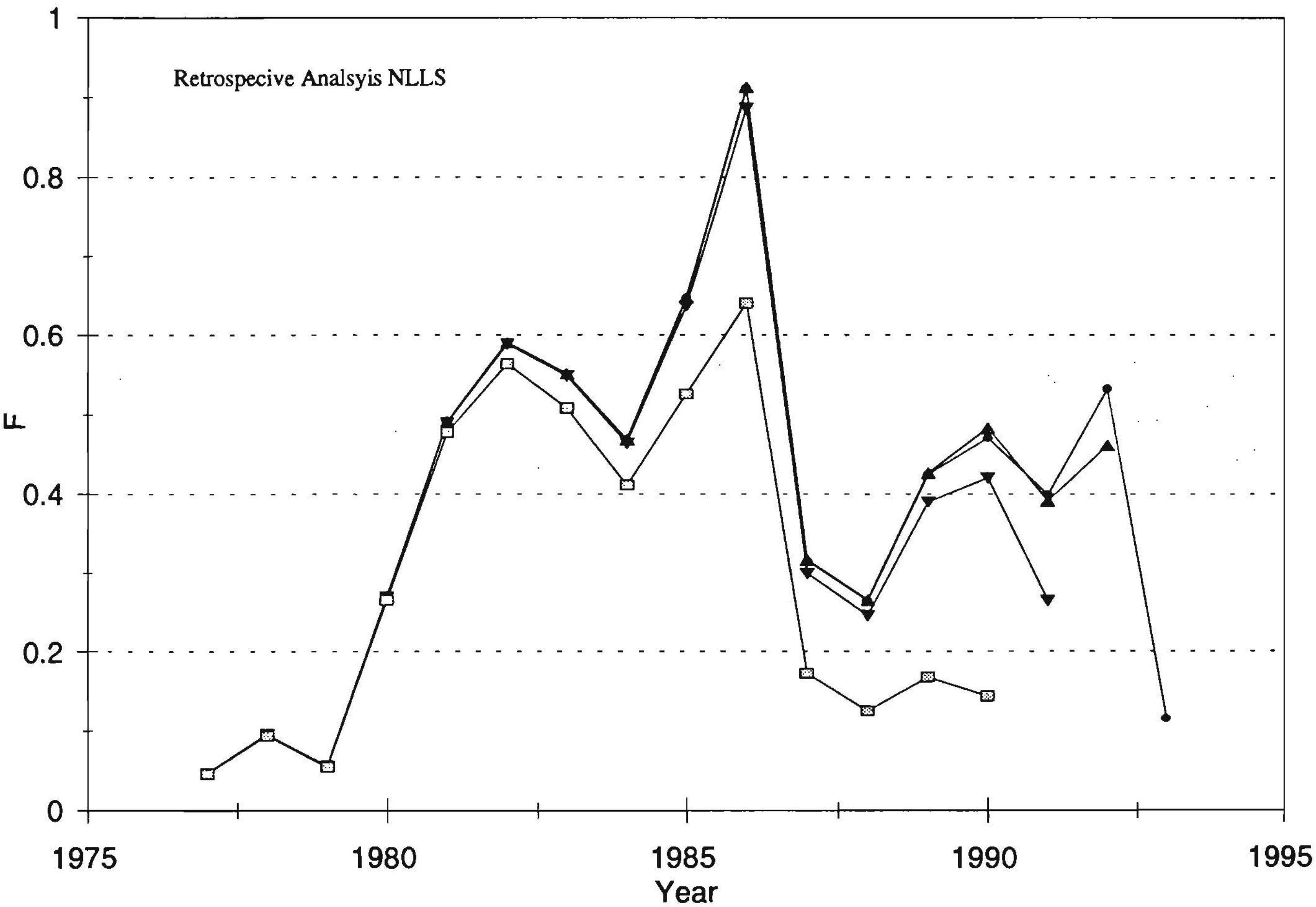


Figure 23. Retrospective analysis of NLLS run.

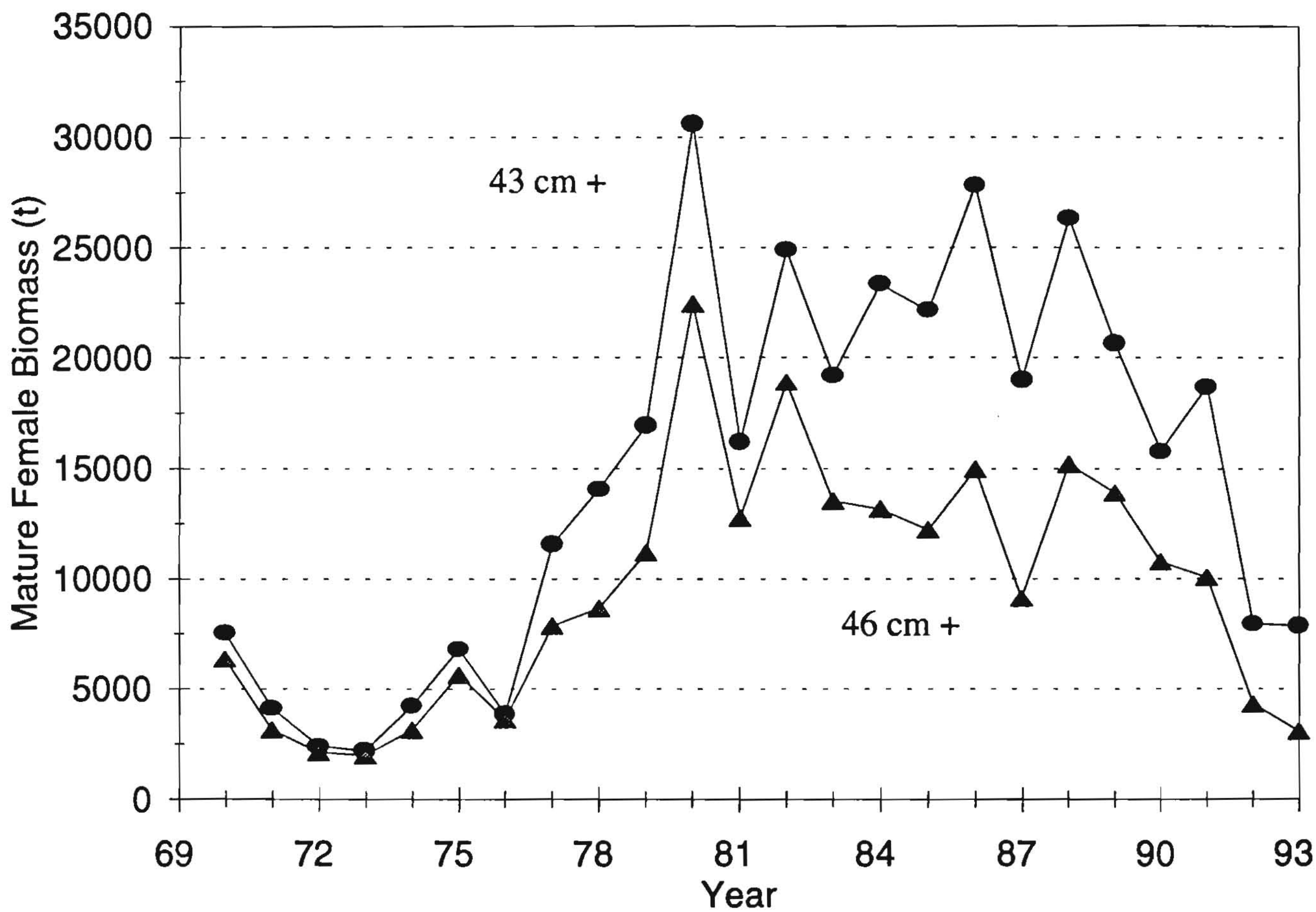


Figure 24. Mature female biomass estimated using knife-edged maturity at 43-46 cm.