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## Assessment of 4X Haddock in 1996 and the first half of 1997

by

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## Abstract

Landings of 4X haddock in 1996 were 5,690t against a TAC of 6,500t. Mean length in both mobile and fixed gear landings decreased substantially in 1996 and remained about the same in the first half of 1997. Revised age data were available for commercial samples using new ageing criteria and these have resulted in a change in the view of exploitation levels through the 1980s and early 1990s. Results of a resource abundance survey conducted by the ITQ fleet in cooperation with DFO Science for the third year in 1997 compare well with the research vessel survey results and indicate that abundance is high in the inshore area off southwest Nova Scotia not covered by the research vessel. The 1993 and 1994 year-classes are both strong and have resulted in an increase in spawning stock biomass from a low of 19,000t in 1994 to 41,000t in 1997. There is a significant retrospective effect between early observations of large year-classes and subsequent estimates, even at age 4. If the estimates of the 1993 and 1994 year-classes are adjusted to account for this effect, then the  $F_{0.1}$  yield in 1998 will be 11,500t if only the 1994 year-class is adjusted and 9,500t if both year-classes are adjusted.

## Résumé

En 1996, les débarquements d'aiglefin de 4X ont atteint 5 690 t pour un TAC de 6 500 t. La longueur moyenne des poissons des débarquements des pêches à engins mobiles ou fixes a diminué de façon appréciable en 1996 et est demeurée à cette valeur environ pendant la première demie de 1997. Des données révisées sur l'âge des prises commerciales fondées sur de nouveaux critères de détermination de l'âge ont donné lieu à une modification des taux d'exploitation pour la période des années 1980 et le début des années 1990. Les résultats d'un relevé d'abondance réalisé par la flotte des QIT en collaboration avec les Sciences du MPO, pour la troisième année consécutive en 1997, se comparent bien à ceux d'un relevé par navires de recherche et montrent que l'abondance est élevée dans la zone côtière au large du sud-ouest de la Nouvelle-Écosse non couverte par le navire de recherche. Les classes d'âge de 1993 et 1994 sont toutes deux importantes et ont donné lieu à une augmentation de la biomasse de géniteurs qui est passée de 19 000 t, en 1994, à 41 000 t, en 1997. Il existe un effet rétroactif important de premières observations de classes d'âge importantes sur les estimations ultérieures, même à l'âge 4. Si les estimations des classes de 1993 et 1994 sont corrigées en fonction de cet effet, le rendement au niveau  $F_{0,1}$  en 1998 sera de 11 500 t si seule la classe d'âge de 1994 est corrigée et de 9 500 t si les deux classes sont corrigées.

## Introduction

This document contains an evaluation of the NAFO Division 4X haddock stock (Figure 1) for the 1996 fishing year and the first half of 1997. As in the past, haddock caught in unit area 4Xs were not included in this analysis because they are believed to be part of the 5Y stock (Halliday 1974).

In a previous assessment of this stock (Frank et al. 1990), it was concluded that problems with the catch-at-age and/or the ADAPT formulation needed to be resolved before the results of Sequential Population Analysis (SPA) could be used as the basis for harvest level advice. In 1992, it was determined that a bias was present in haddock ageing data in recent years.

In 1994 and 1995, length-based SPA techniques were used in an attempt to determine stock status without ageing data for recent years (Hurley et al. 1994, 1995). It was concluded that there were a number of problems with these analyses, the most basic being the uncertainty concerning the growth models that were used.

Criteria for ageing haddock otoliths for this stock were redefined and revised ageing data were available for research vessel samples from 1987-95 for the assessment last year. In the absence of revised ageing data for commercial samples over the same period, the age composition data from the research vessel survey together with the length composition data from commercial samples were used to calculate commercial catch-at-age, for the years 1987-95 (Hurley et al. 1996).

For this assessment, revised ageing data were available for research vessel samples for 1985-86. Revised ageing data for earlier years are not available as a different technique (cracking vs. sectioning the otoliths) was employed in age determinations prior to 1985. Ageing data were also available for the 1996-97 research vessel survey samples. Revised ageing data were now available for commercial samples from 1988-97. Age composition data from the research vessel survey were used with the length composition data from commercial sampling to calculate the commercial catch-at-age for 1985-87 in this assessment.

This assessment uses the research vessel survey data in the current year, together with commercial landings data for the first half of 1997 and commercial samples of those landings, to determine stock status in the current year and to make yield projections for 1998.

## Description of the Fishery

### **Nominal Catches**

The long-term (1930-95) reported annual landings of haddock in NAFO Division 4X average about 20,000t. Landings exceeded 30,000t during the mid- to late 1960s and again during the early 1980s (Figure 2). Landings declined subsequently and have been below the long-term average since 1984. Landings reached 6,672t in 1989 when it was recommended that the fishery be maintained at the lowest possible level and the mobile gear fishery was closed in mid-season. Landings increased from 1989 to 10,351t in 1992 under a Management Plan that called for a by-catch fishery only. A TAC of 6,000t was implemented in 1993 and landings that year were 6,832t. Landings in 1994 were 4,273t, the lowest level observed in recent history, under a quota of 4,500t. This level was a result of a decrease in the quota to 4,500t and stringent fishing plans. The TAC in 1996 was 6,500t and reported landings were 5,690t (Table 1). The 1997 TAC is 6,700t and 2,200t was landed in the first half of the year.

Inshore mobile gear (<65ft) landings were 3,181t in 1996 (Table 2). Fixed gear (longline and handline) landings were 2,315t in 1996 while gillnet landings remained low, at 42t. Landings by the offshore mobile gear fleet increased to 144t in 1996.

The co-ordinates of the Small Mesh Gear Box were re-defined in 1994, resulting in a shift to the east and deeper than before. This change and the introduction of grates in the foreign silver hake fishery appears to have resulted in an overall reduction in groundfish by-catch in this fishery. The foreign catch of 4X haddock in 1996 was 8t (Table 1).

The 4X haddock fishery has been dominated by mobile gear landings historically. During 1990-93, the proportion of landings taken by the fixed gear was greater; however the proportion taken by mobile gear has increased since and was 59% in 1996.

During the late 1980s and early 1990s, the bulk of 4X haddock landings were reported from 4Xmnop. In 1988 and 1989, only 16% of landings came from 4Xqr; however there has been a steady increase in the proportion of haddock landings from 4Xqr since then and 36% of landings were reported from that area in 1996 (Table 3).

The shortfall in the 1996 quota was due primarily to landings reported from 4Xs (427t) and 5Y (94t), areas which are not considered part of the 4X haddock stock unit but which are included by quota monitoring in a 4X/5Y quota group. Haddock landings from these areas have usually been less than 100t in the past (Table 4).

The increase in landings from 4Xs and 5Y in 1996 occurred primarily in the mobile gear sector. Position information (latitude and longitude) of landings has been available from this sector since 1991 and an examination of the location of haddock catches shows that the catches in 4Xs in 1996 and 1997 occurred primarily in the middle of the Bay of Fundy as a continuation from 4Xr and not on the New Brunswick shore (Figure 3 and 4).

Catches in 5Y occurred primarily from the Grand Manan banks. The practice of excluding landings from 4Xs and 5Y should be re-examined.

### **Allocations and Management Actions**

Quota allocations and management actions for 4X haddock in recent years have been quite complicated and are described in detail by Annand and Hansen (1994, 1995, 1996, 1997) for 1993 to 1996 respectively. As in 1995, all fleets were required to submit Conservation Harvesting Plans prior to fishing. Dockside monitoring continued to be the predominant method for collection of landings and effort data. The mobile gear ITQ fleet and the offshore and midshore EA fleets continued with 100% weighout of all landings while the generalist fleet was subject to 50% weighout. The fixed gear <65' were placed under a minimum of 20% weighout distributed on a random basis. Small fish protocols were applied and resulted in the closure of Roseway, LaHave and Baccaro Banks to all fixed gear in January and again in the summer in 1996 due to high catches of small cod and haddock. The spawning closure on Browns Bank in place for all groundfish gears February 1 to June 15. Roseway Bank was closed to fixed gear again in 1997 for 2 weeks in August due to small fish. In 1996, the fixed gear <45' adopted a community structure for quota groups and were eventually divided into twelve different management groups, some of which subdivided further to take into account the different gear types within their group. The fixed gear 45-65' operated independently of the fixed gear <45'. The fixed gear <45' quota groups experienced a number of openings and closures in 1996; the major longline groups in the Shelburne community were closed in late July and most community quotas were reached by the end of August despite the ability to trade quota with other groups to maintain their fisheries. Within the community quota framework, the practice that started in 1996 of either equal shares or sharing arrangements based on catch history within community groups was much more widespread in 1997. Although the overall haddock quota increased in 1996 and 1997, the end of a sharing arrangement between the mobile and fixed gear sectors resulted in an 11% decrease in the fixed gear haddock allocation in 1997.

### **Additional Information about the Fishery**

The introduction of ITQs in the mobile gear sector in 1991 has resulted in significant changes in fishing practices. There has been a decrease in overall effort in the mobile gear <65' sector and an increase in effort directed at non-traditional species (Table 5). During industry consultations, it was indicated that the overall effort trend was realistic; however this is a mixed fishery and the main species designation in the DFO catch/effort data is calculated based on the overall trip and is not necessarily a reflection of the species being directed. The trend of increased effort directed at haddock in 1996 was accurate; fishermen reported that directing for haddock in the Bay of Fundy resulted in sufficient by-catch of cod and pollock to maintain quota balances. Haddock were reported to be distributed higher up in the Bay of Fundy in 1996 and this may explain the increase in

haddock landings in 4Xs and 5Y. The use of square mesh in the mobile gear fleet seems to be minimizing the catch of small haddock.

Reports from the longline fleet of increased abundance of small haddock east of Browns Bank were widespread, in both 1996 and 1997. At-sea surveillance samples from boardings of longline vessels indicate catches of small haddock were common and were high at times. Roseway, LaHave and Baccaro Banks were closed during the summer of 1996 due to high catches of small cod and haddock, and Roseway Bank was closed again for two weeks in August 1997. At-sea surveillance samples and port samples from the longline fleet suggest that some discarding and high-grading of small haddock occurred in 1996 but levels could not be quantified. It was felt that discarding of small haddock was reduced in 1997. The introduction of community quotas in the fixed gear sector led to an increase in misreporting in 1995 and 1996 but the introduction of quota shares has alleviated this somewhat in 1997.

Landings in the first half of 1997 are only 2,200t. This is likely a reflection of the late start of the fixed gear fishery this year due to difficulties in reaching agreement on a Management Plan by that sector. In addition, a number of fishermen now fishing quota shares in 1997 have chosen to catch that share later in the year.

## Data

### **Size and Age Composition of the Catch**

The size composition of 4X haddock landings from 1970-97 are shown in Table 6 and Figure 5 for 4Xmnop and in Table 7 and Figure 6 for 4Xqr respectively. Size and age composition are calculated separately for these areas as haddock growth rates differ between the two areas, and different age/length keys are used for the two areas in construction of the catch-at-age. These show a decrease in the number of larger haddock in catches over the last decade, relative to the long term mean, and a decrease in the number of small haddock in catches, particularly in 4Xqr.

A comparison of the overall 1995 and 1996 size composition of commercial landings of 4X haddock showed a slight shift to larger haddock in 1996 (Figure 7). A comparison of the size composition over time showed that there has been an increase in the mean length of mobile gear landings from 48.3cm since the introduction of square mesh and ITQs in the early 1990s; however mean length in mobile gear landings dropped from 54.7cm in 1995 to 51.6cm in 1996 (Figure 8). Mean length in fixed gear landings decreased from 54.1cm in 1990 to 49.4cm in 1993 and has remained relatively stable since. Mean length in landings in both sectors has remained about the same in 1997 half year landings as in 1996 (Figure 9).

Criteria for ageing haddock otoliths for this stock were redefined. Details can be obtained from Campana (1995) and Hurley et al. (1996). Ageing data, using these more accurate

ageing criteria, are now available for commercial samples from 1988 to present. As revised ageing data were not available for samples of commercial catches from 1985-87, the research vessel survey ageing data were used, together with the size composition of the commercial catches, to estimate the age composition of the commercial catches in those years.

A pairwise comparison of ages for commercial and research vessels samples from the primary and secondary agers showed high precision and little bias, with an overall coefficient of variation of 4.6 and 6.3% for research and commercial samples respectively (Figure 10). Although there was a slightly stronger bias at older ages in the commercial samples, this was considered acceptable for the present analysis. After ageing was completed for this analysis, both agers re-aged a sample from the reference collection with good results, indicating high precision and no bias (Figure 11). A comparison of research vessel numbers-at-ages indicate that the revised age data track year-classes well (Figure 12).

Commercial sampling data were used to construct a catch-at-age as in previous assessments. The gear and quarter stratifications used for 1988-97 are shown in Tables 8-17. The resulting catch-at-age is shown in Table 18. A comparison of the predicted and actual catch-at-age for 1996 shows that the proportion of ages 4, 5 and 6 in the 1996 catch is lower than predicted, while proportion at ages 7-10 is higher (Table 19 and Figure 13). In the first half of 1997, the proportion of ages 5 and 6 is lower than predicted.

A comparison of the catch-at-age for 1985-95 from the assessment last year which used research vessel age/length keys with the catch-at-age here shows the effect of the revised age data (Table 20). Using commercial age/length keys results in more young fish (ages 1-3) and more old fish (ages 8-10) but fewer fish at intermediate ages.

Commercial weight-at-age data from 1988-97 showed no consistent trends over the series; however weights have generally decreased in the last two to three years (Table 21).

### **Commercial Catch Rates**

Commercial catch rates have not been considered a reliable index of haddock abundance in 4X due to the high and variable levels of misreporting, particularly in the mid-1980s, and the extent of management changes in the recent period.

### **Research Vessel Surveys**

A summer groundfish research vessel survey of the Scotian Shelf has been conducted in July since 1970. The stratification scheme used in this stratified random survey design has not changed and is shown in Figure 14. The vessel conversion factor of 1.2 was used

for the *A.T. Cameron* surveys (Fanning 1985), as usual. Mean number per tow by stratum for 4X haddock is shown in Table 22.

Mean number per tow of 4X haddock in the research vessel survey decreased from a high of 92 fish per tow in 1995 to 55 in 1997, relative to a long term mean of 49 (Figure 15). Mean weight per tow decreased from a high of 52 kg in 1996 to 28 in 1997, relative to long term mean of 38 kg. The catch of small (<43cm) haddock decreased from 80 to 46, but was still high relative to the long term mean of 32 fish while the catch of market-size haddock decreased to 9, below the mean of 16 fish per tow.

The research vessel survey strata on and around Browns Bank (strata 477, 480, 481) contribute approximately 50% on average to the survey abundance estimate while stratum 490 in the mouth of the Bay of Fundy contributes an additional 15%. Survey strata were grouped into strata on and around Browns Bank (477, 480, 481), strata west of Browns Bank and in the Bay of Fundy (481-495), and strata east of Browns Bank (470-476 and 478). Haddock showed a wide geographic distribution with relatively high abundance throughout the survey area (Figure 16). The decrease in market-size haddock occurred primarily in the Bay of Fundy (Figure 17). The abundance of market-size haddock has been increasing on Browns Bank and the eastern banks in 4X since 1993 but decreased slightly on Browns Bank in 1997.

Modes in the size composition of the research vessel surveys indicate that the 1993 and 1994 year-classes are both well above average. The 1995 year-class appears relatively weak but the 1996 year-class may be average (Table 23 and 24, Figure 18 and 19). Mean number-at-age from the research vessel survey are shown in Table 25.

### **Biological Indices**

Mean length-at-age of haddock on Browns Bank and the eastern banks has decreased since the early 1980s, particularly at older ages (Table 26, Figure 20). A similar and more extreme decrease in mean length-at-age has occurred in 4TVW haddock during the same period (Frank et al. 1997). There has not been a decrease of mean length-at-age of haddock in the Bay of Fundy (Table 27, Figure 21). It is not known if this decrease in mean length-at-age in eastern 4X is due to change in growth rate or to admixture of haddock from the 4TVW stock area. It was also noted that mean weight-at-age in the research vessel survey has decreased for most ages in the last year or two in 4X (Table 28).

Condition is the relative weight of the fish for their length i.e. their plumpness. An index of condition, the predicted weight of a haddock at a given length, was calculated from the annual length/weight relationship from the summer research vessel surveys. Indices were calculated for lengths of 35 and 50cm (Table 29). While these indices were variable, they indicated that condition has decreased since the late 1980s to low levels in 1995 (Figure 22). The index for a 50cm haddock was at its lowest level in the survey series. These



indices increased in 1996-97; however the increases were not statistically significant. Low condition is one indicator of poor health; however the cause and significance of low condition in this case is uncertain.

### **Oceanographic Conditions**

Oceanographic conditions in 4X in 1996 and 1997 were examined and, unlike on the eastern Scotian Shelf, no conditions were identified in the bottom water that would adversely affect the distribution of haddock in 4X, with the possible exception of LaHave Bank where bottom temperature in 1997 was approximately 2°C (Drinkwater 1997, 1998, Losier et al. 1997). It was noted that water less than 2°C occurred at 50m over a substantial part of eastern 4X (Page et al. 1997), but the significance of this in relation to haddock is unknown.

### **Joint Industry/DFO Survey**

The ITQ fleet in cooperation with DFO Science Branch has conducted a trawl survey of the 4X area since 1995 during July, the same time that the DFO research vessel *Alfred Needler* conducts the annual summer groundfish survey. The ITQ survey was designed to cover the entire 4X area, including the inshore area off southwest Nova Scotia that the *Alfred Needler* is unable to survey. This inshore area has become a major fishing area for the mobile gear sector, and between 12 and 20% of 4X haddock landings by mobile gear in the last seven years have been caught in this area.

This survey has been conducted by three draggers (<65 ft) equipped with standardized gear with the same size codend liner as the research vessel. A fixed station design, based upon the research vessel survey strata, is used and standardized tows are made. Sampling of catches is conducted by Observers and length frequency samples are taken for cod, haddock, pollock, winter flounder and redfish. Further details are summarized in O'Boyle et al. (1995). A total of 139 tows were accomplished 1995 and the results were reported by Hurley et al. (1996). The station allocation was subsequently optimized and 177 and 176 tows were completed in 1996 and 1997. The inshore area not covered by the *Alfred Needler* is well covered by this survey, with the number of tows ranging between 21 and 27 sets.

On a stratum by stratum basis, catch rates were generally higher in the ITQ survey tows (Table 30-33). Overall distribution patterns were similar to those of the research vessel surveys (Figure 23 and 24) and catch rates in the inshore area were high. Although similar in the first year, size composition in the inshore area has differed from the adjacent survey strata (481,485,490), with relatively fewer large fish (Figure 25 and 26). The results of the ITQ fleet surveys also indicate that the 1993 and 1994 year-classes are strong. The catch of market-size haddock in the ITQ survey overall has not changed

significantly over the three years of the survey. This is in contrast to the RV survey results which indicate a sharp increase in 1996 followed by a sharp decrease in 1997.

### Estimation of Parameters and Assessment Results

A traditional age-based SPA was conducted using the ADAPT framework (Gavaris 1988). The model used is as follows:

#### Parameters:

Survey numbers at mid-year  $N_{i,1997}$ ,  $i = 2-7$

Calibration coefficients  $K_i$ ,  $i = 2-7$  for July RV survey

#### Structure Imposed:

Error in catch assumed negligible

Partial selection fixed for ages 1 and 8-10 in 1997

F on oldest age (10) set as average F of ages 2-7 adjusted by the relative selectivity of age 10 in 1997

No intercept was fitted

$M = 0.2$  for all ages

#### Input:

$C_{i,t}$   $i = 1-10$ ;  $t = 1970$  to  $1997$  - catch-at-age for entire year (half year for 1997)

$J_{i,t}$   $i = 2-7$ ;  $t = 1970$  to  $1997$  - July RV survey index

#### Objective function: Minimize

$$\sum \sum (\ln J_{i,t} - K_{i,j} \ln N_{i,t})^2$$

#### Summary:

Number of observations = 168 for July RV (6 ages by 28 years)

Number of parameters = 12, ln Ns estimated by NLLS, Ks algebraically

age	1	2	3	4	5	6	7	8	9	10
selectivity	.0001	.033	.118	.453	.884	.972	1.00	1.00	1.00	1.00

The minimization technique used was a nonlinear least squares (NLLS) gradient technique (the Marquardt algorithm). The NLLS technique is a compiled version of ADAPT written in ACON.

The SPA input data, catch numbers-at-age and research vessel survey stratified mean numbers-at-age per tow, are shown in Table 34 and the resulting estimates of fishing mortality, population numbers and residuals are shown in Table 35 and Figure 27. The CVs on the 1997 population estimates range from 3 to 6% and there is essentially no bias. The survey calibration coefficients have CVs of 11-12% and bias of less than 1%. As with previous assessments of this resource, the residuals show some strong year effects,

with positive residuals in all ages in some years and negative residuals at all ages in other years (Figure 27); however these patterns are less extreme than in the previous assessment (Hurley et al. 1996).

Past assessments of this resource have shown a strong retrospective pattern, where exploitation is under-estimated and population abundance is over-estimated in the current year, than when additional data are available in subsequent years. There was a significant improvement in this retrospective pattern in this assessment (Figure 28).

Population numbers from this assessment are similar to those from last year's assessment; however estimates of fishing mortality since the early 1980s are considerably lower in this assessment (Figure 29). This change in fishing mortality results primarily from the changes in the catch-at-age this year that used the revised ageing data from commercial samples. This reduction in estimates of fishing mortality was largest in the early to mid-1980s and is not consistent with effort trends over the same period. This may be due to the use of research vessel survey age data to calculate the catch-at-age for 1985-87, but discarding or misreporting may be a contributing factor.

Estimates of total mortality calculated from the research vessel survey and of relative fishing mortality calculated from landings and population numbers from the research vessel survey were compared with fishing mortalities from the SPA (Figure 30). These methods confirm the general trend in fishing mortality from the SPA, but the SPA did not show an increase in 1991-92 that the previous assessment did. Overall this assessment is an improvement over last year. There is a change in the perception of exploitation levels of this resource since the early 1980s and in 1991-92 in particular.

The exploitation rate on ages 5-7 has been higher than the target since the early 1970s (Figure 31). Exploitation decreased from approximately 45% in the early 1980s and dropped below the target level in 1994, but has increased to 27% in 1996. If the TAC of 6,700t is reached in 1997, the exploitation rate will drop below the target level (20%,  $F_{0.1}=0.25$ ) to 16%.

In the previous assessment, it was shown that a significant retrospective effect exists between early observations of large year-classes at age 2 and subsequent estimates. This may be due to discarding or higher natural mortality on large year-classes. Based upon the relationship of a Gompertz function fit though contemporaneous vs. converged estimates of age 2 from retrospective SPAs, the size of the 1993 year-class at age 1 was reduced from 80 to 40 million. This retrospective effect is still apparent at ages 3 and 4 (Figure 32). A Gompertz function fit to observations at ages 3 and 4 suggest that the 1994 and 1993 year-classes to be reduced from 75 and 60 million at age 1, as estimated by this assessment, to 47 and 39 million respectively.

Spawning stock biomass calculated using the maturity ogive of Waiwood and Buzeta (1989) has been decreasing since 1980 and reached a low of 19,000t in 1994 (Figure 33). It is estimated that spawning stock biomass has increased to 41,000t in 1997 as the 1993

and 1994 year-classes begin to mature (using unadjusted estimates for 1993 and 1994 year-classes). Except for the 1987 and 1988 year-classes, recruitment of the 1983-91 year-classes was below average; however the 1992 year-class is estimated to be of average strength. Both the 1993 and 1994 year-classes are estimated to be very strong. There appears to be no relationship between spawning stock biomass and recruitment over the biomass range observed (Figure 33).

### Outlook

Given the recent recruitment history of this resource, the apparent lack of a relationship between spawning stock biomass and recruitment, and that the only strong recruitment in recent years occurred when both spawning stock biomass and fish condition was at a low, it was felt that using geometric mean recruitment from 1983 to 1993 of 11.5 million for projections would be appropriate. Projections were made adjusting just the 1994 year-class and both the 1993 and 1994 year-classes.

Year	F	Yield (t)	Population Biomass (t)	Spawning Biomass (t)
1997	.20	6700	66133	47933
1998	.25	11624	72051	58675
1999	.25	11992	65905	56643

Using an estimate of age 1 recruitment of 47 million for the 1994 year-class (reduced from the SPA estimate due to the tendency to over-estimate the size of large year-classes) and a geometric mean from the recent past of 11.5 million for subsequent year-classes, the projected yield at the target exploitation rate (20%,  $F_{0.1}=0.25$ ) in 1998 would be 11,600t. Of this projected yield, 72% will come from the 1993 and 1994 year-classes. Spawning stock biomass would peak at 59,000t in 1998 and decrease to 57,000t at the beginning of 1999.

Risk analysis indicates that at a yield of 11,600t, which corresponds to a 50% risk of exceeding  $F_{0.1}$  (Figure 34a), the spawning stock biomass has a 76% probability of decreasing for 1998 (Figure 34b); this probability of spawning stock biomass decreasing for 1998 declines to 50% at a yield of about 9,790t. The probability of exceeding  $F_{0.1}$  declines below 20% for harvests of 9,300t or lower (Figure 35).

Year	F	Yield (t)	Population Biomass (t)	Spawning Biomass (t)
1997	.20	6700	56367	40570
1998	.25	9523	61195	49001
1999	.25	10223	57614	48771

Using an estimate of age 1 recruitment of 39 million for the 1993 year-class and 47 million for the 1994 year-class (reduce both year-classes) and 11.5 million for subsequent year-classes, the projected yield at the target exploitation rate would be 9,500t. Spawning stock biomass would peak at 49,000t in 1998 and essentially remain stable into 1999.

Risk analysis indicates that at a yield of 9,500t, which corresponds to a 50% risk of exceeding  $F_{0.1}$  (Figure 36a), the spawning stock biomass has a 61% probability of decreasing for 1998 (Figure 36b); this probability of spawning stock biomass decreasing for 1998 declines to 50% at a yield of about 8,700t. The probability of exceeding  $F_{0.1}$  declines below 20% for harvests of 8,200t or lower (Figure 37).

Aside from the strength of the 1993 and 1994 year-classes and subsequent recruitment, there are other sources of uncertainty in the projected yield and spawning stock biomass. Mean weight-at-age in the research vessel survey decreased substantially at most ages in 1997. If this trend continues, then the projected yield and spawning stock biomass will be over-estimated.

As a result of two years of very strong recruitment, this resource is rebuilding quickly from a record low level in 1994. Depending upon the exact magnitude of these strong year-classes, fishing at a target level of  $F_{0.1}$  will result in a decline in spawning stock biomass in 1999. Fishing at an exploitation rate below  $F_{0.1}$  would maintain the spawning stock biomass and help extend the age range in that spawning biomass, increasing the chances of further good recruitment.

The abundance of small fish will continue to be high in 1998, particularly on the offshore banks. The 1994 and 1993 year-classes will have a mean length of about 46 and 54cm respectively in this area and the 1996 year-class will have a mean length of about 31cm. The use of small fish protocols and area and season closures should be continued to allow these recruiting year-classes to realize their growth and reproductive potential. Continuing conservation levels such as low exploitation are also needed to rebuild the population biomass and to expand the age structure in the population.

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Table 1. Reported nominal catch (t rounded) of haddock from NAFO Division 4X (excluding Unit Area 4Xs) by country. The numbers in brackets represent the number of commercial samples collected in that year.

Year	Canada (MQ)	Canada (NFLD)	USA	USSR	Spain	Other	Total	TAC
1970	15560 (26)	-	1638	2	370	12	17582	18000
1971	16067 (29)	-	654	97	347	1	17166	18000
1972	12391 (36)	-	409	10	470	1	13281	9000
1973	12535 (30)	-	265	14	134	6	12954	9000
1974	12243 (25)	-	660	35	97	-	13035	-
1975	15985 (56)	-	2111	39	7	2	18144	15000
1976	16293 (45)	-	972	-	95	5	17365	15000
1977	19555 (79)	-	1648	2	-	12	21217	15000
1978	25299 (62)	114	1135	2	-	27	26577	21500
1979	24275 (49)	268	70	3	-	15	24631	26000
1980	28209 (56)	71	257	38	-	37	28612	28000
1981	30148 (82)	117	466	-	-	15	30746	27850
1982	23201 (92)	28	854	-	-	4	24087	32000
1983	24428 (119)	44	494	17	-	7	24990	32000
1984	19402 (97)	23	206	-	-	-	19631	32000
1985	14902 (86)	-	25	-	-	1	14928	15000
1986	14986 (78)	-	38	10	-	-	15034	15000
1987	13538 (82)	-	17	-	-	-	13555	15000
1988	10921 (79)	-	2	53	-	-	10976	12400
1989	6666 (43)	-	1	5	-	-	6672	4600
1990	7297 (71)	-	32	17 <sup>2</sup>	-	3 <sup>2</sup>	7342	4600
1991	9636 (81)	13	-	38 <sup>2</sup>	-	3 <sup>2</sup>	9690	-
1992	10329 (89)	5 <sup>1</sup>	-	-	-	17 <sup>2</sup>	10351	-
1993	6811 (86)	-	-	-	-	21 <sup>2</sup>	6832	6000
1994	4272 (68)	-	-	-	-	1 <sup>2</sup>	4273	4500
1995	5407 (78)	-	-	-	-	9 <sup>2</sup>	5416	6000
1996	5682 (84)	-	-	-	-	8 <sup>2</sup>	5690	6500
1997*	2200 (56)	-	-	-	-	8 <sup>2</sup>	2208	6700

1 = NAFO Circular Letters

2 = Observer Program Data

\* = 1997 Data only for quarters 1 and 2



Table 2. Reported nominal catch (t round) of haddock from NAFO Division 4X (excluding Unit Area 4Xs) landed in the Maritimes split by tonnage class and gear type. The numbers in brackets represent the mean weight landed per age/size sample collected.

Year	Tonnage Class						Total
	TC 1-3			TC 4+			
	MG (OT)	FG (LL) <sup>1</sup>	Misc. <sup>2</sup>	MG (OT)	FG (LL)	Misc.	
1970	4894 (1224)	3281	767	6501 (296)	114	3	15560
1971	4289 (858)	3475 (1158)	499	7711 (367)	94	0	16068
1972	2742 (686)	4396 (440)	439	4750 (216)	63	0	12390
1973	1822 (304)	6090 (677)	324	4228 (282)	70	0	12534
1974	3949 (494)	6364 (530)	251	1622 (324)	55	0	12241
1975	6085 (320)	5193 (577)	271	4408 (157)	26	0	15983
1976	4347 (1087)	5305 (884)	445 (223)	6144 (186)	46	6	16293
1977	6178 (1030)	4328 (481)	550	8343 (130)	117	35	19551
1978	9413	6814 (568)	1084 (542)	7888 (164)	97	0	25296
1979	10171 (5086)	5127 (394)	600 (600)	8317 (252)	57	0	24272
1980	13043 (1186)	6911 (384)	1127 (376)	7045 (294)	82	0	28208
1981	14765 (328)	7846 (302)	993 (331)	6475 (809)	70	0	30149
1982	11670 (243)	7581 (345)	945 (79)	2972 (297)	32	0	23200
1983	12563 (224)	8533 (225)	754 (75)	2535 (195)	15	0	24400
1984	11828 (208)	6769 (226)	193 (193)	609 (76)	0	0	19399
1985	9834 (173)	4360 (182)	142	565 (113)	1	0	14902
1986	9201 (192)	5336 (184)	240	209 (209)	0	0	14986
1987	7652 (169)	4854 (270)	231 (21)	501 (84)	0	0	13538
1988	7074 (131)	3353 (152)	118 (118)	376 (188)	0	0	10921
1989	3656 (130)	2699 (245)	222	89 (22)	0	0	6666
1990	3183 (76)	3731 (133)	280 (280)	102	0	1	7297
1991	4061 (94)	5117 (151)	275 (275)	183 (61)	0	0	9636
1992	3365 (72)	6468 (175)	249 (125)	245 (82)	0	2	10329
1993	2507 (58)	4083 (136)	97 (14)	124 (31)	0	0	6811
1994	1656 (50)	2175 (84)	46	95 (48)	0	0	4272
1995	2878 (61)	2363 (79)	65	99 (99)	0	2	5407
1996	3181 (76)	2315 (58)	42 (42)	144 (144)	0	0	5682
1997*	1787 (48)	361 (48)	5 (1)	23 (4)	0	0	2200

1 = Includes Handline

2 = Gillnets (set, drift), traps, unspecified.

\* = 1997 Data only for quarters 1 and 2



Table 4. Reported landings from NAFO Divisions 4X and 5Y by gear type.

		4XI	4Xm	4Xn	4Xo	4Xp	4Xq	4Xr	4Xs	4Xu	5Y
Mobile	1989	0	50	733	454	1047	566	207	12	790	60
	1990	0	35	468	533	738	886	223	5	544	7
	1991	0	16	799	851	645	1159	739	87	93	11
	1992	0	32	939	735	427	912	604	51	21	6
	1993	0	7	503	500	355	925	296	108	50	12
	1994	0	3	187	445	104	999	311	112	2	14
	1995	0	7	222	275	1018	975	477	157	8	28
	1996	0	10	541	214	758	993	799	413	9	93
	1997	0	5	393	78	641	462	278	94	6	8
Gill Net	1989	0	96	0	47	0	2	0	2	10	0
	1990	0	82	1	74	3	75	31	1	11	0
	1991	0	79	2	144	5	12	2	3	10	0
	1992	0	79	5	42	1	53	3	7	24	1
	1993	0	21	3	46	6	8	3	1	12	1
	1994	0	4	0	21	3	4	3	0	11	1
	1995	0	5	4	20	7	11	3	3	17	0
	1996	0	10	1	17	6	4	1	7	3	1
	1997	0	0	0	0	3	0	0	0	1	0
Longline	1989	0	256	219	858	277	28	9	1	818	0
	1990	0	275	229	1309	368	30	3	8	1170	0
	1991	0	409	561	1809	801	97	45	1	863	0
	1992	0	133	458	2276	319	98	181	2	2119	1
	1993	0	113	1129	994	400	178	202	1	211	0
	1994	0	50	175	665	171	10	39	0	470	0
	1995	0	82	672	616	435	149	13	3	200	0
	1996	0	67	556	673	350	84	66	6	223	0
	1997	0	11	193	30	48	14	5	1	67	3
Handline	1989	0	4	0	193	0	4	12	0	8	0
	1990	0	3	0	376	0	8	3	0	6	0
	1991	0	11	0	460	0	31	29	0	9	0
	1992	0	13	0	844	1	40	74	0	2	0
	1993	0	3	7	775	27	14	32	3	3	0
	1994	0	1	2	486	21	75	11	0	4	0
	1995	0	0	2	140	13	3	0	0	91	0
	1996	0	2	5	248	13	14	3	1	12	0
	1997	0	0	0	29	1	3	0	0	9	0
Misc	1989	0	25	0	2	0	0	0	0	0	0
	1990	0	0	0	0	0	0	0	0	0	0
	1991	0	1	0	0	0	0	0	0	0	0
	1992	0	2	0	0	2	1	0	0	0	0
	1993	0	0	0	0	0	0	0	0	0	0
	1994	0	0	0	0	0	0	0	0	0	0
	1995	0	0	0	0	0	1	0	0	0	0

Table 5: Effort hours by species for OT tonnage classes 1-3 in NAFO Divions 4X and the Canadian portion of 5Y.

Main Species	1991	1992	1993	1994	1995	1996	1997.5
Cod	49476	60862	45560	25924	16579	21098	12607
Haddock	14237	14250	12866	11748	14928	21398	8494
Redfish	535	1396	4987	9919	12382	8830	7935
Halibut	316	357	1051	146	429	862	747
Plaice	8273	3688	0	702	412	656	579
Yellowtail	780	1044	295	775	1362	1436	59
Witch	3015	5218	2899	2521	3261	5554	2948
Winter Flounder	4137	5307	2576	4435	7787	8651	1558
Unspecified Flounder	25732	34260	35288	23788	14009	10023	2512
Total Flounder	41937	49517	41059	32221	26831	26320	7655
Pollock	22364	25032	18938	13238	8634	8788	7042
White Hake	1147	5155	3348	2901	515	520	129
Silver Hake	61	0	0	116	108	420	12
Cusk	5	4	15	0	9	9	8
Wolffish	620	1445	1599	1298	282	1495	1784
Monkfish	43	272	1307	5841	3443	4466	1542
Sculpin	74	139	29	311	73	12	4
Unspecified	766	487	1	0	6	7	15
Skates	0	4	76	287	265	138	11
Total	173517	208435	171893	136168	111314	120681	55641

Table 6: Commercial 4Xmnop haddock catch-at-length (thousands), 1970-1997. Data for 1997 only includes quarters 1 and 2.

cm.	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0.5	0	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	0
6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.5	1	1	4	0	1	0	0	0	0	0	0	0	0	0	0	0
16.5	4	1	14	1	3	0	0	0	0	0	0	0	0	0	0	0
18.5	19	0	24	7	3	1	4	0	0	0	0	0	0	0	0	0
20.5	48	0	31	7	6	2	8	0	0	0	1	0	0	1	0	0
22.5	19	8	11	5	6	1	7	0	0	0	2	0	0	1	2	0
24.5	11	16	4	5	3	1	5	0	0	0	1	0	0	1	0	0
26.5	8	56	2	9	4	1	3	0	0	0	1	1	0	3	0	0
28.5	10	114	0	17	9	4	9	0	1	3	1	4	0	6	0	2
30.5	14	145	1	31	14	5	6	2	7	2	4	5	1	21	0	8
32.5	57	269	35	55	17	18	31	32	26	3	9	16	1	27	11	21
34.5	147	623	100	82	50	64	52	106	35	25	55	26	7	87	29	26
36.5	270	678	263	91	73	152	112	244	151	73	91	130	57	150	76	50
38.5	398	775	354	91	104	355	164	389	360	149	176	329	134	301	188	110
40.5	482	696	372	123	178	502	289	568	659	313	332	449	179	529	292	228
42.5	446	574	439	178	293	781	374	758	903	445	463	764	240	753	577	392
44.5	493	769	474	321	332	887	608	836	1099	823	652	1064	395	911	840	637
46.5	701	664	413	425	324	1114	825	814	1553	1178	845	1363	662	928	877	847
48.5	847	610	459	440	226	992	1016	852	1629	1367	881	1602	910	1004	941	919
50.5	1093	612	502	518	131	822	1013	955	1596	1404	1048	1471	1052	1132	968	881
52.5	1271	663	452	463	139	596	885	1094	1418	1434	1215	1433	1155	1086	932	776
54.5	1073	568	503	488	181	405	715	1147	1126	1219	1337	1287	1011	1108	918	632
56.5	934	517	476	456	247	365	528	1080	910	998	1393	1228	938	1034	777	568
58.5	605	397	481	449	399	361	465	908	838	775	1085	957	787	788	640	354
60.5	451	369	469	321	439	348	436	563	721	563	868	872	695	668	466	262
62.5	319	298	357	297	387	394	321	434	552	438	685	573	569	495	309	128
64.5	148	191	247	252	309	329	271	287	396	300	437	417	379	297	203	115
66.5	82	99	159	150	226	213	223	216	295	200	289	291	239	219	136	72
68.5	29	71	80	94	160	175	162	113	138	131	188	162	162	127	82	41
70.5	6	37	48	74	120	96	70	85	72	88	87	94	94	79	49	30
72.5	4	14	20	41	36	43	46	37	40	57	57	56	65	37	27	16
74.5	6	6	4	25	22	29	28	22	18	15	23	27	35	22	12	5
76.5	2	5	2	32	35	11	1	8	15	8	7	10	12	8	11	2
78.5	2	2	1	35	3	1	7	3	7	8	5	10	9	3	1	0
80.5	2	0	0	6	1	0	1	1	2	2	1	1	3	1	0	1
82.5	0	0	0	0	0	0	0	0	0	1	3	1	2	0	0	0
84.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86.5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
88.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10002	9848	6801	5591	4481	9068	8685	11554	14567	12006	12242	14643	9793	11827	9364	7123

Table 6: (Continued)

cm.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0.5	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
6.5	0	0	0	0	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0
16.5	0	0	0	0	0	0	0	0	0	0	0	0
18.5	0	0	2	2	0	0	0	0	0	0	0	0
20.5	0	0	4	6	0	0	0	3	0	0	0	0
22.5	0	0	3	4	1	0	0	8	0	1	0	0
24.5	0	0	1	2	1	1	0	8	0	2	0	0
26.5	0	0	0	4	4	2	0	3	0	3	0	0
28.5	1	0	0	10	15	3	1	2	0	2	0	0
30.5	3	0	2	17	43	7	4	3	0	3	0	0
32.5	21	7	6	27	62	21	14	6	2	3	0	0
34.5	102	35	8	22	80	57	23	9	1	4	1	0
36.5	218	88	20	28	116	100	100	22	6	9	10	0
38.5	298	168	49	34	139	171	267	45	24	26	31	11
40.5	378	319	97	51	174	266	439	123	45	69	91	20
42.5	544	545	194	97	243	371	708	207	66	126	158	41
44.5	728	727	328	198	281	437	721	295	107	157	189	77
46.5	893	956	487	329	357	475	746	323	149	223	279	123
48.5	939	1100	662	500	337	495	705	456	218	246	321	130
50.5	964	1082	775	556	368	517	603	443	239	279	343	142
52.5	802	956	765	443	302	443	414	454	240	282	316	113
54.5	658	757	728	420	254	333	301	371	238	269	278	99
56.5	518	537	589	353	226	275	216	260	164	222	205	76
58.5	302	324	403	243	189	204	147	192	121	174	137	61
60.5	235	211	311	160	144	148	88	133	88	120	96	46
62.5	140	123	166	105	85	83	48	78	51	79	57	22
64.5	84	72	109	52	47	54	25	54	29	43	27	13
66.5	58	55	62	35	21	32	11	24	14	35	14	10
68.5	30	20	31	13	12	13	8	13	8	18	6	5
70.5	19	12	18	10	3	7	6	8	3	10	4	2
72.5	7	3	10	4	0	2	2	4	2	6	1	1
74.5	6	5	8	1	1	2	0	7	0	2	1	0
76.5	3	0	2	1	1	0	0	1	0	2	0	0
78.5	0	0	0	0	0	1	0	1	0	0	0	0
80.5	0	0	2	0	0	0	0	0	0	0	0	0
82.5	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
86.5	0	0	0	0	0	0	0	0	0	0	0	0
88.5	0	0	0	0	0	0	0	0	0	0	0	0
90.5	0	0	0	0	0	0	0	0	0	0	0	0
	7951	8102	5842	3727	3506	4520	5597	3556	1816	2419	2566	994

Table 7: Commercial 4Xqr haddock catch-at-length (thousands), 1970-1997. Data for 1997 only includes quarters 1 and 2.

cm.	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
8.5	0	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	0
6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20.5	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24.5	5	0	0	3	0	0	0	0	0	0	12	0	0	0	0	0
26.5	14	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
28.5	10	0	0	24	2	1	20	0	0	2	21	3	8	3	8	0
30.5	5	19	0	72	85	7	28	10	1	0	48	1	21	13	32	9
32.5	46	70	4	183	193	29	75	12	3	2	20	17	57	63	97	15
34.5	162	246	38	294	645	184	78	34	4	7	32	153	132	93	198	94
36.5	299	262	93	363	491	565	242	107	23	14	121	407	193	194	298	211
38.5	332	167	177	368	367	648	224	198	55	62	142	430	286	389	364	359
40.5	261	111	206	237	626	572	239	340	105	97	148	372	386	563	317	459
42.5	148	77	283	134	694	486	194	425	149	132	407	272	523	652	374	442
44.5	83	81	283	79	532	577	133	561	222	291	446	307	670	633	405	445
46.5	112	73	236	67	324	406	239	342	314	409	561	392	601	488	477	328
48.5	159	81	158	51	190	403	252	215	384	449	542	477	494	398	465	284
50.5	208	113	149	68	62	280	267	133	409	412	529	418	453	363	359	279
52.5	202	128	148	63	36	172	189	181	373	425	486	385	297	308	312	236
54.5	173	124	116	71	67	104	230	136	252	314	408	341	266	235	217	215
56.5	156	189	110	95	97	52	171	97	181	281	370	294	279	219	150	126
58.5	91	148	92	57	91	65	89	64	150	180	326	246	160	183	142	124
60.5	82	125	88	32	107	39	86	40	115	154	208	203	141	153	111	89
62.5	41	97	57	26	58	40	48	33	85	123	170	149	111	104	72	65
64.5	61	57	39	22	58	38	39	18	68	85	67	107	72	90	44	52
66.5	41	51	25	17	33	34	12	13	45	49	27	63	63	52	29	12
68.5	16	20	17	7	28	20	19	21	25	27	23	36	40	46	15	22
70.5	1	8	6	10	13	15	6	5	9	14	19	14	29	22	18	4
72.5	3	3	5	4	7	6	2	2	4	8	2	8	13	13	5	4
74.5	11	0	0	2	6	4	14	2	4	2	1	8	7	11	2	1
76.5	3	1	0	3	5	1	0	1	2	1	0	0	1	4	0	0
78.5	1	0	0	5	1	0	1	0	1	0	0	1	1	0	0	0
80.5	5	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
82.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
84.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2731	2251	2330	2368	4818	4748	2897	2990	2984	3540	5145	5104	5304	5292	4511	3875

Table 7: (Continued)

cm.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0.5	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
6.5	0	0	0	0	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0
16.5	0	0	0	0	0	0	0	0	0	0	0	0
18.5	0	0	0	0	0	0	0	0	0	0	0	0
20.5	0	0	0	0	0	0	0	0	0	0	0	0
22.5	0	0	0	0	0	0	0	0	0	0	0	0
24.5	0	0	0	0	0	0	0	0	0	0	0	0
26.5	0	0	0	0	0	0	0	0	1	0	0	0
28.5	0	0	0	0	0	0	0	0	0	0	0	0
30.5	2	0	0	0	3	0	1	0	1	0	0	0
32.5	19	1	0	0	26	0	3	1	1	0	0	0
34.5	47	5	7	1	79	0	4	4	1	0	0	1
36.5	83	29	11	3	69	10	7	8	2	7	2	1
38.5	125	106	25	19	69	34	106	12	12	25	7	2
40.5	205	211	47	27	79	64	28	29	22	68	26	8
42.5	336	223	50	13	79	85	40	48	36	125	59	16
44.5	577	289	82	34	93	134	58	71	47	157	87	30
46.5	632	248	111	47	95	154	97	87	63	222	167	57
48.5	580	268	123	58	106	172	118	107	81	246	196	63
50.5	370	270	151	67	89	160	158	107	99	279	211	79
52.5	269	183	157	74	83	147	173	112	93	282	170	71
54.5	209	151	135	60	66	130	156	113	84	269	131	49
56.5	125	75	92	68	52	110	111	91	83	222	87	32
58.5	65	42	67	59	47	78	83	76	70	174	66	25
60.5	68	22	50	43	41	61	64	69	61	120	44	24
62.5	18	12	29	37	34	46	39	43	41	79	27	13
64.5	6	1	16	25	25	27	33	24	28	43	21	8
66.5	5	5	9	4	17	19	19	17	18	35	10	4
68.5	4	1	4	2	10	8	10	8	10	18	4	2
70.5	2	1	1	6	4	5	6	5	3	10	3	2
72.5	0	0	1	0	1	1	2	4	3	6	1	0
74.5	3	0	1	2	0	0	1	2	0	2	1	0
76.5	1	0	0	0	0	0	1	1	1	2	0	0
78.5	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
82.5	1	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
86.5	0	0	0	0	0	0	0	0	0	0	0	0
88.5	0	0	0	0	0	0	0	0	0	0	0	0
90.5	0	0	0	0	0	0	0	0	0	0	0	0
	3752	2143	1169	649	1167	1445	1228	1039	861	2395	1321	489



Table 8. Summary of commercial sampling for the 4X haddock fishery in 1988. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	2203 (357 - 4635)	77	81	0
2	1476 (221 - 2743)	222	763 (249 - 2471)	16
3	1126 (0 - 505)	17	688 (241 - 1214)	4
4	612 (0 - 701)	40	125 (0 - 195)	0

Longline/Handline				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	1368 (157 - 1542)	0	19	0
2	176	0	29	0
3	1075 (174 - 1490)	0	29	0
4	650 (168 - 1630)	0	7	0

Miscellaneous*				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	25	0	0	0
2	22	0	5	0
3	45	0	2	0
4	19	0	0	0

\* - Longline samples applied to miscellaneous landings

Table 9. Summary of commercial sampling for the 4X haddock fishery in 1989. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls					
Quarter	4Xmnop		4Xqr		
	TC1-3	TC4+	TC1-3	TC4+	
1	2121 (412 - 4053)	34 (26 - 650)	143	0	
2	501 (173 - 1317)	8	587 (0 - 249)	3	
3	46	2	253 (0 - 225)	0	
4	2	42 (0 - 192)	3 (0 - 135)	0	

Longline/Handline					
Quarter	4Xmnop		4Xqr		
	TC1-3	TC4+	TC1-3	TC4+	
1	916 (70 - 441)	0	9	0	
2	216	0	59	0	
3	1023 (197 - 1286)	0	36	0	
4	440 (109 - 400)	0	0	0	

Miscellaneous*					
Quarter	4Xmnop		4Xqr		
	TC1-3	TC4+	TC1-3	TC4+	
1	36	0	0	0	
2	55	0	1	0	
3	65	0	1	0	
4	64	0	0	0	

\* - Longline samples applied to miscellaneous landings

Table 10. Summary of commercial sampling for the 4X haddock fishery in 1990. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	1341 (361 - 4354)	42	93 (36 - 415)	1
2	229 (0 - 177)	16	723 (144 - 2372)	0
3	125	16	427 (125 - 2152)	1
4	128	25	117 (59 - 452)	1

Longline/Handline				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	1267 (319 - 2756)	0	8	0
2	256 (0 - 42)	0	11	0
3	1447 (199 - 1474)	0	29 (0 - 188)	0
4	707 (203 - 1658)	0	6	0

Miscellaneous*				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	20	0	0	0
2	9	0	56	0
3	115	0	53	0
4	27	0	1	0

\* - Longline samples applied to miscellaneous landings

Table 11. Summary of commercial sampling for the 4X haddock fishery in 1991. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	792 (282 - 1998)	37 (31 - 199)	71 (63 - 661)	4
2	305 (73 - 624)	64 (30 - 204)	766 (217 - 1735)	3
3	200.00	20	627 (198 - 1909)	4
4	865 (69 - 910)	34	435 (150 - 1687)	17

Longline/Handline				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	1800 (395 - 3121)	0	20	0
2	451 (155 - 1091)	0	46 (72 - 476)	0
3	1702 (106 - 1079)	0	140 (29 - 230)	0
4	929 (137 - 1113)	0	29	0

Miscellaneous*				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	10	0	0	0
2	27	0	5	0
3	168	0	17	0
4	48	0	0	0

\* - Longline samples applied to miscellaneous landings

Table 12. Summary of commercial sampling for the 4X haddock fishery in 1992. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

## Otter Trawls

Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	1006 (155 - 2237)	92 (48 - 196)	76 (126 - 875)	0
2	410 (70 - 1110)	116 (0 - 200)	563 (89 - 1180)	0
3	197 (0 - 544)	8	534 (93 - 1883)	7
4	264 (90 - 1765)	8	315 (109 - 1480)	14

## Longline/Handline

Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	1698 (204 - 1518)	0	17	0
2	707 (146 - 1905)	0	105 (0 - 184)	0
3	2240 (87 - 1930)	0	256	0
4	1368 (100 - 2062)	0	77	0

## Miscellaneous\*

Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	43	0	0	0
2	22	0	3	0
3	66	0	51	0
4	55	0	11	0

\* - Longline samples applied to miscellaneous landings

Table 13. Summary of commercial sampling for the 4X haddock fishery in 1993. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	598 (83 - 2205)	49.00	62 (33 - 443)	1
2	388 (47 - 1670)	49	503 (96 - 1815)	7
3	155 (22 - 211)	3	436 (61 - 1220)	0
4	130 (44 - 1992)	5	236 (0 - 701)	1

Longline/Handline				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	1009 (153 - 1880)	0	13 (0 - 220)	0
2	671 (73 - 585)	0	220	0
3	1822 (257 - 2308)	0	209	0
4	138 (29 - 968)	0	2	0

Miscellaneous*				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	0	0	0	0
2	18	0	5	0
3	54	0	6	0
4	12	0	1	0

\* - Longline samples applied to miscellaneous landings

Table 14. Summary of commercial sampling for the 4X haddock fishery in 1994. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	239 (154 - 1317)	19 (51 - 418)	231 (231 - 1678)	2
2	194 (208 - 2090)	7	326 (114 - 891)	1
3	87 (55 - 414)	2	399 (132 - 962)	0
4	144 (53 - 472)	48	300 (88 - 895)	16

Longline/Handline				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	331 (189 - 1496)	0	0	0
2	535 (132 - 1478)	0	61	0
3	923 (211 - 1661)	0	90	0
4	233 (49 - 833)	0	2	0

Miscellaneous*				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	0	0	0	0
2	5	0	3	0
3	23	0	7	0
4	8	0	1	0

\* - Longline samples applied to miscellaneous landings

Table 15. Summary of commercial sampling for the 4X haddock fishery in 1995. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	780 (326 - 3275)	74 (28 - 207)	258 (155 - 1523)	1
2	109 (65 - 642)	2	357 (199 - 1619)	7
3	70	4	446 (87 - 1258)	0
4	456 (236 - 1982)	9	383 (84 - 720)	1

Longline/Handline				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	301 (182 - 1711)	0	0	0
2	369 (227 - 1748)	0	125	0
3	1054 (113 - 1841)	0	38	0
4	447 (170 - 1409)	0	29	0

Miscellaneous*				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	0	0	0	0
2	3	0	4	0
3	43	0	13	0
4	0	0	1	0

\* - Longline samples applied to miscellaneous landings



Table 16. Summary of commercial sampling for the 4X haddock fishery in 1996. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	695.63 (99 - 1493)	111.13 (0 - 130)	317.23 (207 - 2039)	0.65
2	233.16 (127 - 1114)	3.62	352.15 (120 - 930)	1.41
3	111.36 (49 - 419)	3.34	422.76 (79 - 829)	4.93
4	351.51 (78 - 888)	15.54	696.88 (109 - 1465)	2.80

Longline/Handline				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	203.29 (105 - 1125)	0	8.54	0
2	405.33 (227 - 1951)	0	63.37 (35 - 225)	0
3	788.39 (86 - 4610)	0	85.34	0
4	734.19 (47 - 634)	0	26.99	0

Miscellaneous*				
Quarter	4Xmnop		4Xqr	
	TC1-3	TC4+	TC1-3	TC4+
1	0	0	0	0
2	4.23	0	0.52	0
3	30.79	0	4.73	0
4	0.96	0	0.83	0

\* - Longline samples applied to miscellaneous landings

Table 17. Summary of commercial sampling for the 4X haddock fishery in 1997. Tonnes landed is followed by the number of fish aged and measured in parenthesis. The boxes represent the aggregation used in age-length key formation.

Otter Trawls							
Quarter	4Xmnop				4Xqr		
	TC1-3		TC4+		TC1-3		TC4+
1	716.20	(207 - 2199)	19.164	(69 - 630)	332.27	(162 - 1279)	1.43
2	362.71	(27 - 2165)	1.91	(25 - 199)	375.77	(205 - 1700)	0.90
3							
4							

Longline/Handline							
Quarter	4Xmnop				4Xqr		
	TC1-3		TC4+		TC1-3		TC4+
1	220.46		0		0.52		0
2	140.59	(28 - 964)	0		23.02	(0 - 157)	0
3							
4							

Miscellaneous*							
Quarter	4Xmnop				4Xqr		
	TC1-3		TC4+		TC1-3		TC4+
1	0		0		0		0
2	4.21		0		0.56		0
3							
4							

\* - Otter Trawl samples applied to longline and miscellaneous landings



Table 19. 4X Haddock catch numbers-at-age from projection and from actual catch-at-age.

Predicted catch (000s)					Actual catch (000s)				
age	1996	%	1997	%	age	1996	%	1997	%
1	0	0	0	0	1	0	0	0	0
2	66	1	70	1	2	35	1	0	0
3	784	15	201	3	3	725	19	35	2
4	1930	36	2422	33	4	892	23	526	35
5	1654	31	2767	38	5	625	16	309	21
6	393	7	1252	17	6	398	10	204	14
7	125	2	274	4	7	341	9	131	9
8	138	3	84	1	8	413	11	74	5
9	151	3	93	1	9	332	8	81	5
10	157	3	102	1	10	125	3	85	6
1+	5398	100	7266	100	11	15	0	28	2
					12	1	0	8	1
					13	2	0	0	0
					14	1	0	0	0
					15	1	0	0	0
					16	2	0	1	0
					1+	3907	100	1482	100

Table 20. Comparison of catch-at-age from this assessment and last year's assessment.

Catch-at-age from this assessment (CAA97)

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0	0	0	13	13	0	3	8	22	9	3	0	0
2	160	52	28	201	188	398	51	139	135	92	94	35	0
3	2013	1184	274	480	484	1412	1276	241	693	349	721	725	35
4	906	3286	1490	990	489	392	2326	2510	512	616	664	892	526
5	4886	2946	3848	872	920	358	575	2279	1801	322	600	625	309
6	1559	2774	2718	1926	305	472	244	228	1052	952	232	398	204
7	744	875	1331	855	711	391	308	246	168	263	438	341	131
8	378	337	352	879	454	653	199	330	105	24	412	413	74
9	228	132	74	366	497	276	309	236	72	17	159	332	81
10	124	115	131	205	251	204	279	239	45	13	24	125	85
1-10	10998	11703	10245	6786	4314	4556	5570	6456	4606	2657	3346	3886	1446

Catch-at-age from 1996 assessment (CAA96)

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0	0	0	8	9	0	0	0	8	0	17
2	198	290	149	79	128	271	11	32	39	37	59
3	1956	1170	729	149	231	840	635	52	434	231	488
4	2261	4378	2226	936	425	541	2013	2392	471	654	842
5	4516	3923	2962	1800	1325	560	953	3016	2009	170	762
6	1463	1476	2433	2292	661	1097	768	564	1282	993	460
7	464	246	1364	1035	1191	590	694	315	194	522	774
8	132	116	261	420	196	466	414	263	83	38	116
9	53	40	44	176	157	125	235	136	31	10	31
10	16	28	71	103	50	178	230	44	34	18	16
1-10	11059	11667	10240	6998	4372	4668	5953	6815	4583	2674	3566

Comparison (CAA96/CAA97)

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.00	0.00	0.00	0.62	0.69	0.00	0.00	0.00	0.36	0.00	5.67
2	1.24	5.58	5.32	0.39	0.68	0.68	0.22	0.23	0.29	0.40	0.63
3	0.97	0.99	2.66	0.31	0.48	0.59	0.50	0.22	0.63	0.66	0.68
4	2.50	1.33	1.49	0.95	0.87	1.38	0.87	0.95	0.92	1.06	1.27
5	0.92	1.33	0.77	2.06	1.44	1.56	1.66	1.32	1.12	0.53	1.27
6	0.94	0.53	0.90	1.19	2.17	2.32	3.15	2.47	1.22	1.04	1.98
7	0.62	0.28	1.02	1.21	1.68	1.51	2.25	1.28	1.15	1.98	1.77
8	0.35	0.34	0.74	0.48	0.43	0.71	2.08	0.80	0.79	1.58	0.28
9	0.23	0.30	0.59	0.48	0.32	0.45	0.76	0.58	0.43	0.59	0.19
10	0.13	0.24	0.54	0.50	0.20	0.87	0.82	0.18	0.76	1.38	0.67
1-10	1.01	1.00	1.00	1.03	1.01	1.02	1.07	1.06	1.00	1.01	1.07

Table 21. 4X haddock commercial weight-at-age (kg).

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.439			0.550	0.671			0.161		
2	0.848	0.810	0.666	1.159	0.790	0.796	0.872	0.773	0.906	0.414
3	1.085	1.085	1.073	1.104	1.026	0.972	1.139	1.074	1.011	0.743
4	1.179	1.232	1.431	1.440	1.232	1.129	1.312	1.369	1.217	1.165
5	1.469	1.350	1.809	1.833	1.572	1.392	1.483	1.597	1.396	1.436
6	1.522	1.511	1.740	2.016	1.956	1.734	1.793	1.730	1.598	1.576
7	1.683	1.690	2.001	2.088	1.887	2.132	2.080	1.976	1.614	1.760
8	1.794	1.672	2.050	2.234	1.963	2.098	2.493	2.013	1.860	1.773
9	2.031	1.815	2.108	2.240	2.158	2.365	2.101	2.355	2.136	2.014
10	2.256	1.882	2.351	2.228	2.167	2.242	2.775	2.286	2.042	2.146
11	2.373	2.256	2.316	2.274	2.100	2.377	2.204	2.584	2.750	2.493
12	2.570	2.379	2.613	2.339	1.968	2.148	2.381	2.305	3.373	1.986
13	2.329	2.490	2.373	2.327	2.660	2.521	2.899	2.623	3.027	4.424
14	3.302	2.713	3.126	2.654	2.919	2.887	4.510	2.902	3.271	4.793
15	3.767	3.135	3.204	3.421	3.218	4.777	4.308	3.095	3.490	
16	4.754	6.052	4.546	3.787	5.541	5.628	2.486	3.224	3.286	3.605

Table 22. 4X haddock mean numbers per standard tow by stratum in the 1970-97 summer RV surveys.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
470	3.94	0.58	5.68	5.13	0.41	4.20	0.70	273.93	5.75	38.25	3.28	6.09	0.00	36.34
471	0.00	0.00	2.47	0.00	0.00	0.55	0.00	0.44	0.46	0.55	2.92	2.86	4.89	3.89
472	13.72	37.80	15.86	12.56	28.86	49.18	35.25	14.92	10.53	32.55	248.91	192.03	141.20	39.75
473	89.87	9.98	82.22	51.92	53.90	11.50	113.46	170.97	26.39	81.26	31.42	10.60	135.88	34.22
474	55.73	25.61	28.96	39.50	75.43	97.01	76.85	26.00	103.58	303.43	27.18	119.46	135.37	58.27
475	78.14	53.88	21.97	57.63	105.68	27.13	137.04	36.58	81.00	77.82	71.20	46.08	48.50	53.94
476	0.00	84.58	12.38	0.00	41.53	39.53	1.31	1055.25	53.78	0.00	23.10	14.84	5.50	62.34
477	45.40	34.13	24.52	31.91	132.00	25.24	66.94	31.07	45.54	44.47	35.92	53.20	94.15	86.99
478	1.75	1.75	0.70	0.58	2.52	3.21	10.50	4.68	6.15	2.52	1.75	0.67	2.94	17.14
480	100.65	242.10	98.74	132.80	264.49	179.52	64.13	631.56	192.55	88.73	224.06	180.81	73.74	93.29
481	63.26	30.89	31.69	183.36	273.08	49.72	56.51	30.81	72.98	85.20	169.64	35.11	170.30	41.82
482	2.33	3.32	0.00	0.00	5.83	3.06	4.69	9.75	8.40	20.54	14.75	9.92	23.33	8.58
483	2.53	0.00	4.08	0.00	1.85	2.10	30.33	9.96	1.75	11.05	23.50	32.23	70.04	5.66
484	0.00	0.53	0.00	0.37	0.35	0.39	6.11	0.41	0.58	14.87	2.33	1.67	6.04	1.28
485	52.16	11.78	3.11	31.92	9.29	12.00	14.77	34.48	13.88	10.87	65.92	15.01	24.85	11.29
490	30.43	56.87	0.53	70.77	324.45	48.12	109.15	189.51	63.48	384.72	311.15	1479.70	485.53	234.97
491	4.16	0.00	11.39	3.92	21.05	3.01	2.58	21.30	11.52	5.21	15.37	15.48	30.46	32.01
495	16.80	13.56	9.33	4.00	20.19	1.73	4.87	33.92	48.00	31.46	6.75	8.68	38.59	14.84
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
470	12.58	0.97	41.18	6.61	6.46	3.19	1.54	0.00	0.97	0.49	0.00	2.11	5.68	16.49
471	0.46	0.00	0.51	2.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.01	0.00
472	49.03	73.40	73.09	28.21	34.73	47.23	17.47	19.11	7.89	7.32	14.77	42.50	74.95	30.98
473	60.70	189.10	174.07	80.29	12.01	12.32	41.51	92.36	5.83	0.46	47.42	210.78	352.79	101.04
474	0.00	134.50	52.61	3.15	1.54	1.80	31.11	6.32	6.69	8.26	8.16	8.15	41.32	107.22
475	254.51	100.85	159.04	14.13	13.90	22.10	54.47	22.48	16.04	8.75	125.37	164.81	175.06	46.38
476	8.75	369.87	22.39	25.03	9.10	9.21	5.30	8.51	11.67	2.83	14.82	51.60	52.17	72.14
477	150.81	92.13	120.41	43.99	59.48	42.02	24.37	38.58	39.23	12.84	56.47	248.00	86.51	60.13
478	16.73	20.42	9.48	25.39	11.32	0.00	13.83	0.00	4.88	3.40	14.39	5.30	22.14	5.90
480	172.05	117.45	97.60	52.78	84.96	175.59	251.54	316.69	200.96	71.76	173.09	274.90	226.30	341.80
481	70.77	18.68	168.47	31.93	25.72	29.26	18.03	40.43	25.32	41.43	41.01	145.58	102.30	71.88
482	20.90	1.46	2.06	31.63	22.73	18.19	39.56	20.86	1.50	7.29	19.23	18.65	138.92	25.17
483	33.42	14.58	13.00	11.48	20.59	1.54	36.84	41.78	4.03	3.83	0.50	3.54	1.96	17.23
484	4.12	2.94	0.69	0.00	1.37	0.97	0.97	0.00	0.00	0.70	0.65	3.03	5.17	2.91
485	26.44	80.44	35.57	2.97	9.68	1.86	13.13	87.06	20.51	8.40	1.69	78.02	94.92	4.35
490	773.65	160.56	31.56	44.66	128.41	129.52	174.02	79.27	104.55	18.53	412.74	541.72	336.00	267.88
491	29.26	16.34	3.09	1.03	0.26	0.00	0.67	1.30	3.56	4.80	22.25	63.99	9.09	44.53
495	3.09	5.22	0.00	0.00	0.98	0.00	18.05	0.00	0.00	0.00	4.93	55.27	16.99	48.84

Table 23. 4X haddock (Scotian Shelf strata 470-481) mean numbers-at-length per standard tow from 1970-97 summer RV surveys.

cm	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
4.5	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.22	0.01	0.00	0.00	0.00
6.5	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.19	0.03	0.24	0.27	0.20
8.5	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.02	0.00	0.41	0.01	0.74	0.21	0.29
10.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.00	0.12	0.00	0.00
12.5	0.05	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.10	0.00	0.00	0.12	0.43	0.08
14.5	0.12	0.02	0.20	0.03	0.14	0.00	0.00	0.00	0.66	0.06	2.45	3.87	3.24	0.75
16.5	0.31	0.03	0.94	0.20	0.35	0.38	0.35	0.43	2.24	0.30	5.16	12.87	7.94	3.90
18.5	1.67	0.00	2.58	1.91	2.57	1.71	2.13	1.66	3.62	1.04	8.10	6.71	7.71	4.39
20.5	4.35	0.09	3.76	4.46	8.62	3.65	3.73	2.74	3.12	1.29	12.54	1.18	8.78	1.15
22.5	2.49	0.15	1.44	4.49	5.68	3.08	1.42	3.20	1.15	0.31	7.47	0.13	7.66	1.17
24.5	1.23	0.76	0.61	1.79	1.29	1.94	0.75	2.42	0.22	0.90	2.56	0.78	8.42	1.18
26.5	0.05	3.90	0.20	3.85	1.48	0.98	0.74	1.53	0.11	2.39	0.63	0.69	6.21	1.12
28.5	0.60	6.36	0.02	9.20	5.53	1.06	1.39	3.43	0.92	4.21	0.98	1.58	4.16	1.45
30.5	0.92	5.54	0.05	12.90	14.07	1.45	1.86	5.44	1.76	3.47	1.66	2.08	2.46	2.42
32.5	1.95	2.59	0.17	4.72	12.90	1.65	1.81	12.22	1.97	2.74	1.62	1.18	1.60	4.23
34.5	2.96	0.90	0.60	2.62	7.62	1.01	1.30	18.30	2.13	2.16	1.68	0.61	1.25	4.50
36.5	1.32	0.83	1.27	0.50	8.54	1.44	1.47	17.02	1.74	0.90	3.23	0.57	0.90	3.25
38.5	0.98	1.18	1.32	0.25	9.07	0.79	1.11	24.30	2.50	0.61	5.15	0.37	2.01	1.80
40.5	1.18	1.71	1.30	0.21	9.03	2.72	0.69	25.35	4.05	0.87	3.52	0.56	2.22	1.45
42.5	1.14	1.75	0.98	0.20	5.81	3.87	1.32	28.16	5.85	1.70	2.43	2.41	1.26	1.75
44.5	0.92	1.95	0.46	0.66	2.56	2.05	1.06	30.32	2.74	2.09	2.43	3.09	0.96	1.23
46.5	1.21	1.84	0.65	0.58	1.58	2.30	2.19	17.89	1.64	3.09	2.31	3.37	1.60	1.40
48.5	1.39	2.06	0.68	1.35	0.57	3.08	2.58	16.82	1.76	3.50	2.27	3.55	1.52	1.27
50.5	1.57	1.79	0.99	1.11	1.24	2.11	3.12	11.86	1.65	2.84	4.75	2.14	2.79	2.51
52.5	1.19	3.42	1.23	1.05	1.23	1.51	3.31	5.63	1.66	2.69	4.43	1.56	1.60	1.82
54.5	1.05	2.84	1.17	1.02	1.86	0.74	1.35	10.45	1.56	1.77	5.39	2.45	1.65	1.92
56.5	1.34	3.33	0.99	0.61	1.41	0.91	1.05	7.25	1.59	1.83	4.21	1.72	1.43	1.15
58.5	0.89	2.06	1.15	0.66	1.63	0.63	0.63	6.55	2.24	1.48	3.42	1.96	0.62	1.09
60.5	0.67	1.47	0.70	0.68	0.78	0.59	0.68	1.61	0.92	1.59	2.26	0.99	0.41	0.73
62.5	0.54	0.74	0.81	0.49	0.78	0.56	0.42	1.73	0.75	1.01	1.64	0.99	0.36	0.39
64.5	0.55	0.33	0.40	0.29	0.77	1.24	0.21	0.78	0.31	0.54	1.50	0.42	0.18	0.44
66.5	0.26	0.31	0.18	0.35	0.62	0.12	0.22	2.25	0.15	0.40	0.75	0.28	0.16	0.28
68.5	0.21	0.23	0.09	0.12	0.16	0.42	0.16	0.28	0.09	0.14	0.72	0.09	0.01	0.06
70.5	0.07	0.05	0.02	0.03	0.01	0.05	0.01	0.06	0.03	0.06	0.41	0.05	0.07	0.08
72.5	0.02	0.19	0.02	0.00	0.00	0.18	0.03	0.13	0.00	0.01	0.09	0.03	0.00	0.00
74.5	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.06	0.00	0.00	0.00	0.07	0.00	0.02
76.5	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.02	0.07	0.00	0.00	0.00	0.00	0.00
78.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.02
80.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sum	33.23	48.43	24.94	56.32	107.91	42.24	37.20	259.92	49.33	46.92	95.79	59.54	80.09	49.49



Table 23 (continued).

cm	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.00
6.5	0.11	0.00	0.19	0.00	0.12	0.00	0.00	0.00	0.02	0.02	0.23	0.00	0.31	0.06
8.5	0.43	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.02	1.74	0.04	0.92	0.06
10.5	0.02	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	1.12	0.00	2.20	0.05
12.5	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.35	0.29	0.00
14.5	0.23	0.31	0.07	0.02	0.07	0.03	0.00	0.00	0.23	0.00	0.00	6.01	0.41	0.00
16.5	1.96	2.00	1.43	0.36	2.18	0.90	0.00	0.38	1.17	0.02	0.12	18.13	3.42	0.27
18.5	2.85	4.93	2.97	0.34	3.88	2.51	0.00	2.37	1.92	0.88	1.08	24.37	4.06	2.10
20.5	2.11	3.81	1.05	0.77	1.78	3.87	0.07	2.26	0.87	2.47	4.84	11.87	1.96	2.73
22.5	2.42	3.41	0.77	0.13	0.23	2.24	0.07	1.45	0.42	3.03	6.63	3.91	5.00	2.65
24.5	4.26	2.12	2.09	0.09	0.03	0.74	0.24	0.71	0.27	1.65	3.55	1.85	9.40	1.91
26.5	3.36	1.99	3.30	0.33	0.10	1.23	0.85	0.14	0.53	0.40	1.00	2.03	9.87	2.36
28.5	3.47	5.94	3.58	0.69	0.22	2.61	2.71	0.18	1.22	0.36	0.40	5.55	6.12	4.52
30.5	2.81	5.18	4.80	0.85	0.49	3.16	4.00	0.24	1.04	0.47	1.21	8.87	4.17	7.97
32.5	1.90	6.47	5.22	0.91	0.56	3.40	2.93	0.25	0.81	0.44	2.18	4.65	3.27	10.92
34.5	2.44	8.09	6.32	1.38	0.83	1.70	1.81	0.71	0.34	0.31	1.98	2.79	3.76	7.86
36.5	3.76	6.14	7.31	2.24	0.55	0.83	1.71	2.11	0.54	0.40	1.14	1.90	5.40	5.80
38.5	5.15	8.15	8.91	2.21	0.90	0.51	2.91	4.08	0.81	0.37	0.62	1.95	4.98	4.12
40.5	5.44	7.87	8.11	2.81	1.29	0.78	3.88	4.56	1.41	0.73	1.00	2.90	3.30	4.90
42.5	5.02	9.11	8.50	2.26	2.32	0.81	2.52	4.06	2.57	0.55	0.82	1.77	3.04	3.91
44.5	3.89	8.53	5.57	2.76	3.31	1.17	1.45	3.74	3.48	0.84	1.03	1.31	2.81	2.45
46.5	2.35	6.89	5.09	2.85	2.30	1.42	1.15	4.58	3.24	1.00	1.15	1.48	1.98	1.54
48.5	2.15	3.22	4.12	2.21	2.04	1.59	1.06	3.58	2.44	0.62	1.11	1.57	1.31	1.37
50.5	1.27	3.57	3.57	1.58	1.70	1.33	1.24	2.34	2.01	1.10	1.23	1.16	1.63	1.00
52.5	1.38	1.92	1.64	1.49	0.85	1.05	0.87	1.95	1.42	0.55	0.95	1.09	1.18	0.59
54.5	1.18	1.34	1.93	1.00	0.87	0.46	0.76	1.43	0.75	0.39	0.61	0.97	0.82	0.48
56.5	0.98	1.05	1.01	0.81	0.17	0.32	0.40	0.71	0.55	0.31	0.30	0.77	0.39	0.19
58.5	0.87	0.98	0.91	0.24	0.19	0.15	0.26	0.56	0.20	0.17	0.19	0.11	0.24	0.19
60.5	0.86	0.85	0.44	0.23	0.16	0.05	0.07	0.37	0.11	0.17	0.17	0.03	0.14	0.05
62.5	0.43	0.23	0.06	0.16	0.08	0.02	0.08	0.10	0.12	0.13	0.00	0.10	0.04	0.06
64.5	0.00	0.06	0.13	0.07	0.00	0.03	0.07	0.09	0.02	0.02	0.02	0.00	0.01	0.00
66.5	0.03	0.10	0.14	0.02	0.04	0.02	0.01	0.00	0.04	0.04	0.00	0.04	0.00	0.00
68.5	0.05	0.00	0.06	0.04	0.01	0.00	0.00	0.02	0.01	0.02	0.00	0.04	0.00	0.00
70.5	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72.5	0.01	0.00	0.06	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
74.5	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
76.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78.5	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sum	62.54	103.66	83.46	28.12	26.89	32.94	31.14	42.94	28.36	17.11	36.53	106.61	81.95	69.99

Table 24. 4X haddock (Bay of Fundy strata 482-491,495) mean numbers-at-length per standard tow from 1970-97 summer RV surveys.

cm	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
8.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
10.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
12.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.5	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.84	0.05	0.00
18.5	0.00	0.00	0.00	0.00	0.09	0.15	0.11	0.11	0.10	0.19	0.05	7.09	0.02	0.33
20.5	0.10	0.00	0.00	0.00	1.64	0.03	0.25	0.15	0.03	0.31	0.31	18.02	0.31	0.47
22.5	0.05	0.00	0.00	0.00	1.63	0.05	0.63	0.46	0.03	0.24	0.53	17.06	0.55	1.26
24.5	0.05	0.00	0.00	0.13	0.52	0.14	0.93	0.23	0.00	0.16	0.67	10.89	0.91	0.89
26.5	0.00	0.06	0.00	0.84	0.22	0.06	0.37	0.30	0.00	0.16	0.28	4.30	2.01	0.42
28.5	0.00	0.00	0.00	1.08	0.44	0.00	0.53	0.27	0.00	0.40	0.15	4.85	3.05	0.49
30.5	0.00	0.16	0.00	2.08	1.40	0.00	0.53	0.26	0.03	1.84	0.67	7.84	4.90	0.39
32.5	0.10	0.17	0.00	2.04	1.72	0.00	0.97	0.50	0.09	2.65	2.04	8.54	6.19	0.72
34.5	0.05	0.10	0.00	1.97	2.08	0.35	0.85	0.98	0.34	4.61	2.66	11.25	4.95	1.53
36.5	0.15	0.15	0.00	0.44	1.83	0.47	1.29	1.63	0.62	3.13	3.19	10.12	3.90	1.71
38.5	0.00	0.21	0.00	0.06	2.60	0.35	0.69	2.41	0.72	2.20	2.36	9.42	2.84	1.93
40.5	0.19	0.22	0.13	0.15	5.38	0.25	0.15	2.11	0.87	2.37	2.81	4.47	2.94	1.98
42.5	0.32	0.68	0.04	0.00	5.02	0.19	0.37	1.91	0.81	1.83	3.91	1.88	2.81	2.23
44.5	0.44	0.71	0.12	0.06	3.18	0.51	1.07	1.99	0.89	3.34	3.72	1.21	3.24	2.22
46.5	1.13	0.29	0.04	0.00	2.10	0.59	0.89	1.72	1.18	2.74	2.88	1.65	2.07	2.07
48.5	1.59	0.82	0.06	0.17	0.78	0.90	0.68	1.72	0.98	2.45	2.47	2.20	3.18	1.49
50.5	2.18	0.63	0.04	0.52	0.35	1.04	1.47	1.67	1.71	2.38	2.78	1.64	2.90	1.60
52.5	2.18	0.62	0.25	0.81	0.05	0.33	0.97	1.34	1.38	1.01	2.91	1.16	2.22	0.92
54.5	2.51	0.47	0.22	0.37	0.33	0.77	1.04	2.10	1.29	2.26	2.27	0.48	2.60	0.93
56.5	1.59	0.62	0.20	0.40	0.00	0.06	1.37	2.01	1.13	1.84	2.80	1.01	2.01	0.91
58.5	0.60	0.90	0.21	0.81	0.27	0.00	0.78	1.42	0.75	2.20	1.83	0.67	2.40	0.82
60.5	0.72	0.68	0.46	0.46	0.35	0.39	0.32	1.19	0.71	1.74	1.54	0.57	1.56	0.76
62.5	0.67	0.90	0.34	0.70	0.38	0.10	0.45	1.44	0.32	1.04	1.51	1.79	1.24	0.66
64.5	0.59	0.35	0.27	0.34	0.36	0.39	0.17	0.76	0.19	1.46	0.87	0.65	1.30	0.33
66.5	0.37	0.00	0.19	0.06	0.10	0.00	0.18	0.34	0.10	1.19	0.56	0.64	0.96	0.34
68.5	0.32	0.09	0.04	0.03	0.31	0.34	0.17	0.43	0.10	0.52	0.27	0.39	0.27	0.26
70.5	0.12	0.05	0.08	0.03	0.03	0.20	0.28	0.34	0.14	0.40	0.19	0.37	0.14	0.04
72.5	0.04	0.00	0.09	0.00	0.10	0.04	0.02	0.05	0.04	0.49	0.00	0.17	0.08	0.00
74.5	0.00	0.04	0.00	0.00	0.09	0.00	0.00	0.06	0.12	0.05	0.04	0.24	0.04	0.07
76.5	0.00	0.04	0.00	0.00	0.05	0.00	0.06	0.03	0.00	0.10	0.00	0.25	0.00	0.00
78.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.05	0.06	0.00	0.05	0.00
80.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
84.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sum	16.08	8.97	2.84	13.56	33.43	7.70	17.62	30.07	14.68	45.36	46.47	131.66	61.71	28.04

Table 24. (continued).

cm	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
6.5	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.67	0.24	0.06	0.00
8.5	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.03	0.00	1.45	0.02	0.25	0.10
10.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.70	0.00
12.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
14.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00
16.5	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	2.31	0.00	0.05
18.5	0.00	0.00	0.00	0.00	0.08	0.19	0.00	0.02	0.09	0.02	0.23	8.03	0.02	0.62
20.5	0.42	0.10	0.03	0.04	0.53	0.40	0.00	0.06	0.15	0.06	0.21	6.92	0.02	2.43
22.5	1.97	0.34	0.06	0.23	0.99	0.32	0.00	0.21	0.33	0.18	5.05	4.30	0.16	4.56
24.5	4.33	0.30	0.03	0.28	1.70	0.40	0.00	0.25	0.27	0.00	11.32	1.05	0.81	4.59
26.5	2.94	0.33	0.04	0.21	1.63	0.09	0.00	0.08	0.06	0.00	7.66	0.30	1.64	1.67
28.5	3.09	0.08	0.03	0.11	1.02	0.27	0.02	0.02	0.03	0.00	2.18	0.88	4.04	0.31
30.5	7.70	0.17	0.00	0.04	0.59	0.54	0.23	0.00	0.00	0.00	0.75	3.10	4.35	0.76
32.5	13.23	1.25	0.07	0.09	0.53	0.72	0.62	0.02	0.21	0.06	0.52	5.23	3.10	1.14
34.5	11.04	1.41	0.29	0.10	0.21	1.05	2.10	0.02	0.12	0.04	1.04	7.12	1.86	1.53
36.5	4.52	2.63	0.28	0.35	0.38	1.67	3.25	0.10	0.36	0.06	1.56	6.68	2.21	2.35
38.5	3.09	2.98	0.45	0.87	0.60	1.65	2.11	0.26	0.07	0.14	1.37	4.16	3.85	2.24
40.5	2.28	4.65	0.48	0.68	0.67	1.27	1.38	0.63	0.09	0.23	0.50	3.09	5.35	2.10
42.5	2.79	3.18	0.65	0.37	0.55	0.54	1.29	0.98	0.00	0.35	0.20	3.42	5.92	1.65
44.5	3.60	3.91	1.67	0.58	0.47	0.18	1.60	1.48	0.34	0.37	0.30	3.31	4.57	1.85
46.5	3.05	2.99	0.96	0.34	0.48	0.28	1.29	3.88	0.30	0.15	0.34	4.40	3.20	2.03
48.5	2.84	1.67	1.36	0.31	0.32	0.78	0.85	3.21	0.36	0.30	0.40	2.02	3.66	1.34
50.5	2.57	1.35	1.27	1.06	0.92	0.18	1.73	3.62	0.55	0.35	0.53	1.99	4.47	1.17
52.5	1.68	0.93	1.04	1.05	0.90	0.67	1.29	3.18	1.65	0.31	0.45	1.92	4.36	0.91
54.5	1.38	0.90	1.14	0.99	1.30	0.71	1.62	4.29	1.87	0.38	0.36	1.04	3.94	0.93
56.5	1.62	1.12	0.43	0.85	1.04	0.62	1.63	3.07	2.33	0.93	0.45	1.18	3.71	0.65
58.5	1.69	0.55	0.64	0.78	0.59	0.67	1.20	2.01	1.27	0.57	0.14	1.09	3.59	0.72
60.5	0.75	1.03	0.29	0.20	0.71	0.36	0.93	1.32	0.97	0.30	0.40	0.55	2.36	0.45
62.5	0.54	0.79	0.18	0.11	0.37	0.38	1.40	1.17	0.98	0.10	0.25	0.48	1.63	0.24
64.5	0.58	0.89	0.09	0.04	0.41	0.05	0.86	0.44	0.80	0.23	0.39	0.26	0.80	0.12
66.5	0.77	0.59	0.35	0.11	0.29	0.04	0.85	0.55	0.24	0.17	0.32	0.26	0.78	0.10
68.5	0.27	0.11	0.07	0.00	0.28	0.05	0.24	0.33	0.34	0.04	0.20	0.15	0.27	0.08
70.5	0.22	0.33	0.03	0.00	0.14	0.02	0.20	0.22	0.04	0.00	0.19	0.18	0.16	0.07
72.5	0.23	0.25	0.06	0.00	0.06	0.00	0.07	0.14	0.03	0.00	0.14	0.00	0.00	0.07
74.5	0.00	0.00	0.04	0.00	0.12	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.05
76.5	0.00	0.00	0.00	0.00	0.04	0.00	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00
78.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
84.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sum	79.19	34.81	12.07	9.78	17.96	14.09	27.34	31.56	13.91	5.34	39.85	75.90	71.95	36.88

Table 25. 4X haddock mean numbers-at-age per standard tow from the 1970-97 summer RV survey (with vessel conversion 1970-81).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.91	0.05	1.09	0.27	0.67
1	5.85	0.12	5.28	6.50	11.58	6.77	5.59	6.42	6.22	2.07	22.28	37.02	13.13	6.86
2	4.68	11.32	0.23	22.97	23.10	3.46	5.72	40.46	5.32	13.93	7.09	27.88	28.17	4.54
3	1.38	4.91	3.34	0.73	32.10	5.25	3.93	63.39	11.89	8.12	15.56	7.50	13.03	14.41
4	2.60	2.11	1.47	3.15	0.97	7.67	4.13	17.86	3.95	10.18	8.03	9.02	4.66	6.19
5	1.05	2.89	0.88	1.50	4.14	0.41	7.10	17.17	1.71	4.97	12.25	3.41	7.45	3.50
6	2.40	1.37	0.98	0.54	0.94	1.75	0.65	9.54	3.27	1.87	4.78	3.72	2.54	2.30
7	5.98	2.06	0.64	0.71	0.55	0.46	0.79	1.28	1.28	3.06	1.74	1.29	2.14	0.95
8	0.91	5.32	0.99	0.49	0.64	0.35	0.15	1.54	0.00	1.04	1.29	0.18	0.31	0.29
9	0.35	0.69	1.30	0.30	0.36	0.14	0.05	0.16	0.00	0.22	0.63	0.35	0.19	0.27
10	0.35	0.09	0.04	0.51	0.26	0.11	0.02	0.16	0.00	0.09	0.26	0.20	0.06	0.15
11	0.08	0.04	0.01	0.02	0.39	0.34	0.01	0.02	0.05	0.00	0.04	0.09	0.02	0.09
12	0.02	0.08	0.01	0.00	0.00	0.28	0.16	0.13	0.05	0.00	0.00	0.04	0.00	0.06
13	0.00	0.00	0.00	0.01	0.00	0.00	0.09	0.08	0.02	0.00	0.00	0.00	0.00	0.02
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.05	0.04	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
unknown	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.01	0.21	0.06	0.05	0.06	0.12	0.05
total	25.66	31.01	15.18	37.45	75.04	27.00	28.56	158.46	34.03	46.23	74.02	91.37	71.98	40.02

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	0.55	0.00	0.22	0.00	0.12	0.01	0.44	0.00	0.00	0.00	5.62	0.31	2.55	0.26
1	4.20	7.04	3.87	1.35	7.20	6.05	0.08	4.33	3.11	4.68	21.45	46.93	5.16	10.14
2	22.13	9.41	9.59	1.55	2.10	9.88	10.74	1.45	2.52	1.07	5.90	24.82	26.76	5.94
3	13.63	23.30	7.40	2.74	1.03	1.98	9.66	12.83	0.99	1.77	2.05	11.60	19.48	20.82
4	18.08	10.66	14.05	3.46	2.14	0.93	1.78	11.48	7.60	0.67	1.92	4.23	9.73	11.78
5	5.83	14.87	5.79	3.87	2.93	1.86	1.44	2.40	5.41	1.93	0.37	1.87	5.05	3.62
6	3.11	3.80	6.25	2.86	3.09	0.79	1.60	1.35	0.91	1.17	1.85	0.80	2.14	1.56
7	1.38	1.93	2.25	1.96	1.49	1.65	1.45	1.19	0.39	0.19	1.14	1.53	2.01	0.57
8	0.58	1.14	1.17	0.83	1.09	0.59	1.22	1.01	0.39	0.14	0.15	0.42	2.81	0.19
9	0.41	0.66	0.68	0.24	0.71	0.49	0.51	0.76	0.30	0.06	0.05	0.10	0.75	0.32
10	0.09	0.24	0.36	0.31	0.40	0.14	0.41	0.91	0.21	0.05	0.09	0.00	0.65	0.20
11	0.03	0.07	0.06	0.06	0.13	0.10	0.20	0.09	0.04	0.10	0.01	0.00	0.14	0.02
12	0.03	0.03	0.13	0.00	0.02	0.09	0.09	0.09	0.02	0.02	0.06	0.02	0.17	0.01
13	0.04	0.03	0.09	0.00	0.00	0.00	0.06	0.02	0.00	0.03	0.11	0.00	0.12	0.00
14	0.00	0.04	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
unknown	0.03	0.03	0.13	0.80	0.54	0.06	0.02	0.00	0.11	0.03	0.00	0.02	0.00	0.04
total	69.89	73.27	51.95	20.02	22.95	24.62	29.46	37.92	21.98	11.91	38.00	92.50	77.53	55.37

Table 26. Mean length-at-age (cm) for the scotian shelf component (strata 470-481) of the 4X haddock stock.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1970		20.96	33.80	40.99	45.04	49.74	52.43	56.42	60.49	62.19	67.34	67.98	60.50					
1971		20.64	29.19	40.69	46.38	51.05	52.76	54.68	57.63	62.90	69.52	69.44	71.97					
1972		19.95	26.92	38.96	48.23	52.62	55.75	56.09	59.66	62.16	64.44	68.50	76.50					
1973		21.25	29.88	34.85	48.39	53.37	58.82	59.16	60.62	61.76	63.84	67.65						
1974		20.84	30.94	38.84	44.27	53.84	58.16	61.34	62.42	63.06	62.22	66.46						
1975		21.92	31.51	40.64	47.80	54.15	58.19	63.63	64.69	65.60	69.66	68.37	67.10					
1976		20.54	31.10	38.35	47.93	51.64	57.38	61.62	60.50				64.50	66.50				
1977	8.50	21.67	34.66	42.19	47.61	53.38	55.80	63.00	64.92	69.90	64.50		66.98	70.50	66.40			
1978		18.96	33.01	41.76	48.59	53.62	57.35	60.67				62.50						
1979	7.30	19.51	29.58	36.41	47.20	52.27	58.19	60.74	62.14	69.25						68.50		
1980	6.50	19.84	31.68	38.99	47.85	53.42	57.10	61.36	62.93	66.45	67.49	70.50						
1981	8.29	16.93	29.69	40.78	46.86	53.28	57.55	60.06	64.72	66.11	67.96	70.50						
1982	6.50	17.72	24.11	35.99	45.69	50.46	55.74	58.99	63.02	68.09		66.50						
1983	7.69	17.64	25.47	34.32	44.55	52.06	55.30	60.18	61.15	62.97	63.17	61.39	73.82	70.50				
1984	8.18	17.81	24.48	31.97	40.15	47.38	54.24	57.09	59.40	61.79								
1985		19.12	28.65	33.67	40.57	44.51	48.73	53.86	56.18	57.12	60.86				66.50			
1986	6.50	19.42	29.77	36.33	38.73	44.62	47.47	50.34	54.18	57.87	58.44	64.82	67.02	60.50				
1987		19.27	29.62	36.66	40.86	43.63	46.96	50.31	51.70	54.19	56.22	58.50						
1988	6.50	18.50	31.88	38.88	42.05	45.84	45.86	47.99	50.24	51.33	51.35	59.16	62.50					
1989	10.50	20.27	30.77	40.27	41.90	47.10	50.18	49.61	50.47	51.61	54.69	55.48	50.90		66.50			
1990		21.53	30.60	39.78	44.67	49.67	50.44	50.12	51.92	54.35	49.48	58.03	54.04		66.50			
1991		20.49	34.47	40.31	46.54	49.90	54.95	54.72	54.55	52.31	49.91	63.26	58.37		68.50			64.50
1992		18.93	30.12	39.41	45.13	48.93	54.37	56.02	53.15	52.46	62.35	58.50	62.50	68.50				
1993		22.11	31.61	39.62	45.87	49.29	53.61	54.55	54.38	51.03	58.03	53.61	56.50	56.37	74.50			
1994	9.08	22.32	32.90	39.28	45.45	48.09	49.54	51.86	55.45	53.29	54.50	58.50	51.48	52.01				
1995	8.50	18.24	30.29	39.23	45.85	49.36	50.86	53.18	56.27	60.34			54.50					
1996	9.76	17.82	26.33	36.37	42.73	45.67	50.56	52.38	52.77	56.08	49.89	58.50	59.55	52.50				
1997	8.32	20.76	27.69	32.69	39.72	45.29	46.60	50.38	54.24	53.96	53.97	60.35	62.50					
Mean	8.01	19.82	30.03	38.15	44.88	49.79	53.39	56.08	57.77	59.54	59.99	63.11	62.29	62.17	68.15	68.50		64.50

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Table 27. Mean length-at-age (cm) for the Bay of Fundy component (strata 482-491, 495) of the 4X haddock stock.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1970		22.00	34.83	41.52	47.06	50.01	51.47	55.68	59.10	58.64	63.06	68.50						
1971			32.89	44.52	49.40	51.72	54.65	56.05	60.63	61.02	74.50		60.50					
1972		16.50		43.12	52.04	53.58	57.09	59.32	61.67	63.65	70.50							
1973		24.50	31.50	39.23	52.27	57.84	61.70	60.16	60.42	63.92	62.45			70.50				
1974		22.00	32.23	41.83	47.95	59.27	63.89	61.11	64.25	62.84	66.54	69.55						
1975		22.20	37.01	46.01	50.57	54.50	64.43				64.50	64.54	66.80					
1976		23.28	33.35	43.62	50.05	55.06	62.50	68.33	66.50	67.61	66.50	72.50	67.70	72.28				
1977		23.68	38.20	46.35	52.25	57.41	60.61	67.19	66.87	69.58	65.75	66.50		73.42	75.72			
1978		19.63	37.79	46.56	52.95	56.69	59.05	63.07					68.50	72.50	74.50	62.50		
1979		21.34	34.56	44.01	52.48	58.81	61.62	64.20	66.13	72.68	68.22				72.50	72.50		
1980		22.84	34.59	42.88	51.21	57.27	63.18	63.36	65.51	71.38								
1981		21.62	33.17	41.18	49.85	59.01	62.49	66.01	62.50	69.58	74.57	72.50	74.50					
1982		22.12	31.72	41.08	49.74	55.05	59.33	62.88	66.46	67.76	74.83							
1983		21.68	31.97	41.95	48.98	54.50	59.95	62.96	66.95	67.93								
1984		24.09	31.40	35.95	45.83	51.70	57.36	61.53	62.81	66.58	69.40	70.50	72.50	66.50				
1985		24.10	35.52	42.55	46.99	52.32	61.85	64.40	62.25	63.69	67.13	62.69	66.50	66.50	70.50			
1986	6.50	23.70	36.80	44.68	49.19	54.06	56.46	55.30	56.50	64.07	59.95		64.06	62.50				
1987		25.24	37.93	46.25	51.47	54.59	60.50	59.49	57.06	64.04		66.50						
1988		24.93	37.07	47.12	50.97	54.77	56.85	64.41	58.23	67.37	62.13							
1989		21.85	35.53	41.18	49.67	52.55	55.95	57.45	53.91	62.50	62.50	61.89						
1990	8.50		36.95	46.19	53.60	55.55	58.62	59.93	63.87	65.02	63.75	65.54	62.50	67.98				
1991		23.93	43.87	46.98	53.71	54.52	61.49	62.25	63.99	65.38	58.11	70.50	70.50	70.50				
1992		22.36	35.05	34.50	52.76	58.66	57.75	61.70	58.50	67.56	59.40		72.50					
1993		21.71	38.24	45.62	51.85	55.94	59.41	61.93	60.50			66.35						
1994	8.10	25.02	36.17	46.17	53.29		61.31	64.71	67.71					70.50				
1995	6.69	20.02	34.91	45.11	51.37	57.90	59.97	61.45	62.78	70.50								
1996	8.09	21.15	30.09	41.89	52.01	56.59	58.11	60.19	61.40	64.60	67.19	58.50						
1997	8.50	23.04	30.73	38.57	46.12	53.84	58.62	59.99	71.81	71.83							58.50	
Mean	7.73	23.09	36.07	43.60	51.00	55.11	58.99	61.02	61.42	66.05	62.52	65.56	65.89	67.60	70.50		58.50	

Table 28. 4X haddock RV survey mean weight-at-age (kg).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.079	0.083	0.077	0.098	0.091	0.101	0.088	0.103	0.064	0.077	0.083	0.072	0.056	0.053
2	0.380	0.246	0.197	0.285	0.306	0.345	0.320	0.448	0.402	0.334	0.390	0.347	0.196	0.195
3	0.717	0.731	0.639	0.473	0.654	0.731	0.636	0.807	0.855	0.708	0.723	0.713	0.608	0.484
4	1.020	1.058	1.269	1.304	0.952	1.209	1.158	1.192	1.399	1.292	1.279	1.132	1.201	0.981
5	1.359	1.386	1.625	1.782	1.719	1.733	1.517	1.707	1.855	1.691	1.767	1.753	1.569	1.475
6	1.563	1.558	1.963	2.300	2.262	2.251	2.034	1.976	2.192	2.274	2.117	2.241	2.066	1.826
7	1.990	1.723	2.009	2.294	2.508	2.875	2.580	2.826	2.657	2.628	2.500	2.679	2.494	2.346
8	2.453	2.088	2.467	2.428	2.670	3.028	2.419	3.066	3.142	2.873	2.717	2.915	3.054	2.653
9	2.572	2.576	2.810	2.626	2.731	3.165	3.261	3.797	4.203	4.094	3.263	3.425	3.434	2.841
10	3.281	3.763	3.485	2.765	2.805	3.480	3.099	3.087	3.492	3.502	3.325	4.287	4.635	1.103

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.082	0.072	0.066	0.093	0.086	0.083	0.108	0.086	0.076	0.104	0.133	0.061	0.054	0.108
2	0.238	0.279	0.260	0.335	0.418	0.332	0.394	0.547	0.304	0.342	0.396	0.336	0.196	0.223
3	0.402	0.484	0.539	0.544	0.670	0.695	0.782	0.790	0.629	0.723	0.739	0.766	0.598	0.393
4	0.748	0.696	0.644	0.897	0.951	0.847	1.260	1.271	1.076	1.051	1.135	1.128	1.133	0.720
5	1.205	0.959	0.946	1.071	1.289	1.229	1.692	1.448	1.556	1.360	1.124	1.421	1.356	1.106
6	1.804	1.314	1.141	1.102	1.247	1.476	1.772	2.060	1.859	1.753	1.455	1.535	1.629	1.239
7	2.124	1.957	1.362	1.367	1.471	1.472	2.035	2.069	2.077	1.897	1.793	1.729	1.804	1.564
8	2.391	1.905	1.667	1.556	1.511	1.486	2.084	2.015	1.626	1.821	2.252	2.112	1.874	1.966
9	2.962	1.952	2.263	1.899	1.751	1.535	2.323	1.806	1.751	1.325	1.535	2.805	2.431	1.821
10	3.559	2.528	2.163	1.882	1.738	1.841	1.558	1.616	2.219	1.958	1.643	2.689	2.195	1.591

Table 29. 4X haddock length-weight relationship from the summer RV survey strata 470-491, 495 and predicted weight at lengths of 35 and 50 cm.

YEAR	OBS	ALPHA	BETA	CORR		35	50
1970	1355	3.55E-06	3.288536	0.994303		0.424	1.371
1971	1014	6.83E-06	3.106394	0.992718		0.428	1.295
1972	979	6.26E-06	3.145178	0.995261		0.450	1.382
1973	855	8.28E-06	3.067603	0.995938		0.451	1.348
1974	1458	7.28E-06	3.097837	0.994435		0.442	1.334
1975	723	6.05E-06	3.147423	0.993870		0.438	1.346
1976	1192	7.20E-06	3.090724	0.993807		0.426	1.284
1977	1131	7.19E-06	3.104179	0.994474		0.447	1.351
1978	1048	5.65E-06	3.174272	0.993745		0.450	1.397
1979	1175	7.27E-06	3.098744	0.993896		0.443	1.337
1980	1089	9.57E-06	3.029040	0.993877		0.455	1.341
1981	738	5.90E-06	3.149542	0.994067		0.431	1.325
1982	859	7.66E-06	3.085153	0.994444		0.445	1.336
1983	837	5.21E-06	3.167803	0.992509		0.405	1.255
1984	882	7.04E-06	3.097570	0.993478		0.427	1.289
1985	836	8.84E-06	3.033299	0.992374		0.427	1.259
1986	762	5.66E-06	3.153722	0.991519		0.419	1.290
1987	663	8.80E-06	3.045925	0.988703		0.444	1.316
1988	645	6.44E-06	3.129167	0.994064		0.437	1.335
1989	626	7.67E-06	3.079300	0.993717		0.436	1.307
1990	821	1.08E-05	3.000986	0.991222		0.465	1.355
1991	812	7.68E-06	3.075023	0.994843		0.430	1.287
1992	633	1.12E-05	2.979470	0.995656		0.447	1.294
1993	540	8.61E-06	3.037356	0.995971		0.422	1.246
1994	957	8.72E-06	3.038004	0.997744		0.428	1.264
1995	1179	8.54E-06	3.036685	0.997278		0.417	1.232
1996	1200	8.46E-06	3.039866	0.996869		0.418	1.237
1997	1062	9.68E-06	3.011167	0.995643		0.432	1.264
mean						0.435	1.310



Table 30. Mean number of haddock per tow by stratum from the RV Survey July 4 - 15, 1996 and ITQ Survey, July 8 - 18, 1996.

Stratum	RV Survey			ITQ Survey		
	Sets	Mean	St. Dev	Sets	Mean	St. Dev.
470	2	5.68	1.44	5	2.33	1.56
471	1	1.01		3	0.00	0.00
472	3	74.95	33.62	12	109.35	164.88
473	2	352.79	369.34	2	225.94	65.08
474	2	41.32	1.51	2	155.56	67.73
475	2	175.06	220.53	1	51.86	
476	4	52.17	66.48	18	98.49	165.06
477	5	86.51	91.57	11	170.00	80.27
478	3	22.14	24.92	1	15.87	
480	8	226.30	110.47	8	427.40	394.79
481	9	102.30	129.46	20	112.18	113.91
482	3	138.92	188.39	5	8.19	6.52
483	2	1.96	2.77			
484	3	5.17	3.10	11	10.67	14.94
485	3	94.92	153.04	18	87.50	121.23
490	4	336.00	234.03	10	138.63	123.24
491	3	9.09	6.49	5	41.72	33.24
492				8	96.29	88.59
493				5	27.25	54.51
494				4	6.26	6.26
495	2	16.99	19.64	7	74.69	62.46
<b>Inshore</b>				21	142.53	135.56

Table 31. Mean weight (kg) of haddock per tow by stratum from the RV Survey July 4 - 15, 1996 and ITQ Survey, July 8 - 18, 1996.

Stratum	RV Survey			ITQ Survey		
	Sets	Mean	St. Dev	Sets	Mean	St. Dev.
470	2	0.77	1.00	5	1.06	0.67
471	1	0.70		3	0.00	
472	3	11.64	3.84	12	45.42	64.52
473	2	173.31	181.34	2	142.34	33.34
474	2	33.25	14.86	2	130.17	68.79
475	2	95.00	126.63	1	35.98	
476	4	17.81	23.40	18	29.28	45.09
477	5	25.01	25.07	11	42.91	21.83
478	3	18.10	21.74	1	10.58	
480	8	139.17	71.51	8	187.40	122.12
481	9	31.80	35.88	20	44.44	41.11
482	3	250.24	378.34	5	7.53	6.80
483	2	4.48	6.34			
484	3	7.53	7.30	11	13.83	18.35
485	3	98.15	162.57	18	53.45	53.88
490	4	202.34	144.88	10	89.27	59.48
491	3	11.16	8.33	5	58.12	47.42
492				8	93.34	79.86
493				5	28.37	56.73
494				4	4.17	4.29
495	2	15.09	16.48	7	69.13	60.98
<b>Inshore</b>				21	60.18	59.58

Table 32. Mean number of haddock per tow by stratum from the RV Survey July 2 - 16, 1997 and ITQ Survey, June 30 - July 9, 1997.

Stratum	RV Survey			ITQ Survey		
	Sets	Mean	St. Dev	Sets	Mean	St. Dev.
470	2	16.49	3.82	5	1.06	0.75
471	2	0.00	0.00	4	0.00	0.00
472	4	30.98	12.21	12	41.54	43.32
473	2	101.04	2.52	2	358.75	448.98
474	2	107.22	0.28	2	370.92	457.21
475	2	46.38	5.31	2	158.21	123.47
476	4	72.14	36.33	15	50.09	128.99
477	5	60.13	18.31	11	107.27	47.25
478	2	5.90	8.34	1	31.75	
480	8	341.80	50.92	7	392.29	370.31
481	9	71.88	9.22	20	86.35	99.60
482	3	25.17	10.37	6	5.87	9.14
483	2	17.23	24.37			
484	3	2.91	1.74	11	3.74	4.63
485	3	4.35	2.55	16	108.39	250.51
490	4	267.88	109.08	10	333.36	287.89
491	3	44.53	20.15	5	31.46	26.21
492				9	124.34	250.46
493				5	16.56	35.49
494				4	14.14	16.57
495	2	48.84	13.89	7	26.22	22.39
Inshore				22	99.59	134.11

Table 33. Mean weight (kg) of haddock per tow by stratum from the RV Survey July 2 - 16, 1997 and ITQ Survey, June 30 - July 9, 1997.

Stratum	RV Survey			ITQ Survey		
	Sets	Mean	St. Dev	Sets	Mean	St. Dev.
470	2	9.43	1.47	5	0.85	0.47
471	2	0.00	0.00	4	0.00	0.00
472	4	9.65	3.00	12	18.96	20.53
473	2	60.18	12.35	2	217.47	270.14
474	2	96.00	0.37	2	352.93	448.23
475	2	29.93	4.49	2	48.68	13.47
476	4	36.33	18.42	15	16.09	38.89
477	5	23.63	5.69	11	34.83	17.37
478	2	5.31	7.51	1	21.17	
480	8	154.02	19.72	7	155.62	170.77
481	9	32.58	3.94	20	34.56	40.20
482	3	26.59	11.99	6	4.74	7.42
483	2	37.51	53.05			
484	3	4.50	3.02	11	5.98	8.03
485	3	5.44	3.50	16	71.41	131.33
490	4	90.16	24.86	10	195.79	152.43
491	3	46.97	16.53	5	39.74	29.49
492				9	146.72	282.75
493				5	21.80	47.21
494				4	16.56	19.15
495	2	46.03	13.48	7	27.79	19.76
<b>Inshore</b>				22	59.64	117.04

Table 34. SPA Input Data

## a. Catch Numbers-at-Age

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0	0	41	150	1	37	18	2	0	0	16	1	0	0
2	1055	788	22	3077	694	2175	1296	1285	75	81	161	1182	491	64
3	724	1617	3434	113	4653	4568	1644	3126	3354	1158	2445	2215	3639	3294
4	1502	788	1841	2247	309	5164	4261	2019	7014	6709	3008	6219	2474	5476
5	379	1422	509	1067	1779	485	3682	3193	2094	3881	5413	4199	4628	3733
6	524	404	645	527	509	1103	434	2881	2832	1070	3499	3195	1703	2232
7	4536	69	90	600	189	247	807	360	1040	1244	527	1163	1457	940
8	1863	3316	57	322	269	172	154	389	137	263	623	357	340	395
9	133	1020	1166	259	186	62	71	107	107	57	169	323	183	187
10	96	163	512	614	269	32	95	72	26	68	34	97	94	119
1-10	10812	9587	8317	8976	8858	14045	12462	13434	16679	14531	15895	18951	15009	16440

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	2	0	0	0	13	13	0	3	8	22	9	3	0	0
2	708	160	52	28	201	188	398	51	139	135	92	94	35	0
3	1108	2013	1184	274	480	484	1412	1276	241	693	349	721	725	35
4	4680	906	3286	1490	990	489	392	2326	2510	512	616	664	892	526
5	3439	4886	2946	3848	872	920	358	575	2279	1801	322	600	625	309
6	2396	1559	2774	2718	1926	305	472	244	228	1052	952	232	398	204
7	948	744	875	1331	855	711	391	308	246	168	263	438	341	131
8	340	378	337	352	879	454	653	199	330	105	24	412	413	74
9	110	228	132	74	366	497	276	309	236	72	17	159	332	81
10	77	124	115	131	205	251	204	279	239	45	13	24	125	85
1-10	13808	10998	11703	10245	6786	4314	4556	5570	6456	4606	2657	3346	3886	1446

## B. RV Mean Numbers-at-Age per Tow

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	5.85	0.12	5.28	6.50	11.58	6.77	5.59	6.42	6.22	2.07	22.28	37.02	13.13	6.86
2	4.68	11.32	0.23	22.97	23.10	3.46	5.72	40.46	5.32	13.93	7.09	27.88	28.17	4.54
3	1.38	4.91	3.34	0.73	32.10	5.25	3.93	63.39	11.89	8.12	15.56	7.50	13.03	14.41
4	2.60	2.11	1.47	3.15	0.97	7.67	4.13	17.86	3.95	10.18	8.03	9.02	4.66	6.19
5	1.05	2.89	0.88	1.50	4.14	0.41	7.10	17.17	1.71	4.97	12.25	3.41	7.45	3.50
6	2.40	1.37	0.98	0.54	0.94	1.75	0.65	9.54	3.27	1.87	4.78	3.72	2.54	2.30
7	5.98	2.06	0.64	0.71	0.55	0.46	0.79	1.28	1.28	3.06	1.74	1.29	2.14	0.95
8	0.91	5.32	0.99	0.49	0.64	0.35	0.15	1.54	0.00	1.04	1.29	0.18	0.31	0.29
9	0.35	0.69	1.30	0.30	0.36	0.14	0.05	0.16	0.00	0.22	0.63	0.35	0.19	0.27
10	0.35	0.09	0.04	0.51	0.26	0.11	0.02	0.16	0.00	0.09	0.26	0.20	0.06	0.15
1-10	25.55	30.88	15.15	37.40	74.64	26.37	28.13	157.98	33.64	45.55	73.91	90.57	71.68	39.46

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	4.20	7.04	3.87	1.35	7.20	6.05	0.08	4.33	3.11	4.68	21.45	46.93	5.09	10.14
2	22.13	9.41	9.59	1.55	2.10	9.88	10.74	1.45	2.52	1.07	5.90	24.82	26.63	5.94
3	13.63	23.30	7.40	2.74	1.03	1.98	9.66	12.83	0.99	1.77	2.05	11.60	21.40	20.82
4	18.08	10.66	14.05	3.46	2.14	0.93	1.78	11.48	7.60	0.67	1.92	4.23	11.37	11.78
5	5.83	14.87	5.79	3.87	2.93	1.86	1.44	2.40	5.41	1.93	0.37	1.87	5.05	3.62
6	3.11	3.80	6.25	2.86	3.09	0.79	1.60	1.35	0.91	1.17	1.85	0.80	1.67	1.56
7	1.38	1.93	2.25	1.96	1.49	1.65	1.45	1.19	0.39	0.19	1.14	1.53	1.16	0.57
8	0.58	1.14	1.17	0.83	1.09	0.59	1.22	1.01	0.39	0.14	0.15	0.42	1.63	0.19
9	0.41	0.66	0.68	0.24	0.71	0.49	0.51	0.76	0.30	0.06	0.05	0.10	0.40	0.32
10	0.09	0.24	0.36	0.31	0.40	0.14	0.41	0.91	0.21	0.05	0.09	0.00	0.34	0.20
1-10	69.44	73.05	51.41	19.17	22.18	24.36	28.89	37.71	21.83	11.73	34.97	92.30	74.74	55.14

Table 35. SPA Results

## A. Fishing Mortality

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.10	0.04	0.00	0.09	0.02	0.13	0.04	0.03	0.00	0.00	0.01	0.04	0.01	0.00
3	0.15	0.23	0.27	0.03	0.20	0.19	0.14	0.12	0.11	0.06	0.10	0.11	0.15	0.11
4	0.25	0.25	0.44	0.28	0.11	0.35	0.28	0.24	0.41	0.34	0.23	0.39	0.18	0.36
5	0.19	0.40	0.25	0.50	0.37	0.26	0.45	0.35	0.43	0.42	0.51	0.56	0.57	0.46
6	0.20	0.31	0.32	0.44	0.47	0.42	0.39	0.79	0.59	0.41	0.84	0.65	0.47	0.60
7	0.43	0.04	0.10	0.55	0.28	0.44	0.62	0.65	0.76	0.57	0.37	0.76	0.72	0.52
8	0.42	0.66	0.04	0.66	0.51	0.44	0.55	0.71	0.56	0.44	0.64	0.46	0.52	0.43
9	0.19	0.43	0.51	0.24	1.08	0.21	0.32	0.98	0.42	0.48	0.56	0.83	0.45	0.61
10	0.38	0.36	0.40	0.55	0.42	0.52	0.55	0.63	0.67	0.52	0.59	0.73	0.61	0.59
Avg 5-7	0.27	0.25	0.22	0.50	0.37	0.37	0.49	0.60	0.59	0.47	0.57	0.66	0.59	0.53

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.03	0.02	0.01	0.01	0.03	0.01	0.02	0.01	0.03	0.02	0.01	0.00	0.00	0.00
3	0.06	0.09	0.17	0.05	0.16	0.10	0.10	0.10	0.06	0.17	0.06	0.05	0.02	0.00
4	0.23	0.06	0.22	0.33	0.25	0.24	0.11	0.23	0.30	0.17	0.23	0.17	0.08	0.02
5	0.40	0.40	0.30	0.43	0.32	0.39	0.27	0.24	0.36	0.36	0.15	0.37	0.24	0.03
6	0.61	0.32	0.42	0.50	0.40	0.18	0.35	0.30	0.14	0.29	0.33	0.16	0.44	0.11
7	0.56	0.38	0.29	0.36	0.29	0.25	0.37	0.41	0.56	0.15	0.11	0.25	0.36	0.24
8	0.36	0.45	0.30	0.18	0.43	0.24	0.38	0.32	1.08	0.50	0.03	0.24	0.39	0.12
9	0.20	0.44	0.28	0.10	0.29	0.47	0.23	0.31	0.80	0.72	0.14	0.26	0.31	0.12
10	0.54	0.37	0.41	0.48	0.42	0.34	0.35	0.37	0.42	0.33	0.26	0.29	0.33	0.12
Avg 5-7	0.52	0.37	0.34	0.43	0.34	0.27	0.33	0.32	0.35	0.27	0.20	0.26	0.35	0.13

## B. Population Numbers

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	25337	6085	47138	44062	24374	49158	54096	32024	42904	33861	44425	51973	31783	38006
2	11860	20744	4982	38556	35939	19955	40214	44273	26217	35127	27723	36358	42551	26022
3	5687	8755	16271	4059	28783	28796	14370	31751	35085	21397	28686	22552	28698	34394
4	7511	4001	5705	10214	3221	19355	19443	10277	23167	25691	16471	21274	16460	20203
5	2454	4791	2563	3005	6330	2358	11174	12063	6587	12621	14963	10763	11790	11238
6	3202	1666	2636	1638	1495	3573	1491	5817	6987	3499	6822	7353	5013	5466
7	14321	2148	999	1574	864	763	1927	828	2156	3158	1896	2419	3129	2563
8	5981	7621	1696	736	746	536	401	847	353	824	1460	1076	928	1244
9	861	3211	3239	1337	311	367	283	189	342	165	437	632	558	452
10	331	585	1706	1597	860	87	245	168	58	183	83	205	225	291
1-10	77546	59608	86934	106778	102923	124948	143644	138240	143857	136525	142966	154604	141135	139878

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	12903	9572	5527	8504	25629	22352	7141	7400	9339	24524	59325	74877	19024	0
2	31117	10563	7837	4525	6963	20972	18288	5847	6055	7639	20058	48563	61302	15575
3	21247	24836	8503	6369	3679	5519	17000	14613	4741	4832	6132	16339	39675	50158
4	25179	16393	18512	5890	4966	2578	4080	12641	10809	3663	3329	4704	12725	31827
5	11586	16380	12602	12183	3475	3171	1668	2986	8244	6579	2536	2168	3251	9611
6	5823	6374	8989	7652	6493	2056	1763	1042	1925	4687	3756	1784	1232	2096
7	2455	2599	3808	4849	3805	3573	1407	1017	632	1370	2885	2214	1251	649
8	1248	1152	1455	2326	2766	2342	2282	799	554	295	970	2125	1416	716
9	661	714	601	886	1586	1469	1507	1277	474	155	146	772	1367	786
10	201	441	378	373	659	967	753	984	766	175	62	105	489	819
1-10	112420	89025	68213	53558	60021	64999	55890	48604	43539	53918	99199	153652	141731	112237

Table 35. SPA Results (cont.)

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
2	0.09	0.38	-2.11	0.50	0.53	-0.71	-0.97	0.89	-0.63	0.04	-0.40	0.72	0.56	-0.78
3	-0.58	0.31	-0.68	-0.95	0.98	-0.84	-0.47	1.51	-0.26	-0.18	0.20	-0.28	0.05	-0.05
4	-0.26	0.16	-0.44	-0.36	-0.48	-0.07	-0.73	1.35	-0.88	-0.07	0.07	0.02	-0.50	-0.32
5	-0.28	0.19	-0.47	0.05	0.25	-1.14	0.27	1.01	-0.64	-0.23	0.56	-0.36	0.33	-0.44
6	0.15	0.31	-0.48	-0.53	0.13	-0.15	-0.28	1.28	-0.09	-0.06	0.45	0.02	-0.08	-0.19
7	-0.36	0.24	-0.13	-0.22	-0.03	0.01	-0.27	1.08	0.18	0.56	0.39	0.07	0.30	-0.43
Avg 2-7	-0.21	0.26	-0.72	-0.25	0.23	-0.48	-0.41	1.19	-0.39	0.01	0.21	0.03	0.11	-0.37

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.64	0.86	1.17	-0.10	-0.22	0.22	0.45	-0.42	0.10	-0.99	-0.26	0.29	0.13	0.00
3	0.34	0.74	0.71	-0.06	-0.43	-0.21	0.24	0.68	-0.78	-0.15	-0.31	0.44	0.15	-0.13
4	0.46	0.26	0.51	0.31	-0.04	-0.23	-0.11	0.69	0.47	-0.95	0.24	0.65	0.59	-0.32
5	0.00	0.60	-0.14	-0.44	0.48	0.15	0.47	0.38	0.25	-0.56	-1.38	0.52	1.04	-0.48
6	0.05	-0.01	0.20	-0.37	-0.19	-0.53	0.43	0.76	-0.35	-0.90	-0.19	-0.39	0.88	0.15
7	0.01	0.18	-0.10	-0.44	-0.51	-0.37	0.50	0.65	0.10	-1.63	-0.61	0.03	0.39	0.41
Avg 2-7	0.25	0.44	0.39	-0.18	-0.15	-0.16	0.33	0.46	-0.03	-0.86	-0.42	0.26	0.53	-0.06

Mean Square of the Residuals = 0.332

Est.	Param	SE	CV	Bias
1	9.55387	0.58716	0.061458	-0.00883
2	10.7227	0.41573	0.038771	-0.00745
3	10.2516	0.34609	0.033759	-0.00317
4	9.03818	0.31946	0.035346	0.021621
5	7.44758	0.34326	0.046091	0.077203
6	6.13261	0.36078	0.05883	-0.03224
7	0.0004285	4.93E-05	0.115097	-0.58142
8	0.0005296	5.99E-05	0.1131	-0.56907
9	0.0005843	6.57E-05	0.112486	-0.59059
10	0.0007103	8.01E-05	0.112709	-0.64098
11	0.0008149	9.26E-05	0.113657	-0.72033
12	0.0008685	9.98E-05	0.114869	-0.8155

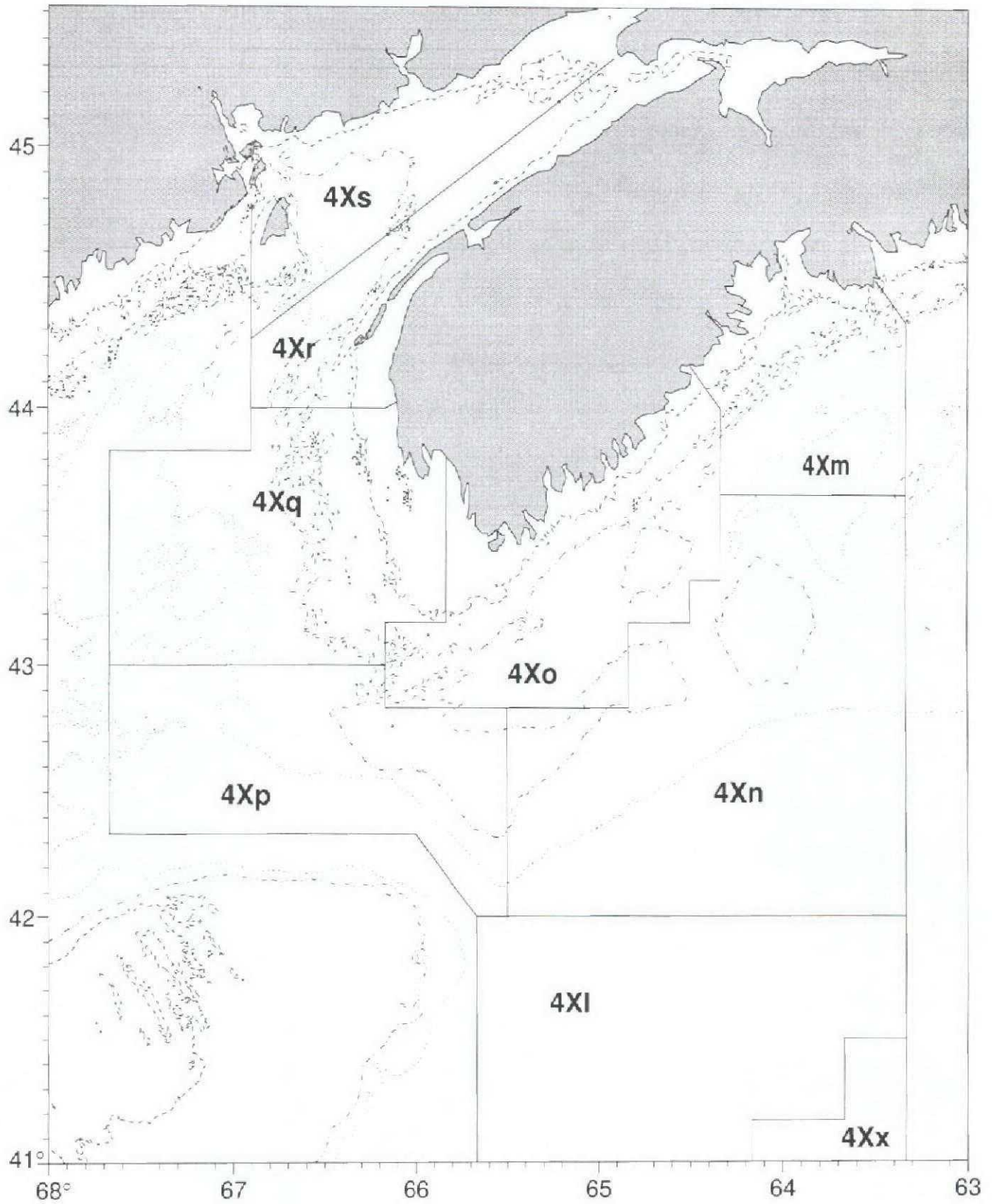


Figure 1. Unit areas in NAFO Division 4X.



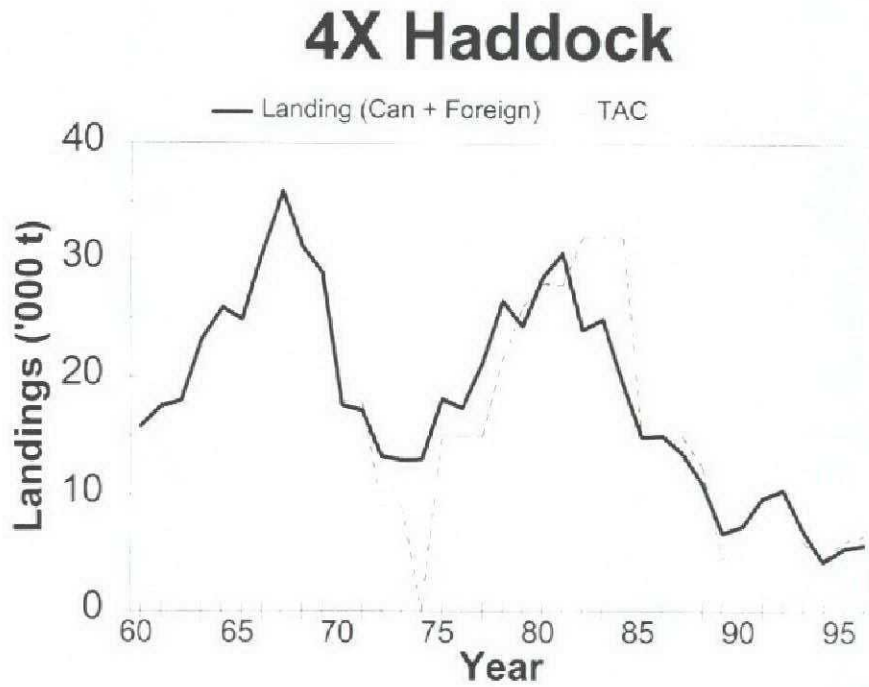


Figure 2. Long-term trends in 4X haddock landings, along with TAC.

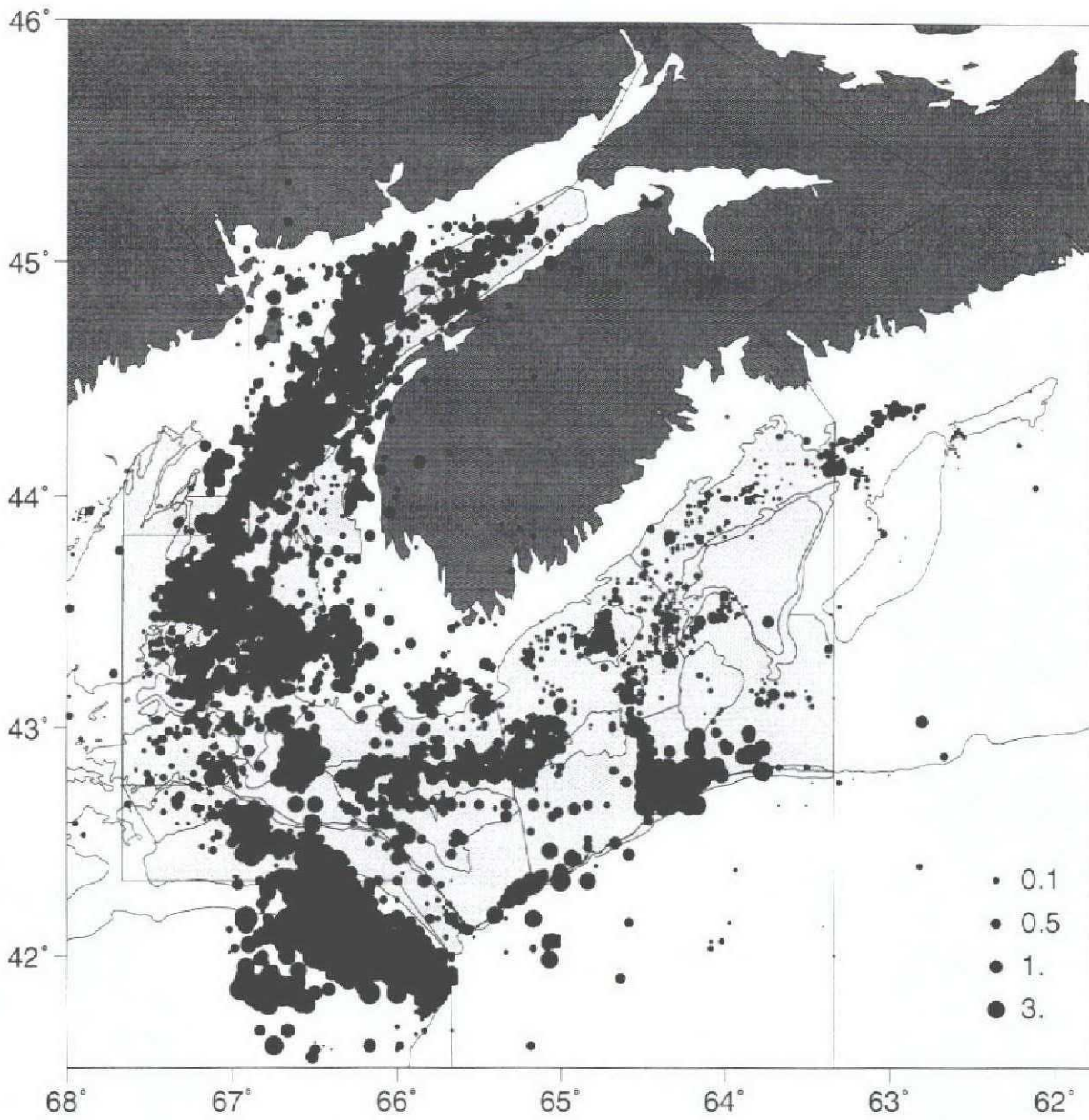


Figure 3. Distribution of mobile gear haddock catches (t per subtrip) in 4WX+5, January-December 1996.

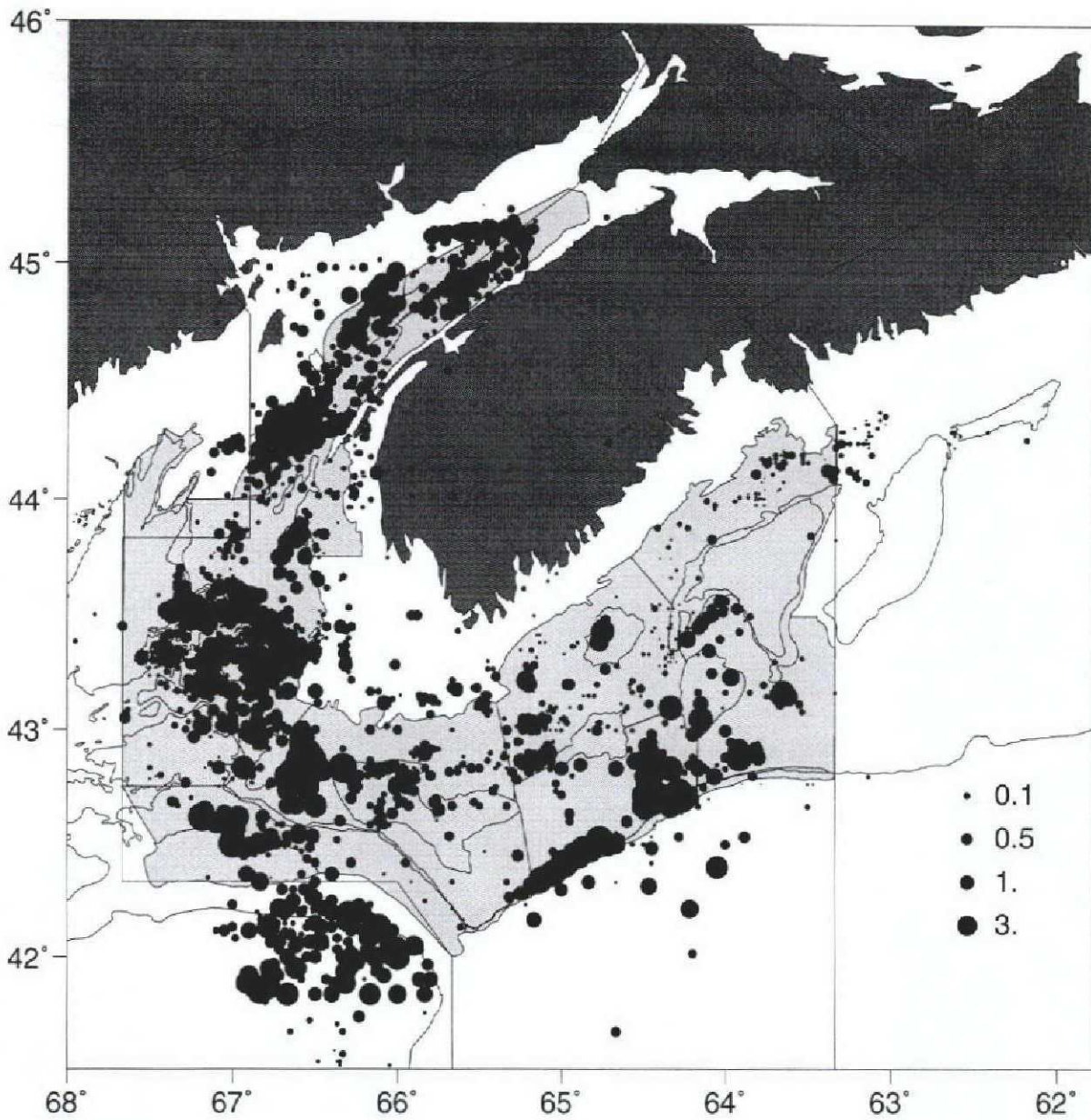


Figure 4. Distribution of mobile gear haddock catches (t per subtrip) in 4WX+5, January-July 1997.

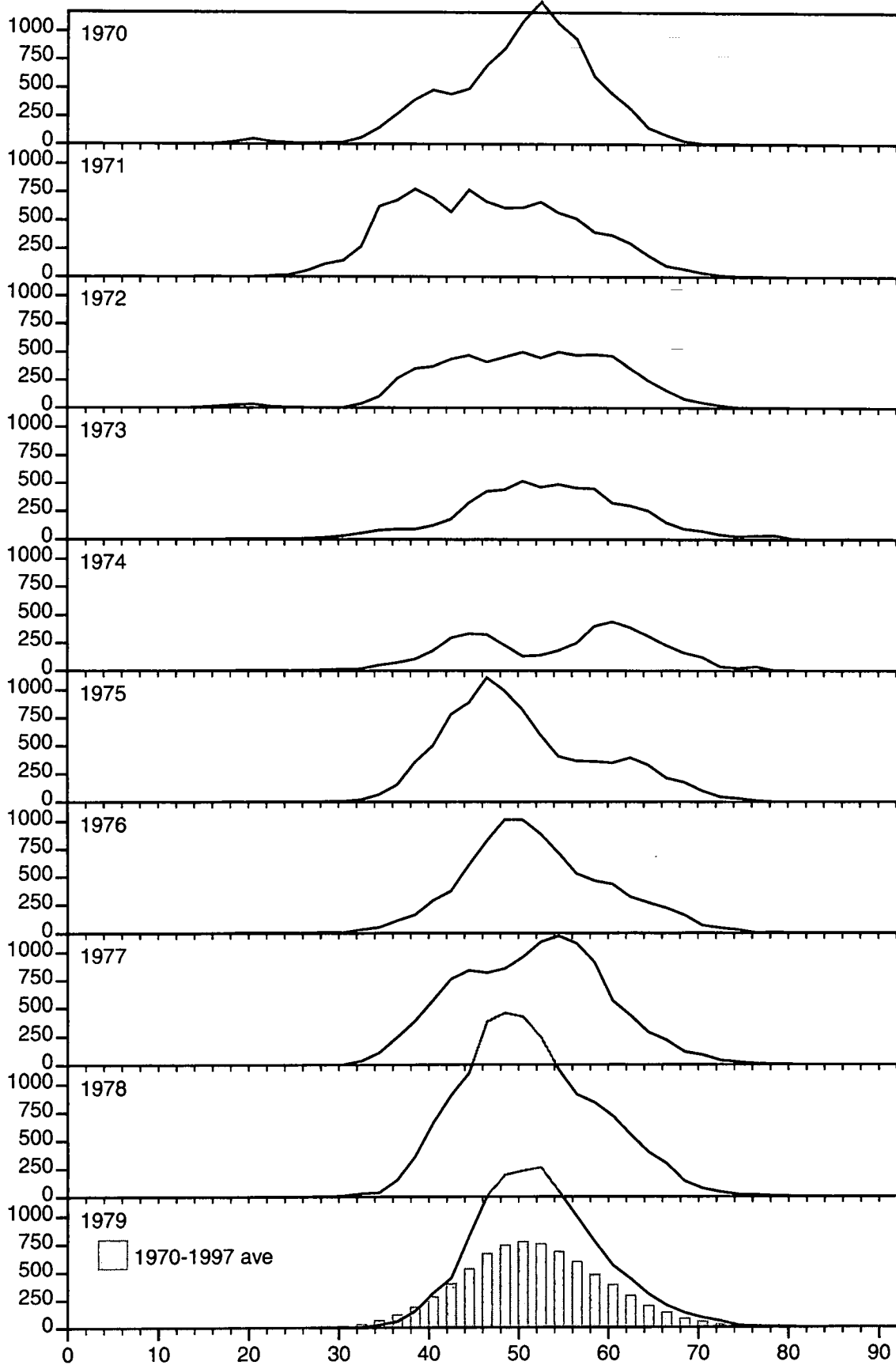


Figure 5a. Commercial catch-at-length for 4X haddock (Scotian Shelf component 4Xmnop), 1970-1979 (bars represent long term mean).

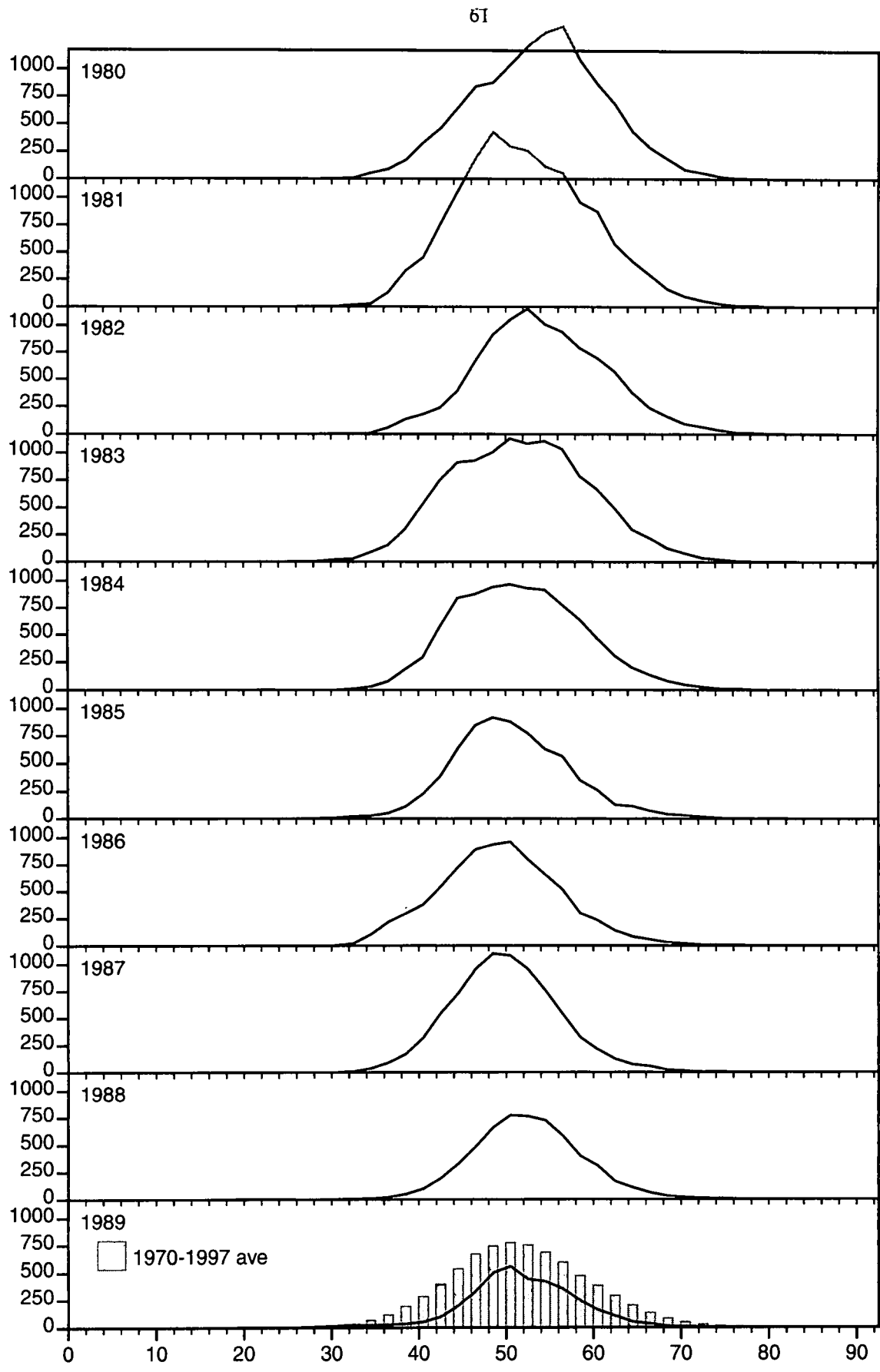


Figure 5b. Commercial catch-at-length for 4X haddock (Scotian Shelf component 4Xmnop), 1980-1989 (bars represent long term mean).

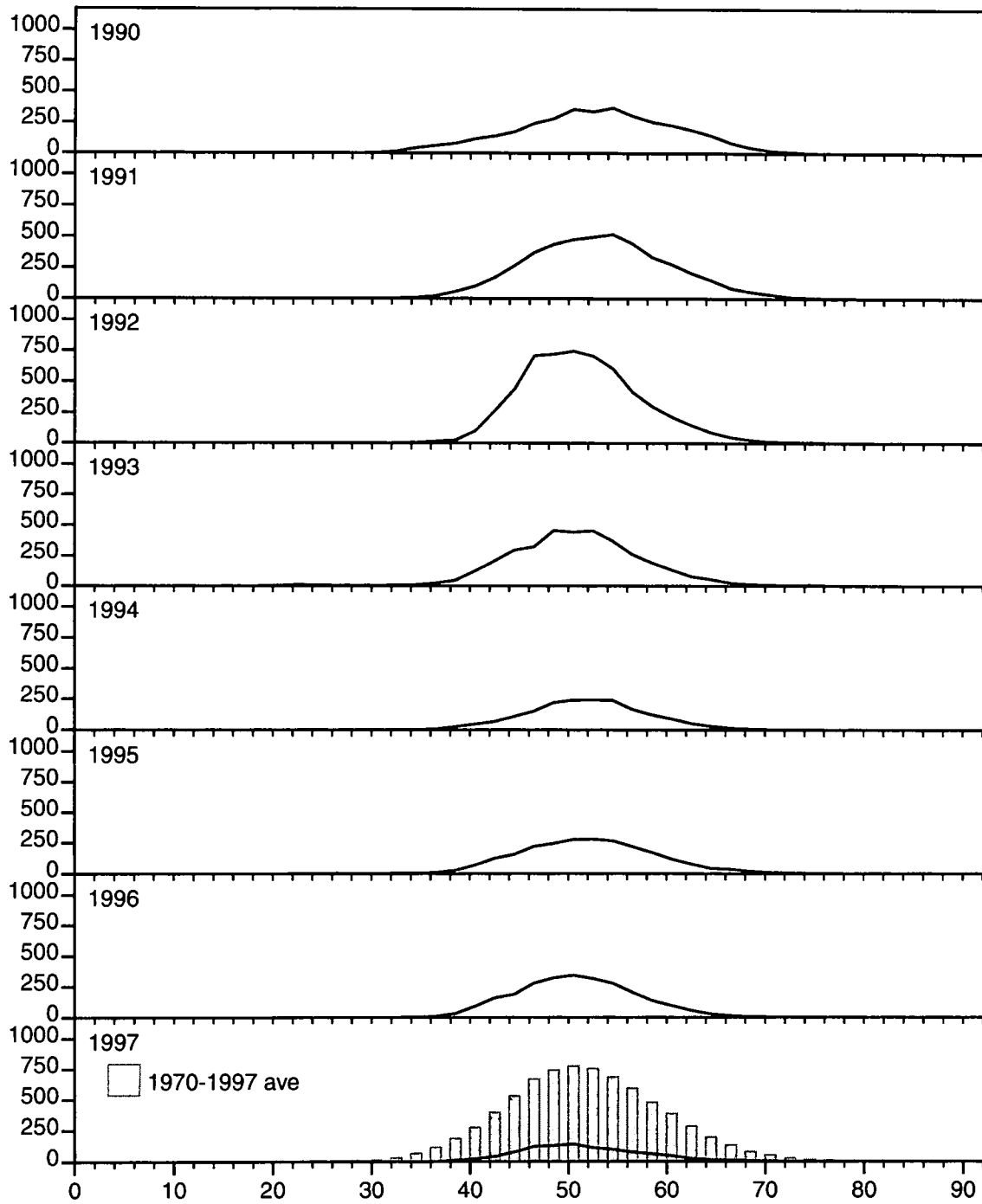


Figure 5c. Commercial catch-at-length for 4X haddock (Scotian Shelf component 4Xmnop), 1990-1997 (bars represent long term mean, 1997 half year only).

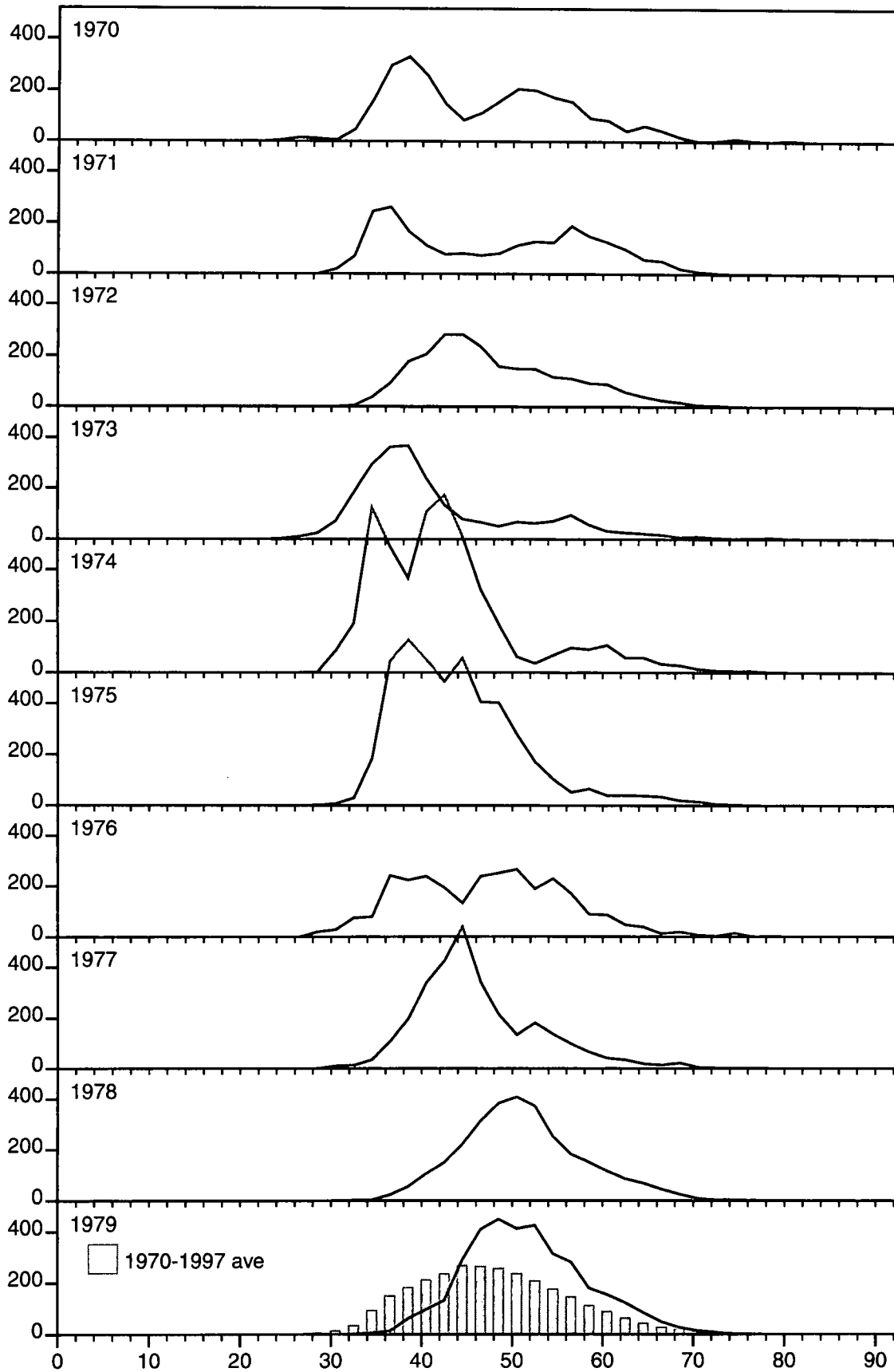


Figure 6a. Commercial catch-at-length for 4X haddock (Bay of Fundy component 4Xqr), 1970-1979 (bars represent long term mean).

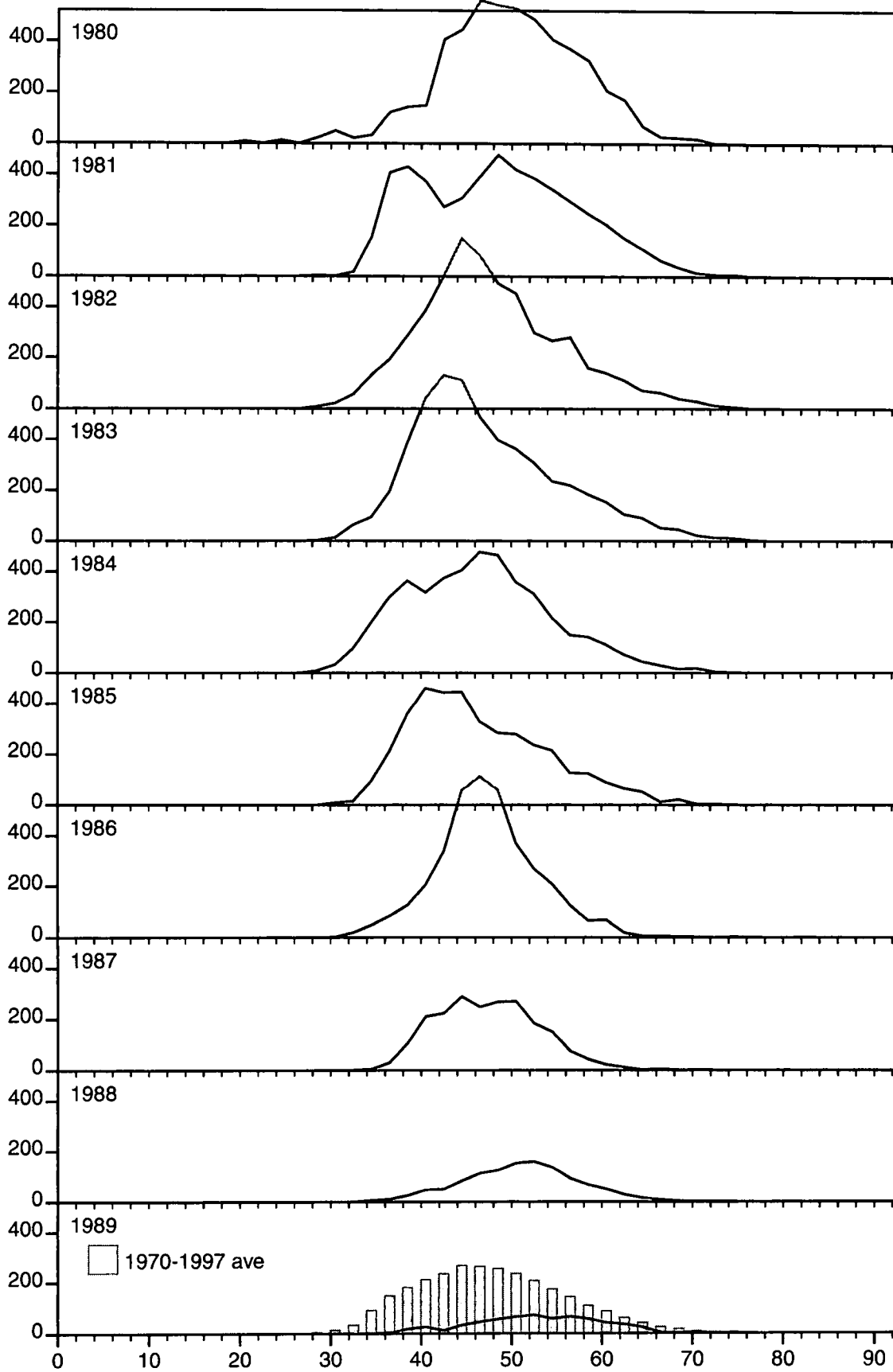


Figure 6b. Commercial catch-at-length for 4X haddock (Bay of Fundy component 4Xqr), 1980-1989 (bars represent long term mean).



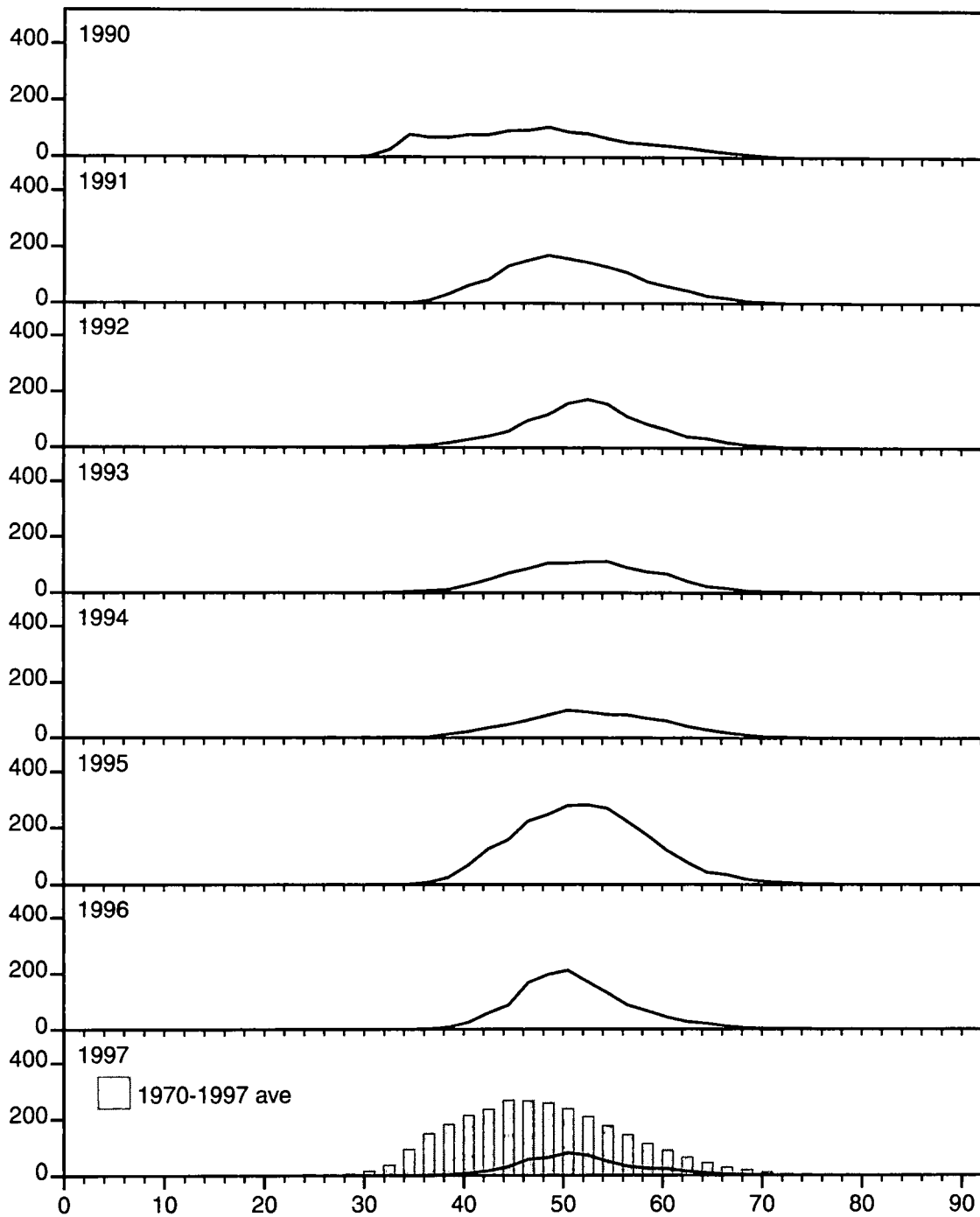


Figure 6c. Commercial catch-at-length for 4X haddock (Bay of Fundy component 4Xqr), 1990-1997 (bars represent long term mean, 1997 half year only).

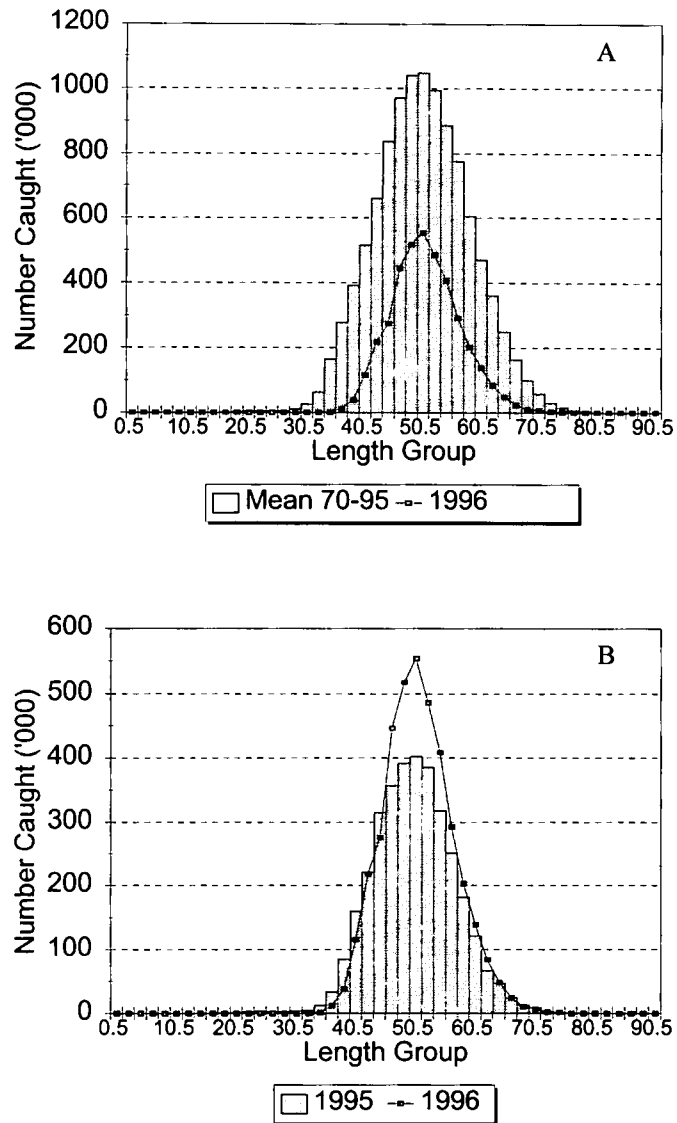
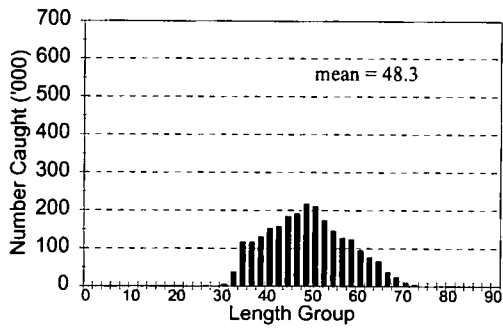
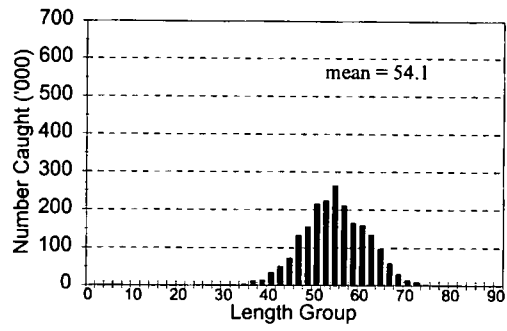


Figure 7. Commercial catch-at-length for 4X haddock, (a) 1996 catch compared to 1970-1995 mean, (b) 1996 catch compared to the 1995 catch-at-length.

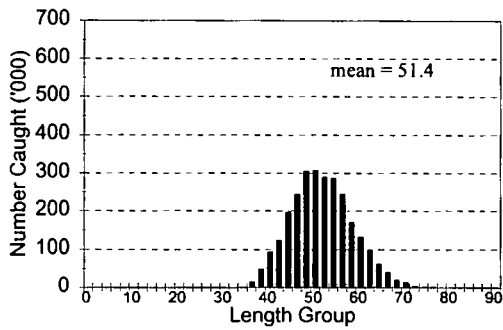
**OT LF 1990**



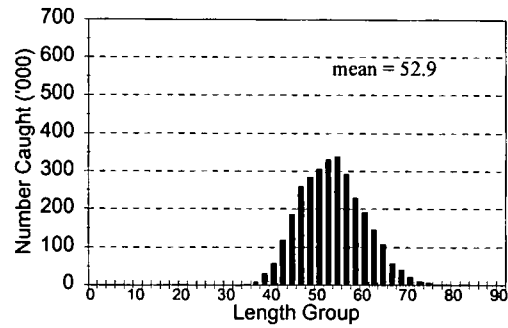
**LL LF 1990**



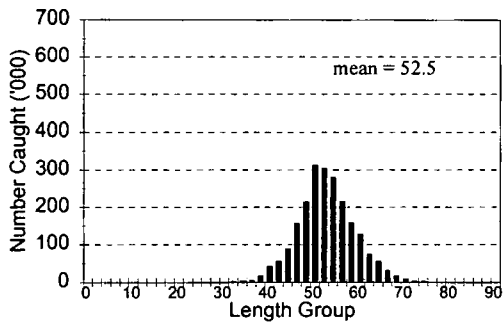
**OT LF 1991**



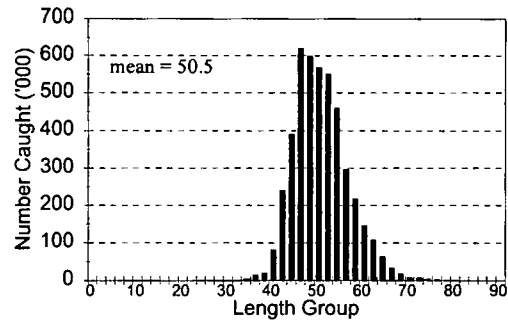
**LL LF 1991**



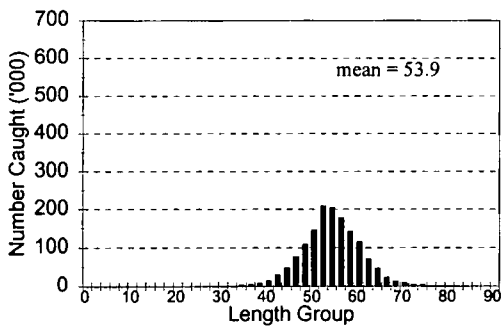
**OT LF 1992**



**LL LF 1992**



**OT LF 1993**



**LL LF 1993**

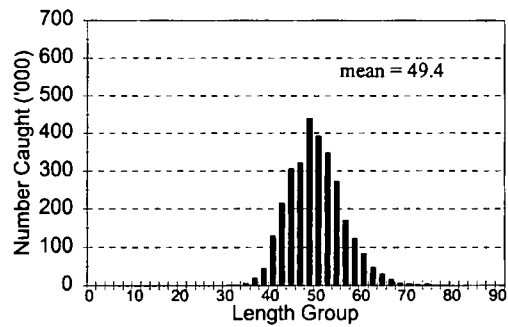
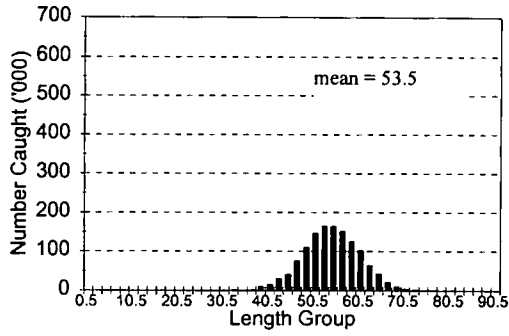
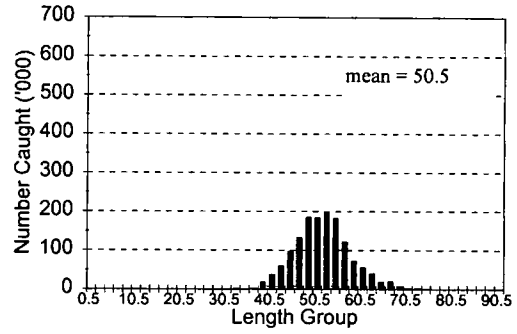


Figure 8a. Catch-at-length (cm) for 4X haddock, 1991-1993, for the otter trawl and longline gear sectors

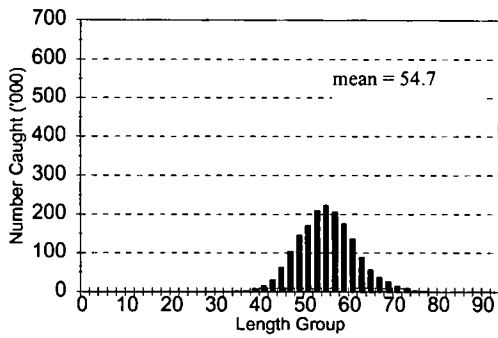
**OT LF 1994**



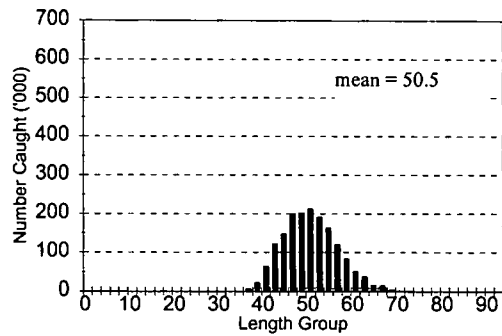
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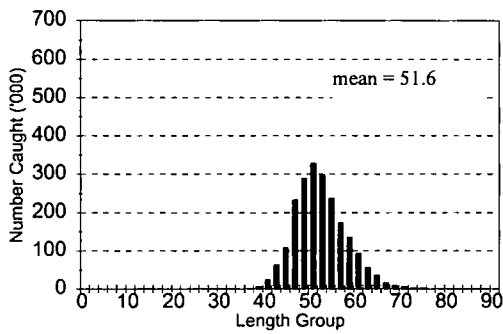
**OT LF 1995**



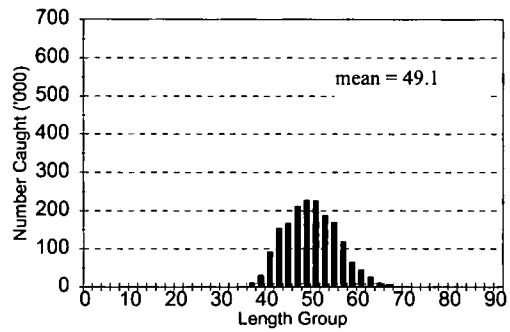
**LL LF 1995**



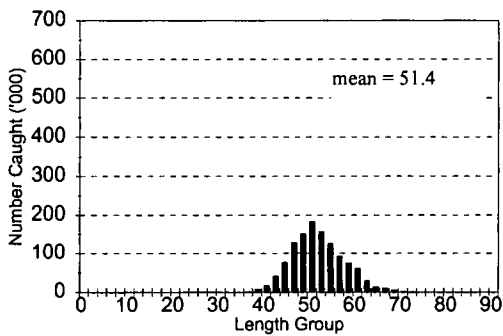
**OT LF 1996**



**LL LF 1996**



**OT LF 1997**



**LL LF 1997**

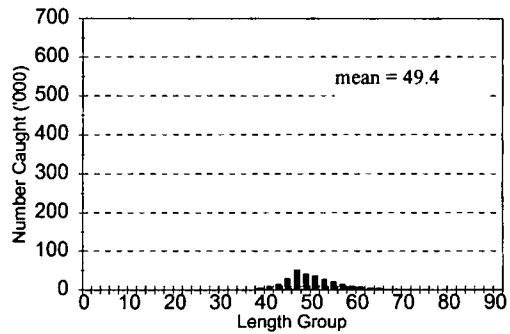


Figure 8b. Catch-at-length (cm) for 4X haddock, 1994-1997\*, for the otter trawl and longline gear sectors.

\* - 1997 Catch only from quarter 1 and 2

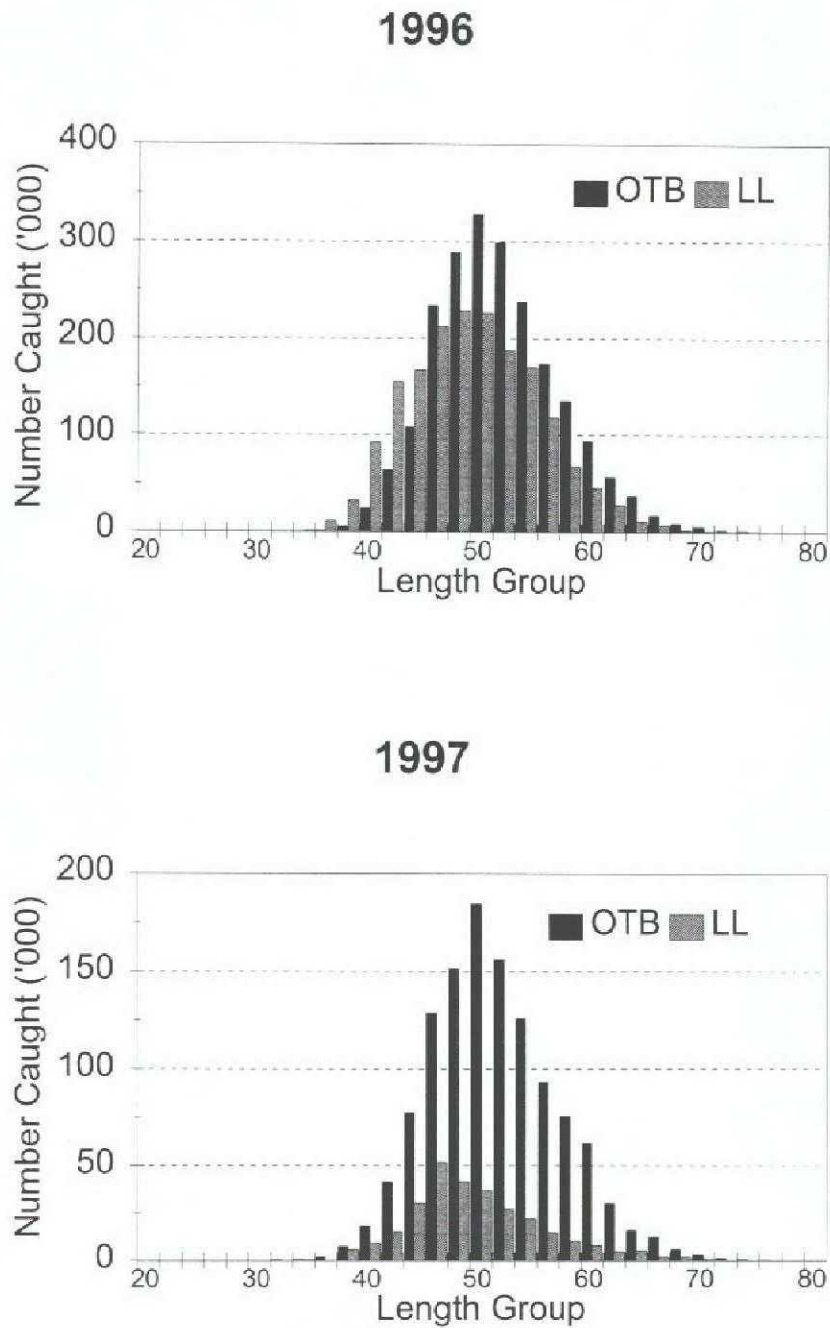


Figure 9. 4X Haddock commercial catch at length for mobile and longline gear sectors for 1996 and the first half of 1997.

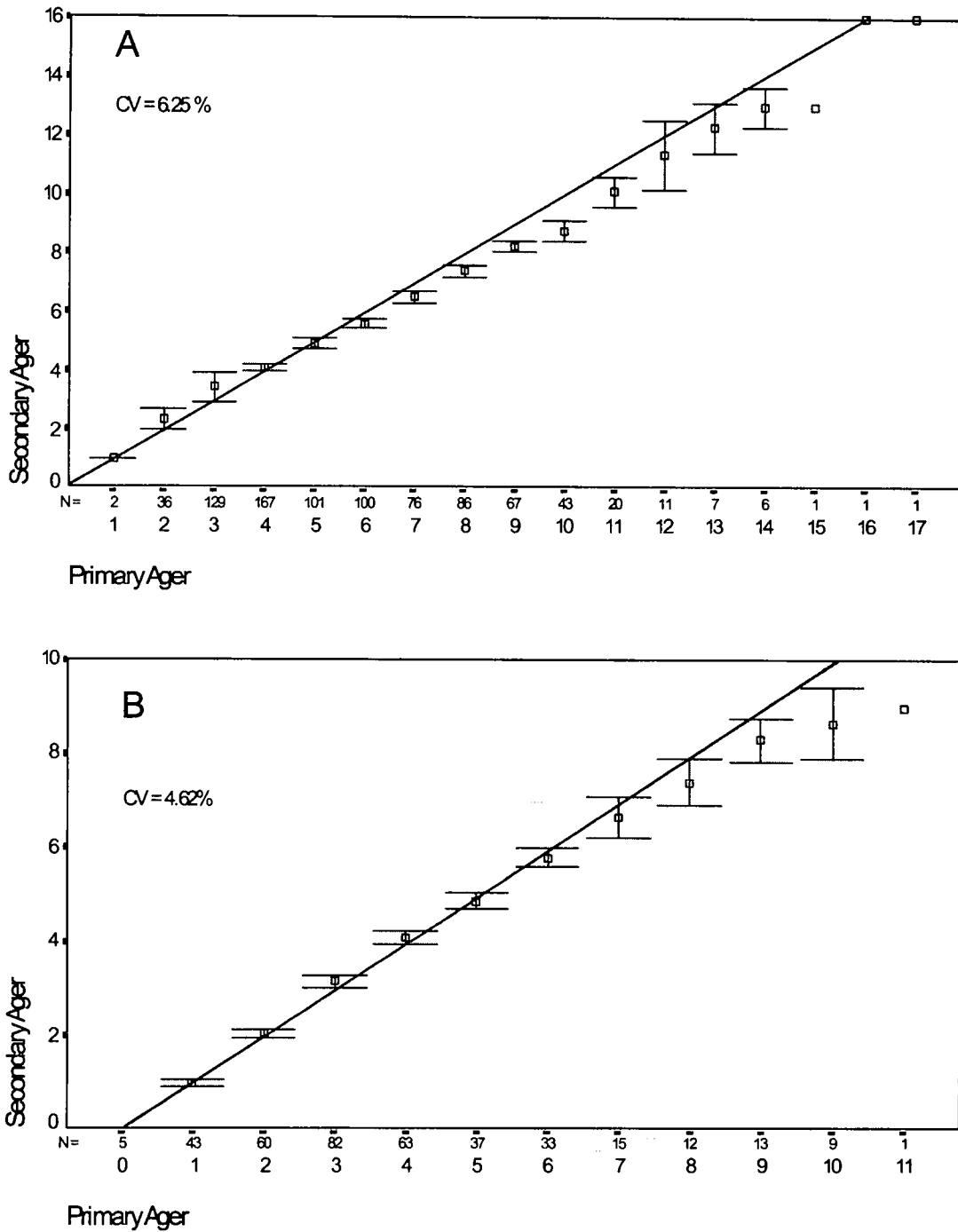


Figure 10. Age bias plot of pairwise age comparisons of revised 4X haddock ages from BIO agers for commercial (A) and research vessel (B) samples. Bars represent 95% confidence interval around each category. The line represents the 1:1 line. Sample size is indicated above the x-axis labels.

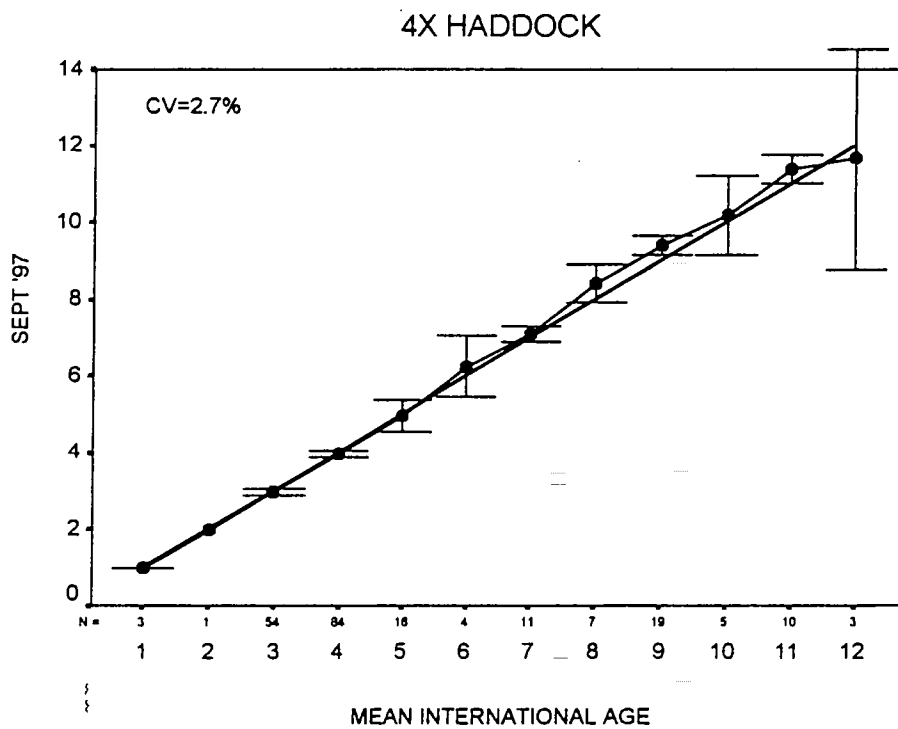
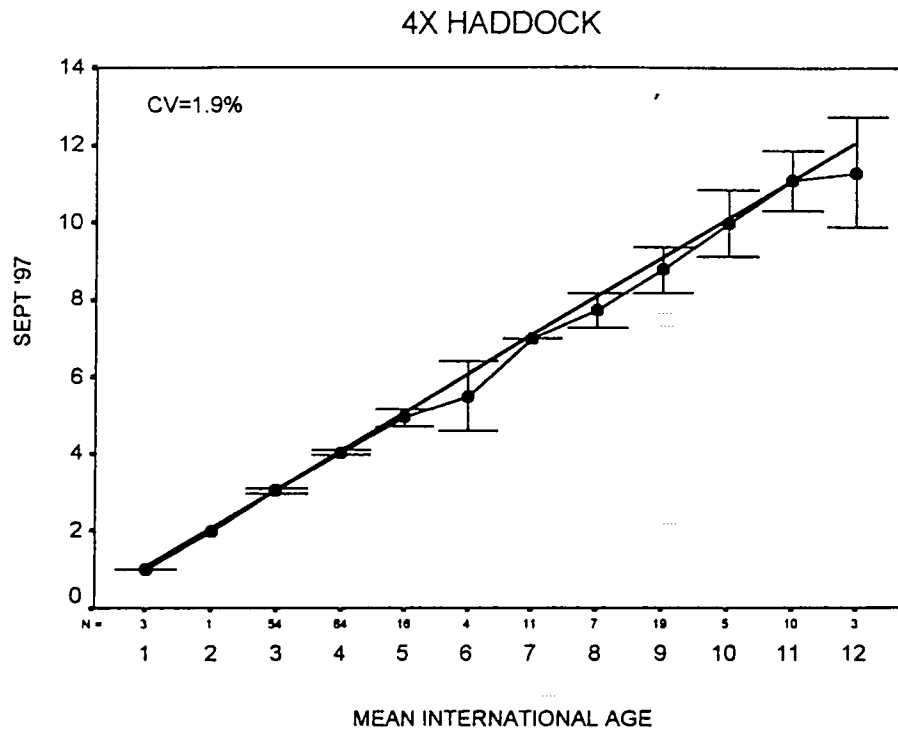


Figure 11. Age bias plot of pairwise comparisons of ages from BIO agers (y-axis) and international agers (x-axis) for the 4X haddock reference collection. Bars represent 95% confidence interval around each category. The line represents the 1:1 line. Sample size is indicated above the x-axis labels.

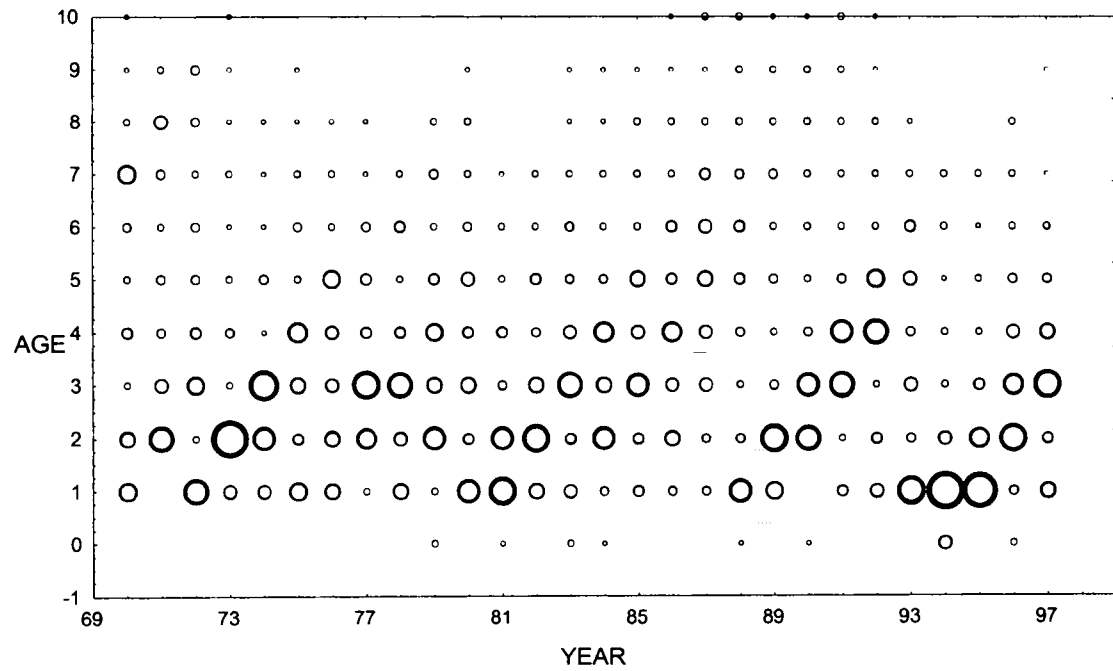


Figure 12. 4X Haddock RV survey percent numbers-at-age.



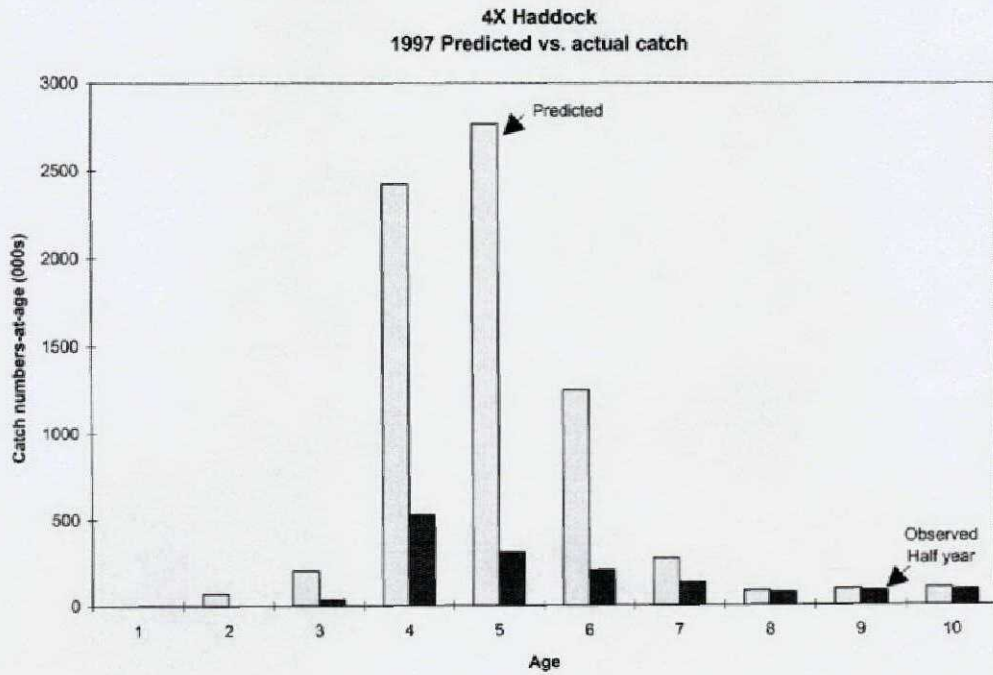
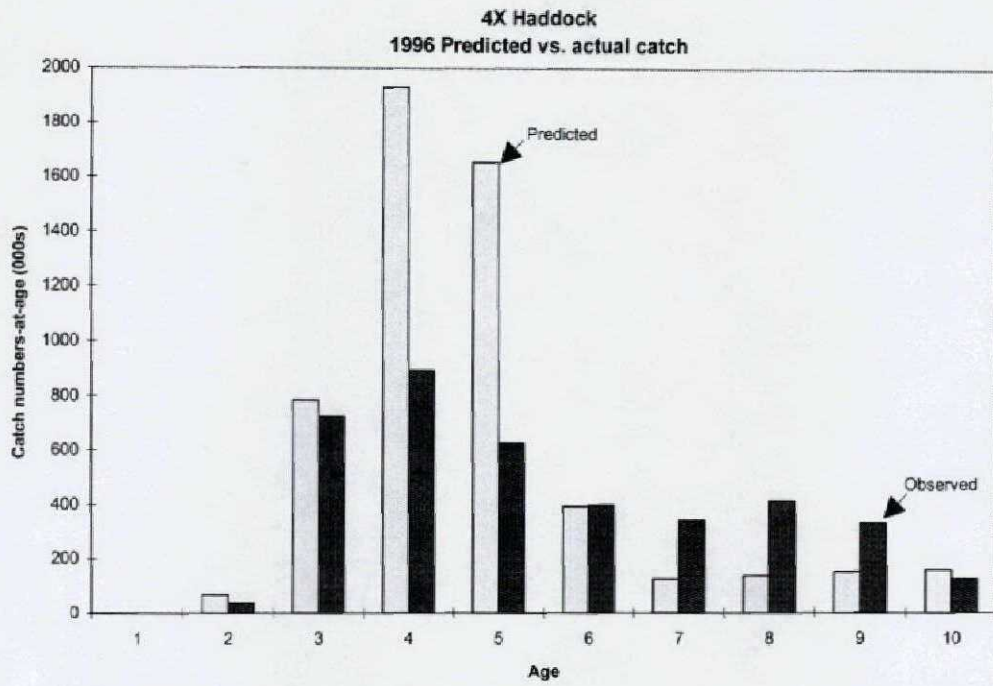


Figure 13. 4X Haddock predicted and actual catch numbers-at-age (000s).

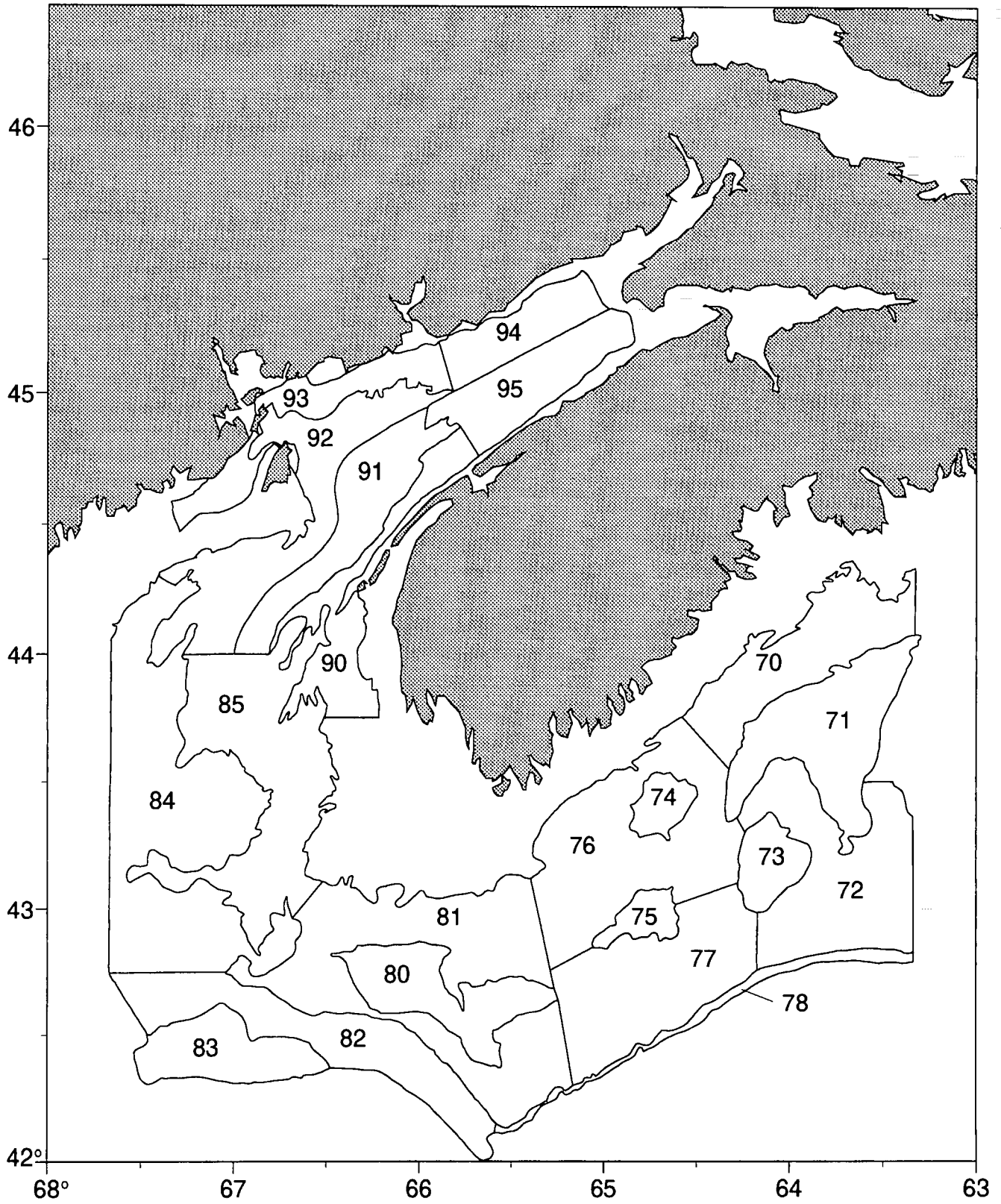


Figure 14. Research vessel survey strata in NAFO Division 4x.

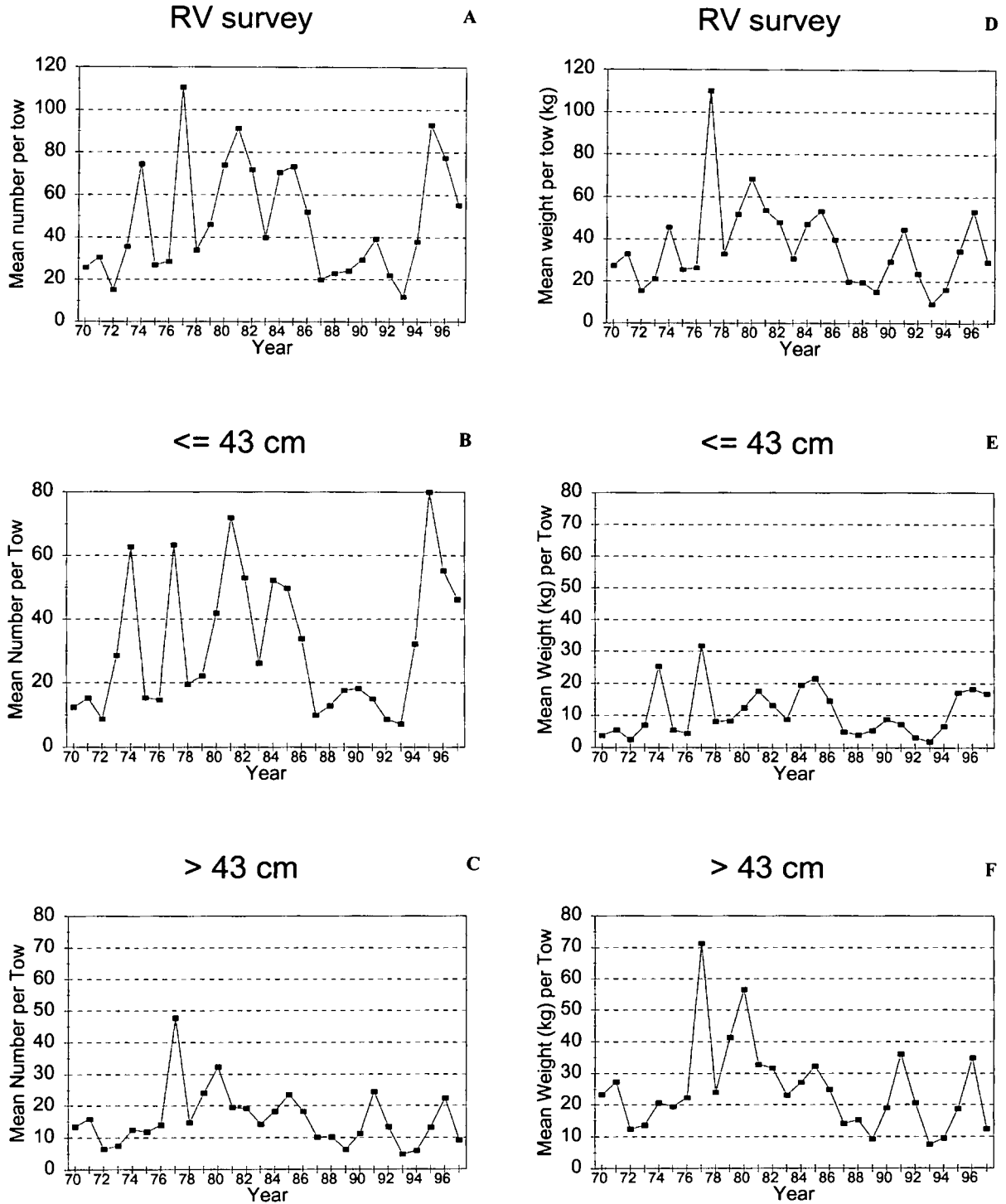
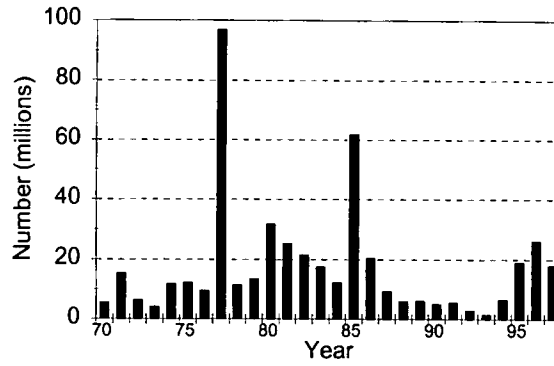
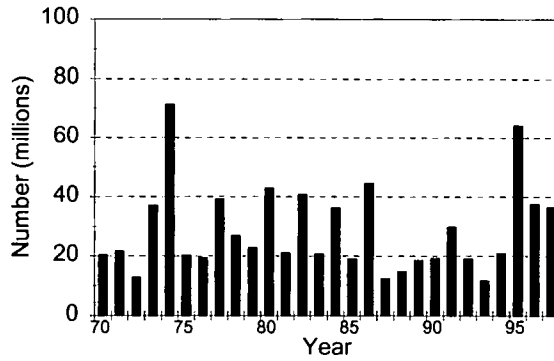


Figure 15. Summer RV survey, mean catch rate of haddock from 4X during 1970-1997 for (a) all lengths combined (nos./tow), (b) lengths  $\leq 43$  (nos./tow), (c) lengths  $> 43$ cm (nos./tow), (d) all lengths combined (wt/tow), (e) lengths  $\leq 43$ cm (wt/tow) and (f) lengths  $> 43$ cm (wt/tow).

### Strata 70-76 + 78



### Strata 77, 80, 81



### Strata 82-95

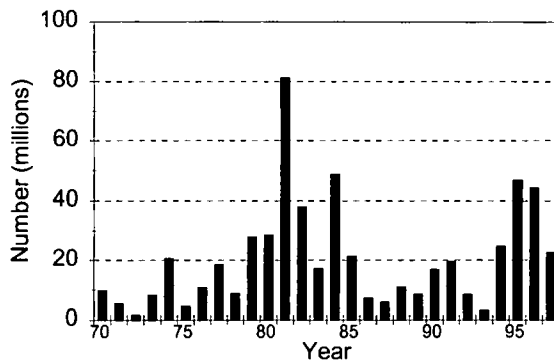


Figure 16. 4X haddock summer RV survey stratified numbers by stratum grouping

	east		
	total	<43cm	>43cm
1989	6,994,501	4,729,428	2,265,073
1990	4,982,041	2,835,932	2,146,109
1991	5,545,756	2,200,021	3,345,735
1992	2,903,071	1,799,390	1,103,681
1993	1,473,200	787,962	685,238
1994	6,537,415	5,003,600	1,533,815
1995	18,296,868	16,451,294	1,845,574
1996	26,231,769	23,705,473	2,526,296
1997	18,061,859	15,576,778	2,485,081

	Browns		
	total	<43cm	>43cm
1989	18,762,470	15,090,035	3,672,435
1990	19,366,864	15,668,778	3,698,086
1991	28,034,715	16,161,593	11,873,122
1992	19,273,136	9,144,001	10,129,135
1993	11,906,750	8,537,393	3,369,357
1994	22,028,308	18,274,036	3,754,272
1995	64,288,847	59,355,591	4,933,256
1996	37,850,297	32,382,945	5,467,352
1997	36,667,442	32,985,812	3,681,630

	Bay of Fundy		
	total	<43cm	>43cm
1989	8,708,286	5,640,124	3,068,162
1990	16,895,274	7,071,493	9,823,781
1991	19,504,794	1,631,548	17,873,246
1992	8,593,667	1,139,042	7,454,625
1993	3,299,721	708,984	2,590,737
1994	24,625,364	21,631,602	2,993,762
1995	46,902,345	35,272,729	11,629,616
1996	44,460,058	21,226,544	23,233,514
1997	22,788,207	16,132,398	6,655,809

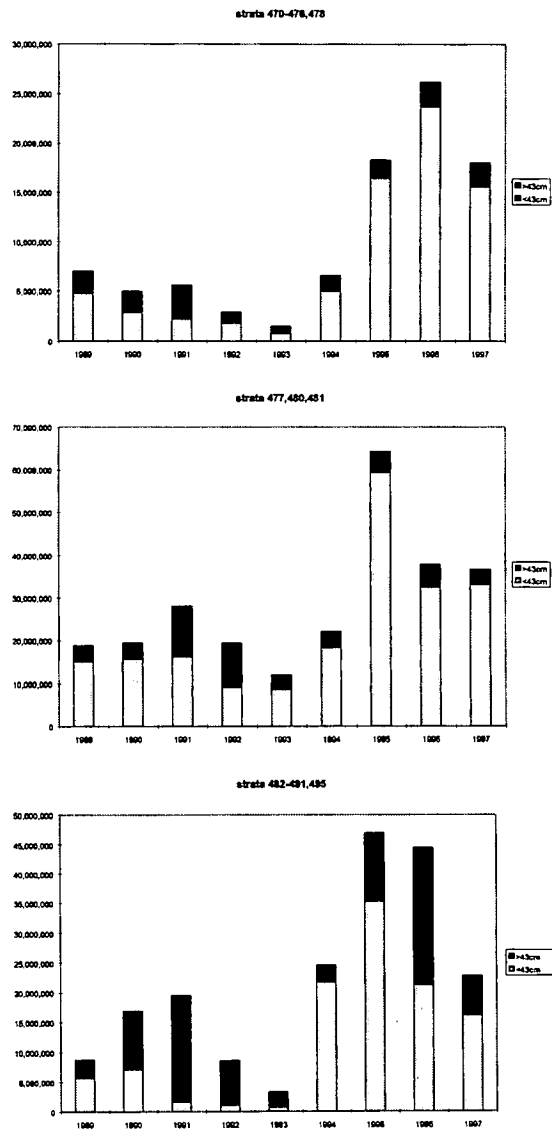


Figure 17. 4X Haddock summer RV stratified numbers by stratum grouping total, <43cm and >43cm.

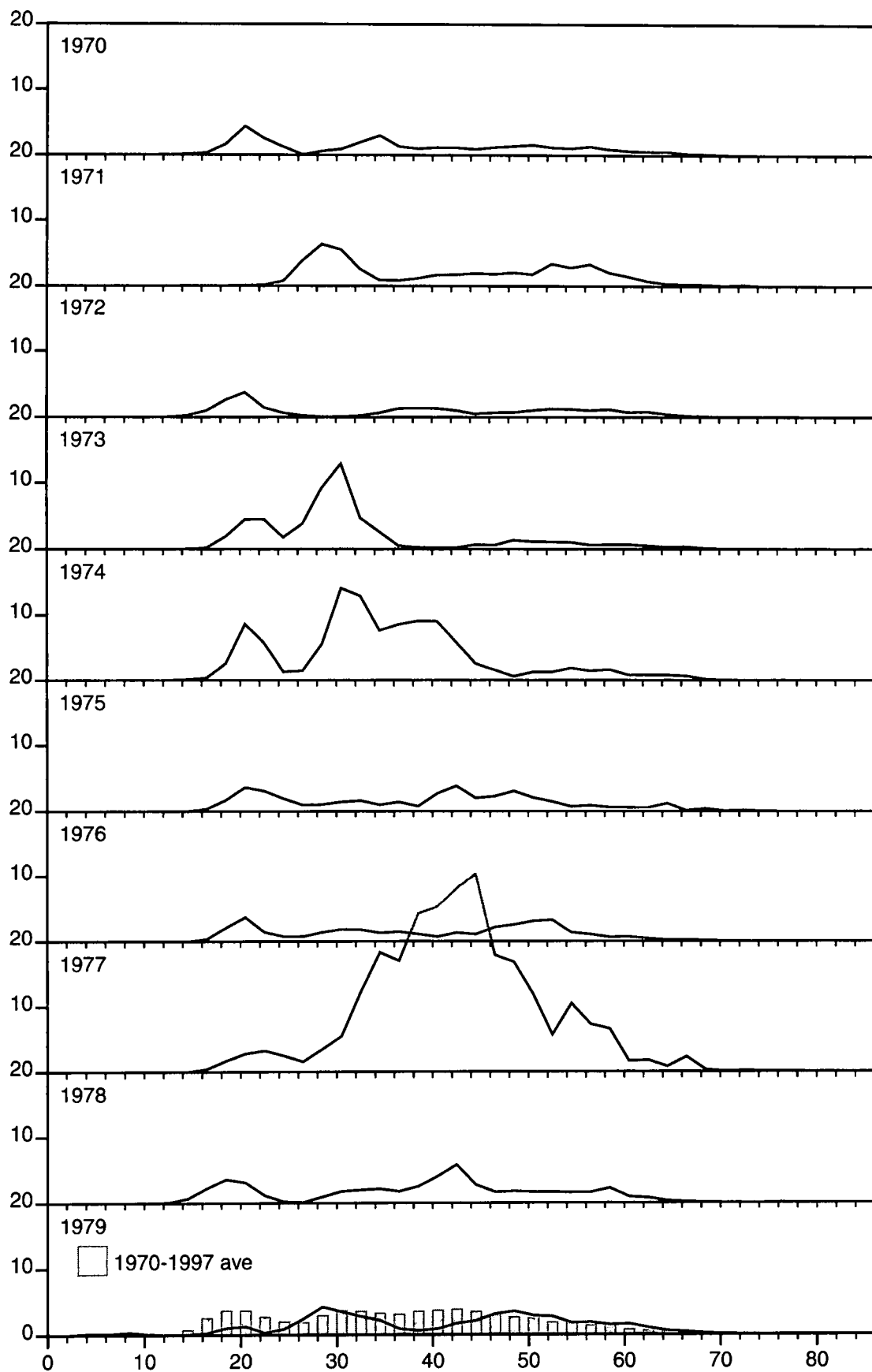


Figure 18a. Mean numbers-at-length per tow for 4X haddock (Scotian Shelf component strata 470-481) from research vessel surveys, 1970-79 (bars represent long term mean).

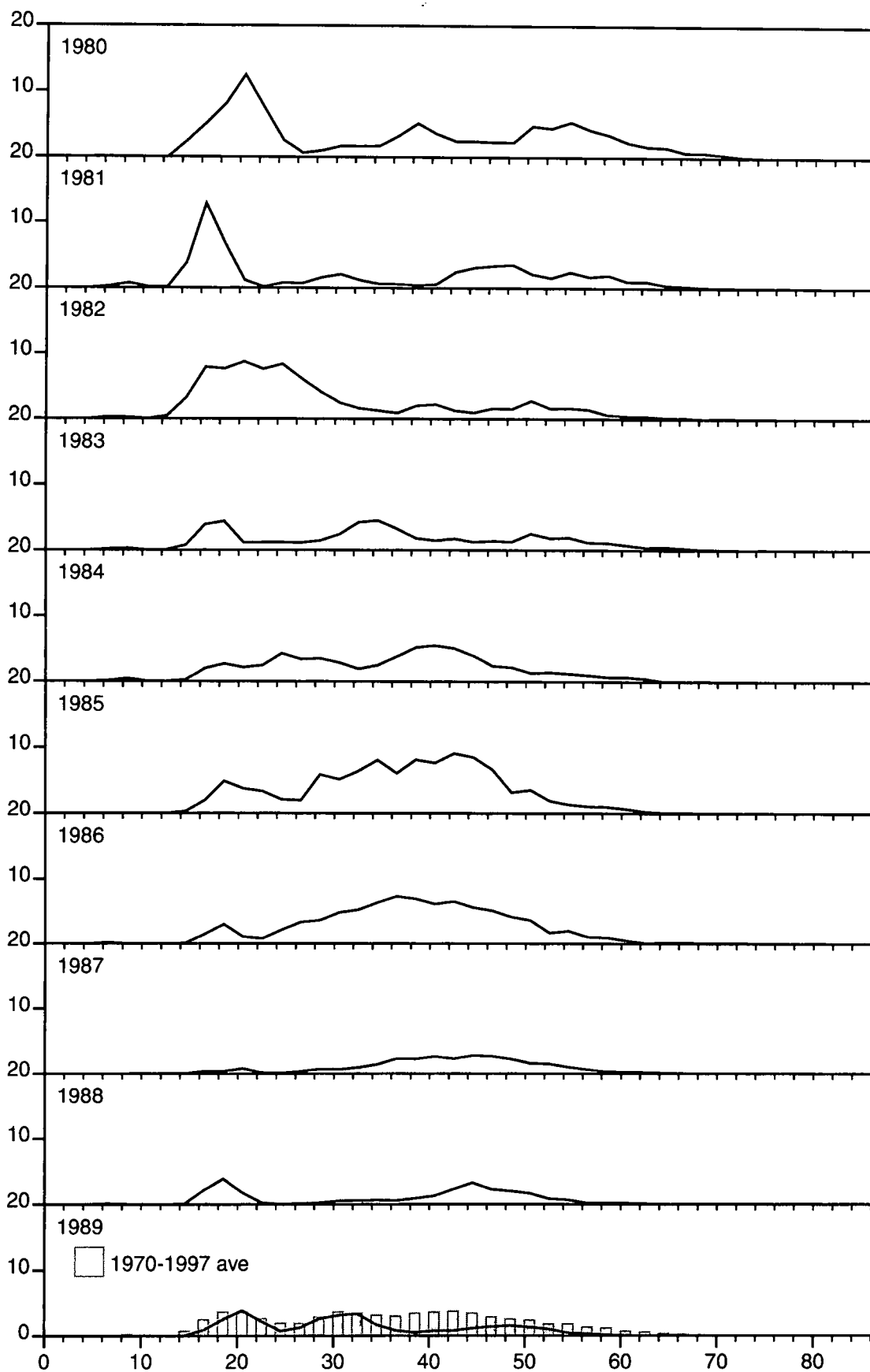


Figure 18b. Mean numbers-at-length per tow for 4X haddock (Scotian Shelf component strata 470-481) from research vessel surveys, 1980-89 (bars represent long term mean).

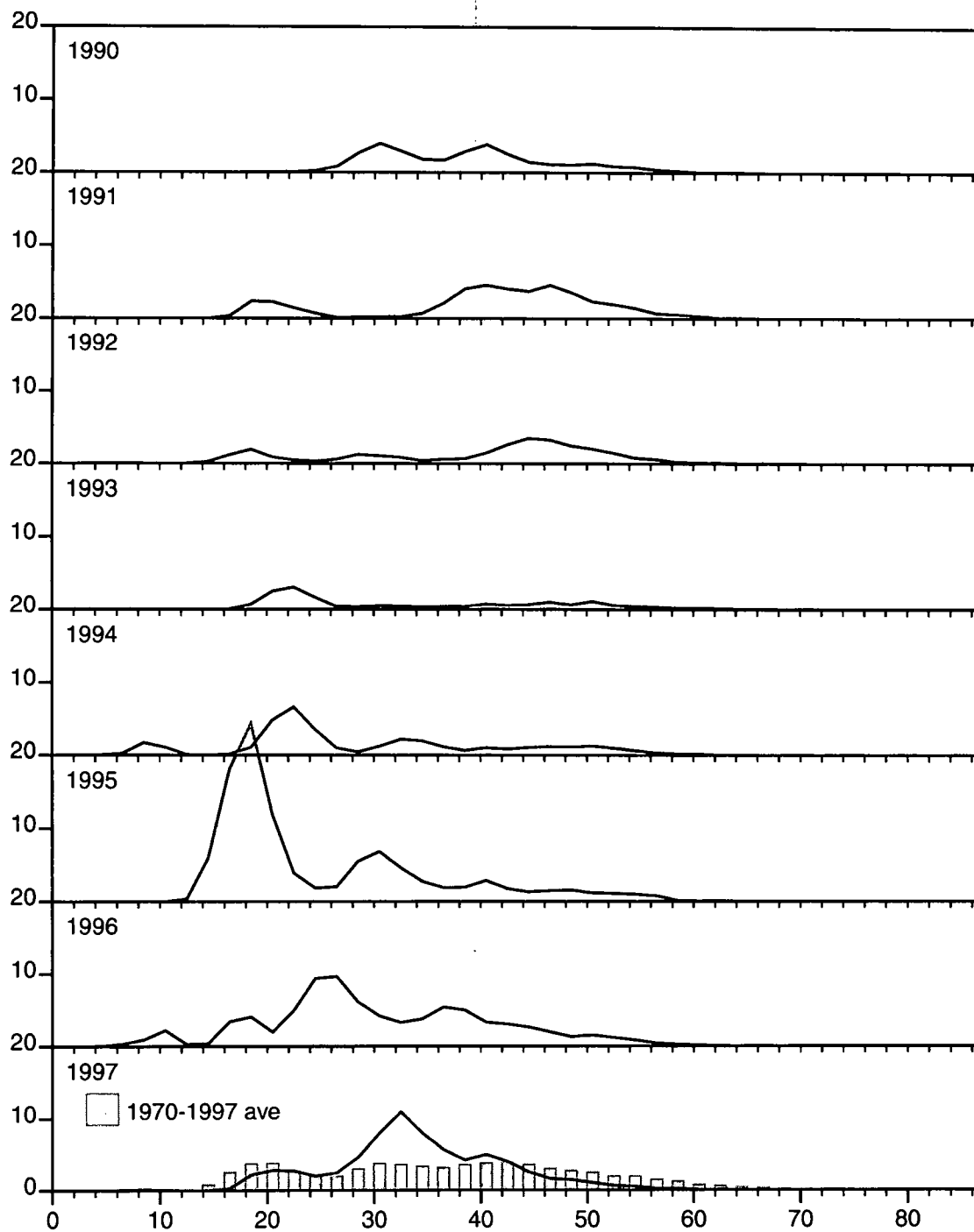


Figure 18c. Mean numbers-at-length per tow for 4X haddock (Scotian Shelf component strata 470-481) from research vessel surveys, 1990-97 (bars represent long term mean).



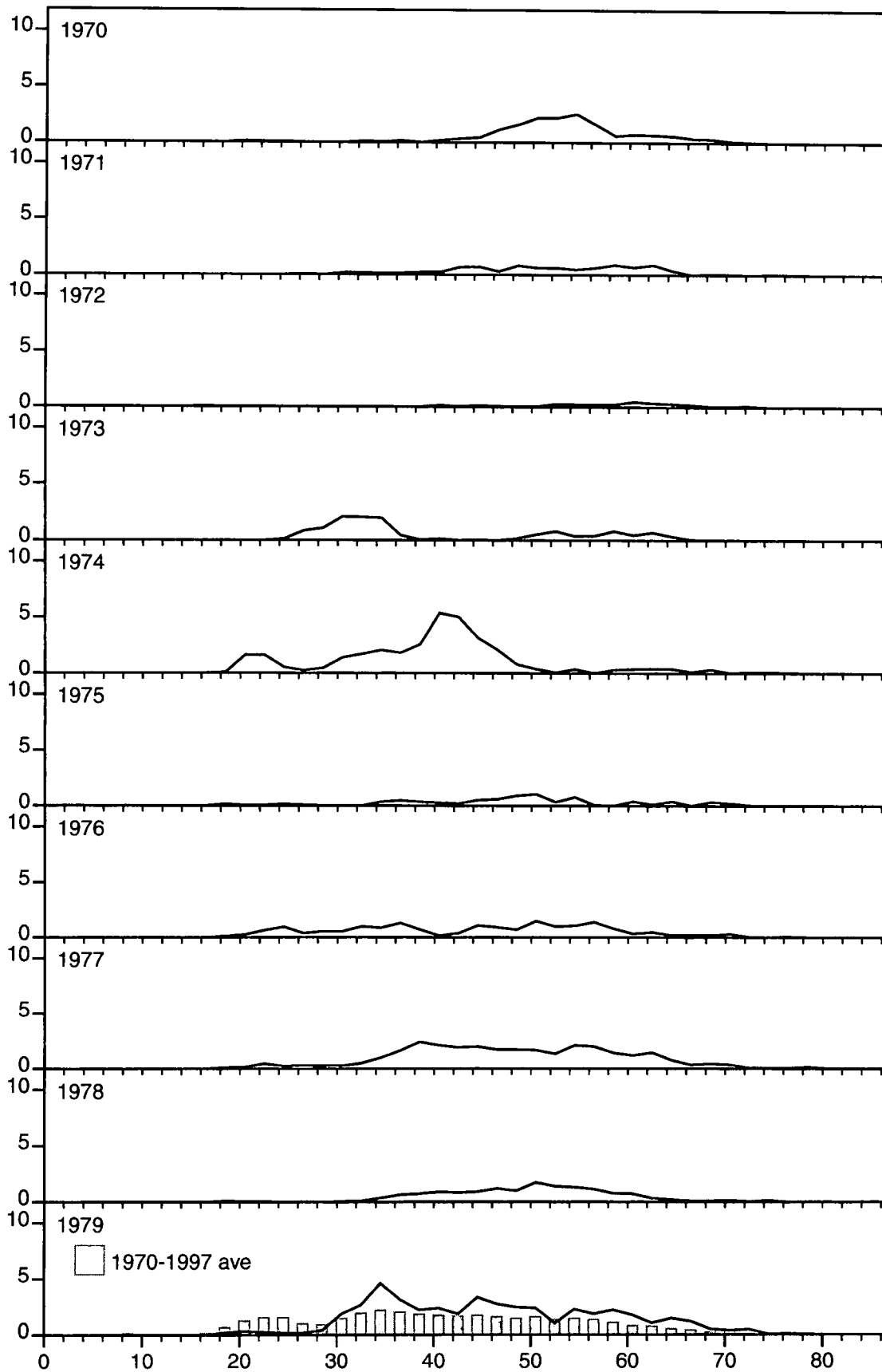


Figure 19a. Mean numbers-at-length per tow for 4X haddock (Bay of Fundy component strata 482-495) from research vessel surveys, 1970-79 (bars represent long term mean).

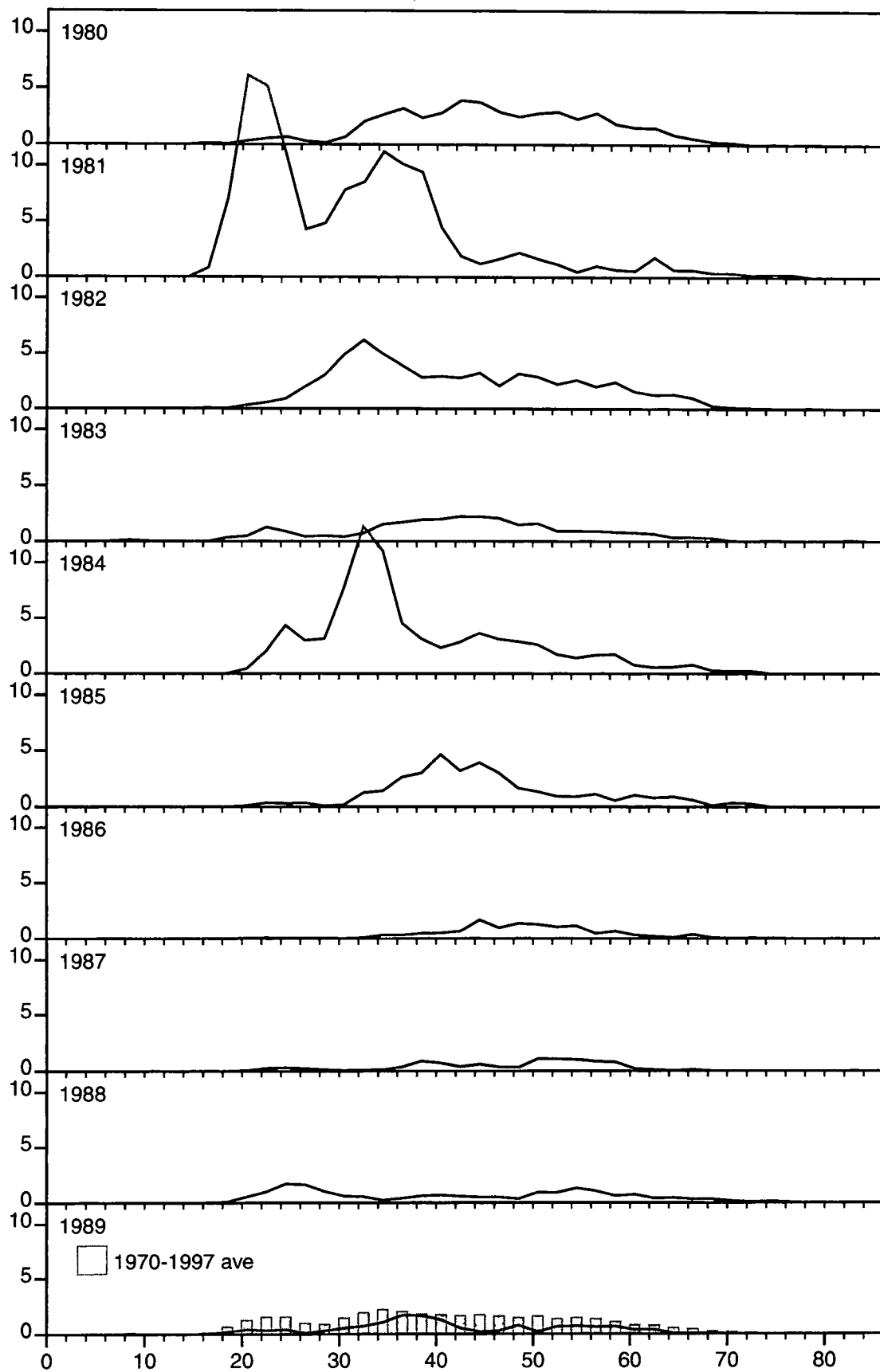


Figure 19b. Mean numbers-at-length per tow for 4X haddock (Bay of Fundy component strata 482-495) from research vessel surveys, 1980-89 (bars represent long term mean).

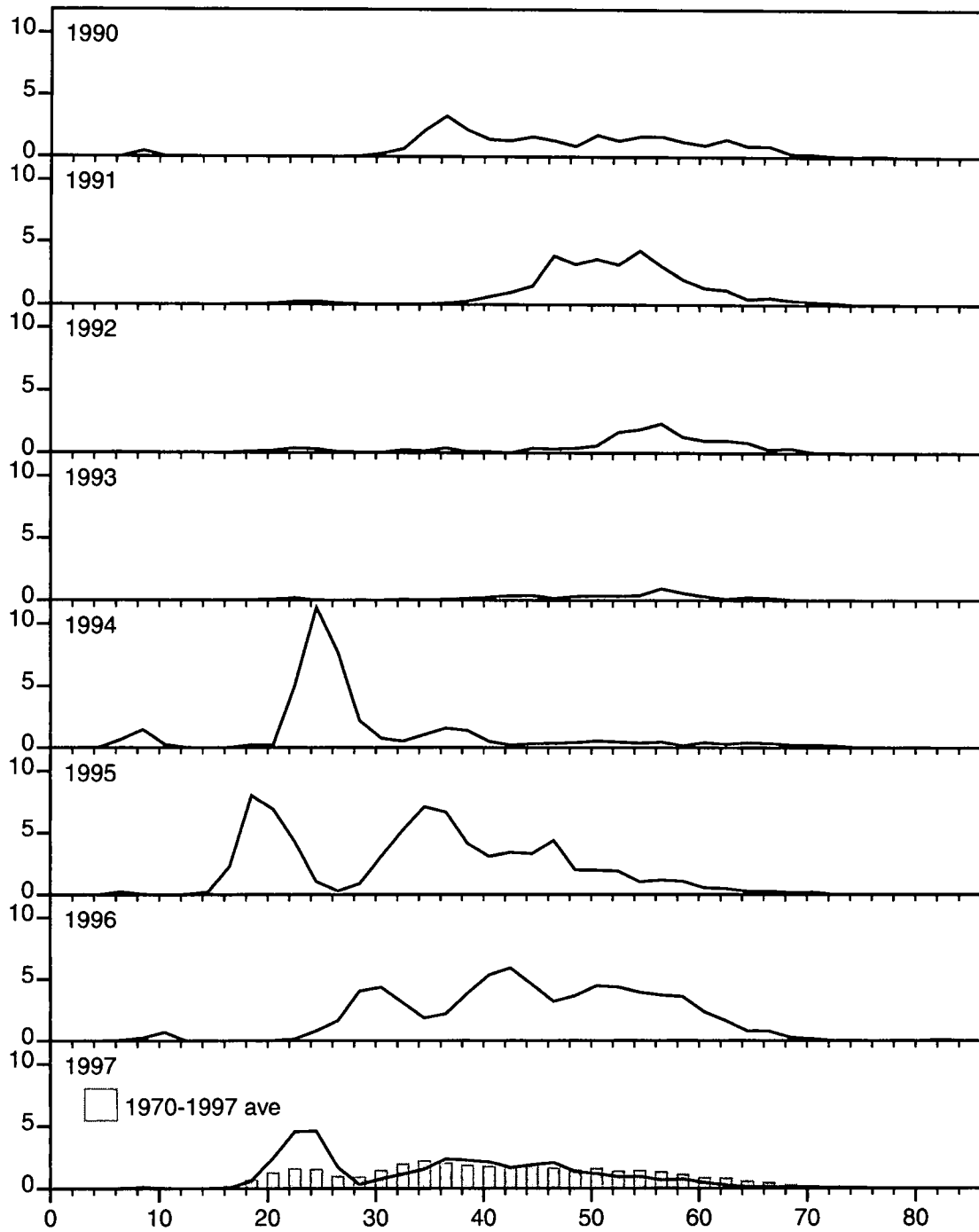


Figure 19c. Mean numbers-at-length per tow for 4X haddock (Bay of Fundy component strata 482-495) from research vessel surveys, 1990-97 (bars represent long term mean).

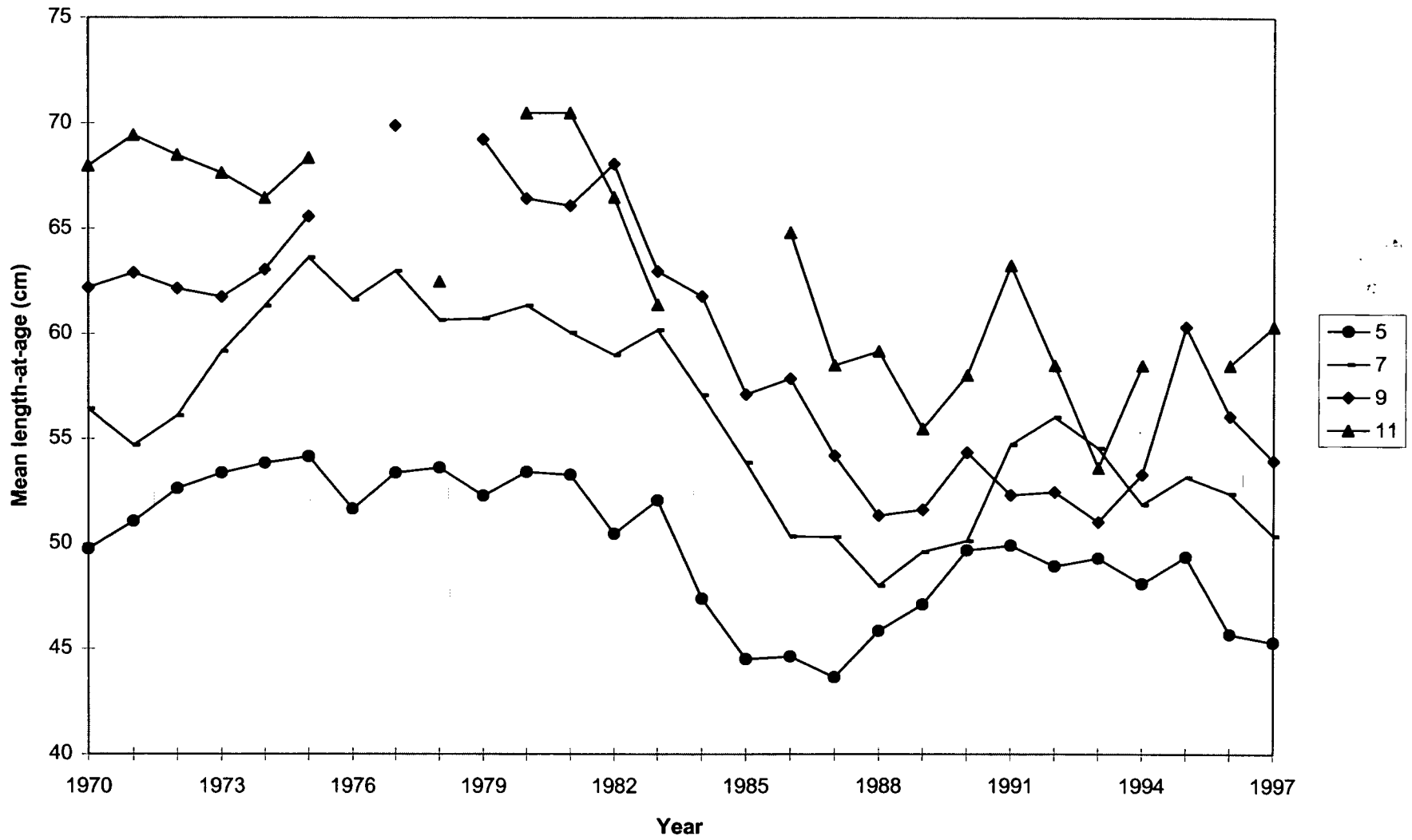


Figure 20. 4X Haddock summer RV survey mean length-at-age (cm) for Scotian Shelf component, strata 470 - 481.

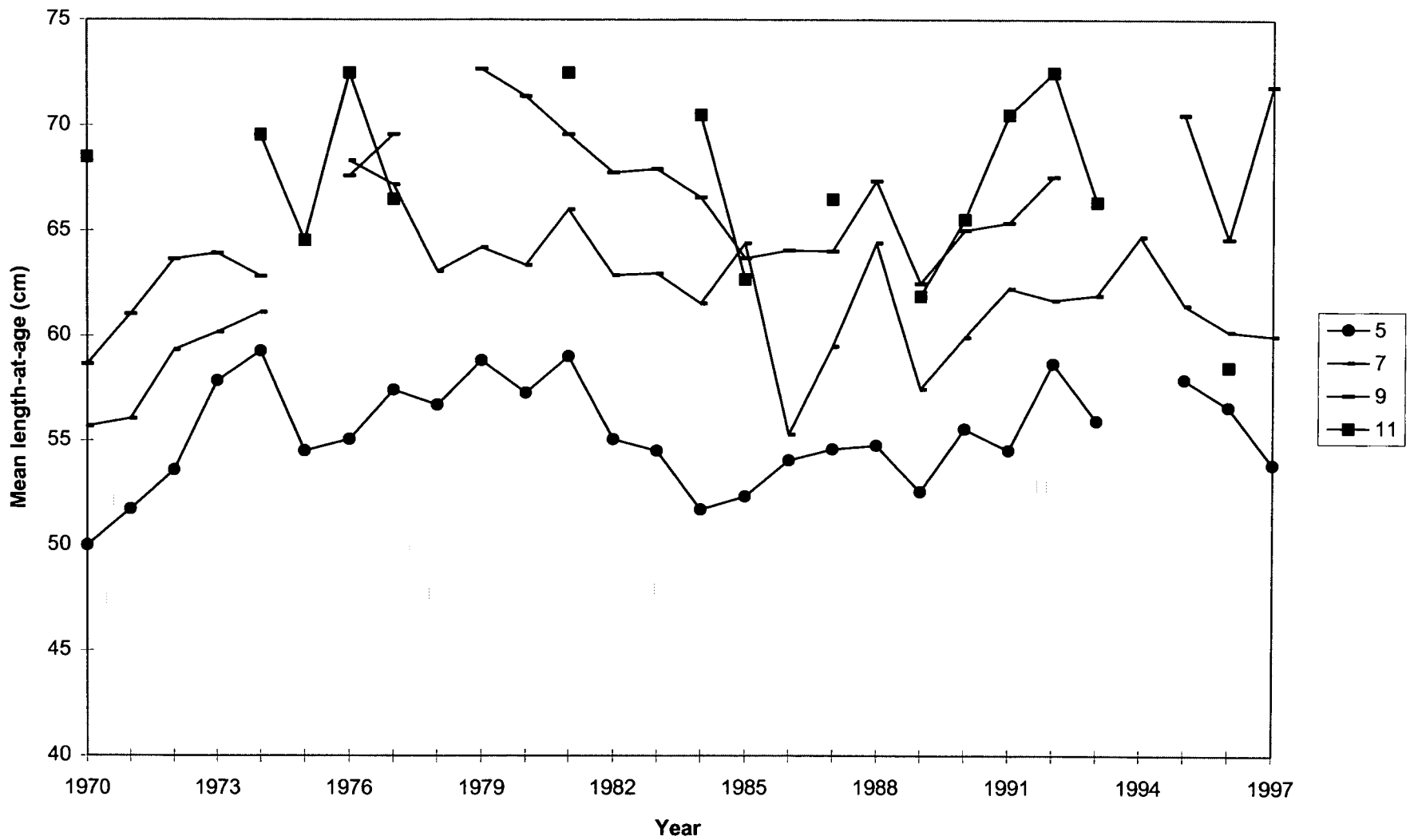


Figure 21. 4X Haddock summer RV survey mean length-at-age (cm) for the Bay of Fundy component, strata 482-491, 495.

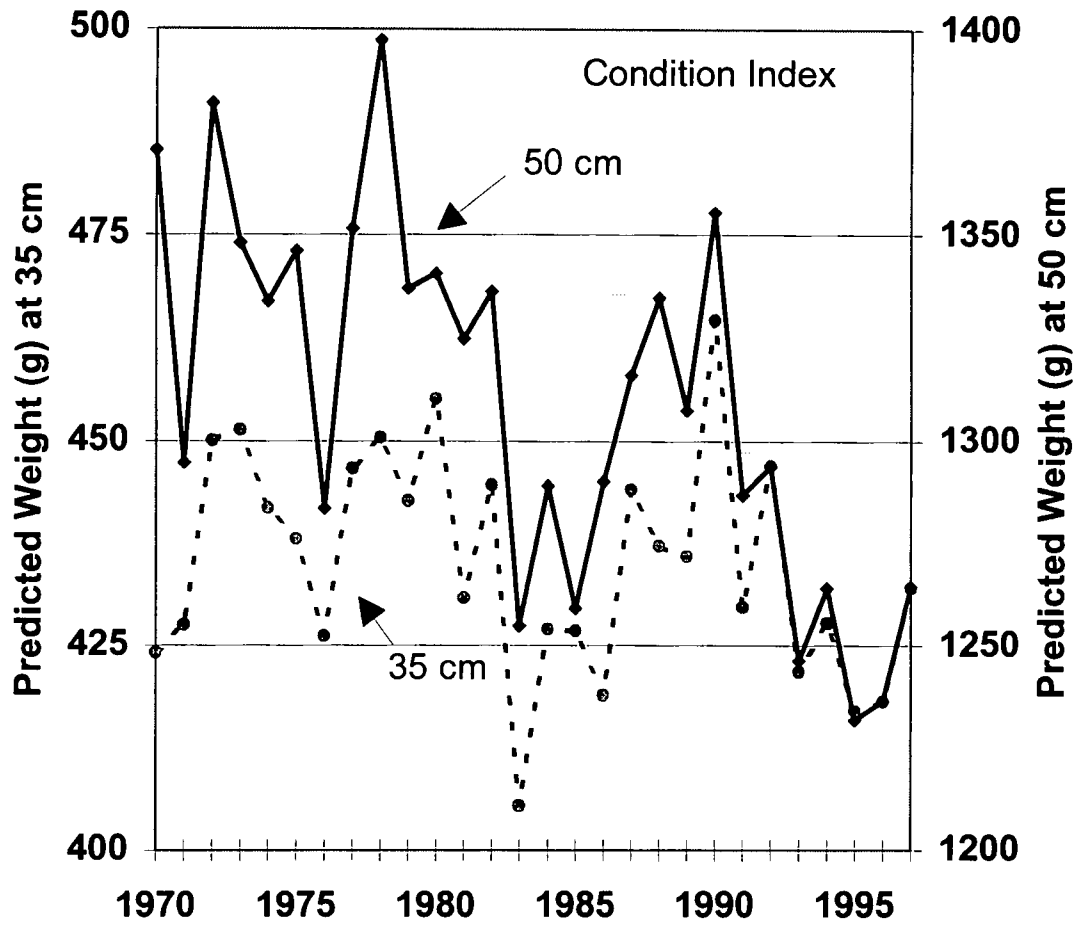


Figure 22. Trends in predicted weight (g) for a 35cm and 50cm haddock in NAFO Division 4X.

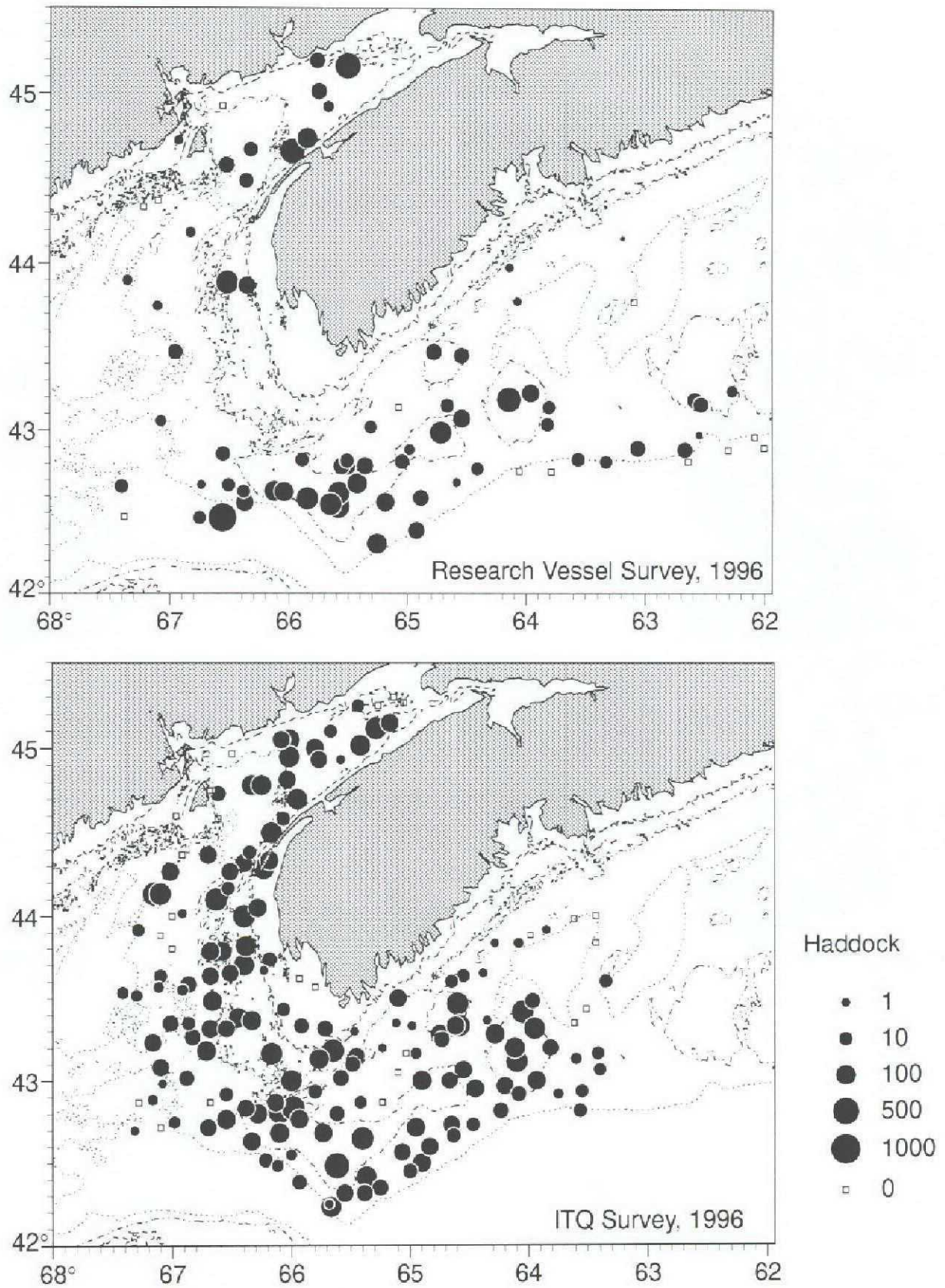


Figure 23. Haddock catches (kg. per standard tow) in 1996 Research Vessel Survey and ITQ Survey.



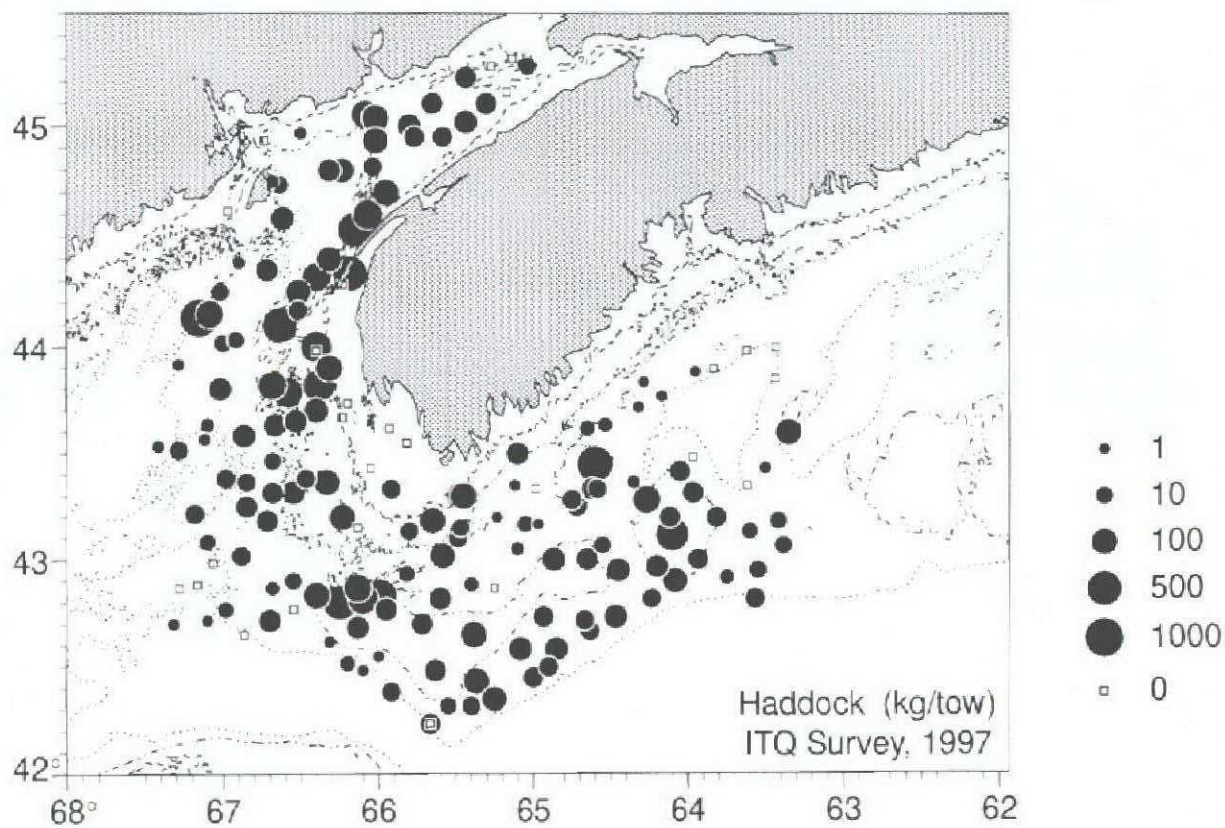
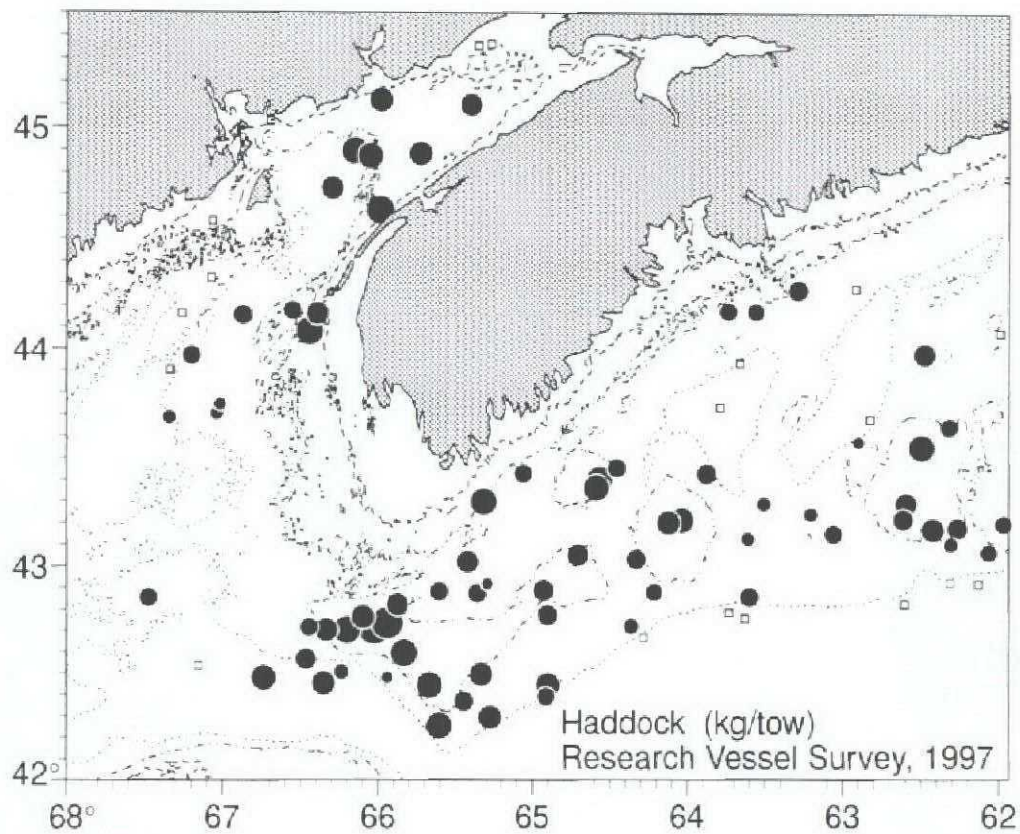


Figure 24. Haddock catches (kg. per standard tow) in 1997 Research Vessel Survey and ITQ Survey.



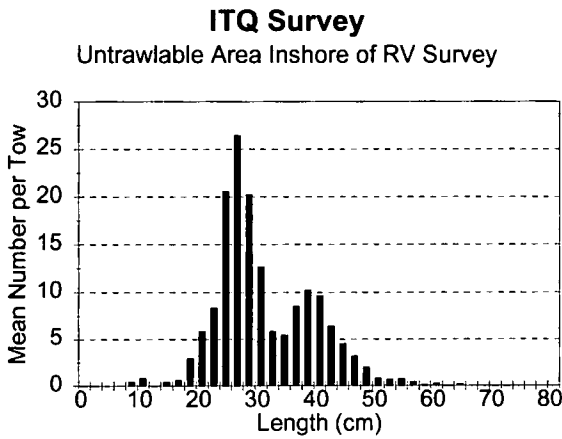
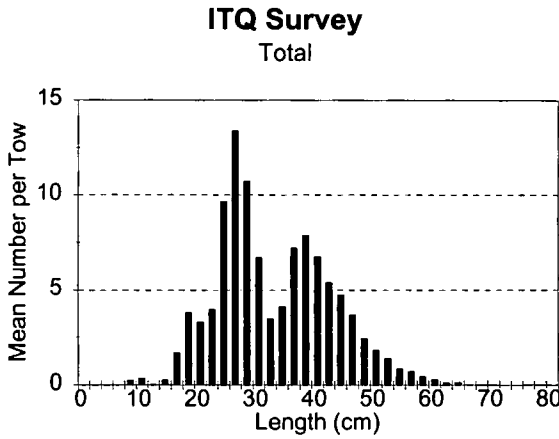
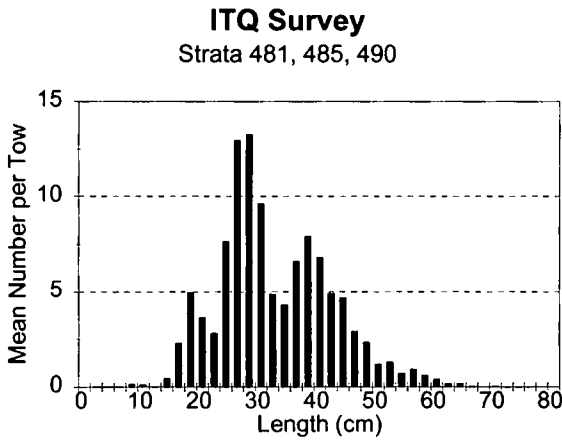
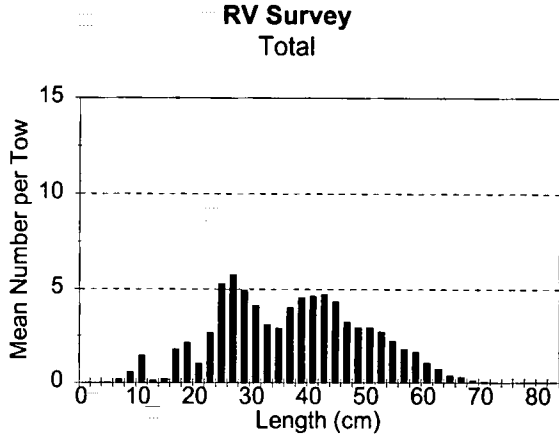
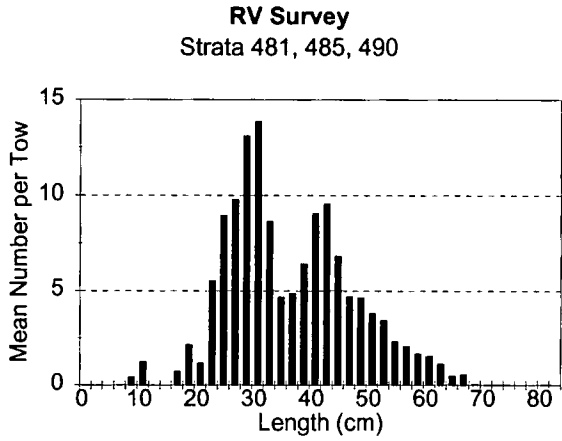


Figure 25. Length frequency distributions from the Research Vessel Survey (July 4 - 15, 1996) and ITQ Survey (July 8 - 18, 1996).

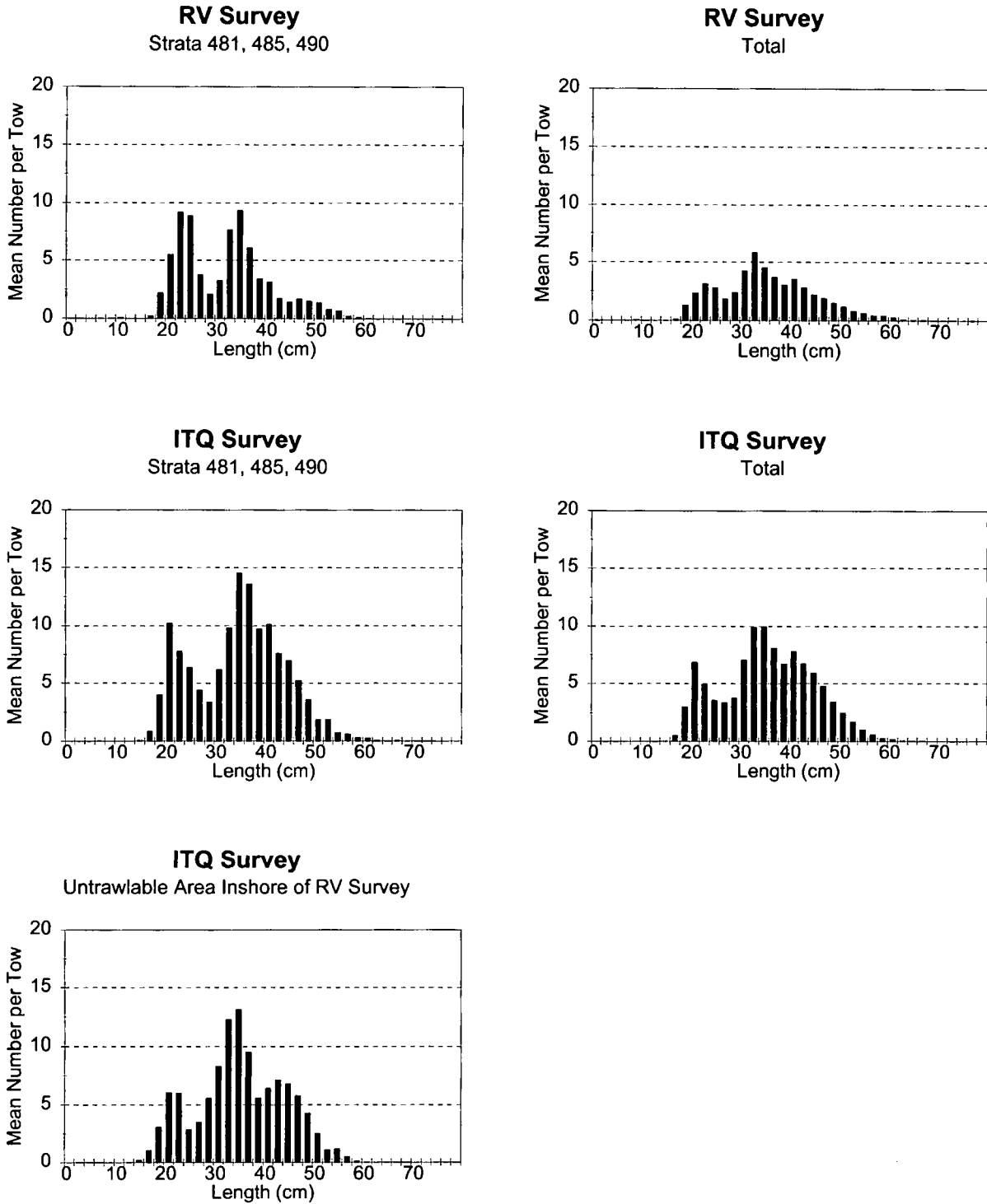


Figure 26. Length frequency distributions from the Research Vessel Survey (July 2 - 16, 1997) and ITQ Survey (June 30 - July 9, 1997).

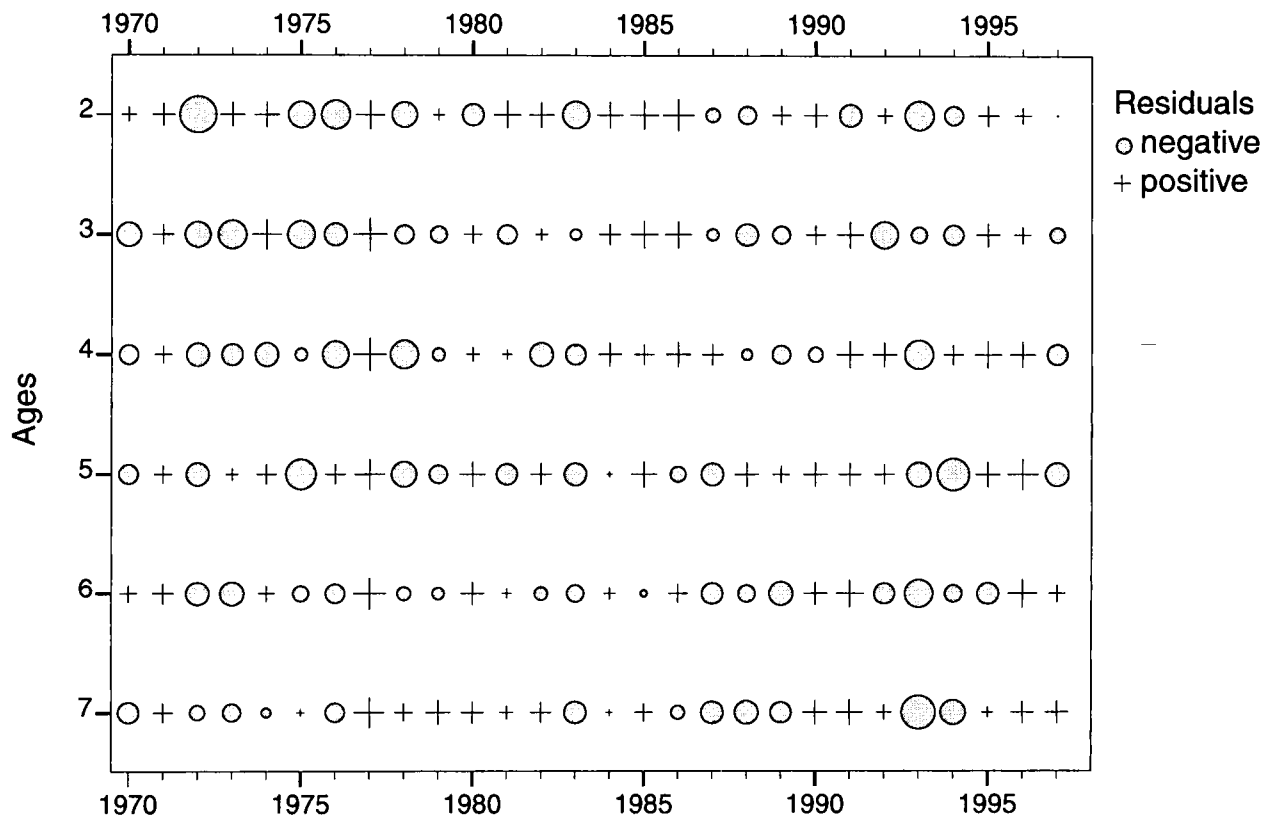
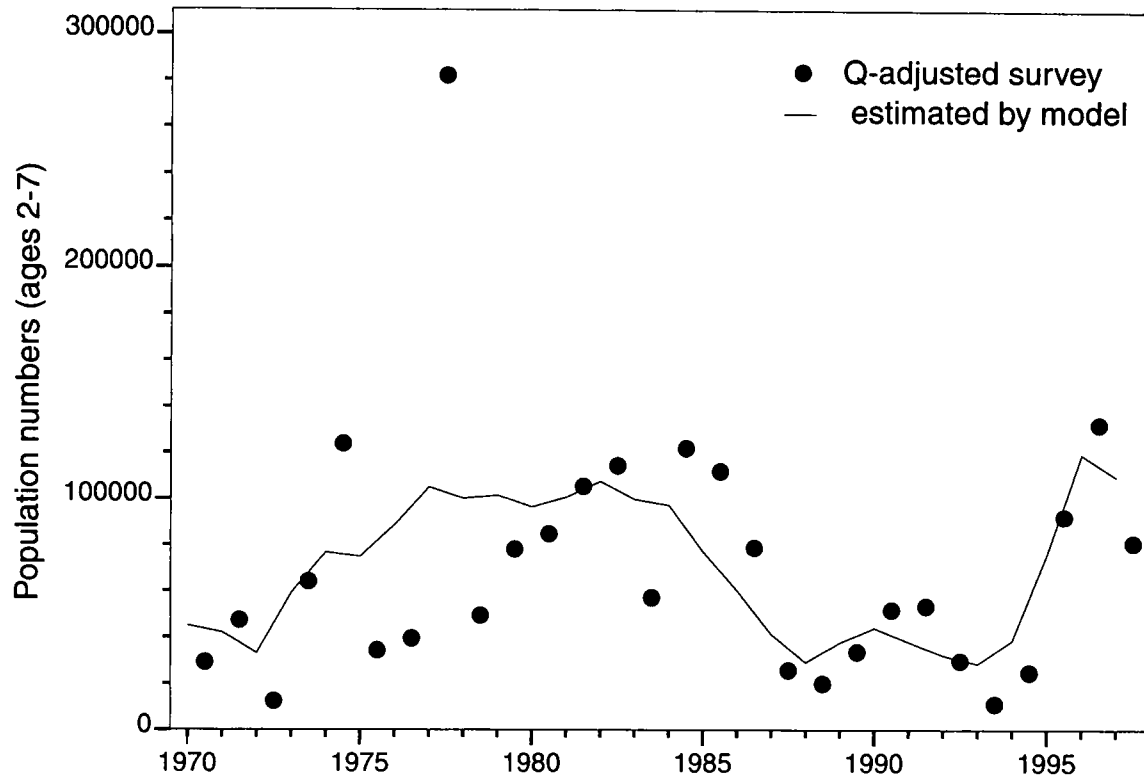


Figure 27. SPA results.

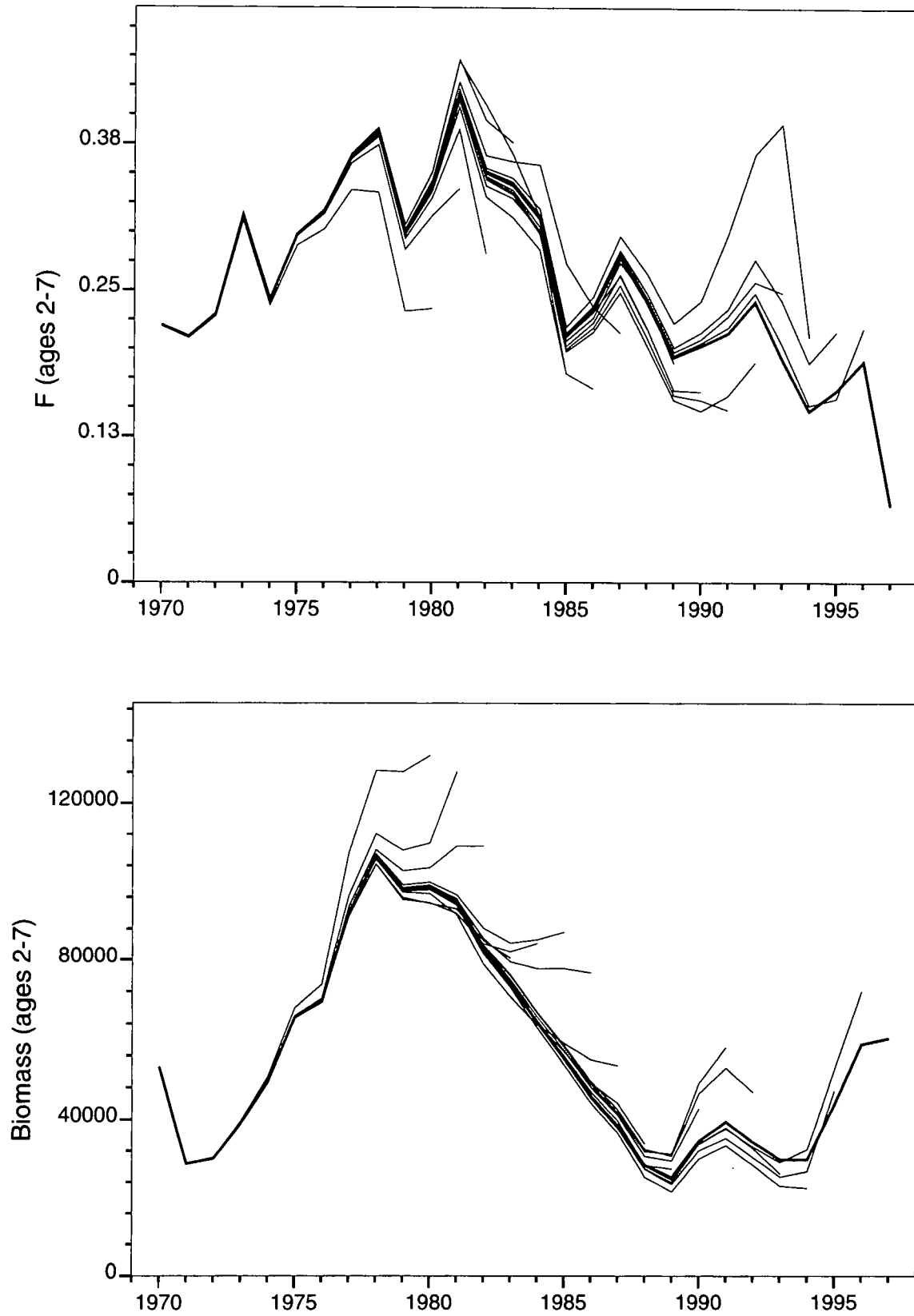


Figure 28. Retrospective analysis of SPA results.

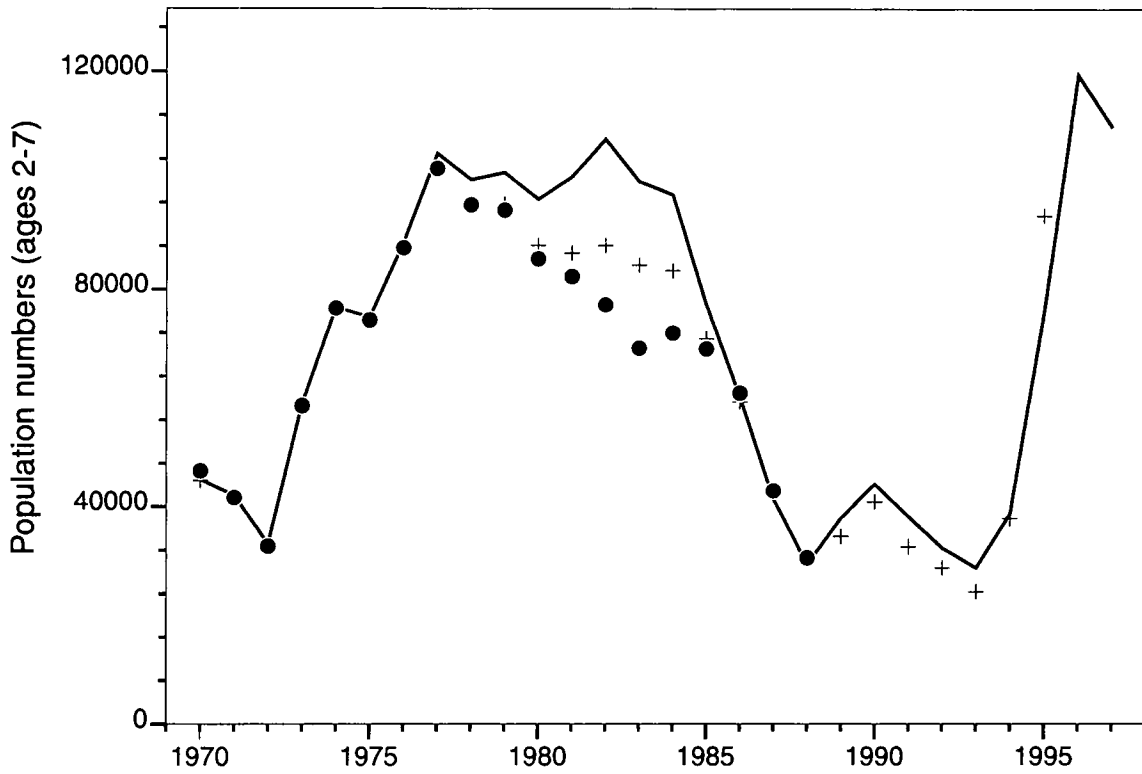
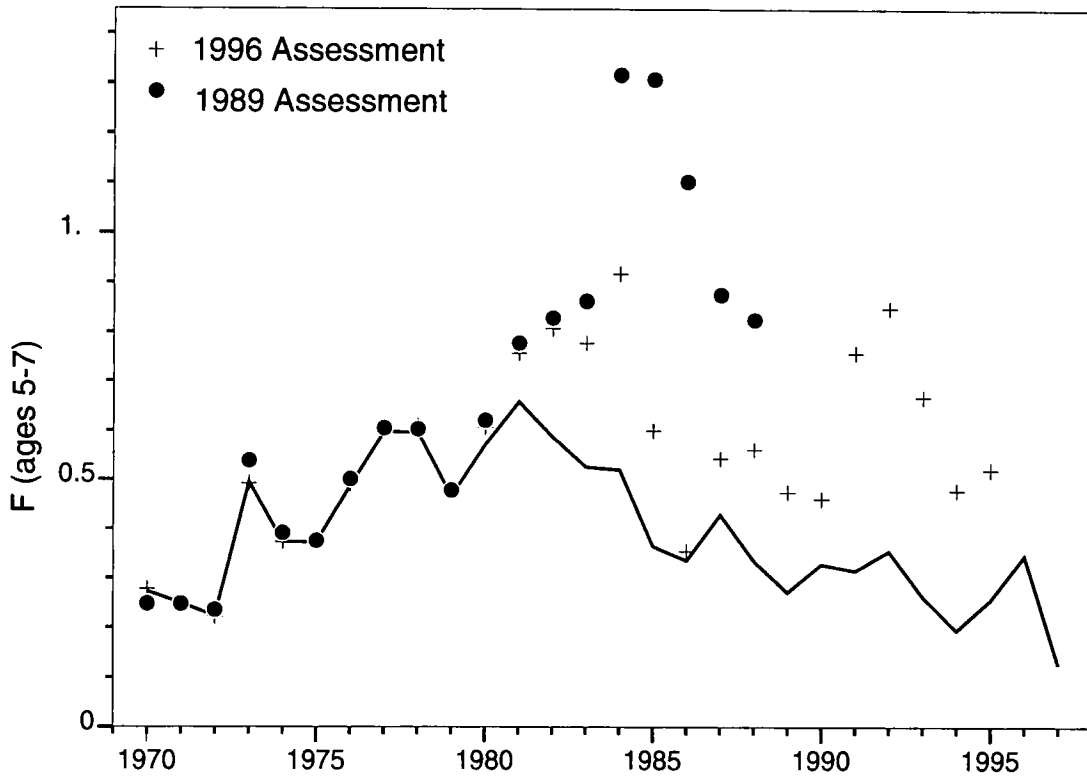


Figure 29. Comparison to previous analyses.

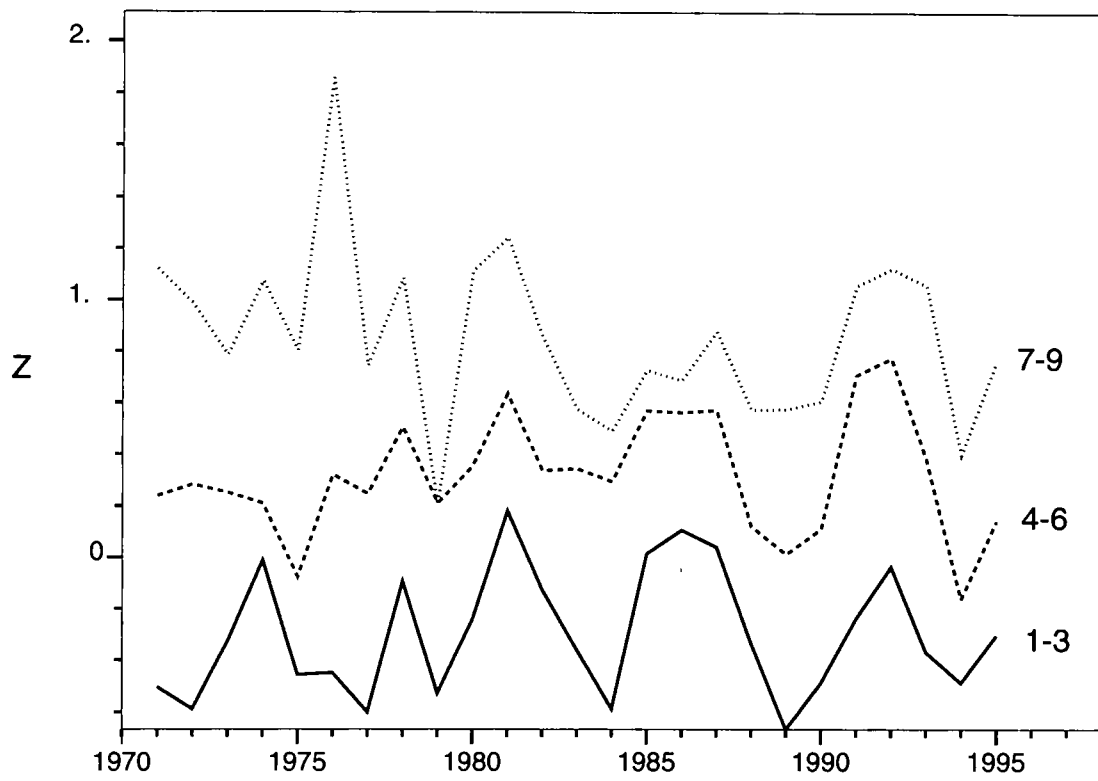


Figure 30a. Total mortality (Z) for ages 1-3, 4-6, and 7-9.

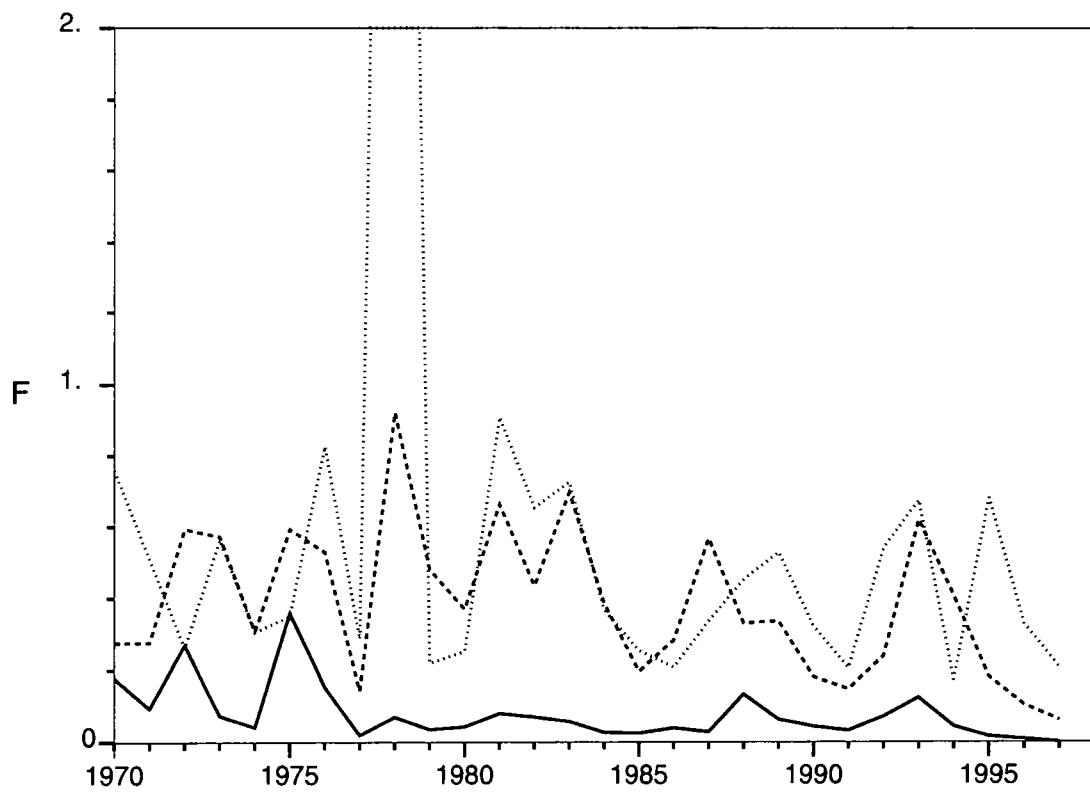


Figure 30b. Relative F for ages 1-3, 4-6, and 7-9.

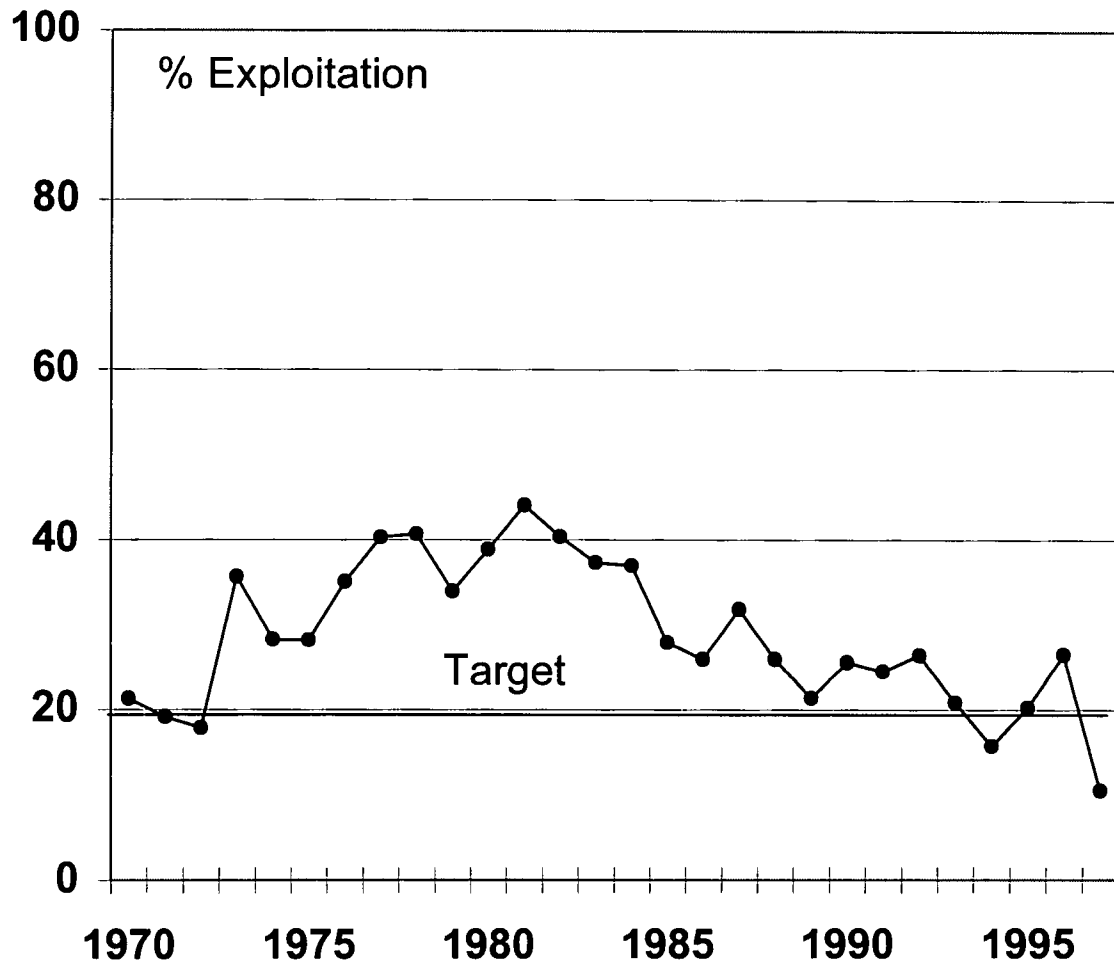


Figure 31. Exploitation level (%) for 4X haddock 1970-97 from this assessment.

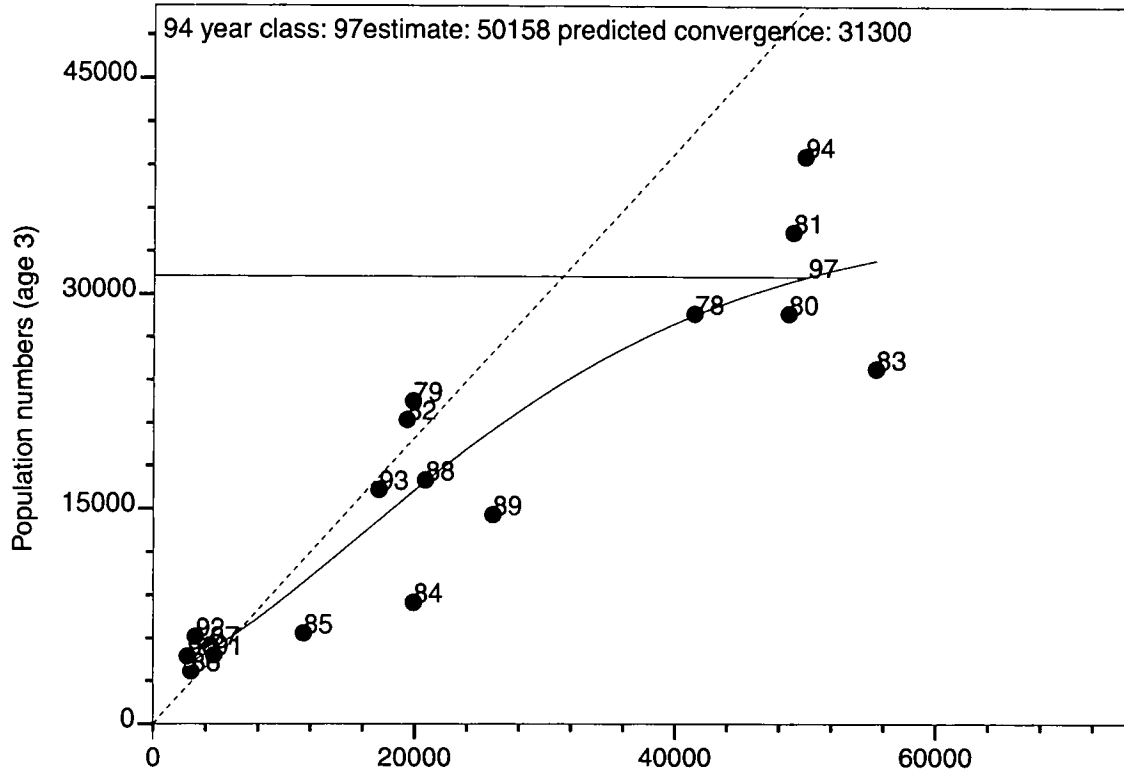


Figure 32a. Contemporaneous and 'converged' SPA estimates of age 3 numbers. The solid line is a Gompertz fit and the dashed line is unit slope. The numbers denote year.

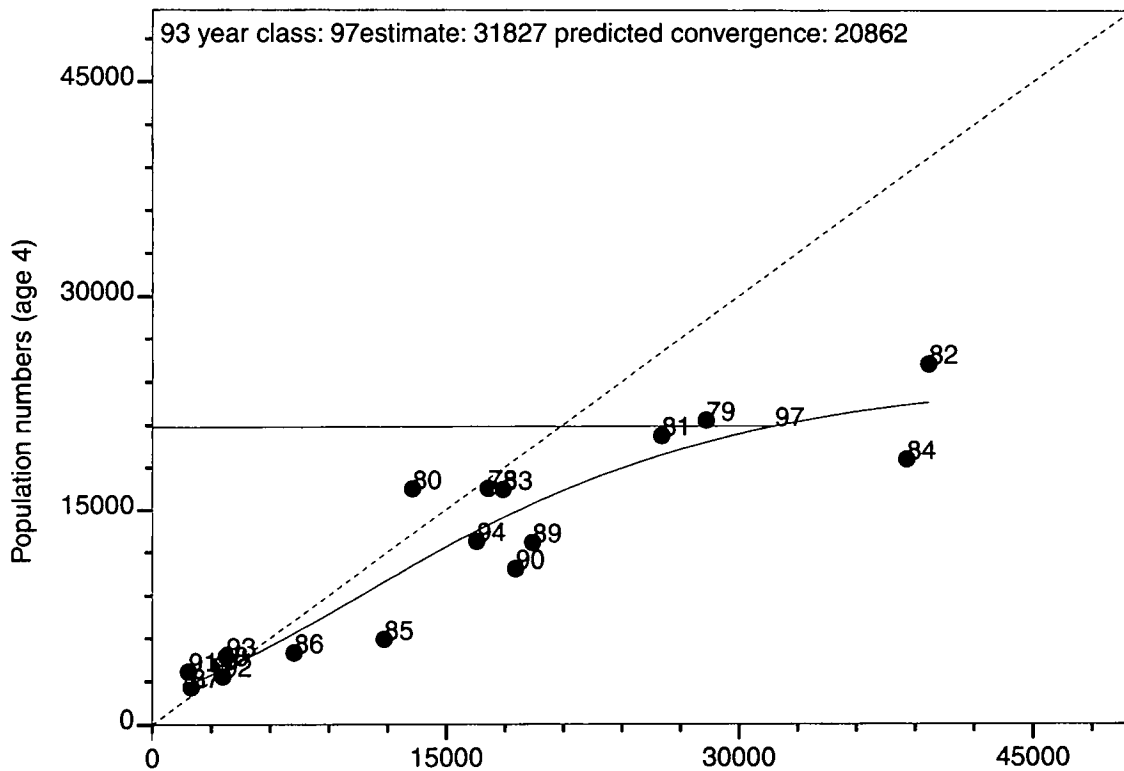


Figure 32b. Contemporaneous and 'converged' SPA estimates of age 4 numbers. The solid line is a Gompertz fit and the dashed line is unit slope. The numbers denote year.



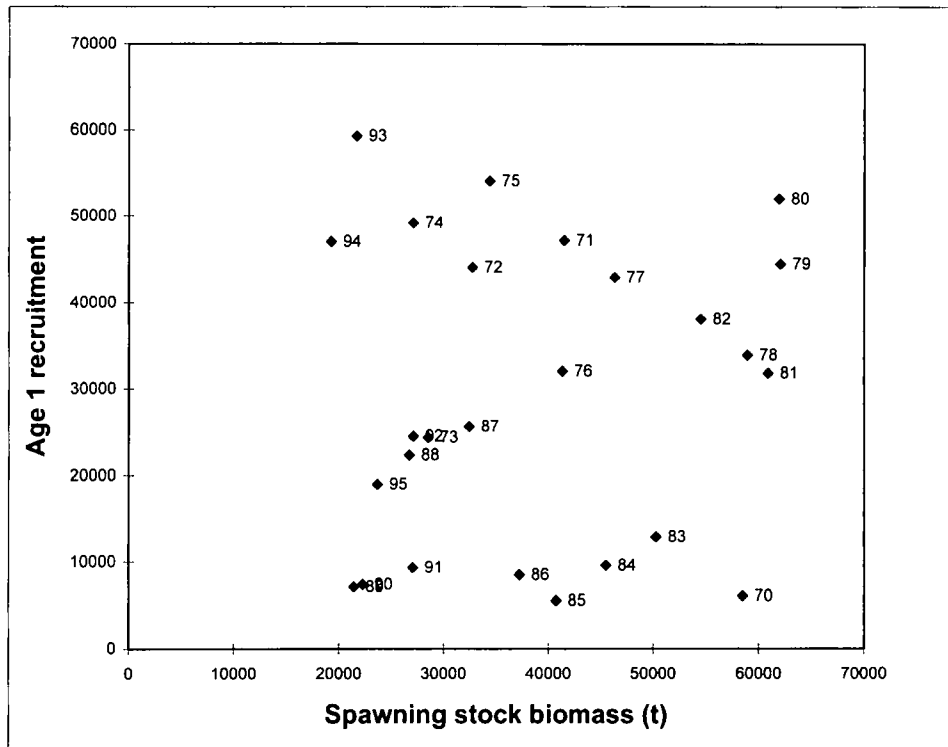
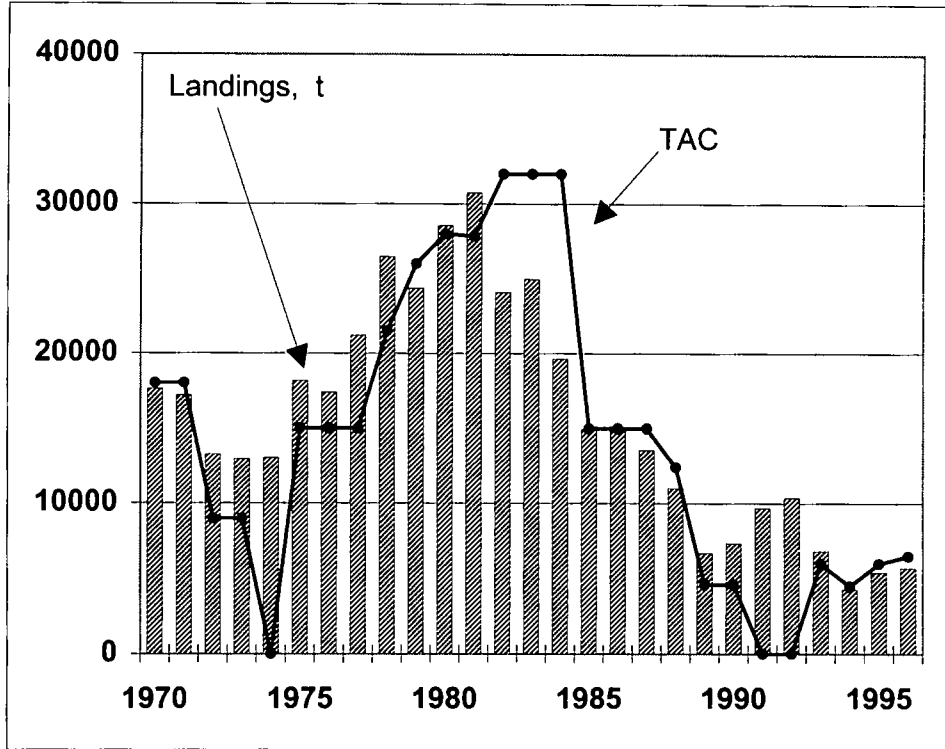


Figure 33. 4X haddock spawning stock biomass and age 1 recruitment in the subsequent year.

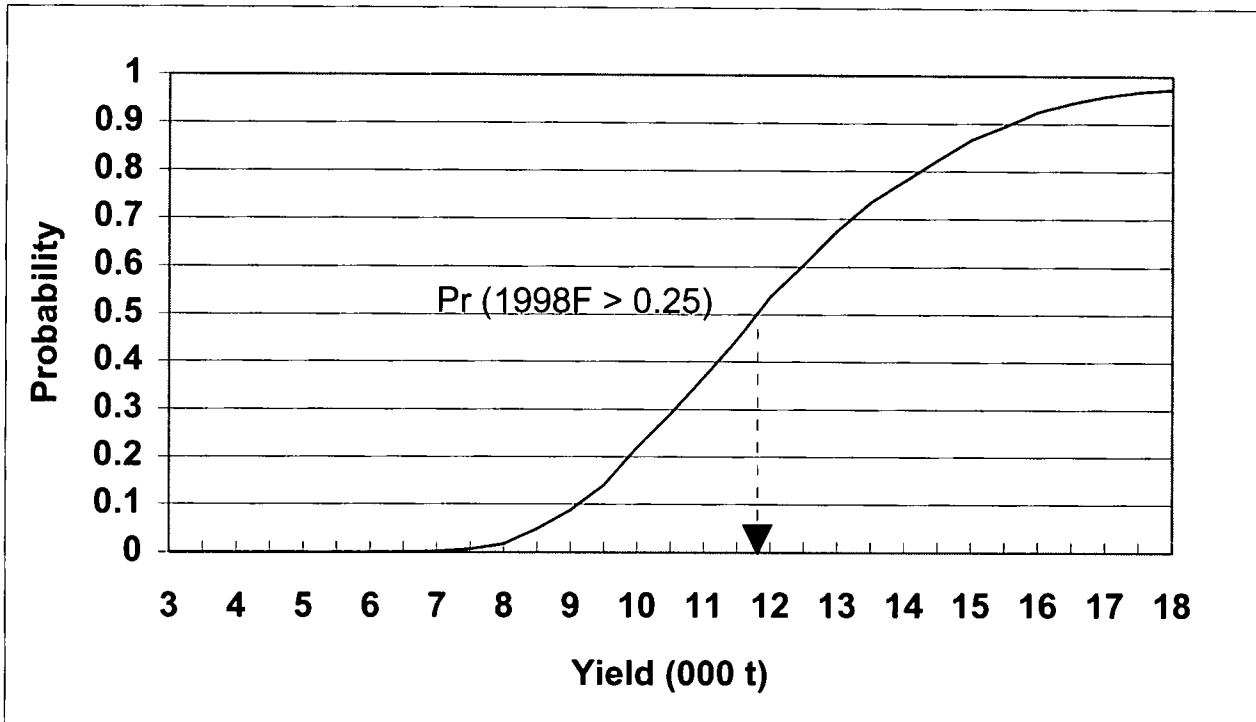


Figure 34a. Probability that  $F_{0.1}$  will be exceeded at various levels of yield in 1998 from 4X haddock projection. (1994 yearclass adjusted).

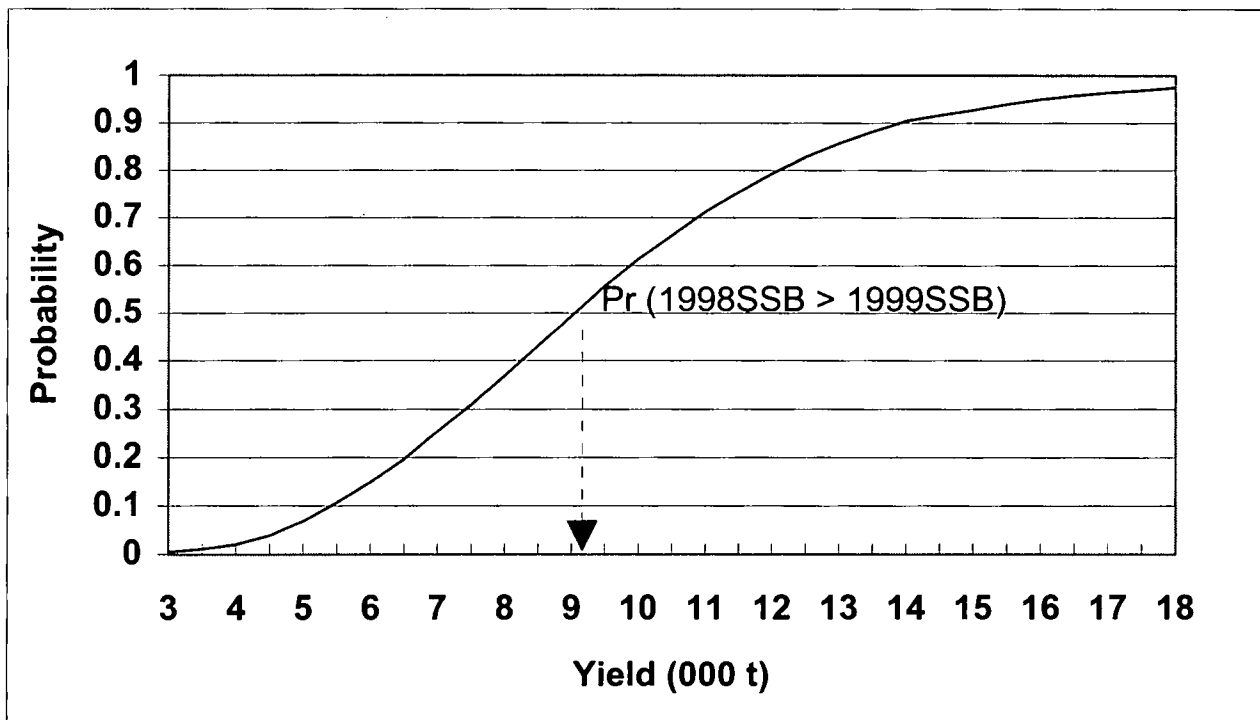


Figure 34b. Probability that spawning stock biomass will decrease at various levels of yield in 1998 from 4X haddock projection (1994 yearclass adjusted).

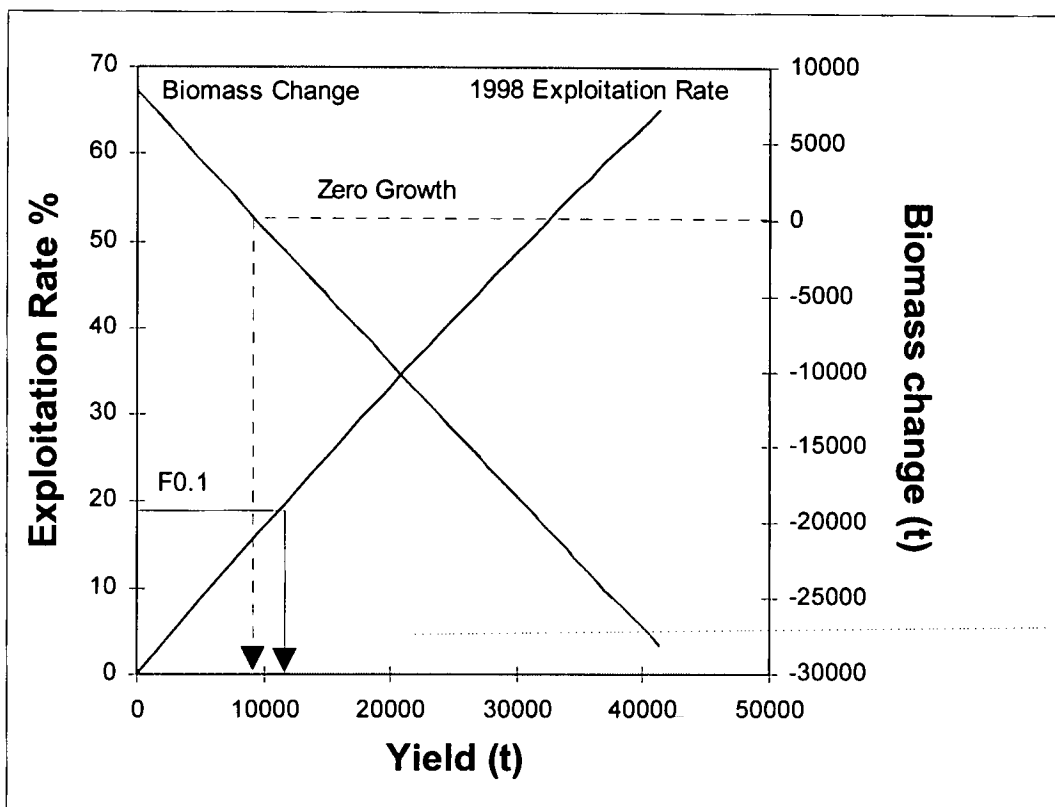


Figure 35. 4X haddock projection showing trajectories of exploitation rate and change in spawning stock biomass at various levels of yield in 1998 (1993 yearclass adjusted).

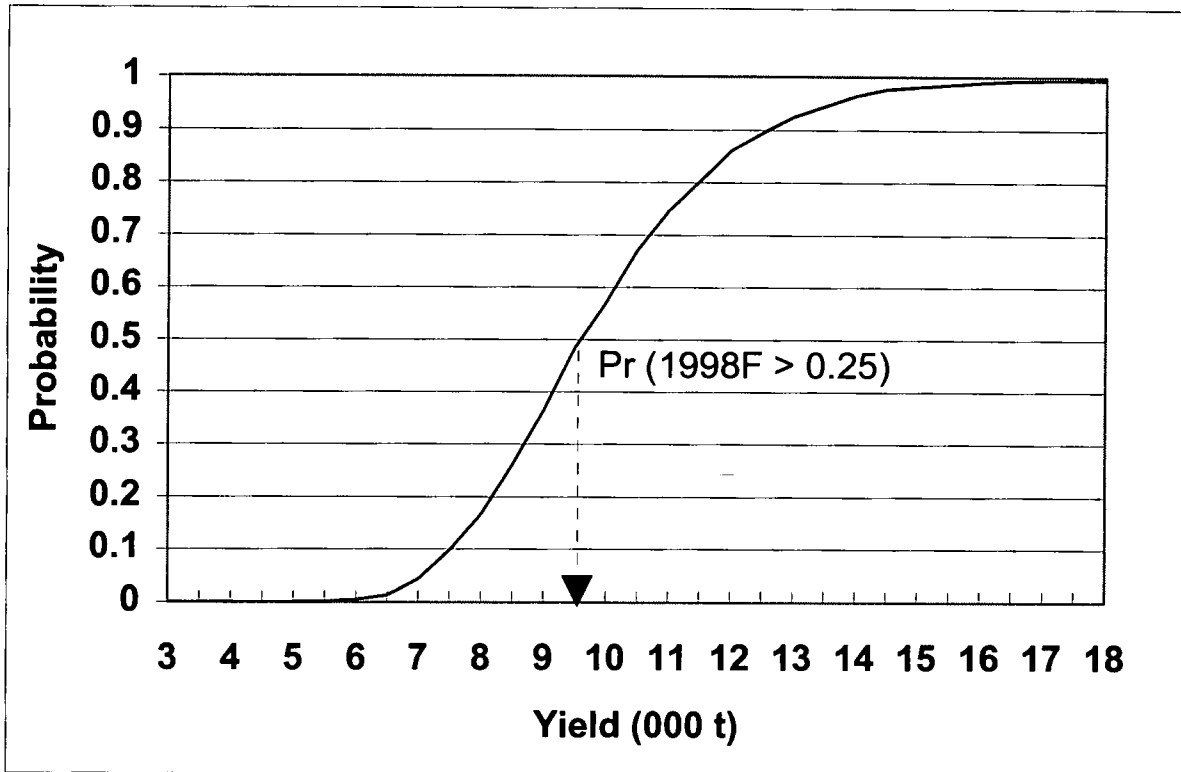


Figure 36a. Probability that  $F_{0.1}$  will be exceeded at various levels of yield in 1998 from 4X haddock projection (1993 and 1994 yearclasses adjusted).

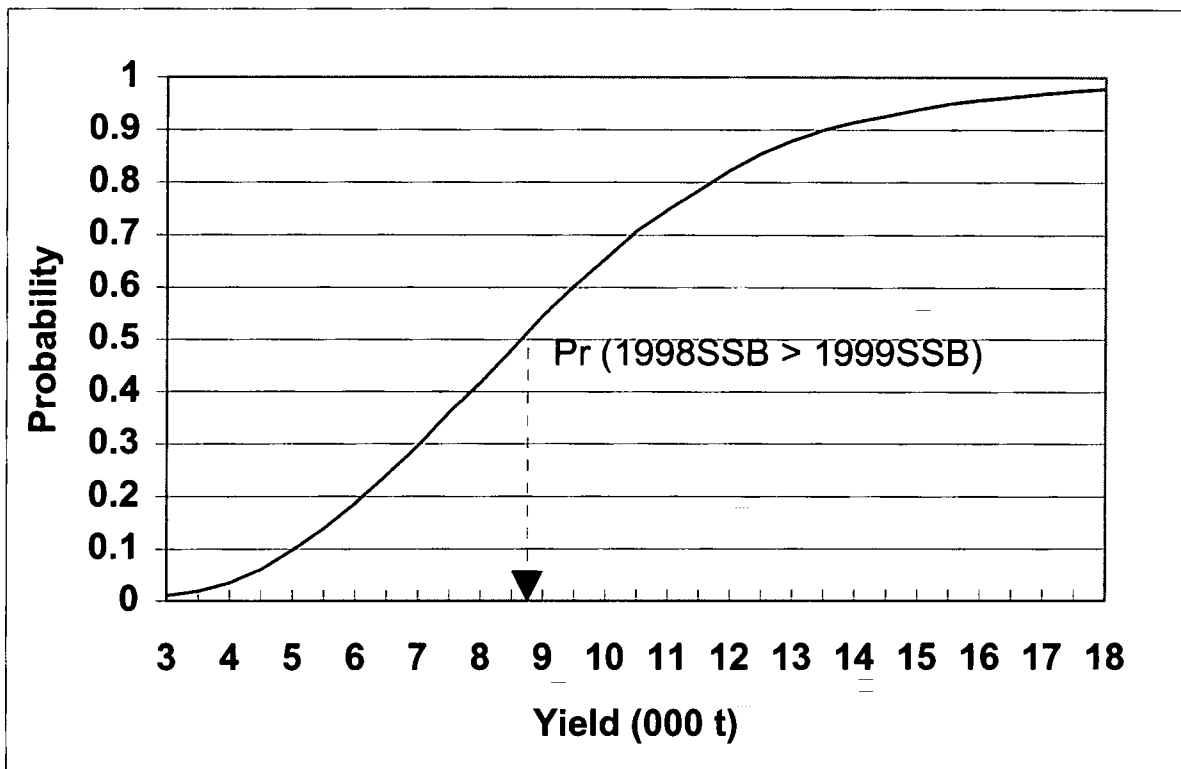


Figure 36b. Probability that spawning stock biomass will decrease at various levels of yield in 1998 from the 4X haddock projection (1993 and 1994 yearclasses adjusted).

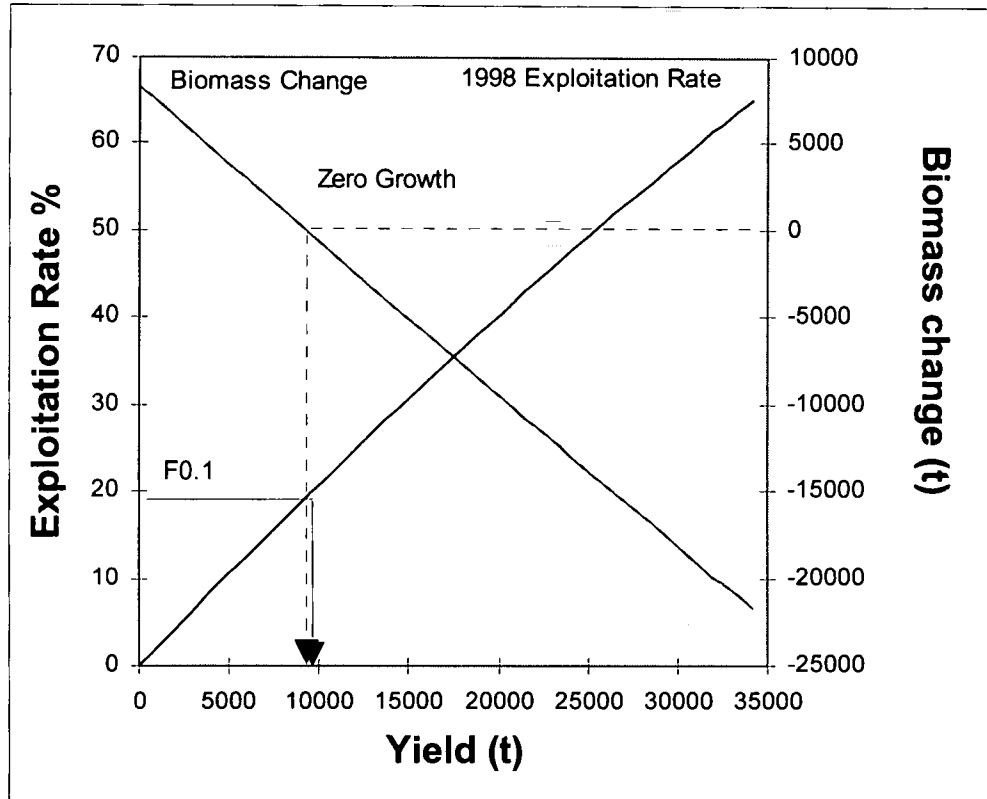


Figure 37. 4X haddock projection showing trajectories of exploitation rate and change in spawning stock biomass at various levels of yield in 1998 (1993 and 1994 yearclasses adjusted).