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Assessment of the Status of Division 4X/5Y Haddock in 2003

Évaluation de l'état du stock d'aiglefin des divisions 4X/5Y en 2003

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Abstract

The quota for NAFO Division 4X/5Y haddock has remained at 8,100t for the last 5 years. Reported landings have been close to the quota each year. The quota in 2003 is 10,000t. Abundance has been increasing since the early 1990s and is presently near the high levels observed in the late 1970s. Size-at-age and growth have decreased since 1970, particularly at older ages. Exploitation rate for ages 5-7 decreased from approximately 50% in the early 1980s to below 20% (corresponds to currently used $F_{0.1}$=0.25) since 1994. Partial recruitment has changed in recent years and fully recruited ages have changed from 5-7 to 8-10. Exploitation on fully recruited ages (8-10) has remained high at about 20%. The 1998 yearclass is estimated to be the largest observed in the time series, and the 1999 yearclass is estimated to be very large; however due to the retrospective pattern these yearclasses may be substantially over-estimated. Spawning stock biomass (ages 4+) is estimated to increase to a high in 2004 and then decrease subsequently unless further strong recruitment occurs. Projected yield at $F_{0.1}$ in the 2004 fishing year is estimated to be 11,000t; however due to the retrospective pattern, this may also be over-estimated. Emphasis should be on how the potential yield from the current good recruitment is to be utilised over time. The catch of cod in the mixed groundfish fishery is a concern and conservation of cod should be considered in the management plan for this fishery.

Résumé

Le quota pour l'aiglefin des divisions 4X/5Y de l'OPANO se chiffrait à 8 100 t pour chacune des cinq dernières années et les prises annuelles signalées se rapprochaient du quota. Le quota pour 2003 a été fixé à 10 000 t. L'abondance est à la hausse depuis le début des années 1990, se situant actuellement près des pics observés à la fin des années 1970. La taille selon l'âge et le taux de croissance ont diminué depuis 1970, en particulier chez les individus âgés. Le taux d'exploitation des âges 5 à 7 a diminué, passant d'environ 50 % au début des années 1980 à moins de 20 % (taux correspondant au F0,1 = 0,25 actuellement utilisé) depuis 1994. Le recrutement partiel a changé dans les dernières années et les âges pleinement recrutés sont passés de 5 à 7 à 8 à 10. Le taux d'exploitation des âges pleinement recrutés (8-10 ans) est encore élevé, se situant à environ 20 %. La classe d'âge 1998 est considérée comme la plus abondante de la série chronologique et celle de 1999 très abondante, mais à cause du profil rétrospectif, il se peut que leurs effectifs soient considérablement surestimés. On prévoit que la biomasse du stock reproducteur (individus de 4 ans et plus) atteindra un pic en 2004 puis diminuera par après à moins qu'un recrutement important se manifeste. Le rendement prévu de la pêche à F0,1 en 2004 devrait atteindre 11 000 t, mais à cause du profil rétrospectif, ceci pourrait aussi être une surestimation. Comment utiliser au fil du temps le rendement potentiel du bon recrutement actuel devrait être un objectif de gestion. La capture de la morue lors de la pêche mixte du poisson de fond étant une préoccupation, il faudrait tenir compte de la conservation de l'espèce dans le plan de gestion de cette pêche.

Introduction

This document contains an evaluation of the haddock stock on the southern Scotian Shelf and Bay of Fundy (NAFO Division 4X). As in previous assessments of this stock (Hurley et al. 2002, 1999), haddock caught by Canadian fishermen in NAFO Division 5Y are included in the management unit. Haddock in the Bay of Fundy area grow faster than haddock on the southern Scotian Shelf. As a result, haddock landings from 4Xmnop and 4Xqrs5Y are handled separately and separate age/length keys are used for landings from the two areas, designated as Scotian Shelf and Bay of Fundy stock components respectively (Figure 1). Similarly haddock catches from the summer research vessel survey strata 470-481 and 482-495 are handled separately, as Scotian Shelf and Bay of Fundy components. In 1999, the fishing year changed from January to December to April to March.

Quota management was introduced for this stock by ICNAF in 1970 and a seasonal spawning closure of Browns Bank was instituted that same year. The current closure extends from February 1 to June 15. The history of this area closure is documented by Halliday 1988.

This assessment includes the summer research vessel survey data from the current year, together with commercial landings data for the first half of the year and port samples of those landings, to determine stock status in the current year and make yield projections for the fishing year 2004-05. The results of an industry survey were also used in the assessment.

The Fishery

The long-term (1948-2002) reported annual landings of haddock in NAFO Division 4X/5Y average about 18,000t. Landings exceeded 30,000t during the mid- to late 1960s and again during the early 1980s (Table 1 and 2, Figure 2). Landings declined subsequently and have been below the long-term average since 1984. Landings reached 6,800t in 1989 when it was recommended that the fishery be maintained at the lowest possible level and the mobile gear fleet was closed in mid-season. Landings increased from 1989 to exceed 10,000t in 1992 under a Management Plan that called for a by-catch fishery only. Landings in 1994 were 4,406t, the lowest level in recent history, under a quota of 4,500t and stringent fishing plans. Quotas have not been exceeded since then. The TAC of 8,100t established for the 12-month fishery in 1999 was extended to 9,800t for the 15-month period ending March 31, 2000, based on the proportion of landings in the first quarter of the year over the previous 10 years. The fishing year since then has been April 1 to March 31. The quota remained at 8,100t for the next 3 years and landings have been close to the quota. The quota in the 2003/4 fishing year was initially set at 8,100t but was increased to 10,000t in September 2003.

The fishery was dominated by the mobile gear sector between 1977 and 1989 (Table 3). Between 1990 and 1994, the fixed gear sector took a larger proportion of the landings; however the proportion taken by the mobile gear sector has increased since and was 71% in 2002 (Table 4, Figure 3). Fixed gear landings are primarily from longlines. Landings by handlines have been small and have been declining since 1994.

Several recent changes to the management of this fishery have had a significant impact on the timing of the fishery. As a result of the change to an April-March fishing year in 2000, haddock landings in the first quarter (January-March) of 2000 and 2001 were the highest since 1992 (Table 4a, Figure 4). Landings in the first quarter of 2002 and 2003 were also high. Both the fixed gear

and mobile gear sectors indicate this is due primarily to the ability to direct for haddock with a minimal bycatch of cod at that time of year.

This change in timing of the fishery has also led to changes in the distribution of catches. The proportion of catches coming from 4Xn and 4Xp has been increasing in recent years (Table 4b, Figure 5). While the increase in 4Xn is largely a result of the increase in the winter fishery, the increase in catches in 4Xp reflects directing for larger haddock in deeper water, which generally returns higher market value and also is an area in which the bycatch of cod is relatively low.

Nominal landings of 4X/5Y haddock in the fishing year ending March 31, 2003, were 7,964t relative to a quota of 8,100t. The 2003 fishing year is progressing more slowly than last year (Table 4 and 5, Figure 6 and 7). Haddock landings from April to September were down 9% from the same period last year, while cod landings were down 20%. Groundfish landings overall were down 25% (11% if silver hake and dogfish are excluded). Some of this delay is due to the abundance of dogfish in 2003, particularly in eastern 4X. Low fish prices and uncertainty regarding the mid-season increase in the haddock quota also contributed to this delay.

Reports from industry indicate that haddock abundance has been good throughout the stock area in recent years although there were reports of changes in inshore distribution in the last year or two. Catches of small fish have been prevalent, particularly in eastern 4X. Reports indicate that discarding and misreporting of 4X/5Y haddock have been minimal in recent years.

Data

Age Composition of the Catch

Port samples of landings were used to construct a catch-at-age for 2002 and the first half of 2003 as in previous assessments of this resource. The age composition was derived by application of age/length keys to length frequencies, stratified by quarter and gear. Due to differences in growth rates between haddock on the Scotian Shelf and in the Bay of Fundy, landings are separated into 4Xmnop and 4Xqrs5Y and separate age/length keys were used, whenever possible. Seasonal length/weight parameters derived by O'Boyle et al. (1983) were used. When insufficient samples were available to satisfy the stratification, length frequencies were aggregated and a common age/length key was applied. In some cases, a key from one gear, quarter or area was applied to another where no otoliths were available. The gear and quarter aggregations are shown in Table 6 and 7.

As a routine check, the primary ager reads the 4X haddock otolith reference collection. A pair-wise comparison of ages showed high precision and little bias, with an overall coefficient of variation of 1.1% (Figure 8). These results were considered acceptable.

The resulting catch-at-age is shown in Table 8 and the age composition for 1996-2003 is shown in Table 9 and Figure 9. The 1998 yearclass began to recruit to the fishery in 2001. At age 4 in 2002, it made up 35% of the catch by weight. The 1999 yearclass began to recruit to the fishery in 2003 and made up 24% of the half-year catch by weight. The 1998 yearclass made up 37% of the half-year catch.

Mean weights-at-age in the commercial landings have been variable with a modest decline since the early 1990s (Table 10, Figure 10). The age 5 and younger weights-at-age in recent years are similar

to those in the 1970s but ages 7 and older are very low compared to the late 1970s and early 1980s. Similar declines in weights-at-age have been observed for haddock on the eastern Scotian Shelf (Mohn and Simon 2002, Frank et al. 2001).

As the 1998 and 1999 yearclasses dominate the fishery, the proportion of small (<43cm) haddock in the catch has increased, particularly in the winter fishery (Figure 11-13). The proportion of small haddock in landings from 4Xmnop in the first quarter of 2003 was 24% and 38% for otter trawl and longline landings respectively.

Research Vessel Surveys

A summer groundfish research vessel (RV) survey of the Scotian Shelf and Bay of Fundy has been conducted since 1970. The stratification scheme used in the stratified random survey design is shown in Figure 14. A vessel conversion factor of 1.2 was used for the *A.T. Cameron* surveys (Fanning 1985). Catches from the 2000-2002 surveys are shown in Figure 15. Mean numbers per standard tow by stratum are shown in Table 11.

Stratified mean number per standard tow of 4X/5Y haddock declined in 2002 from the high levels observed in 1999-2001 and declined again in 2003 but was still above the long-term mean (Table 11, Figure 16). Stratified mean weight per standard tow increased in 2003 and was above the long-term mean (Figure 16). Catches in the Scotian Shelf component (strata 470-481) have declined in recent years while catches in the Bay of Fundy (strata 482-495) remained relatively stable (Table 11, Figure 17).

Stratified mean numbers-at-age per standard tow for the 1970-2003 summer RV surveys are shown in Table 12 and the age composition of the RV survey catches from 1996-2003 are shown in Figure 18. The above average 1993 and 1994 yearclasses are apparent. Catches of the 1998 and 1999 yearclasses were very large and 2000 yearclass was above the long-term mean. The 2001 and 2002 yearclasses were well below the long-term mean.

The biomass of ages 4+ haddock in the RV survey, a proxy for spawning stock biomass, has shown an increasing trend since 1993 and in 2003 was near the high levels observed in the late 1970s (Figure 19). The 1998 and 1999 yearclasses made up approximately two-thirds of the 4+ biomass in 2003. The proportion of the 4+ biomass on the Scotian Shelf has shown an increasing trend but decreased and was close to 50% in 2003 (Figure 19).

The catch per tow of ages 2 and 3 in the summer RV surveys, adjusted by the calibration coefficients from the SPA, an indicator of recruitment, was below average from 1983 to 1992, with the exception of the 1987 and 1988 yearclasses. The 1993 and 1994 yearclasses were strong. The 1998 yearclass was the largest in the RV survey series and the 1999 yearclass was the third largest. The 2000 yearclass was above the long-term mean.

The age structure of a population reflects the quality of the population abundance. In general, a broader range of ages is more likely to represent a healthy stock. The number of above average yearclasses in the summer RV survey, ages 4-10, is a measure of age structure. This indicator has been increasing since 1996 and all ages were above average in 2002 (Figure 21). This decreased by one age in 2003. This may not be the best indicator of age structure because it is insensitive to the relative contribution of older ages within the age distribution, which are thought to have a higher reproductive potential. Further research in the development of this index is required.

Several indices can provide insight into the distributional properties of abundance. The stratified proportion of the area associated with non-zero RV survey sets is a measure of the area occupied by a species. Area occupied by haddock 43cm and greater in length (approximates ages 4+) has shown an increasing trend since the late 1980s and is near the high levels seen in the late 1970s and early 1980s (Figure 22). The area occupied by haddock 26-42cm in length (approximates ages 2 and 3) has shown an increasing trend since the late 1980s and was at the highest levels observed in 2001 (Figure 22). Although this indicator has decreased in the last 2 years, it is still above the long-term mean.

The average catch rate in annual survey sets where a species occurs is an indicator of the local density of the species. Local density in the RV survey of haddock 43cm and greater has shown no trend over the entire time period (Figure 22). The local density in the RV survey of haddock 26-42cm has been increasing since the early 1990s and is near the highest levels observed in the series (Figure 22).

Mean lengths-at-age of 4X/5Y haddock in the summer RV surveys decreased through the mid- to late 1980s (Table 13, Figure 23). Some recovery occurred in the late 1980s and early 1990s, but not to the sizes of the earlier period. Mean lengths-at-age have been decreasing since the early to mid- 1990s, particularly at older ages. Mean weights-at-age show similar trends (Table 14, Figure 23). Most ages are below long-term mean and many ages are at or near the smallest size observed. We do see small increases in last year or two for some ages, suggesting that the trend may be stabilizing. When the Scotian Shelf and Bay of Fundy components are examined separately, the trends are similar although the decrease/recovery in the late 1980s/early 1990s is less apparent in the Bay of Fundy (Figure 24). A comparison of weights-at-age from the commercial fishery and from the RV survey, show similar trends at ages 7 and 9, but some differences at age 5 in the recent period and different trends at age 3, suggesting that age 3 is not fully recruited to the fishery and that age 5 has become less so in the last 5 years (Figure 25).

The instantaneous annual growth rate (G) calculated using length at ages 2-4 and 5-7 for haddock from the summer RV surveys shows a long-term decreasing trend since the mid-1970s, but shows some signs of stabilising in the last few years (Figure 26). The trends in growth rates between the two age groups are similar.

An index of fish condition, Fulton's K, developed for haddock from the summer RV surveys, has shown a decreasing trend since the early 1980s and reached a minimum in 2002 (Figure 26). Low levels of this index in Atlantic cod have been related to poor reproductive success, and to post-spawning mortality at very low levels (Dutil and Lambert 2000). Similar experiments have not been conducted for haddock but should be. It would appear that the levels observed here for 4X/5Y haddock have not affected reproductive success or survivorship. However, poor condition does reflect low productivity.

Total mortality (Z) estimated for ages 5-7 (historically fully recruited) from the summer RV surveys was relatively stable in recent years with an implied fishing mortality of about $F_{0.1}$ (Figure 27). Unlike a number of other stocks on the Scotian Shelf, this estimate of total mortality does not suggest that the natural mortality for 4X/5Y haddock has increased in recent years. Relative fishing mortality (estimated for ages 5-7) showed an increasing trend through the 1970s to a maximum in the early 1980s, followed by a decreasing trend (Figure 27). Relative F increased in 1992-94, but decreased in 1995 and has remained relatively stable since then.

Industry Survey

The mobile gear <65 ft (ITQ) fleet has conducted a joint resource survey of the 4X/5Y area with DFO since the summer of 1995. The survey is conducted in July, the same time that the DFO research vessel survey is conducted, by 3 draggers (<65 ft) equipped with standardized gear with the same size codend liner as used in the RV survey. A fixed station design, based on the RV survey strata, is used and standardized tows are made. The survey is designed to cover the entire 4X area, included the large inshore area off southwest Nova Scotia not covered by the RV survey. Further details are summarised in O'Boyle et al. 1995 and Hurley et al. 1999. Due to changes in the survey design between 1995, the first year of the survey, and subsequent years, the 1995 survey was not used in the time series here.

Haddock catches in the 2002 and 2003 ITQ surveys are shown in Figure 28. As with the RV survey, haddock catches are widespread throughout most of 4X5Y, with the exception of the inshore areas off southwest Nova Scotia and in eastern 4X. Mean number and weight per tow trends and mean number-at-age per tow are shown in Figure 29. Both mean number and mean weight per tow were stable 1996-1998, then increased 1999-2001 and decreased in 2002. Mean number per tow decreased again in 2003. Haddock age composition from the ITQ survey is shown in Figure 30. The 1993 and 1994 yearclasses were also above average in this survey. The 1998, 1999 and 2000 yearclasses were all strong , but the 2001 and 2002 yearclasses were considerably lower.

Mean weight per tow of ages 4+ from this survey was also used as an indicator of abundance and has shown an increasing trend since 1996 (Figure 31). The 1998 and 1999 yearclasses made up approximately three-quarters of the 4+ weight per tow in 2003. The catch per tow of ages 2 and 3 in the ITQ survey, adjusted by the calibration coefficients for this survey from the SPA, indicates that the 1998 yearclass is the largest and that the 1999 is the second largest (Figure 31).

Estimation of Stock Parameters and Results

A traditional age-based Sequential Population Analysis (SPA) using the ADAPT framework (Gavaris 1988) was used to produce estimates of population abundance in numbers. The SPA model used is as follows:

Parameters:

Population numbers at mid-year $N_{i,2003}$ i = 2-10

Calibration coefficients $q_{1,i}$ i = ages 2-10 for July RV survey

$q_{2,i}$ i = ages 2-10 for ITQ survey

Structure Imposed:

Error in catch assumed negligible

Partial recruitment fixed for age 1 in 2003

F on oldest age (10) set as average F of ages 8-9 adjusted by the partial recruitment of age 10 in 2003

No intercepts were fitted

M = 0.2 for all ages

Input:

$C_{i,t}$ i = 1-10; t = 1970 to 2003 - catch-at-age for entire year (half year for 2003)
$J_{i,t}$ i = 2-10; t = 1970 to 2003 - July RV survey index
$ITQ_{i,t}$ i = 2-10; t = 1996 to 2003 - ITQ survey index

Objective function:

Minimise $\{ \sum\sum (\ln J_{i,t} - \ln q_{1,i} N_{i,t})^2 \} + \{ \sum\sum (\ln ITQ_{i,t} - \ln q_{2,i} N_{i,t})^2 \}$

Summary:

Number of observations: 306 for July RV (9 ages by 34 years)
72 for ITQ (9 ages by 8 years)
Number of parameters: 27, 9 ln Ns estimated by NLLS, 18 qs algebraically

age	1	2	3	4	5	6	7	8	9	10
partial recruitment	.0001	.033	.118	.452	.884	.972	1.00	1.00	1.00	1.00

The SPA inputs, commercial catch numbers-at-age, RV survey stratified mean numbers-at-age per tow, and ITQ survey mean numbers-at-age per tow, are shown in Tables 8 and 12 and Figure 29 respectively. Residuals from the model fit and summary statistics of overall fit of the model are shown in Table 15 and Figure 32. The resulting estimates of population numbers and biomass, and fishing mortality are shown in Tables 16-18. As with previous assessments of this resource, the residuals show some strong year effects, with positive residuals at all ages in some years and negative residuals at all ages in other years.

Recruitment in this stock was high through the 1970s and into the early 1980s (Table 16, Figure 33). This was followed by a ten year period of below average recruitment, from 1983-92, although the 1987 and 1988 yearclasses were near-average in strength. Both the 1993 and 1994 yearclasses were above average. The 1997 yearclass was average, the 1998 yearclass is estimated to be the strongest in the time series, and the 1999 yearclass is estimated to be the second strongest. The model suggests that the 2000 yearclass is also strong.

Spawning stock biomass (ages 4+) decreased from a peak of 69,000t in 1979 and reached a low of 19,000t in 1990 (Table 18, Figure 33). The above average 1993 and 1994 yearclasses resulted in spawning stock biomass increasing to 40,000t in 1998. The average 1997 yearclass and the large 1998 and 1999 yearclasses are estimated to increase spawning stock biomass to 67,000t in 2003.

There appears to be no relationship between spawning stock biomass and recruitment over the biomass range observed (Figure 34).

The exploitation rate on ages 5-7 (historically fully recruited) increased from the 1970s to approximately 50% in the early 1980s (Table 17, Figure 33). It declined to close to $F_{0.1}$ (20%, currently used value of $F_{0.1}$=0.25) in the late 1980s and dropped below $F_{0.1}$ in 1994. Exploitation rate on ages 5-7 dropped again in 1999. Partial recruitment has changed in recent years due to changes in the fishery or changes in size-at-age and fully recruited ages changed from 5-7 to 8-10. The exploitation rate on older ages has remained high at about 20%.

Estimates of total mortality calculated from the RV surveys were comparable with fishing mortality estimates from the SPA (Figure 35). This implies that there has not been an increase in natural

mortality in this resource, as has been the case with a number other groundfish stocks on the Scotian Shelf recently.

Past assessments of this resource have exhibited a strong retrospective pattern, where exploitation is under-estimated and population abundance is over-estimated in the current year, relative to when additional data are available in subsequent years. The pattern of exploitation estimates in this case is variable and does not show a consistent over- or under-estimation (Figure 36). The biomass estimates do exhibit a consistent pattern of over-estimation of population abundance in the most recent year, particularly when strong yearclasses occur. Retrospective estimates of yearclass size indicate that early estimates of large yearclasses may be over-estimated by a factor of at least 2 and that this pattern of over-estimation can persist at older ages (Figure 37). This analysis estimates the 1998 and 1999 yearclasses to be very strong, which may produce this retrospective pattern again.

In 1984/1985, there was a change in the methodology used to determine ages in this resource. Concerns have been expressed that the decreases in size-at-age observed in that period may be due to changes in the methodology, not to changes in growth rate. This was investigated and it does not appear the change in methodology was the cause of these decreases. The construction of the catch-at-age during this period will be investigated to determine if these decreases are a result of how the catch-at-age was produced. This would not effect just estimates of size-at-age, but also estimates of spawning stock biomass and exploitation rates during that period.

Projected yield and spawning stock biomass were calculated using recent mean weights-at-age. Weights-at-age in this resource have been declining since the mid- 1990s. If this trend continues, then yield and spawning stock biomass will be over-estimated. A shift in the proportion of landings from the Bay of Fundy to the Scotian Shelf, where growth is considerably slower, would also result in yield being over-estimated.

Outlook

Indicators of abundance (RV survey wt/tow ages 4+, ITQ survey wt/tow ages 4+, SPA biomass ages 4+, RV Survey age structure) all show increasing trends in the most recent period and all indicate that the 2003 value is near the high levels observed in the late 1970s. The large increase in 2003 4+ biomass is a result of the 1998 and 1999 yearclasses.

Indicators of recruitment (RV survey recruitment index ages 2+3, ITQ survey recruitment index ages 2+3, SPA recruitment age 1) all show that the 1998 yearclass is the strongest observed in the survey/SPA time series. The 1999 yearclass is also very strong and the 2000 yearclass is above average. Early indications of the 2001 yearclass suggest it is below average.

The distribution indicators (RV survey area occupied 43+cm, RV survey local density 43+cm, RV survey area occupied 26-42cm, RV survey local density 26-42cm) show that fish at lengths that approximate the spawning stock are near the widest area occupied observed although local density has shown no trend. The area occupied by fish at lengths that approximate recruits has decreased to but is still above the long-term average and the local density is high.

The indicators of production (RV survey growth rate, RV survey fish condition) have been decreasing since the late 1970s to early 1980s and are at or near the lowest levels observed but may be showing signs of stabilising.

The indicators of mortality (RV survey total mortality ages 5-7, SPA exploitation ages 5-7, relative fishing mortality ages 5-7) show that mortality has been low in recent years.

Projected yield was calculated using the recent partial recruitment pattern and recent weights-at-age from the fishery. Weights-at-age in the fishery are currently larger than those indicated for the population by the RV survey. Spawning stock biomass was calculated using recent weights-at-age from the RV survey. The projected yield at F=0.25 (currently used for $F_{0.1}$) for the 2004 fishing year is 11,000t and the projected spawning stock biomass (ages 4+) at the beginning of the 2004 fishing year is 67,000t.

This analysis indicates that landings of 10,000t (TAC) in the 2003 fishing year will result in an exploitation rate close to $F_{0.1}$. If fished at $F_{0.1}$, spawning stock biomass is estimated to increase to a high in 2004 and then decrease subsequently, unless further strong recruitment occurs.

Given the retrospective pattern observed in this resource in the past when strong yearclasses were present, this assessment likely over-estimates biomass and projected yield.

It is possible to estimate the uncertainties from the model regarding stock size and then use these in a risk analysis (Figure 38). The risk plot incorporates the discrepancy between the accepted model and the data. Other uncertainties not considered in this risk analysis include errors in the model assumptions, changes in fishing practices, and environmental effects on survivorship. The spawning stock biomass is currently near the high levels observed in the late 1970s; therefore a change in spawning stock biomass is not an immediate concern. Accordingly the risk analysis is done only to measure if we are keeping fishing mortality at a moderate level. The steepness of the curve indicates that the risk analysis results are relatively robust to estimation error for abundance.

Although we have observed high recruitment and recruits that are widely distributed at high local density, the spawners exhibit low growth rate, below average size-at-age, and lower condition. It is uncertain how this will impact future production.

In summary, high exploitation in the early 1980s, despite good recruitment, led to declines in spawning stock biomass. Although exploitation decreased to near $F_{0.1}$ in the late 1980s, declining production and poor recruitment resulted in further declines in spawning stock biomass. Improved recruitment and low exploitation in the early 1990s started stock rebuilding. Continued low exploitation since 1994 and the above average 1993 and 1994 yearclasses allowed spawning stock biomass to continue to rebuild. The very strong 1998 and 1999 yearclasses continued this trend.

Spawning stock biomass is currently near the high levels observed in the late 1970s, due to record high levels of recruitment and low recent exploitation levels but will decrease unless further strong recruitment occurs. Emphasis should be on how the potential yield from the current good recruitment is to be utilised over time, and on the implications of that decision for 4X cod conservation, as a result of the mixed fishery issue. Based on this, caution should be exercised in setting the quota for 2004 and the potential yield of 11,000t should be considered a maximum.

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Table 1. Reported nominal catch (t) and TAC of haddock from NAFO Division 4X.

Year	Annual Catch	TAC	Fishing Year** Catch	TAC
1960	15800			
1961	17918			
1962	18032			
1963	24461			
1964	36049			
1965	29166			
1966	43349			
1967	37896			
1968	32602			
1969	30703			
1970	18072	18000		
1971	17592	18000		
1972	13483	9000		
1973	13106	9000		
1974	13378	0		
1975	18298	15000		
1976	17498	15000		
1977	21281	15000		
1978	27323	21500		
1979	25193	26000		
1980	29210	28000		
1981	31475	27850		
1982	25729	32000		
1983	27405	32000		
1984	21156	32000		
1985	16131	15000		
1986	15555	15000		
1987	13780	15000		
1988	11272	12400		
1989	6800	4600		
1990	7556	4600		
1991	9826	0		
1992	10530	0		
1993	6968	6000		
1994	4406	4500		
1995	5669	6000		
1996	6245	6500		
1997	6527	6700		
1998	7843	8100		
1999	6621	8100	9291	9800
2000	6961		7761	8100
2001	8466		7411	8100
2002	7997		7964	8100
2003*	5159		3826	8100***

* - Landings to Sept 19th,2003

** Fishing year in 1999 was extended to Mar 31,2000. TAC prorated upwards. Subsequent fishing years begin on April 1.

*** Quota increased to 10,000t during the fishing year.

Table 2. Reported nominal catch (t) of haddock from NAFO Division 4X (Canadian landings include 5Y) 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	16050 (26)	-	1638	2	370	12	18072	18000
1971	16493 (29)	-	654	97	347	1	17592	18000
1972	12593 (36)	-	409	10	470	1	13483	9000
1973	12687 (30)	-	265	14	134	6	13106	9000
1974	12586 (25)	-	660	35	97	-	13378	-
1975	16139 (56)	-	2111	39	7	2	18298	15000
1976	16426 (45)	-	972	-	95	5	17498	15000
1977	19619 (79)	-	1648	2	-	12	21281	15000
1978	26045 (62)	114	1135	2	-	27	27323	21500
1979	24837 (49)	268	70	3	-	15	25193	26000
1980	28807 (56)	71	257	38	-	37	29210	28000
1981	30877 (82)	117	466	-	-	15	31475	27850
1982	24843 (92)	28	854	-	-	4	25729	32000
1983	26843 (119)	44	494	17	-	7	27405	32000
1984	20927 (97)	23	206	-	-	-	21156	32000
1985	16105 (86)	-	25	-	-	1	16131	15000
1986	15507 (78)	-	38	10	-	-	15555	15000
1987	13763 (82)	-	17	-	-	-	13780	15000
1988	11217 (79)	-	2	53	-	-	11272	12400
1989	6794 (43)	-	1	5	-	-	6800	4600
1990	7504 (71)	-	32	172	-	32	7556	4600
1991	9772 (81)	13	-	382	-	32	9826	-
1992	10508 (89)	51	-	-	-	172	10530	-
1993	6947 (86)	-	-	-	-	212	6968	6000
1994	4405 (68)	-	-	-	-	12	4406	4500
1995	5660 (78)	-	-	-	-	92	5669	6000
1996	6237 (84)	-	-	-	-	82	6245	6500
1997	6519 (87)	-	-	-	-	82	6527	6700
1998	7842 (86)	-	-	-	-	12	7843	8100
1999	6621 (74)	-	-	-	-	-	6621	8100
2000	6961 (91)	-	-	0	-	-	6961	8100
2001	8466 (100)	-	-	-	-	-	8466	8100
2002	7997 (72)	-	-	-	-	-	7997	8100
*2003	3560 (48)	-	-	-	-	-	3560	10000

* 2003 Data only until June 30th

Table 3. Reported nominal catch (t) of haddock from NAFO Division 4X landed in the Maritimes by tonnage class and gear type. The numbers in brackets represent the mean weight landed per age/size sample collected.

	Tonnage Class									
	TC 1-3					TC 4+				
Year	MG	(OT)	FG (LL)[1]		Misc [2]	MG	(OT)	FG (LL)	Misc.	Total
1970	5510	(1377)	3393		492	6503	(296)	113	0	16012
1971	4744	(949)	3598	(1199)	260	7712	(367)	94	0	16407
1972	2929	(732)	4472	(447)	357	4742	(216)	63	8	12570
1973	1930	(322)	6124	(680)	285	4228	(282)	70	0	12637
1974	4119	(515)	6391	(533)	200	1623	(325)	56	0	12388
1975	6186	(326)	5194	(577)	246	4408	(157)	26	0	16059
1976	4393	(1098)	5312	(885)	432 (216)	6117	(185)	46	33	16333
1977	6238	(1040)	4329	(481)	529	8246	(129)	117	134	19593
1978	9694		6817	(568)	906 (453)	7473	(156)	97	416	25404
1979	10555	(5278)	5133	(395)	515 (515)	8272	(251)	56	48	24580
1980	13471	(1225)	6926	(385)	1079 (360)	7046	(294)	82	0	28604
1981	14991	(333)	7861	(302)	967 (322)	6475	(809)	70	0	30364
1982	12120	(252)	7599	(345)	842 (70)	2972	(297)	32	0	23565
1983	12964	(231)	8548	(225)	751 (75)	2562	(197)	15	0	24840
1984	12097	(212)	6778	(226)	193 (193)	613	(77)	0	0	19682
1985	10292	(181)	4367	(182)	134	520	(104)	1	0	15314
1986	9630	(201)	5345	(184)	99	209	(209)	0	0	15282
1987	8103	(180)	4856	(270)	212 (19)	502	(84)	0	0	13673
1988	7174	(133)	3442	(156)	93 (93)	377	(189)	0	0	11085
1989	3731	(133)	2686	(244)	194	90	(22)	0	0	6701
1990	3322	(79)	3785	(135)	278 (278)	110		0	0	7495
1991	4171	(97)	5127	(151)	258 (258)	206	(69)	0	0	9761
1992	3462	(74)	6560	(177)	217 (109)	258	(86)	0	2	10500
1993	2620	(61)	4091	(136)	100 (14)	123	(31)	0	0	6935
1994	2068	(63)	2177	(84)	48	97	(48)	0	0	4391
1995	3035	(65)	2420	(81)	69	105	(105)	0	2	5631
1996	3593	(86)	2351	(59)	50 (50)	151	(151)	0	0	6145
1997	4214	(73)	2158	(94)	56 (56)	64	(13)	0	0	6493
1998	5154	(99)	2558	(80)	50	80	(40)	0	0	7842
1999	4475	(73)	1995	(249)	31 (31)	120	(17)	0	0	6621
2000	4129	(59)	2699	(159)	28 (14)	105	(35)	0	0	6961
2001	6128	(96)	2229	(64)	21 (11)	88	(88)	0	0	8466
2002	5632	(85)	2304	(79)	23 (12)	37	(12)	0	0	7997
*2003	2937	(79)	584	(73)	7	30		0	0	3558

1 = Includes Handline

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

* = 2003 Data only until June 30

Table 4a. Reported landings by month and gear type from NAFO Divisions 4X and 5Y (from ZIF).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mobile	1985	331	2598	439	792	1067	1924	1306	856	1046	713	240	290	11602
	1986	421	1806	754	364	1021	900	871	688	1852	938	206	242	10062
	1987	448	1192	1739	520	1207	1142	549	293	1009	473	75	40	8687
	1988	1312	1037	109	555	756	1185	670	117	1103	469	89	248	7648
	1989	614	1062	667	289	193	735	171	83	47	15	9	24	3909
	1990	720	794	77	244	379	361	315	113	154	95	100	87	3439
	1991	280	508	122	159	449	589	440	195	280	235	319	811	4388
	1992	578	414	225	97	353	659	450	137	197	161	163	293	3727
	1993	259	232	223	107	396	467	320	166	209	163	147	67	2755
	1994	112	244	137	155	227	195	234	141	202	160	121	252	2178
	1995	246	375	518	117	182	185	207	188	269	292	188	402	3168
	1996	197	450	481	270	203	141	267	275	364	414	453	319	3836
	1997	78	457	539	399	176	249	337	277	559	502	420	311	4303
	1998	319	885	1033	511	99	170	320	304	492	259	340	504	5235
	1999	476	494	229	241	296	305	349	589	733	283	291	308	4595
	2000	518	826	549	123	288	217	341	316	414	282	226	133	4234
	2001	1049	502	1258	296	386	269	301	475	722	331	397	230	6216
	2002	780	598	621	538	347	529	541	481	432	300	221	282	5670
	2003	440	361	1107	241	550	270							2968
Gillnet	1985	0	0	2	1	1	2	16	43	36	10	0	1	113
	1986	0	1	0	0	1	7	18	16	15	25	3	2	88
	1987	2	1	4	7	15	17	32	24	44	58	12	0	215
	1988	1	1	3	1	1	11	14	14	18	13	4	1	82
	1989	0	0	0	12	2	13	10	15	41	35	25	4	158
	1990	6	5	6	0	13	51	66	31	72	23	4	0	278
	1991	0	0	2	5	5	20	18	63	98	41	2	1	257
	1992	4	1	0	5	5	10	26	29	69	64	3	0	215
	1993	0	0	1	2	4	18	11	14	36	12	1	0	100
	1994	0	0	0	1	1	5	10	7	13	9	1	0	48
	1995	0	0	0	1	0	6	10	2	49	1	0	0	69
	1996	0	0	0	0	1	4	12	9	22	2	0	0	50
	1997	0	0	0	0	0	4	8	23	15	6	0	1	58
	1998	0	0	0	0	0	10	16	7	9	6	1	1	50
	1999	0	0	0	0	0	6	6	5	7	4	2		31
	2000	0	0	1	0	0	2	6	5	4	8	0	0	28
	2001	0	0	0	0	0	1	5	5	5	2	0	0	21
	2002	0	0	1	1	1	3	9	3	4	0	0	0	23
	2003	1	0	4	0	0	1							8
Longline	1985	457	1300	185	207	91	99	159	291	448	357	190	271	4056
	1986	438	1107	316	117	84	102	186	429	713	621	418	356	4888
	1987	718	1126	342	66	138	180	291	367	361	516	259	210	4575
	1988	807	485	104	81	50	83	177	367	538	288	128	254	3362
	1989	382	385	168	69	47	115	229	357	325	266	110	54	2506
	1990	645	463	205	48	33	107	265	382	555	270	202	216	3391
	1991	777	851	193	77	87	236	444	481	524	427	262	229	4589
	1992	937	638	140	127	243	330	506	570	717	507	349	529	5592
	1993	102	691	227	205	275	223	294	608	471	84	45	2	3228
	1994	292	36	2	53	41	236	352	158	180	116	98	16	1580
	1995	293	11	0	112	126	162	363	372	230	197	68	238	2173
	1996	199	13	0	12	64	260	267	249	215	280	254	240	2053
	1997	31	157	33	40	16	102	254	344	323	357	178	232	2066
	1998	99	54	71	139	32	152	352	316	507	378	161	201	2461
	1999	55	32	23	27	27	102	335	377	372	299	202	104	1955
	2000	126	302	347	22	37	149	411	422	370	319	118	49	2670
	2001	321	101	237	47	27	116	297	355	215	295	147	62	2219
	2002	201	72	150	30	13	62	327	427	379	277	207	106	2252
	2003	204	84	187	22	26	52							576
Handline	1985	1	0	0	0	4	35	118	101	54	15	5	0	334
	1986	0	0	0	0	3	50	188	120	72	29	7	0	469
	1987	0	0	0	0	3	41	88	94	44	10	2	3	286
	1988	0	0	0	0	0	10	15	32	38	21	9	1	126
	1989	0	0	0	1	3	43	75	48	31	15	4	1	221
	1990	0	0	0	0	3	77	93	114	82	20	4	2	396
	1991	1	1	0	1	2	97	184	138	77	39	1	0	539
	1992	0	0	0	0	5	132	315	290	143	70	14	4	974
	1993	0	0	0	2	2	189	284	297	81	9	2	0	865
	1994	0	0	0	0	9	256	242	61	26	5	1	0	600
	1995	0	0	0	0	7	91	117	9	23	3	0	0	250
	1996	0	0	0	0	4	134	113	44	0	2	0	0	298
	1997	0	0	0	0	1	40	43	21	3	3	0	0	110
	1998	0	0	0	0	0	22	56	27	34	1	0	0	141
	1999	0	0	0	0	1	6	25	5	1	1	0	0	40
	2000	0	0	0	0	0	15	11	2	0	0	0	0	29
	2001	0	0	0	0	0	3	2	5	0	0	0	0	10
	2002	0	0	0	0	0	5	25	25	1	0	0	0	55
	2003	0	0	0	0	0	9							9
Total	1985	789	3898	626	1000	1164	2060	1599	1291	1585	1096	436	562	16105
	1986	859	2913	1071	481	1109	1059	1262	1254	2652	1613	635	599	15507
	1987	1168	2320	2085	594	1363	1381	961	777	1458	1057	347	253	13763
	1988	2119	1523	216	637	808	1289	876	529	1697	790	231	503	11217
	1989	996	1447	836	371	245	906	485	504	444	330	147	83	6794
	1990	1371	1262	288	293	429	597	739	640	864	408	309	305	7504
	1991	1057	1361	318	241	542	942	1086	877	978	742	585	1042	9772
	1992	1519	1052	366	228	606	1131	1297	1027	1127	801	529	825	10508
	1993	361	924	452	316	676	897	909	1085	797	267	195	69	6947
	1994	404	280	139	209	278	692	838	366	421	289	220	268	4405
	1995	539	387	518	230	314	445	697	570	572	492	256	640	5660
	1996	396	463	481	282	273	539	659	578	602	699	707	559	6237
	1997	109	614	572	439	194	395	642	664	899	867	598	544	6538
	1998	419	939	1103	650	132	354	743	654	1042	645	503	705	7887
	1999	531	526	252	269	324	420	716	976	1114	587	495	412	6621
	2000	644	1129	897	146	325	383	769	745	788	609	344	182	6961
	2001	1371	603	1496	343	413	389	606	840	942	628	545	292	8466
	2002	982	670	772	568	361	599	902	936	816	578	428	388	8000
	2003	646	445	1298	263	576	332							3561

* = 2003 Data only until June 30

Table 4b. Reported landings by unit area and gear type from NAFO Divisions 4X and 5Y (from ZIF).

		4XL	4XM	4XN	4XO	4XP	4XQ	4XR	4XS	4XU	5Y	Total
Mobile	1985	0	144	1455	1949	1401	1930	1330	277	2326	791	11602
	1986	1	295	1624	1329	538	2254	910	198	2690	224	10062
	1987	0	132	2194	1059	901	1221	210	63	2823	83	8687
	1988	0	269	1007	728	963	559	107	22	3896	97	7648
	1989	0	41	733	454	1047	566	207	12	761	89	3909
	1990	0	35	468	533	738	886	223	5	543	7	3439
	1991	0	16	786	851	645	1153	739	87	93	11	4382
	1992	0	32	939	735	427	912	604	51	21	6	3727
	1993	0	7	503	500	355	925	296	108	50	12	2755
	1994	0	3	187	445	104	999	311	112	2	14	2178
	1995	0	7	222	275	1018	975	477	157	8	28	3168
	1996	0	10	541	214	758	995	800	413	14	92	3836
	1997	1	11	407	173	1063	860	1121	627	14	25	4303
	1998	0	25	1954	108	867	803	1013	404	4	56	5234
	1999	0	21	825	143	1402	932	709	516	6	41	4595
	2000	0	16	1157	93	1141	941	468	387	0	30	4234
	2001	0	22	1790	181	1702	980	762	727	2	50	6216
	2002	0	6	1150	231	1324	605	1235	1057	5	54	5667
	2003	0	1	853	25	584	501	820	166	4	15	2969
Gillnet	1985	0	29	0	67	0	0	1	12	4	0	113
	1986	0	31	0	47	0	0	1	7	1	1	88
	1987	0	95	0	90	2	0	1	18	3	6	215
	1988	0	40	2	26	3	0	2	1	8	0	81
	1989	0	96	0	47	0	2	0	2	10	0	158
	1990	0	82	1	74	3	75	31	1	11	0	278
	1991	0	79	2	144	5	12	2	3	10	0	257
	1992	0	79	5	42	1	53	3	7	23	1	215
	1993	0	21	3	46	6	8	3	1	12	1	100
	1994	0	4	0	21	3	4	3	0	11	1	48
	1995	0	5	4	20	7	11	3	3	16	0	69
	1996	0	10	1	17	6	4	1	7	3	0	50
	1997	0	5	0	12	29	4	1	2	4	1	57
	1998	0	7	1	6	22	8	2	2	2	1	51
	1999	0	7	0	3	9	5	1	4	1	1	31
	2000	0	5	0	1	10	4	1	6	0	0	28
	2001	0	7	0	1	2	6	1	3	1	0	21
	2002	0	3	0	1	7	8	1	2	1	0	23
	2003	0	0	0	0	6	1	0	0	0	0	7
Longline	1985	0	493	485	1545	528	33	86	6	858	0	4034
	1986	0	856	432	1924	486	11	61	6	1100	0	4875
	1987	10	552	286	1798	391	54	33	2	1445	2	4572
	1988	0	359	403	791	247	30	18	21	1446	35	3350
	1989	0	256	219	861	277	28	9	1	814	4	2469
	1990	0	275	229	1309	368	30	3	8	1168	1	3391
	1991	0	409	561	1809	801	97	45	1	863	0	4588
	1992	0	133	458	2276	319	98	181	2	2119	1	5587
	1993	0	113	1129	994	400	178	202	1	211	0	3227
	1994	0	50	175	663	171	10	39	0	470	0	1578
	1995	0	82	672	616	435	149	13	3	200	0	2171
	1996	0	68	556	678	351	84	66	6	243	0	2053
	1997	0	73	616	490	380	61	30	8	391	0	2049
	1998	7	109	583	652	805	124	20	6	112	3	2421
	1999	0	150	321	678	708	31	22	2	43	1	1955
	2000	0	202	903	752	636	44	40	3	89	1	2670
	2001	0	199	930	478	474	35	29	5	70	1	2219
	2002	0	199	779	506	583	73	35	3	71	1	2250
	2003	0	35	332	122	39	7	25	3	13	0	576
Handline	1985	0	23	0	294	0	11	6	0	0	0	334
	1986	0	17	0	426	0	15	10	1	0	0	469
	1987	0	33	0	236	4	8	4	1	0	0	286
	1988	0	5	0	111	0	2	4	2	3	0	126
	1989	0	4	0	193	0	4	12	0	8	0	221
	1990	0	3	0	376	0	8	3	0	6	0	396
	1991	0	11	0	460	0	30	29	0	9	0	539
	1992	0	13	0	844	1	40	74	0	2	0	974
	1993	0	3	7	775	27	14	32	3	3	0	865
	1994	0	1	2	486	21	75	11	0	4	0	600
	1995	0	0	2	140	13	3	0	0	91	0	250
	1996	0	2	5	248	13	14	3	1	13	0	298
	1997	0	1	1	72	5	6	2	0	23	0	109
	1998	0	1	1	111	2	8	0	0	14	0	137
	1999	0	1	1	25	1	8	2	0	1	0	40
	2000	0	1	0	9	5	9	3	0	2	0	29
	2001	0	0	0	7	1	1	0	0	0	0	10
	2002	0	0	1	45	1	5	0	0	2	0	54
	2003	0	0	0	8	1	0	0	0	1	0	10
Total	1985	0	699	1941	3861	1928	1974	1426	295	3191	791	16105
	1986	1	1203	2055	3732	1023	2280	982	212	3794	225	15507
	1987	10	814	2481	3183	1297	1283	249	84	4271	90	13763
	1988	0	673	1412	1656	1212	597	131	46	5358	132	11217
	1989	0	432	952	1557	1324	599	228	15	1593	92	6794
	1990	0	396	698	2292	1108	999	259	14	1729	9	7504
	1991	0	515	1349	3264	1452	1292	816	91	975	12	9766
	1992	0	259	1402	3898	749	1104	862	60	2166	8	10508
	1993	0	144	1642	2316	788	1124	533	112	276	13	6947
	1994	0	58	365	1618	298	1088	364	113	487	15	4405
	1995	0	95	900	1052	1473	1139	493	164	316	28	5660
	1996	0	89	1103	1158	1127	1097	870	427	274	92	6237
	1997	1	90	1025	746	1477	931	1154	638	431	25	6518
	1998	7	142	2539	877	1696	943	1035	412	132	60	7843
	1999	0	180	1147	848	2120	976	733	522	51	42	6621
	2000	0	224	2060	856	1791	998	512	396	92	32	6961
	2001	0	228	2720	667	2179	1022	792	735	72	51	8466
	2002	0	208	1930	783	1915	691	1271	1062	79	55	7994
	2003	0	36	1185	155	630	509	845	169	18	15	3562

* = 2003 Data only until June 30

Table 5.
April to September 4X5Y groundfish landings (first half) of 2003 fishing year relative to previous year.

4X5Y all groundfish Species	2003 (t) April-Sept	2002 (t) April-Sept	2003-2002 (t) change	% change		proportion of change
Catfish	125	151	-26	-17		0.4
Cod	3159	3936	-777	-20	**	12.0
Cusk	491	717	-226	-31	*	3.5
Dogfish	997	3179	-2182	-69	***	33.6
Greysole	133	157	-24	-16		0.4
Haddock	3826	4183	-356	-9	*	5.5
Halibut	257	249	9	3		-0.1
Lumpfish	0	0	0	0		0.0
Monkfish	636	561	74	13	*	-1.1
Plaice	49	49	0	0		0.0
Pollock	4592	4123	469	11	**	-7.2
Red hake	9	27	-18	-66		0.3
Redfish	2213	2999	-786	-26	**	12.1
Roundnose grenadier	0	0	0	0		0.0
Sculpin	120	139	-19	-14		0.3
Silver hake	553	2684	-2131	-79	***	32.8
Skate	16	13	3	25		-0.1
Tilefish	0	3	-3	-94		0.0
Turbot	2	1	2	219		0.0
Unspecified flounder	139	151	-11	-7		0.2
Unspecified groundfish	2	5	-4	-71		0.1
White hake	1206	1822	-616	-34	**	9.5
Winter flounder	685	550	136	25	*	-2.1
Yellowtail	13	19	-5	-29		0.1
Grand Total	19225	25717	-6492	-25		100.0

April to September 4X5Y groundfish landings (first half) of 2003 fishing year relative to previous year.

cod down 777t - 20%
cusk down 226t - 5%
dogfish down 2182 - 69% (one third of overall change)
haddock down 356t - 9%
monkfish up 74t - 13%
pollock up 469t - 11%
redfish down 786t - 26%
silver hake down 2130t - 79% (one third of overall change)
white hake down 616t - 34%
winter flounder up 136t - 25%

overall decrease 25%
19% if you don't include silver hake
11% if you don't include dogfish also

Table 6. Sampling data that went into the generation of the commercial catch at age in Div. 4X/5Y haddock in 2002

Area	Gear	Quarter	Tonnage	# Measured	Number Aged	ALK used	Comment: file =2002-Oct03.awf
4Xmnop	Otter trawl	1	1323	4231	601	4Xmnop_Qtr1	as is
4Xmnop	Otter trawl	2	544	1196	110	4Xmnop_Qtr2	as is
4Xmnop	Otter trawl	3	564	699	165	4Xmnop_Qtr3	as is
4Xmnop	Otter trawl	4	266	1456	331	4Xmnop_Qtr4	as is
4Xqrs5Y	Otter trawl	1	641	1993	203	4Xqrs5Y_Qtr1	as is
4Xqrs5Y	Otter trawl	2	868	2671	259	4Xqrs5Y_Qtr2	as is
4Xqrs5Y	Otter trawl	3	890	1921	206	4Xqrs5Y_Qtr3	as is
4Xqrs5Y	Otter trawl	4	536	1671	168	4Xqrs5Y_Qtr4	as is
4Xmnop	LL/HL	1	420	1649	601	4Xmnop_Qtr1	added quarterly 4Xmnop Misc. tonnage to each quarter
4Xmnop	LL/HL	2	86	235	110	4Xmnop_Qtr2	added quarterly 4Xmnop Misc. tonnage to each quarter
4Xmnop	LL/HL	3	1127	2393	165	4Xmnop_Qtr3	added quarterly 4Xmnop Misc. tonnage to each quarter
4Xmnop	LL/HL	4	565	1724	331	4Xmnop_Qtr4	added quarterly 4Xmnop Misc. tonnage to each quarter
4Xqrs5Y	LL/HL	1	2				see 4Xqrs5Y LL/HL Qtr2 below
4Xqrs5Y	LL/HL	2	25		259	4Xqrs5Y_Qtr2	applied LF from 4Xqrs5Y LL/HL Qtr3 and Misc Qtr2 to the combined 4Xqrs5Y LL/HL+Misc tonnage from the 1st and 2nd quarter
4Xqrs5Y	LL/HL	3	63	559	206	4Xqrs5Y_Qtr3	added LF from 4Xqrs5Y misc Qtr2 and added tonnage from 4Xqrs5Ymisc Qtr3
4Xqrs5Y	LL/HL	4	26		168	4Xqrs5Y_Qtr4	applied LF from 4Xqrs5Y LLqtr3 and Miscqtr2 to the combined 4Xqrs5Y LL/HL,Misc tonnage from the 3rd and 4th quarter
4Xmnop	Misc.	1	1				see 4Xmnop LL/HL Qtr1 above
4Xmnop	Misc.	2	1				see 4Xmnop LL/HL Qtr2 above
4Xmnop	Misc.	3	7				see 4Xmnop LL/HL Qtr3 above
4Xmnop	Misc.	4	1				see 4Xmnop LL/HL Qtr4above
4Xqrs5Y	Misc.	1	1				see 4Xqrs5Y LL/HL Qtr2 above
4Xqrs5Y	Misc.	2	3	99			see 4Xqrs5Y LL/HL Qtr2 above
4Xqrs5Y	Misc.	3	9				see 4Xqrs5Y LL/HL Qtr3 above
4Xqrs5Y	Misc.	4	-				

Table 7. Sampling data that went into the generation of the commercial catch at age in Div. 4X/5Y haddock in the first half of 2003.

Area	Gear	Quarter	Tonnage	# Measured	Number Aged	ALK used	Comment: file =2003-Oct03.awf
4Xmnop	Otter trawl	1	1315	2961	305	4Xmnop_Qtr1	as is
4Xmnop	Otter trawl	2	147	1394	165	4Xmnop_Qtr2	as is
4Xqrs5Y	Otter trawl	1	592	1879	160	4Xqrs5Y_Qtr1	as is
4Xqrs5Y	Otter trawl	2	913	2431	194	4Xqrs5Y_Qtr2	added tonnage from 4Xqrs5Y LL/HL Qtr2 and Misc. Qtr2
4Xmnop	LL/HL	1	475	1266	160	4Xmnop_Qtr1	added quarterly 4Xmnop Misc. tonnage to each quarter
4Xmnop	LL/HL	2	74	365	194	4Xmnop_Qtr2	added quarterly 4Xmnop Misc. tonnage to each quarter
4Xqrs5Y	LL/HL	1	0				
4Xqrs5Y	LL/HL	2	35				see 4Xqrs5Y OT Qtr2 above
4Xmnop	Misc.	1	5				see 4Xmnop LL/HL Qtr1 above
4Xmnop	Misc.	2	1				see 4Xmnop LL/HL Qtr2 above
4Xqrs5Y	Misc.	1	0				
4Xqrs5Y	Misc.	2	1				see 4Xqrs5Y OT Qtr2 above

Table 8. NAFO Div. 4X/5Y haddock commercial catch-at-age (000's).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0	0	42	152	1	37	18	2	0	0	16	1	0	0	2	0	0
2	1088	809	22	3114	713	2198	1306	1289	77	83	164	1210	526	70	763	228	294
3	747	1660	3490	114	4783	4617	1657	3137	3453	1184	2497	2268	3895	3621	1195	2105	1153
4	1549	809	1871	2274	318	5220	4295	2026	7221	6862	3071	6369	2648	6020	5046	2455	4871
5	391	1460	517	1080	1829	490	3712	3204	2156	3970	5527	4300	4954	4104	3708	4658	4021
6	541	415	656	533	523	1115	437	2891	2916	1094	3573	3272	1823	2454	2583	1508	1512
7	4679	71	91	607	194	250	813	361	1071	1272	538	1191	1560	1033	1022	509	226
8	1922	3404	58	326	277	174	155	390	141	269	636	366	364	434	367	136	98
9	137	1047	1185	262	191	63	72	107	110	58	173	331	196	206	119	51	36
10	99	167	520	621	277	32	96	72	27	70	35	99	101	131	83	16	31
11	181	186	26	56	567	167	39	23	9	11	21	14	48	76	39	7	11
12	28	150	196	13	25	231	104	8	6	1	3	24	17	27	22	4	6
13	38	108	93	6	4	11	158	87	49	18	10	9	15	27	13	2	3
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*
1	0	13	13	0	3	8	22	10	3	0	0	0	0	0	0	1	0
2	90	214	190	403	52	141	139	98	99	37	13	31	28	227	95	41	2
3	1043	512	497	1422	1304	243	709	368	757	809	526	149	472	409	1587	375	85
4	3030	1016	499	394	2351	2523	520	632	694	993	1676	1052	511	761	1013	2294	723
5	4588	896	936	358	580	2290	1828	327	617	682	1008	1795	1219	520	750	652	1199
6	2096	1968	310	472	246	229	1070	971	238	428	455	1137	941	1208	622	515	311
7	291	871	720	391	310	247	170	269	449	355	269	536	581	924	1278	467	205
8	58	894	460	654	200	331	106	24	421	439	138	329	221	524	889	689	183
9	7	372	504	277	310	237	73	17	162	355	110	181	54	210	366	484	152
10	9	209	255	204	280	240	46	13	24	130	94	192	48	104	120	226	65
11	6	146	57	61	142	132	58	20	26	17	35	140	53	37	24	104	26
12	0	49	81	48	169	152	51	15	18	1	4	31	25	8	16	55	5
13	0	44	30	9	71	36	12	7	11	3	2	6	5	11	4	15	0
14	0	22	12	9	13	15	7	1	11	1	0	8	0	6	15	2	0
15	0	7	4	2	4	2	1	0	3	1	0	5	0	5	0	2	0
16	0	4	0	1	4	2	0	1	2	2	1	1	0	0	0	1	0

* = 2003 data only until June 30th

Table 9. NAFO Div.4X/5Y haddock commercial catch-at-age (percent at age).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0	0	0.5	1.7	0.0	0.3	0.1	0.0	0	0	0.1	0.0	0	0	0.0	0	0
2	9.5	7.9	0.3	34.0	7.3	15.0	10.2	9.5	0.4	0.6	1.0	6.2	3.3	0.4	5.1	2.0	2.4
3	6.6	16.1	39.8	1.2	49.3	31.6	12.9	23.1	20.0	8.0	15.4	11.7	24.1	19.9	8.0	18.0	9.4
4	13.6	7.9	21.3	24.8	3.3	35.7	33.4	14.9	41.9	46.1	18.9	32.7	16.4	33.1	33.7	21.0	39.7
5	3.4	14.2	5.9	11.8	18.9	3.4	28.9	23.6	12.5	26.7	34.0	22.1	30.7	22.5	24.8	39.9	32.8
6	4.7	4.0	7.5	5.8	5.4	7.6	3.4	21.3	16.9	7.3	22.0	16.8	11.3	13.5	17.3	12.9	12.3
7	41.0	0.7	1.0	6.6	2.0	1.7	6.3	2.7	6.2	8.5	3.3	6.1	9.7	5.7	6.8	4.4	1.8
8	16.9	33.1	0.7	3.6	2.9	1.2	1.2	2.9	0.8	1.8	3.9	1.9	2.3	2.4	2.5	1.2	0.8
9	1.2	10.2	13.5	2.9	2.0	0.4	0.6	0.8	0.6	0.4	1.1	1.7	1.2	1.1	0.8	0.4	0.3
10	0.9	1.6	5.9	6.8	2.9	0.2	0.7	0.5	0.2	0.5	0.2	0.5	0.6	0.7	0.6	0.1	0.3
11	1.6	1.8	0.3	0.6	5.8	1.1	0.3	0.2	0.1	0.1	0.1	0.1	0.3	0.4	0.3	0.1	0.1
12	0.2	1.5	2.2	0.1	0.3	1.6	0.8	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0
13	0.3	1.0	1.1	0.1	0.0	0.1	1.2	0.6	0.3	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003* (half year)
1	0	0.2	0.3	0	0.0	0.1	0.5	0.4	0.1	0	0	0	0	0	0	0.0	0.0
2	0.8	3.0	4.2	8.6	0.9	2.1	2.9	3.5	2.8	0.9	0.3	0.6	0.7	4.6	1.4	0.7	0.1
3	9.3	7.1	10.9	30.2	21.6	3.6	14.7	13.3	21.4	19.0	12.1	2.7	11.4	8.3	23.4	6.3	2.9
4	27.0	14.0	10.9	8.4	38.9	37.0	10.8	22.8	19.6	23.3	38.7	18.8	12.3	15.4	14.9	38.7	24.5
5	40.9	12.4	20.5	7.6	9.6	33.5	38.0	11.8	17.5	16.0	23.3	32.1	29.3	10.5	11.1	11.0	40.6
6	18.7	27.2	6.8	10.0	4.1	3.4	22.2	35.0	6.7	10.1	10.5	20.3	22.6	24.4	9.2	8.7	10.5
7	2.6	12.0	15.8	8.3	5.1	3.6	3.5	9.7	12.7	8.3	6.2	9.6	14.0	18.6	18.8	7.9	6.9
8	0.5	12.4	10.1	13.9	3.3	4.8	2.2	0.9	11.9	10.3	3.2	5.9	5.3	10.6	13.1	11.6	6.2
9	0.1	5.1	11.0	5.9	5.1	3.5	1.5	0.6	4.6	8.3	2.5	3.2	1.3	4.2	5.4	8.2	5.1
10	0.1	2.9	5.6	4.3	4.6	3.5	1.0	0.5	0.7	3.1	2.2	3.4	1.2	2.1	1.8	3.8	2.2
11	0.1	2.0	1.2	1.3	2.4	1.9	1.2	0.7	0.7	0.4	0.8	2.5	1.3	0.7	0.4	1.8	0.9
12	0	0.7	1.8	1.0	2.8	2.2	1.1	0.5	0.5	0.0	0.1	0.6	0.6	0.2	0.2	0.9	0.2
13	0	0.6	0.7	0.2	1.2	0.5	0.2	0.3	0.3	0.1	0.0	0.1	0.1	0.2	0.1	0.3	0.0
14	0	0.3	0.3	0.2	0.2	0.2	0.1	0.0	0.3	0.0	0	0.1	0.0	0.1	0.2	0.0	0.0
15	0	0.1	0.1	0.0	0.1	0.0	0.0	0	0.1	0.0	0	0.1	0.0	0.1	0.0	0.0	0.0
16	0	0.1	0	0.0	0.1	0.0	0	0.0	0.1	0.0	0.0	0.0	0	0	0	0.0	0.0

Table 10. NAFO Div. 4X/5Y haddock commercial weight-at-age (kg).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	0.29	0.29	0.29	0.27	0.18	0.23	0.23	0.28	0.29	0.29	0.16	0.23			0.25	
2	0.57	0.5	0.45	0.51	0.46	0.52	0.52	0.46	0.44	0.51	0.522	0.593	0.493	0.394	0.527	0.573
3	0.9	0.96	0.9	0.75	0.82	0.82	0.81	0.71	0.87	0.87	0.882	0.877	0.907	0.758	0.785	0.83
4	1.05	1.25	1.35	1.25	1.1	1.2	1.19	1.22	1.33	1.33	1.326	1.26	1.294	1.141	1.069	1.071
5	1.16	1.4	1.6	1.8	1.7	1.55	1.6	1.72	1.85	1.84	1.777	1.721	1.653	1.714	1.411	1.408
6	1.43	1.5	1.75	2	2.3	2.25	2.1	2.2	2.33	2.36	2.355	2.219	2.13	2.146	1.932	1.966
7	1.65	1.75	1.9	2.2	2.5	2.85	2.95	2.94	2.7	2.83	2.906	2.654	2.577	2.607	2.287	2.442
8	1.95	1.95	2.1	2.3	2.6	3	3.5	3.3	3.39	3.3	3.278	3.134	2.947	2.869	2.683	2.92
9	2.3	2.3	2.3	2.5	2.8	3.2	3.6	3.57	3.77	4.03	3.811	3.608	3.47	3.108	3.054	3.501
10	2.82	2.65	2.8	2.7	2.95	3.45	3.8	3.77	4.17	4.15	4.332	3.688	4.033	3.55	3.431	3.313
11	2.8	3.25	3	3.3	3.2	3.5	4.1	3.69	4.03	4.96	4.2	4.546	3.946	3.63	3.841	4.029
12	2.85	3	3.7	3.4	3.8	3.7	4	3.94	3.62	6	4.963	4.823	4.033	3.78	4.114	4.424
13	3.6	3	3.3	4.2	3.9	4.4	4.2	3.91	4.63	5.68	5.711	4.68	4.908	4.064	4	5.468
14																5.595
15																
16																

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1		0.439			0.55	0.671			0.161							0.284
2	0.615	0.848	0.81	0.666	1.159	0.79	0.796	0.872	0.773	0.906	0.827	0.611	0.965	0.798	0.752	0.824
3	0.779	1.085	1.085	1.073	1.104	1.026	0.972	1.139	1.074	1.011	1.03	0.922	1.176	0.947	1.001	1.046
4	1.005	1.179	1.232	1.431	1.44	1.232	1.129	1.312	1.369	1.217	1.289	1.029	1.436	1.193	1.096	1.225
5	1.328	1.469	1.35	1.809	1.833	1.572	1.392	1.483	1.597	1.396	1.561	1.23	1.407	1.274	1.217	1.317
6	1.796	1.522	1.511	1.74	2.016	1.956	1.734	1.793	1.73	1.598	1.869	1.429	1.620	1.320	1.216	1.328
7	2.472	1.683	1.69	2.001	2.088	1.887	2.132	2.08	1.976	1.614	2.048	1.676	1.966	1.532	1.318	1.367
8	3.123	1.794	1.672	2.05	2.234	1.963	2.098	2.493	2.013	1.86	2.069	1.88	2.198	1.776	1.502	1.399
9	4.061	2.031	1.815	2.108	2.24	2.158	2.365	2.101	2.355	2.136	2.199	2.08	2.100	2.201	1.696	1.601
10	3.309	2.256	1.882	2.351	2.228	2.167	2.242	2.775	2.286	2.042	2.357	2.122	2.154	2.450	2.094	1.852
11	4.15	2.373	2.256	2.316	2.274	2.1	2.377	2.204	2.584	2.75	2.648	2.433	2.678	2.090	2.410	2.074
12	4.775	2.57	2.379	2.613	2.339	1.968	2.148	2.381	2.305	3.373	2.55	2.939	2.490	3.405	2.484	1.828
13	5.173	2.329	2.49	2.373	2.327	2.66	2.521	2.899	2.623	3.027	3.072	3.537	2.141	2.525	2.579	3.177
14	5.827	3.302	2.713	3.126	2.654	2.919	2.887	4.51	2.902	3.271	4.481	3.604	5.700	3.477	1.788	4.459
15		3.767	3.135	3.204	3.421	3.218	4.777	4.308	3.095	3.49		2.348	5.184	2.645	3.167	4.737
16	7.526	4.754	6.052	4.546	3.787	5.541	5.628	2.486	3.224	3.286	3.674	3.081				5.560

Table 11. NAFO Div. 4X/5Y haddock mean numbers per standard tow by stratum from the 1970-2003 summer RV survey.

	trawlable units	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
470	77962	4.73	0.70	6.82	6.16	0.49	5.04	0.84	328.72	6.90	45.90	3.94	7.31	0.00	36.34	12.58	0.97
471	85080	0.00	0.00	2.96	0.00	0.00	0.66	0.00	0.53	0.55	0.66	3.50	3.43	4.89	3.89	0.46	0.00
472	105842	16.46	45.36	19.03	15.07	34.63	59.02	42.30	17.90	12.64	39.06	298.69	230.44	141.20	39.75	49.03	73.40
473	22456	107.84	11.98	98.66	62.30	64.68	13.80	136.15	205.16	31.67	97.51	37.70	12.72	135.88	34.22	60.70	189.10
474	13643	66.88	30.73	34.75	47.40	90.52	116.41	92.22	31.20	124.30	364.12	32.62	143.35	135.37	58.27	0.00	134.50
475	13220	93.77	64.66	26.36	69.16	126.82	32.56	164.45	43.90	97.20	93.38	85.44	55.30	48.50	53.94	254.51	100.85
476	125248	0.00	101.50	14.86	0.00	49.84	47.44	1.57	1266.30	64.54	0.00	27.72	17.81	5.50	62.34	8.75	369.87
477	104401	54.48	40.96	29.42	38.29	158.40	30.29	80.33	37.28	54.65	53.36	43.10	63.84	94.15	86.99	150.81	92.13
478	19745	2.10	2.10	0.84	0.70	3.02	3.85	12.60	5.62	7.38	3.02	2.10	0.80	2.94	17.14	16.73	20.42
480	55506	120.78	290.52	118.49	159.36	317.39	215.42	76.96	757.87	231.06	106.48	268.87	216.97	73.74	93.29	172.05	117.45
481	158890	75.91	37.07	38.03	220.03	327.70	59.66	67.81	36.97	87.58	102.24	203.57	42.13	170.30	41.82	70.77	18.68
482	88301	2.80	3.98	0.00	0.00	7.00	3.67	5.63	11.70	10.08	24.65	17.70	11.90	23.33	8.58	20.90	1.46
483	45082	3.04	0.00	4.90	0.00	2.22	2.52	36.40	11.95	2.10	13.26	28.20	38.68	70.04	5.66	33.42	14.58
484	191855	0.00	0.64	0.00	0.44	0.42	0.47	7.33	0.49	0.70	17.84	2.80	2.00	6.04	1.28	4.12	2.94
485	134061	62.59	14.14	3.73	38.30	11.15	14.40	17.72	41.38	16.66	13.04	79.10	18.01	24.85	11.29	26.44	80.44
490	50930	36.52	68.24	0.64	84.92	389.34	57.74	130.98	227.41	76.18	461.66	373.38	1775.64	485.53	234.97	773.65	160.56
491	58217	4.99	0.00	13.67	4.70	25.26	3.61	3.10	25.56	13.82	6.25	18.44	18.58	30.46	32.01	29.26	16.34
492	92029	1.46	25.20	8.09	5.77	23.80	9.34	30.66	19.45	9.22	33.95	6.77	25.57	103.64	18.56	1.24	5.04
493	45167	2.90	1.14	1.87	5.24	0.89	7.38	5.30	7.87	12.68	0.49	1.90	3.71	1.65	0.39	36.04	2.31
494	35337	0.00	1.68	6.90	8.94	19.39	7.24	4.19	19.88	5.83	20.75	2.22	3.85	5.04	0.00	5.56	3.50
495	49489	20.16	16.27	11.20	4.80	24.23	2.08	5.84	40.70	57.60	37.75	8.10	10.42	38.59	14.84	3.09	5.22
470-481	781993	33.23	48.42	24.94	56.33	107.20	42.24	37.20	259.73	49.33	46.84	95.82	59.54	80.09	49.49	63.65	103.70
482-495	790468	12.85	9.58	3.35	11.75	29.21	7.55	17.16	26.51	13.19	39.61	37.16	105.72	58.54	23.75	63.96	27.95
Total	1572461	22.98	28.90	14.09	33.91	67.99	24.80	27.12	142.49	31.16	43.20	66.34	82.75	69.26	36.55	63.81	65.62

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
470	6.61	6.46	3.19	1.54	0.00	0.97	0.49	0.00	2.11	5.68	16.49	8.09	0.97	2.08	99.64	3.44	0
471	2.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.01	0.00	1.01	5.34	0.00	182.22	0.50	0
472	28.21	34.73	47.23	17.47	19.11	7.89	7.32	14.77	42.50	74.95	30.98	7.25	194.46	41.45	78.14	27.93	45.64
473	80.29	12.01	12.32	41.51	92.36	5.83	0.46	47.42	210.78	352.79	101.04	199.85	85.43	66.13	75.46	155.32	117.76
474	3.15	1.54	1.80	31.11	6.32	6.69	8.26	8.16	8.15	41.32	107.22	92.83	58.35	128.46	15.56	574.19	42.07
475	14.13	13.90	22.10	54.47	22.48	16.04	8.75	125.37	164.81	175.06	46.38	47.18	65.12	267.81	153.13	171.72	103.32
476	25.03	9.10	9.21	5.30	8.51	11.67	2.83	14.82	51.60	52.17	72.14	25.26	19.05	32.62	175.65	133.00	35.67
477	43.99	59.48	42.02	24.37	38.58	39.23	12.84	56.47	248.00	86.51	60.13	120.74	213.79	279.37	304.24	141.85	79.7
478	25.39	11.32	0.00	13.83	0.00	4.88	3.40	14.39	5.30	22.14	5.90	3.09	6.14	35.14	18.65	53.90	0
480	52.78	84.96	175.59	251.54	316.69	200.96	71.76	173.09	274.90	226.30	341.80	322.51	1022.21	964.38	448.81	298.95	350.53
481	31.93	25.72	29.26	18.03	40.43	25.32	41.43	41.01	145.58	102.30	71.88	58.67	274.05	130.46	326.67	176.67	128.29
482	31.63	22.73	18.19	39.56	20.86	1.50	7.29	19.23	18.65	138.92	25.17	10.82	19.44	48.93	8.48	24.83	10.94
483	11.48	20.59	1.54	36.84	41.78	4.03	3.83	0.50	3.54	1.96	17.23	4.46	4.22	4.97	13.76	15.99	1.54
484	0.00	1.37	0.97	0.97	0.00	0.00	0.70	0.65	3.03	5.17	2.91	3.01	3.73	8.55	23.14	6.04	8.77
485	2.97	9.68	1.86	13.13	87.06	20.51	8.40	1.69	78.02	94.92	4.35	34.48	84.82	219.97	10.63	98.90	15.18
490	44.66	128.41	129.52	174.02	79.27	104.55	18.53	412.74	541.72	336.00	267.88	139.75	62.71	137.85	219.26	87.83	61.41
491	1.03	0.26	0.00	0.67	1.30	3.56	4.80	22.25	63.99	9.09	44.53	10.16	38.49	64.99	132.13	50.37	11.04
492	2.63	5.33	0.31	0.00	0.39	8.21	0.00	7.00	6.02	4.69	37.18	67.20	7.05	4.99	6.61	13.28	206.95
493	13.65	0.00	0.00	0.00	0.00	1.56	0.00	0.00	1.12	0.62	24.29	1.63	5.90	14.70	25.74	4.97	0.3
494	0.00	0.70	0.00	0.00	2.92	0.58	0.00	6.00	25.43	300.70	0.00	17.83	29.51	139.30	7.41	36.51	11.32
495	0.00	0.98	0.00	18.05	0.00	0.00	0.00	4.93	55.27	16.99	48.84	21.23	61.06	52.01	7.41	80.04	2.18
470-481	28.12	26.89	32.96	31.14	42.94	28.36	17.11	36.53	105.6	81.94	69.99	65.11	191.56	152.85	212.82	120.28	79.34
482-495	8.55	14.58	11.05	21.37	24.83	11.77	4.17	32.06	60.91	67.92	33.6	26.38	30.88	69.7	36.04	39.77	35.54
Total	18.28	20.7	21.95	26.23	33.83	20.02	10.61	34.28	83.14	74.89	51.7	45.64	110.78	111.05	123.95	79.80	57.32

Table 12. NAFO Div. 4X/5Y haddock mean numbers-at-age per standard tow from the 1970-2003 summer RV survey, strata 470-495.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	0	0	0	0	0	0	0	0.01	0	0.47	0.03	0.54	0.14	0.32	0.27	0	0.14
1	5.21	0.10	4.72	5.79	10.31	6.02	4.98	5.77	5.54	1.84	19.84	32.96	11.70	6.11	3.75	6.31	3.44
2	4.17	10.08	0.21	20.57	20.71	3.24	5.86	36.36	4.73	12.40	6.31	25.42	25.09	4.04	21.44	8.68	8.54
3	1.23	4.38	3.04	0.66	29.86	4.83	3.77	56.66	10.95	7.46	13.91	6.14	11.91	12.89	10.98	20.81	6.75
4	2.31	1.94	1.38	2.89	0.91	7.17	3.94	16.13	3.74	9.45	7.16	8.43	4.73	5.70	16.55	9.54	13.55
5	0.93	2.70	0.81	1.36	3.74	0.37	6.65	15.62	1.55	4.78	11.11	3.43	7.69	3.36	5.20	13.15	5.30
6	2.14	1.28	0.90	0.48	0.84	1.62	0.58	8.61	2.98	2.00	4.29	3.80	3.14	2.12	2.66	3.38	5.66
7	5.51	1.99	0.59	0.70	0.49	0.41	0.72	1.17	1.18	2.99	1.55	1.21	3.43	0.87	1.28	1.68	2.02
8	0.78	5.49	0.92	0.52	0.59	0.31	0.13	1.41	0.08	1.29	1.16	0.16	0.59	0.31	0.54	1.06	1.04
9	0.31	0.71	1.44	0.34	0.32	0.13	0.07	0.16	0	0.22	0.59	0.30	0.38	0.29	0.36	0.59	0.59
10	0.30	0.08	0.05	0.57	0.23	0.11	0.02	0.14	0	0.10	0.23	0.18	0.21	0.21	0.08	0.22	0.34
11	0.07	0.04	0.01	0.02	0.35	0.34	0.01	0.02	0.04	0	0.03	0.08	0.14	0.17	0.03	0.06	0.06
12	0.02	0.10	0.00	0	0	0.26	0.14	0.15	0.03	0	0	0.04	0	0.05	0.03	0.03	0.10
13	0	0	0.01	0.01	0	0	0.10	0.08	0.02	0	0	0	0	0.05	0.04	0.03	0.06
14	0	0	0	0	0	0	0	0.28	0.09	0.06	0	0	0	0	0	0.04	0
15	0	0	0	0	0	0	0	0	0.05	0.11	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unknown	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.01	0.18	0.03	0.06	0.05	0.11	0.05	0.03	0.03	0.10
4X total	22.98	28.89	14.09	33.91	68.35	24.80	27.12	142.59	31.16	43.21	66.27	82.74	69.26	36.54	63.24	65.60	47.69
SS total	33.23	48.43	24.94	56.32	107.91	42.24	37.2	259.92	49.33	46.92	95.79	59.54	80.09	49.49	62.54	103.66	83.46
BoF total	12.85	9.57	3.35	11.75	29.21	7.55	17.15	26.51	13.19	39.55	37.16	105.72	58.56	23.74	63.95	27.94	12.3

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	1970-2002
0	0	0.06	0.00	0.17	0	0	0	2.55	0.18	2.00	0.12	1.63	24.78	24.79	4.32	0.01	0.52	1.90
1	1.20	6.44	5.39	0.07	3.86	2.81	4.17	19.09	41.81	4.53	9.02	8.98	32.51	24.61	27.74	3.81	2.11	10.01
2	1.38	1.92	8.79	9.56	1.24	2.24	0.95	5.34	22.41	24.17	5.30	6.94	18.43	40.10	28.72	15.27	4.78	12.44
3	2.45	0.91	1.76	8.60	11.35	0.88	1.57	1.98	10.63	22.71	19.25	4.26	8.71	6.19	37.22	20.80	12.88	11.08
4	3.03	1.90	0.82	1.58	10.37	6.92	0.60	1.78	3.77	11.56	11.62	12.52	5.84	4.29	10.91	23.00	14.27	6.85
5	3.67	2.65	1.66	1.28	2.18	4.92	1.72	0.36	1.71	4.67	3.60	6.74	9.92	3.48	4.15	5.48	12.32	4.42
6	2.55	2.81	0.71	1.42	1.20	0.94	1.04	1.75	0.70	1.54	1.50	1.72	5.53	4.81	1.98	2.87	2.35	2.41
7	1.86	1.34	1.47	1.29	1.06	0.35	0.17	1.02	1.43	1.07	0.55	1.39	2.72	1.71	5.06	2.09	2.61	1.59
8	0.81	1.05	0.52	1.08	0.91	0.36	0.13	0.14	0.37	1.50	0.17	0.91	1.05	0.68	1.95	3.18	1.51	0.94
9	0.24	0.65	0.44	0.45	0.67	0.26	0.05	0.05	0.09	0.37	0.28	0.25	0.79	0.30	1.08	1.71	2.59	0.44
10	0.29	0.36	0.13	0.37	0.80	0.19	0.04	0.08	0	0.30	0.18	0.16	0.17	0.06	0.73	0.91	0.95	0.24
11	0.07	0.12	0.10	0.18	0.08	0.04	0.09	0.01	0	0.12	0.02	0.11	0.17	0.02	0.08	0.62	0.40	0.10
12	0.01	0.01	0.08	0.08	0.08	0.02	0.02	0.05	0.02	0.02	0.01	0.01	0.11	0.01	0	0.03	0	0.05
13	0	0	0	0.05	0.02	0.00	0.03	0.09	0	0.07	0	0	0.04	0	0.03	0.04	0.03	0.02
14	0.03	0	0.01	0.00	0.01	0	0.00	0	0	0	0	0	0.02	0	0.00	0	0	0.02
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
16	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0.00
17	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0.00
unknown	0.70	0.48	0.05	0.02	0	0.09	0.02	0	0.02	0.27	0.04	0.01	0	0.01	0	0	0	0.08
4X total	18.28	20.70	21.93	26.23	33.83	20.02	10.61	34.28	83.14	74.90	51.69	45.64	110.79	111.06	123.97	79.81	57.32	52.59
SS total	28.12	26.89	32.94	31.14	42.94	28.36	17.11	36.53	105.62	81.95	69.99	65.11	191.56	152.85	212.92	120.28	79.35	75.34
BoF total	8.55	14.58	11.05	21.37	24.82	11.76	4.17	32.06	60.92	67.92	33.59	26.38	30.88	69.72	36.03	39.77	35.54	30.11

Table 13. Mean length-at-age (cm) of NAFO Div. 4X/5Y haddock from the summer RV survey, strat 470-495.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0								8.5		7.3	6.5	8.3	6.5	7.8	8.2		6.5
1	21.0	20.6	19.9	21.3	21.0	21.9	21.0	21.9	19.0	19.9	20.0	19.9	17.9	18.7	20.5	19.5	19.5
2	33.8	29.3	26.9	30.2	31.1	32.6	32.3	35.1	33.8	32.0	33.3	32.8	26.9	28.2	29.4	30.8	30.1
3	41.1	41.6	39.3	35.7	40.0	41.4	40.0	42.4	43.0	41.0	40.8	41.4	38.8	37.1	34.5	36.6	38.2
4	45.7	47.0	48.7	49.6	45.3	48.5	48.4	48.1	50.2	49.6	49.3	47.8	48.8	46.7	42.2	41.2	41.0
5	49.9	51.3	52.8	54.8	54.4	54.2	53.1	54.1	54.7	54.4	54.8	55.3	53.5	53.5	49.1	45.7	45.4
6	52.0	53.1	56.0	59.5	59.3	59.3	58.1	56.6	57.7	60.2	58.1	59.9	59.6	56.8	55.8	50.7	48.3
7	56.2	54.9	56.5	60.1	61.3	63.6	62.8	63.6	61.2	62.8	61.4	62.8	63.9	61.4	58.9	57.5	51.2
8	59.6	58.7	60.2	60.7	62.7	64.7	61.3	65.2	66.2	65.6	63.2	64.3	67.7	63.7	61.4	58.1	54.2
9	60.5	63.0	63.1	63.0	63.0	65.6	65.7	69.8		71.6	67.1	67.5	68.7	64.8	65.5	57.8	59.8
10	65.1	70.5	69.1	63.9	63.6	67.5	66.5	65.2		69.1	67.5	72.8	74.6	66.9	69.4	62.9	60.1
11	68.2	69.4	68.5	67.7	68.0	67.0	72.5	66.5	62.5		70.5	72.3	74.9	67.6	70.5	62.7	64.8
12	60.5	72.9	76.5			66.8	66.9	69.0	68.5			74.5		70.8	72.5	66.5	65.5
13			78.5	70.5			69.7	72.9	72.5					75.0	66.5	66.5	61.1
14								69.8	73.2	72.5						68.7	
15									70.3	72.9							
16																	
17																	

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	1970-2002
0		6.5	10.5	8.5				8.7	7.5	9.7	8.4	8.7	9.7	10.0	9.0	6.5	7.8	8.2
1	21.0	20.9	20.4	21.5	20.7	19.4	22.1	23.8	18.6	17.8	22.1	18.7	21.7	22.3	20.6	19.9	18.9	20.5
2	31.9	34.6	32.0	33.1	37.5	30.8	32.7	34.2	32.6	27.4	28.1	29.5	25.8	33.7	28.7	27.6	27.5	31.2
3	37.5	40.1	40.7	41.6	42.7	39.3	41.8	42.7	42.8	39.9	34.2	34.2	37.1	37.9	37.2	34.0	32.3	39.3
4	44.1	44.9	43.4	48.8	49.7	47.2	47.3	48.9	48.6	48.6	42.1	38.9	38.6	43.8	39.4	39.8	39.9	45.8
5	47.1	49.6	49.0	53.8	52.1	53.4	51.5	49.9	52.5	51.7	48.4	46.7	42.5	42.7	45.1	41.4	47.0	50.6
6	47.2	49.1	52.0	54.7	58.3	57.3	55.9	53.2	53.6	54.8	50.3	51.7	45.1	45.6	45.4	45.5	46.8	54.0
7	51.3	51.6	52.0	57.2	58.4	59.1	57.4	56.0	56.3	56.8	54.0	54.6	47.7	50.0	46.7	46.5	48.1	56.8
8	53.6	52.9	52.1	57.7	57.9	54.7	56.6	60.4	59.7	57.6	57.9	58.4	49.8	52.0	49.1	46.6	48.9	58.6
9	58.0	54.8	52.7	59.8	55.8	55.2	51.0	53.3	65.6	62.5	56.5	56.4	50.0	56.4	51.6	48.9	50.5	60.2
10	56.8	54.4	56.0	52.3	53.9	61.1	58.0	54.5		60.5	54.0	54.5	55.3	61.5	46.9	49.1	50.8	61.4
11	61.7	59.2	60.9	60.7	66.3	64.2	58.3	58.5		58.5	60.4	60.4	55.6	56.5	53.9	41.6	53.6	63.6
12	76.5	62.5	50.9	58.1	61.0	62.5	56.5	51.5	54.5	59.6	62.5	54.5	55.1	62.5		59.6		63.7
13				68.0	70.5	68.5	56.4	57.8		69.3			51.4		52.5	61.1	66.5	66.0
14	65.9		66.5	66.5	68.5		74.5						68.5		74.5			69.9
15																		71.6
16											58.5							58.5
17					64.5													64.5

Table 14. Mean weight-at-age(kg) of NAFO Div. 4X/5Y haddock from the summer research vessel survey, strata 470-495.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0																	
1	0.080	0.102	0.078	0.092	0.087	0.102	0.090	0.103	0.067	0.082	0.073	0.075	0.047	0.040	0.083	0.073	0.053
2	0.392	0.248	0.203	0.296	0.309	0.369	0.367	0.463	0.413	0.345	0.440	0.401	0.223	0.241	0.290	0.331	0.285
3	0.761	0.762	0.661	0.510	0.708	0.759	0.695	0.838	0.900	0.781	0.793	0.864	0.678	0.550	0.465	0.549	0.603
4	1.078	1.083	1.303	1.347	1.012	1.266	1.160	1.258	1.465	1.369	1.309	1.201	1.310	1.103	0.836	0.728	0.776
5	1.384	1.424	1.633	1.816	1.716	1.800	1.523	1.771	1.951	1.757	1.752	1.864	1.697	1.586	1.273	1.010	1.017
6	1.607	1.618	1.991	2.374	2.218	2.271	1.926	2.009	2.260	2.383	2.111	2.312	2.325	1.886	1.847	1.380	1.178
7	2.033	1.721	2.145	2.396	2.516	2.828	2.411	2.870	2.640	2.709	2.496	2.761	2.869	2.383	2.073	2.023	1.431
8	2.337	2.181	2.501	2.464	2.679	3.013	2.384	2.917	3.422	3.368	2.712	3.109	3.341	2.665	2.447	1.977	1.693
9	2.384	2.590	2.897	2.717	2.784	3.251	2.685	4.021		4.034	3.451	3.308	3.446	2.818	2.830	1.936	2.173
10	2.951	4.073	3.966	2.885	2.817	3.169	2.600	2.972		3.477	3.319	3.970	4.212	3.176	3.769	2.483	2.200
11	3.631	3.516	3.700	3.386	3.408	3.314	3.500	3.500	2.600		3.400	3.811	4.468	3.146	2.350	2.635	2.803
12	2.225	4.738	4.600			3.326	3.056	3.531	4.200			4.000		3.690	3.500	3.200	2.836
13			6.200	4.000			3.374	3.631	3.900					4.366	2.300	3.100	2.119
14								3.693	4.195	3.600						3.036	
15									4.237	4.721							
16																	
17																	

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	1970-02
0								0.007	0.005	0.010	0.005	0.007	0.009	0.010	0.007	0.003	0.005	0.007
1	0.093	0.092	0.089	0.109	0.083	0.082	0.098	0.139	0.063	0.053	0.114	0.065	0.104	0.108	0.087	0.078	0.068	0.084
2	0.342	0.520	0.356	0.424	0.600	0.307	0.366	0.423	0.353	0.210	0.231	0.261	0.188	0.393	0.235	0.209	0.215	0.334
3	0.581	0.689	0.747	0.819	0.839	0.624	0.770	0.865	0.829	0.680	0.428	0.409	0.540	0.569	0.542	0.396	0.356	0.673
4	0.968	0.987	0.911	1.338	1.331	1.141	1.109	1.234	1.157	1.210	0.793	0.621	0.606	0.888	0.642	0.635	0.670	1.066
5	1.154	1.348	1.292	1.690	1.503	1.666	1.394	1.341	1.436	1.450	1.187	1.069	0.820	0.802	0.925	0.711	1.076	1.417
6	1.139	1.384	1.510	1.879	2.083	2.010	1.777	1.657	1.536	1.780	1.392	1.448	0.966	1.013	0.933	0.915	1.045	1.731
7	1.436	1.654	1.543	2.132	2.064	2.299	1.941	1.926	1.793	1.878	1.648	1.790	1.171	1.332	1.040	0.980	1.109	2.028
8	1.660	1.645	1.612	2.187	2.123	1.761	1.859	2.319	2.197	1.898	1.902	2.136	1.314	1.574	1.211	0.993	1.133	2.230
9	2.090	1.989	1.555	2.531	2.005	2.004	1.396	1.567	2.648	2.503	1.895	2.024	1.373	1.991	1.424	1.147	1.288	2.421
10	1.816	1.903	1.799	1.644	1.679	2.537	2.226	1.705		2.454	1.535	1.581	1.890	2.458	1.143	1.167	1.316	2.567
11	2.328	2.203	2.310	2.450	3.511	2.786	2.191	2.195		2.233	2.045	2.171	1.809	1.858	1.644	0.905	1.442	2.768
12	6.000	2.900	1.310	2.479	2.564	2.760	1.995	1.274	1.510	2.019	1.358	1.465	1.642	2.200		1.887		2.825
13				3.513	3.555	3.500	1.682	2.179		3.879			1.347		1.450	2.430	2.802	3.140
14	2.870		2.400	3.300	3.400		4.540						3.260		3.810			3.464
15																		4.479
16											2.054							2.054
17					2.945													2.945

Table 15. SPA results - Residuals

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
2	0.00	0.29	-2.17	0.42	0.45	-0.75	-0.92	0.84	-0.72	-0.06
3	-0.60	0.26	-0.70	-0.97	0.98	-0.85	-0.43	1.46	-0.25	-0.20
4	-0.35	0.15	-0.46	-0.40	-0.49	-0.08	-0.73	1.31	-0.89	-0.05
5	-0.34	0.19	-0.41	0.05	0.25	-1.13	0.31	1.02	-0.62	-0.17
6	0.42	0.35	-0.45	-0.44	0.16	-0.07	-0.23	1.33	-0.04	0.18
7	-0.37	0.56	-0.16	-0.19	0.02	-0.03	-0.28	1.09	0.18	0.62
8	-1.50	0.51	0.18	0.44	0.45	0.30	-0.37	1.36	-0.67	1.15
9	-0.18	-1.04	-0.07	-0.38	0.93	-0.54	-0.56	0.74	0.00	1.07
10	0.41	-0.90	-3.16	-0.28	0.01	0.66	-1.83	0.97	0.00	0.10
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
Ave 2-10	-0.14	0.02	-0.41	-0.10	0.15	-0.14	-0.28	0.56	-0.17	0.15

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	-0.47	0.72	0.63	-0.97	0.56	0.61	0.88	-0.21	-0.27	0.15
3	0.15	-0.39	0.11	0.09	0.10	0.62	0.47	-0.23	-0.49	-0.25
4	0.01	0.01	-0.40	-0.21	0.67	0.16	0.50	0.15	-0.19	-0.30
5	0.63	-0.24	0.49	-0.29	0.24	0.93	-0.05	-0.31	0.52	0.03
6	0.49	0.33	0.32	-0.02	0.26	0.40	0.61	-0.24	0.03	-0.43
7	0.40	0.07	1.20	-0.32	0.25	0.40	0.20	-0.24	-0.46	-0.17
8	0.60	-1.10	0.29	0.04	0.06	0.81	0.45	-0.30	-0.17	-0.79
9	1.06	0.14	0.48	0.38	1.11	0.62	0.57	-0.74	-0.10	-0.34
10	1.89	0.69	0.64	0.78	-0.10	1.21	0.42	0.16	0.15	-1.10
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
Ave 2-10	0.26	0.01	0.21	-0.03	0.18	0.32	0.23	-0.11	-0.05	-0.18

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.31	-0.70	-0.41	-1.39	-0.30	0.90	0.65	0.05	0.05	0.83
3	0.22	0.58	-0.98	-0.66	-0.59	0.45	0.97	0.46	-0.12	0.34
4	-0.16	0.67	0.38	-1.17	-0.32	0.24	0.70	0.48	0.16	0.32
5	0.46	0.41	0.30	-0.65	-1.49	-0.13	0.67	-0.30	0.16	0.06
6	0.31	0.80	-0.13	-0.81	-0.20	-0.57	0.08	-0.18	-0.74	0.24
7	0.55	0.41	0.09	-1.61	-0.55	-0.07	0.15	-0.68	0.07	-0.02
8	0.27	0.89	0.19	-0.06	-1.38	-1.03	0.61	-1.13	0.45	0.37
9	-0.47	0.49	0.51	-1.11	-0.52	-1.43	-0.49	-0.63	-0.25	0.73
10	0.16	0.70	0.12	-0.53	-0.21	0.00	0.35	-0.71	-0.67	-0.15
2	0	0	0	0	0	0	0.04	-0.51	0.35	0.46
3	0	0	0	0	0	0	0.26	0.20	-0.27	0.27
4	0	0	0	0	0	0	-0.14	0.40	0.11	-0.07
5	0	0	0	0	0	0	0.19	-0.16	0.14	-0.02
6	0	0	0	0	0	0	-0.12	0.23	-0.76	0.40
7	0	0	0	0	0	0	0.02	-0.30	-0.19	0.01
8	0	0	0	0	0	0	0.28	-0.67	-0.08	0.11
9	0	0	0	0	0	0	-0.82	-0.28	-0.19	0.56
10	0	0	0	0	0	0	0.10	-0.44	-0.28	-0.52
Ave 2-10	0.09	0.24	0.00	-0.44	-0.31	-0.09	0.19	-0.23	-0.11	0.22

Age	2000	2001	2002	2003
2	0.49	0.43	0.17	-0.07
3	-0.21	0.47	0.14	0.04
4	-0.22	0.51	0.12	-0.11
5	-0.06	-0.11	-0.05	-0.37
6	-0.45	-0.38	-0.26	-0.70
7	-0.67	-0.18	-0.10	-0.18
8	-0.88	0.07	-0.17	0.07
9	-0.40	0.02	0.45	-0.06
10	-1.40	1.01	0.31	0.30
2	-0.02	-0.07	-0.32	0.07
3	-0.35	0.08	-0.28	0.10
4	-0.13	0.13	-0.21	-0.09
5	0.48	-0.11	-0.07	-0.44
6	0.42	0.02	0.13	-0.33
7	0.04	0.16	0.24	0.03
8	-0.20	0.34	0.07	0.14
9	-0.12	0.22	0.67	-0.03
10	-0.73	1.13	0.46	0.29
Ave 2-10	-0.25	0.21	0.07	-0.08

Mean Square of the Residuals = 0.353355

	Est. Param	CV	Bias (%)
1	9.44720	0.44124	-0.02105
2	10.16430	0.31437	-0.01877
3	10.31370	0.26200	-0.01207
4	10.28950	0.23956	0.00099
5	8.87916	0.22467	0.01013
6	8.35353	0.21880	0.02296
7	7.70542	0.22695	0.05081
8	8.39631	0.21128	0.03236
9	7.10415	0.22965	0.06783

Table 16. SPA results - Population Numbers (000s)

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	25931	6199	48002	45063	24734	50508	53828	32684	44027	33902
2	12185	21230	5075	39262	36757	20249	41319	44054	26758	36046
3	5728	8992	16650	4136	29328	29449	14590	32647	34902	21838
4	7861	4014	5860	10474	3283	19684	19933	10446	23891	25451
5	2619	5034	2554	3105	6518	2400	11392	12434	6719	13026
6	2723	1790	2801	1623	1565	3681	1522	5968	7281	3550
7	15119	1740	1090	1699	847	808	2005	850	2271	3322
8	7374	8144	1360	810	842	518	435	906	370	890
9	750	4299	3588	1061	368	439	267	216	389	175
10	442	490	2572	1865	632	129	302	153	80	219
1-10	80731	61932	89552	109099	104873	127865	145593	140359	146687	138420

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	42495	45144	35692	41756	16041	12085	5765	8594	25573	23776
2	27757	34778	36960	29222	34187	13131	9894	4720	7036	20926
3	29437	22577	27379	29784	23862	27300	10545	7835	3783	5567
4	16808	21842	16432	18891	21109	18455	20446	7590	5471	2634
5	14629	10982	12120	11057	10020	12717	12888	12333	3472	3560
6	7073	6976	5101	5440	5340	4848	6197	6914	5946	2032
7	1917	2558	2751	2527	2233	2035	2605	3705	3764	3087
8	1569	1083	1017	841	1134	904	1205	1928	2770	2293
9	485	709	555	503	296	596	617	898	1526	1459
10	91	241	281	277	225	134	442	473	729	913
1-10	142260	146889	138286	140299	114446	92205	70605	54989	60071	66248

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	8387	11407	12855	24316	30613	42503	16841	21800	26670	81978
2	19454	6867	9336	10518	19888	25054	34796	13789	17848	21836
3	16961	15563	5575	7516	8485	16194	20423	28455	11277	14585
4	4108	12600	11562	4345	5512	6614	12574	15989	22821	9098
5	1705	3007	8188	7183	3087	3941	4787	9396	11574	17732
6	2068	1072	1937	4632	4227	2231	2669	3303	6781	7852
7	1383	1266	655	1379	2824	2582	1611	1798	2292	4523
8	1876	779	756	313	975	2069	1708	998	1228	1392
9	1462	944	457	319	160	777	1313	1001	692	708
10	739	946	493	159	195	116	489	754	720	403
1-10	58143	54450	51815	60680	75967	102082	97212	97281	101904	160106

Age	2000	2001	2002	2003
1	62270	42863	17087	23587
2	67118	50982	35094	13989
3	17852	54746	41655	28695
4	11514	14246	43386	33765
5	6987	8738	10747	33446
6	13415	5250	6476	8209
7	5577	9890	3735	4836
8	3177	3730	6941	2636
9	939	2127	2250	5059
10	531	579	1410	1404
1-10	189380	193152	168780	155625

Table 17. SPA results - Fishing Mortality.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	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
3	0.16	0.23	0.26	0.03	0.20	0.19	0.13	0.11	0.12	0.06
4	0.25	0.25	0.44	0.27	0.11	0.35	0.27	0.24	0.41	0.35
5	0.18	0.39	0.25	0.49	0.37	0.26	0.45	0.34	0.44	0.41
6	0.25	0.30	0.30	0.45	0.46	0.41	0.38	0.77	0.58	0.42
7	0.42	0.05	0.10	0.50	0.29	0.42	0.59	0.63	0.74	0.55
8	0.34	0.62	0.05	0.59	0.45	0.46	0.50	0.65	0.55	0.41
9	0.23	0.31	0.45	0.32	0.85	0.17	0.35	0.79	0.37	0.46
10	0.28	0.47	0.25	0.45	0.65	0.32	0.43	0.72	0.46	0.43
5-7	0.28	0.24	0.22	0.48	0.37	0.36	0.47	0.58	0.59	0.46

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	0.04	0.02	0.00	0.02	0.02	0.03	0.02	0.03	0.01
3	0.10	0.12	0.17	0.14	0.06	0.09	0.13	0.16	0.16	0.10
4	0.23	0.39	0.20	0.43	0.31	0.16	0.31	0.58	0.23	0.23
5	0.54	0.57	0.60	0.53	0.53	0.52	0.42	0.53	0.34	0.34
6	0.82	0.73	0.50	0.69	0.76	0.42	0.31	0.41	0.46	0.18
7	0.37	0.72	0.99	0.60	0.70	0.32	0.10	0.09	0.30	0.30
8	0.59	0.47	0.50	0.85	0.44	0.18	0.09	0.03	0.44	0.25
9	0.50	0.73	0.49	0.60	0.59	0.10	0.07	0.01	0.31	0.48
10	0.55	0.60	0.50	0.72	0.52	0.14	0.08	0.02	0.38	0.37
5-7	0.58	0.67	0.70	0.61	0.67	0.42	0.28	0.34	0.36	0.28

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.02	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
3	0.10	0.10	0.05	0.11	0.05	0.05	0.04	0.02	0.01	0.04
4	0.11	0.23	0.28	0.14	0.14	0.12	0.09	0.12	0.05	0.06
5	0.26	0.24	0.37	0.33	0.12	0.19	0.17	0.13	0.19	0.08
6	0.29	0.29	0.14	0.29	0.29	0.13	0.20	0.17	0.20	0.14
7	0.37	0.32	0.54	0.15	0.11	0.21	0.28	0.18	0.30	0.15
8	0.49	0.33	0.66	0.47	0.03	0.25	0.33	0.17	0.35	0.19
9	0.24	0.45	0.85	0.29	0.12	0.26	0.35	0.13	0.34	0.09
10	0.36	0.39	0.76	0.38	0.08	0.26	0.34	0.15	0.35	0.14
5-7	0.31	0.28	0.35	0.26	0.18	0.18	0.22	0.16	0.23	0.12

Age	2000	2001	2002	2003*
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.03	0.03	0.01	0.00
4	0.08	0.08	0.06	0.02
5	0.09	0.10	0.07	0.04
6	0.10	0.14	0.09	0.04
7	0.20	0.15	0.15	0.05
8	0.20	0.31	0.12	0.08
9	0.28	0.21	0.27	0.03
10	0.24	0.26	0.19	0.05
5-7	0.13	0.13	0.10	0.04

* 2003 landings to June 30 only

Table 18. SPA results - Biomass (t).

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	1178	282	3471	1804	1242	2134	2895	1297	2265	1001
2	3426	2990	730	5966	6198	3628	7994	8993	5519	5480
3	3654	4914	6741	1331	13426	14262	7389	18105	22530	12402
4	7373	3644	5839	9883	2358	18635	18704	9767	26471	28251
5	3352	6238	3397	4776	9909	3239	15819	17821	10527	20899
6	4228	2679	4716	3196	3140	7267	2833	10440	14566	7655
7	29675	2893	2031	3712	2070	2023	4692	1999	5229	8221
8	16371	17149	2822	1863	2134	1426	1037	2403	1158	2654
9	1368	10575	9019	2766	965	1295	716	669	1885	650
10	1221	1528	8243	5381	1747	382	786	432	258	761
1-10	71846	52892	47008	40678	43188	54292	62864	71927	90408	87975
4+	63588	44706	36067	31577	22323	34267	44587	43531	60094	69091

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	1504	1406	1552	867	238	502	213	179	1006	1112
2	5272	5950	4780	3110	3682	2176	1427	635	1547	3787
3	15397	13920	14276	10431	7988	10893	4711	3188	1836	3470
4	16994	21315	17482	16337	14314	10738	13345	5799	4143	2087
5	22656	17155	17302	15938	11873	11685	11090	11670	3967	4020
6	13622	14040	10619	9732	9139	6426	6759	7441	7514	2899
7	4675	6175	7085	5947	4416	3933	3661	4819	5166	4511
8	4254	3016	3087	2240	2738	1787	2040	2972	4258	3697
9	1654	2125	1817	1417	812	1154	1279	1689	2773	2269
10	301	891	1050	880	734	333	912	858	1387	1643
1-10	86330	85994	79050	66900	55934	49628	45438	39252	33598	29495
4+	64156	64717	58442	52491	44026	36056	39086	35248	29208	21126

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	342	530	555	944	1444	2678	581	553	1734	3133
2	3779	1756	1490	1822	4049	5550	4002	1526	3079	2414
3	9158	9282	3411	3654	4774	9590	10006	8531	3466	5475
4	4107	13155	11312	3614	5373	6617	12593	11741	11765	4530
5	2116	4264	12194	9059	3764	5246	6201	11153	10657	12654
6	3222	2011	3367	7970	6424	3202	4266	4597	8890	7585
7	2482	2493	1434	2676	5225	4451	2737	2962	3618	5296
8	3446	1653	1331	582	2069	4256	3151	1886	2305	1829
9	2952	1893	915	446	251	1925	3079	1897	1358	972
10	1181	1588	1111	337	301	209	1201	1157	1138	762
1-10	32786	38627	37120	31104	33676	43723	47817	46004	48010	44649
4+	19506	27057	31664	24684	23407	25906	33228	35393	39731	33628

Age	2000	2001	2002	2003
1	3331	3138	959	0
2	13569	8122	4732	1812
3	5839	25267	12707	7832
4	7973	8610	25453	17386
5	4871	7919	7261	27652
6	12227	4541	5925	7077
7	6326	10152	3572	4872
8	4314	4517	6893	2777
9	1519	3029	2580	5721
10	975	662	1646	1725
1-10	60944	75958	71728	76854
4+	38205	39430	53330	67210

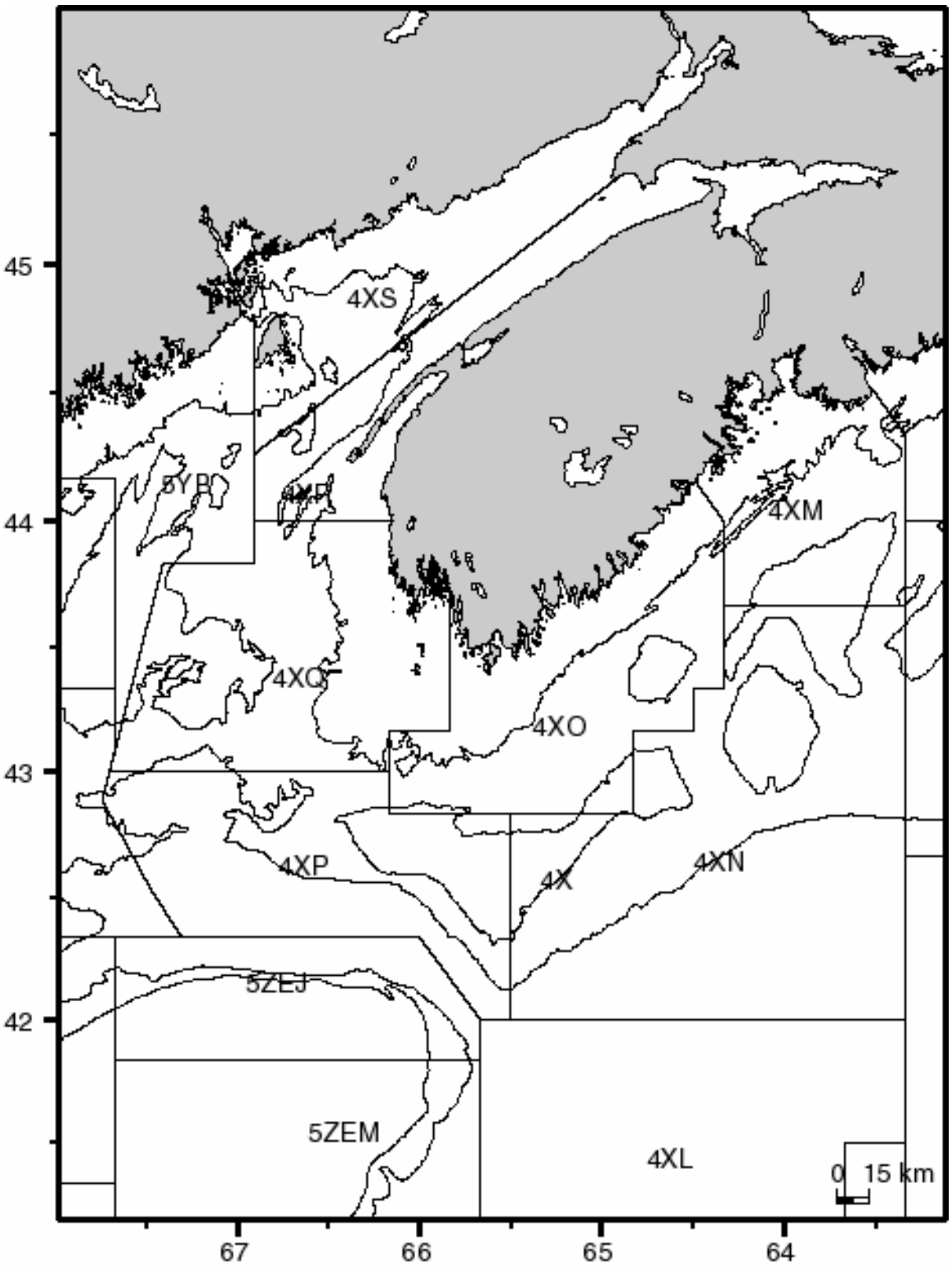


Figure 1. Statistical unit areas in NAFO Div. 4X, 5Z and 5Y.

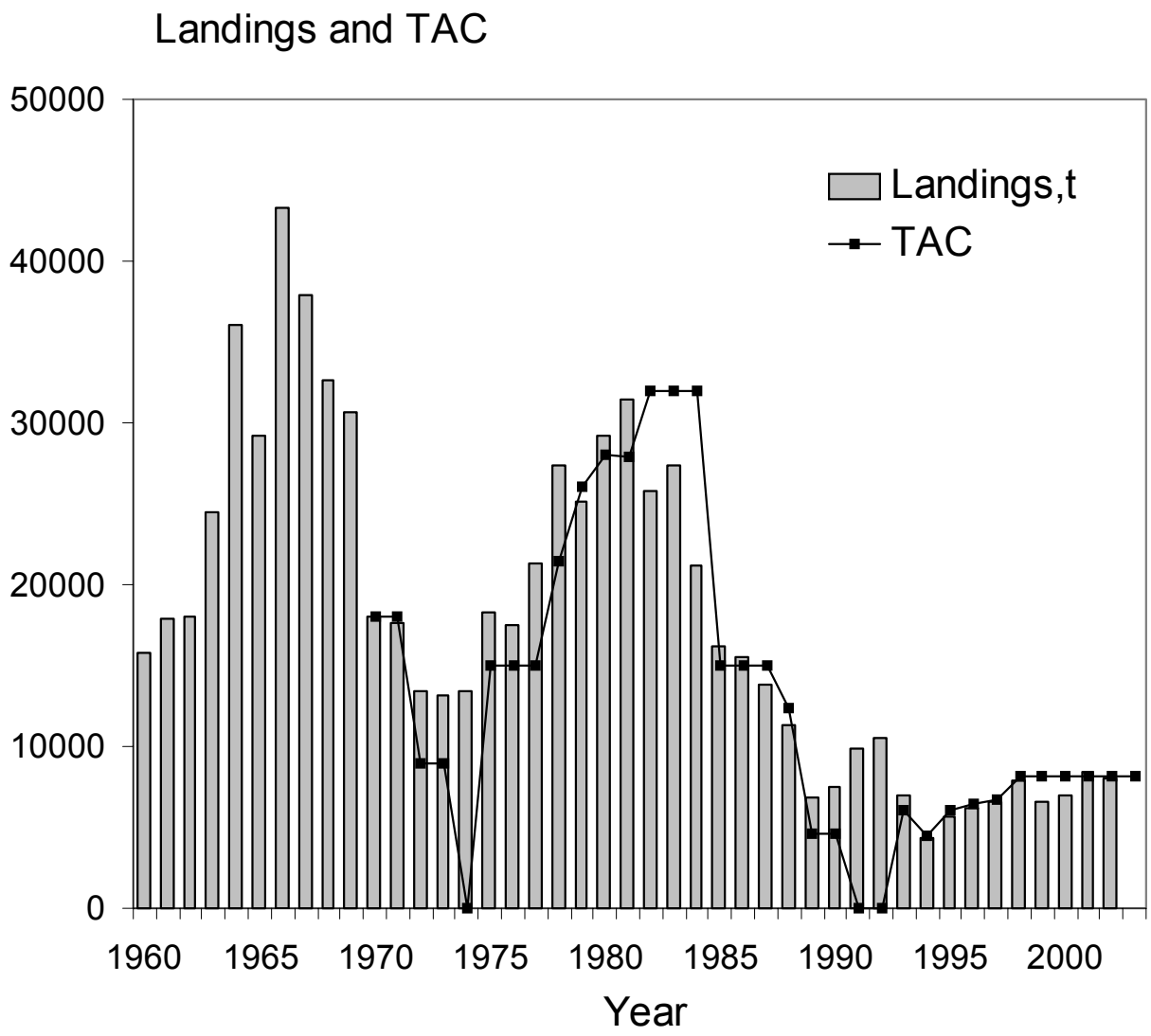


Figure 2. Long-term trends in NAFO Div. 4X/5Y haddock landings and TAC.

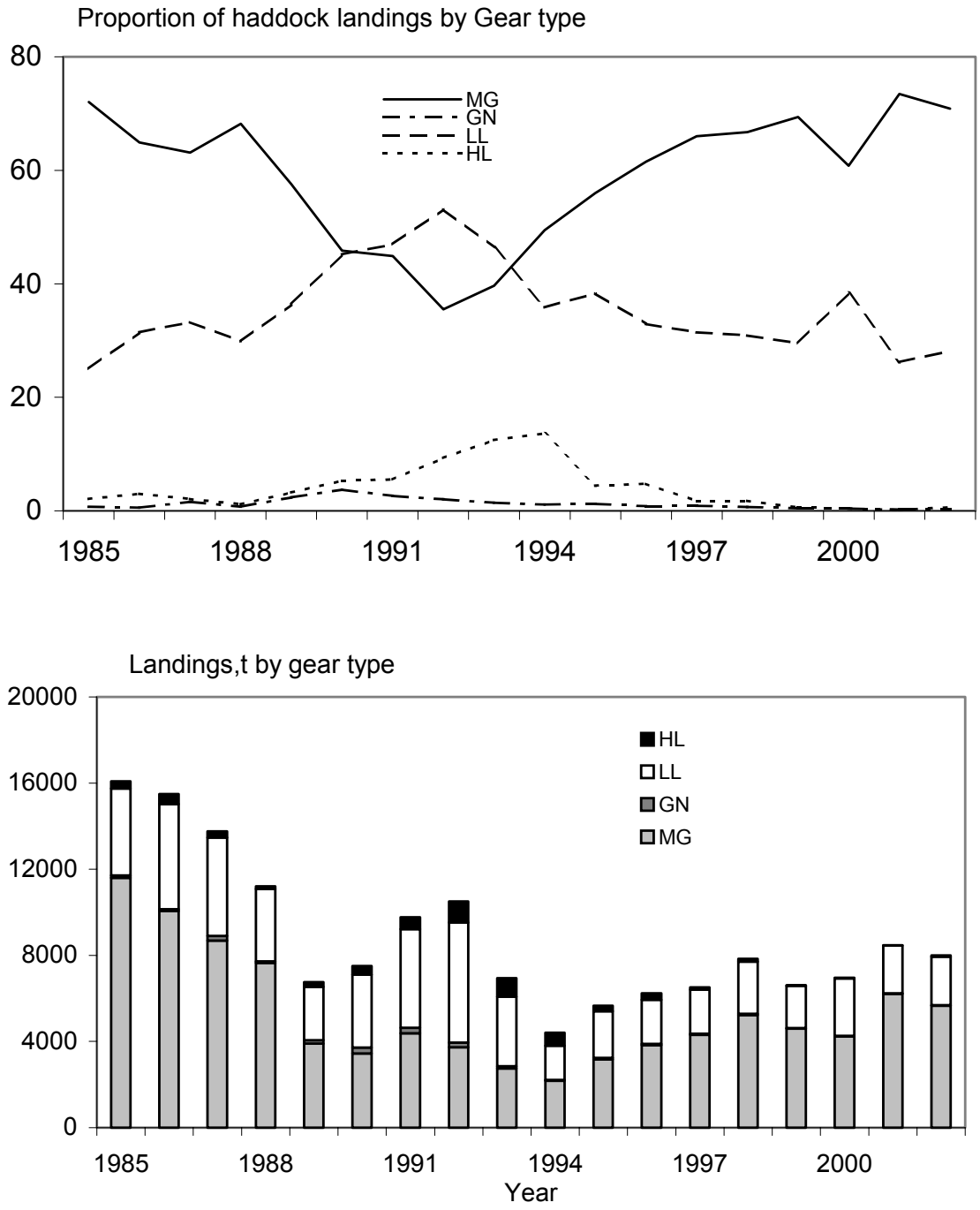


Figure 3. NAFO Div. 4X/5Y haddock landings by gear type, 1985-2002.

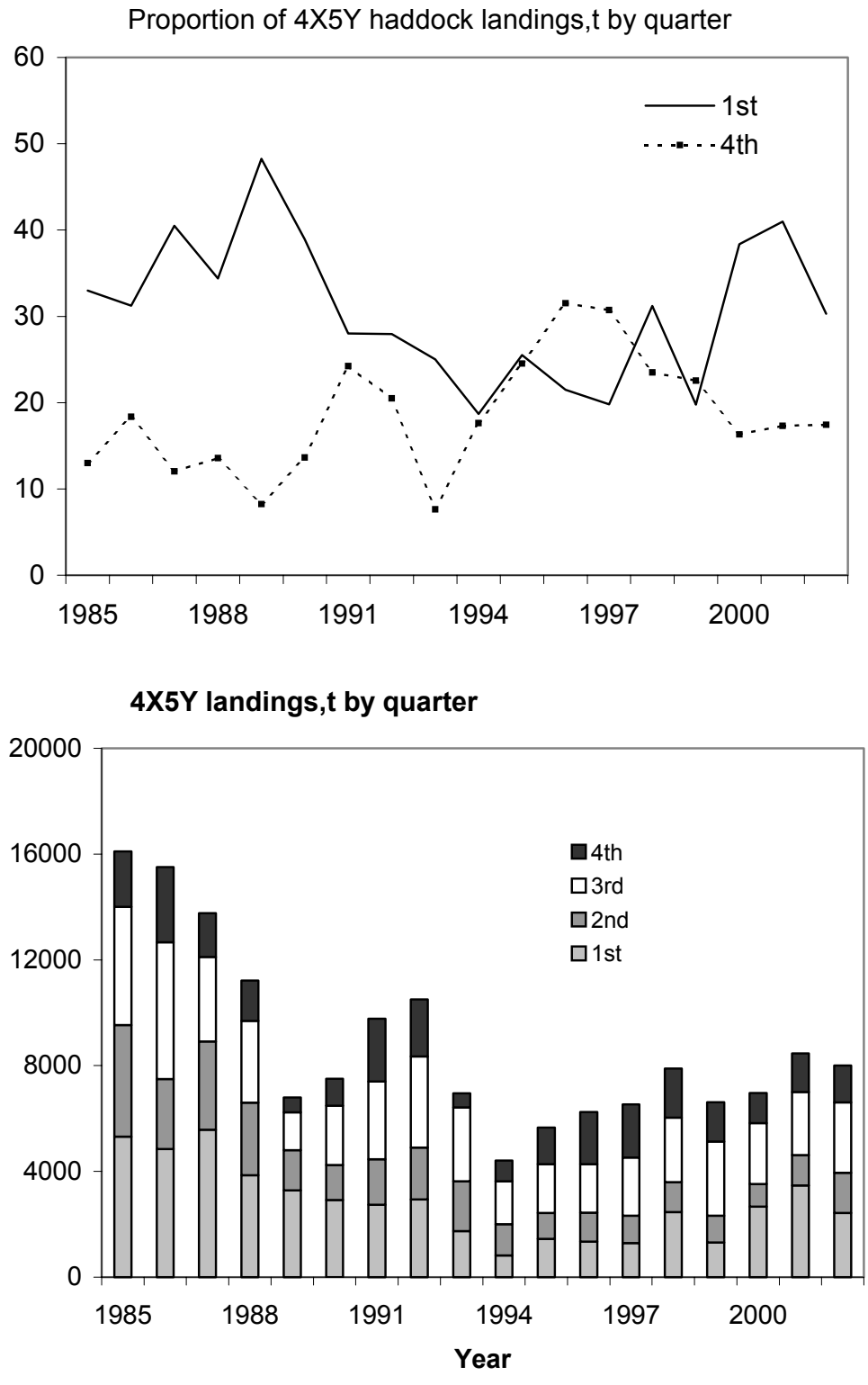


Figure 4. NAFO Div. 4X/5Y haddock landings by quarter, 1985-2002.

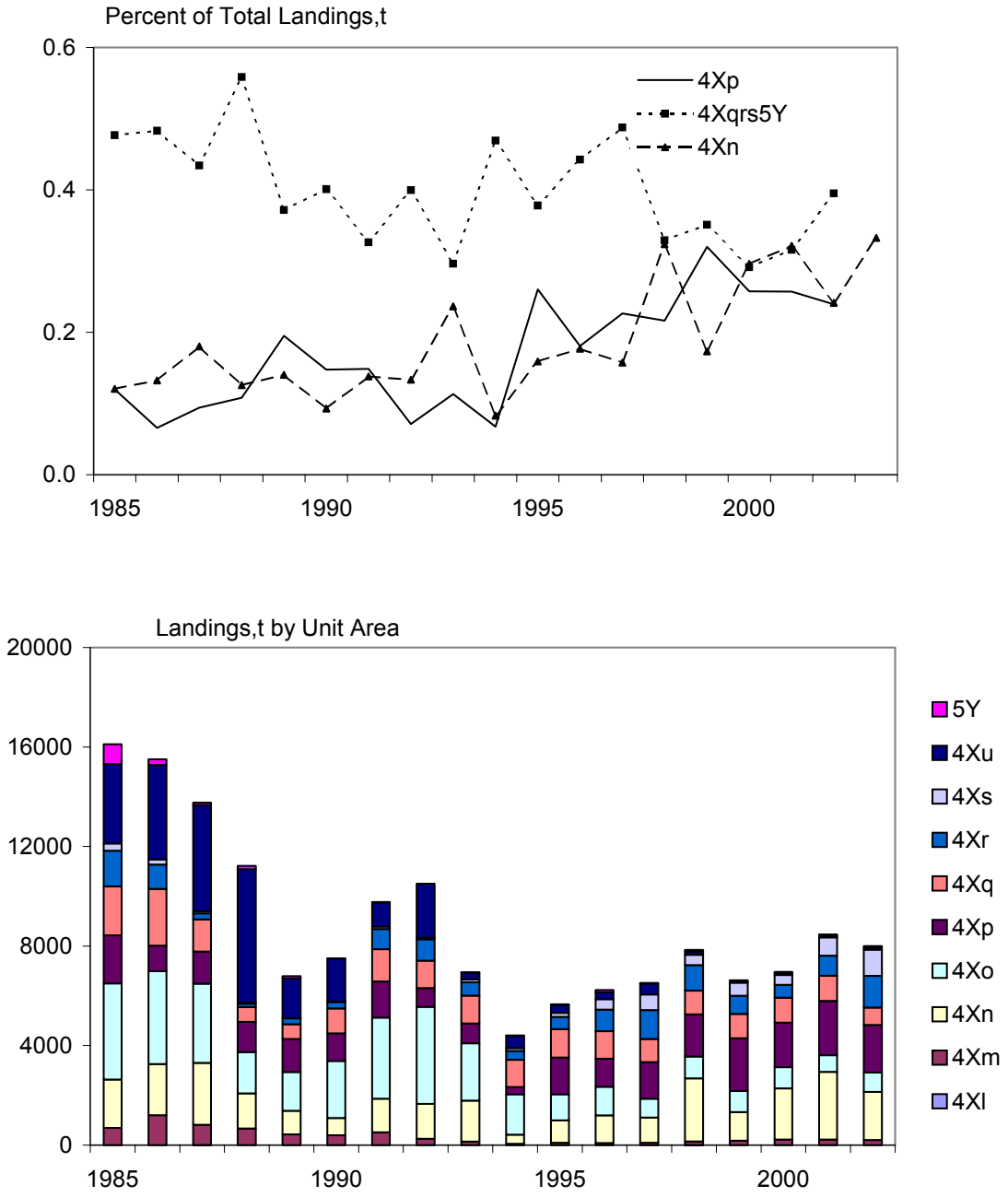


Figure 5. NAFO Div. 4X/5Y haddock landings by unit area, 1985-2002.

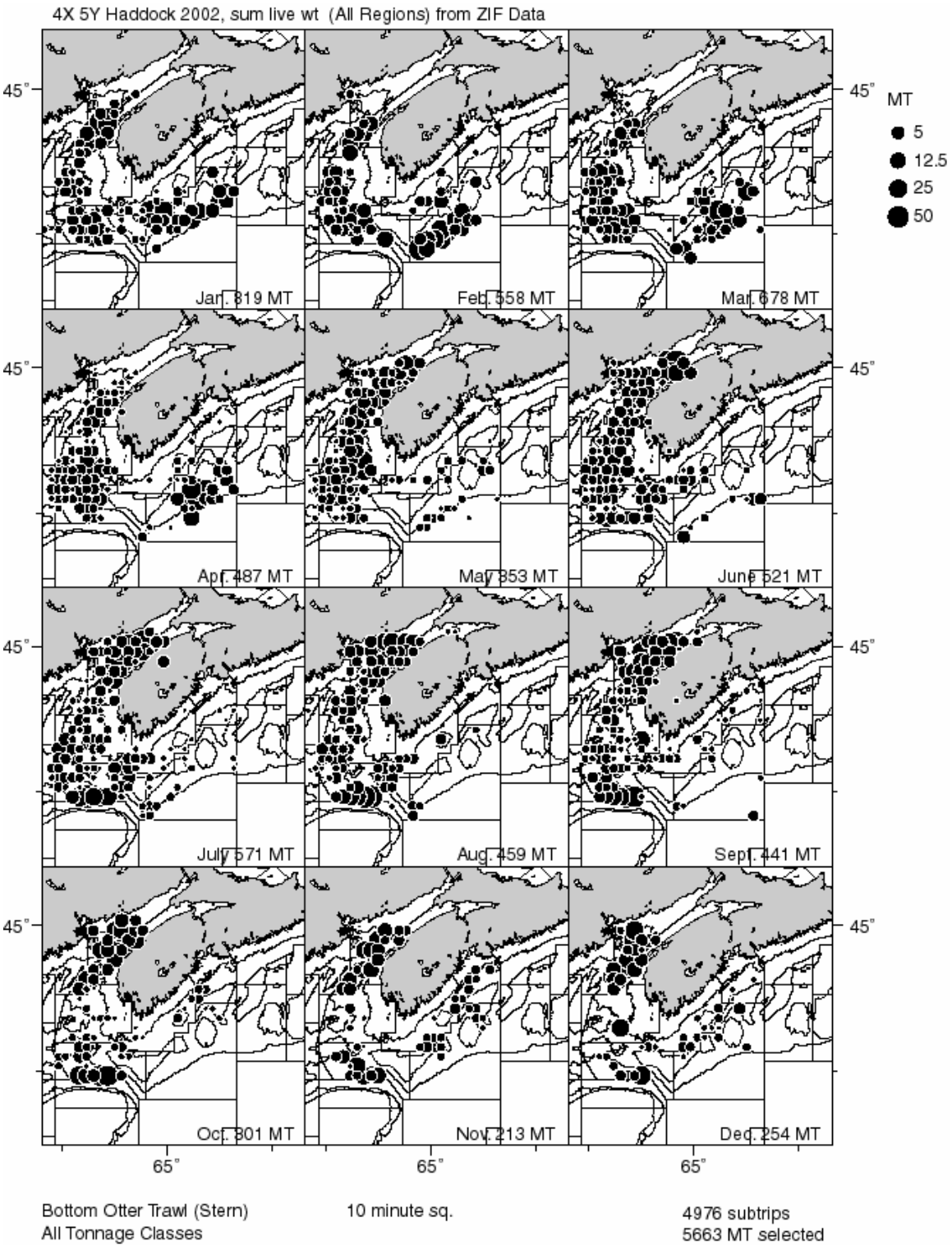


Figure 6a. Haddock catches by otter trawls in NAFO Div. 4X/5Y by month in 2002, aggregated by 10x10 minute squares (where catch position was reported).

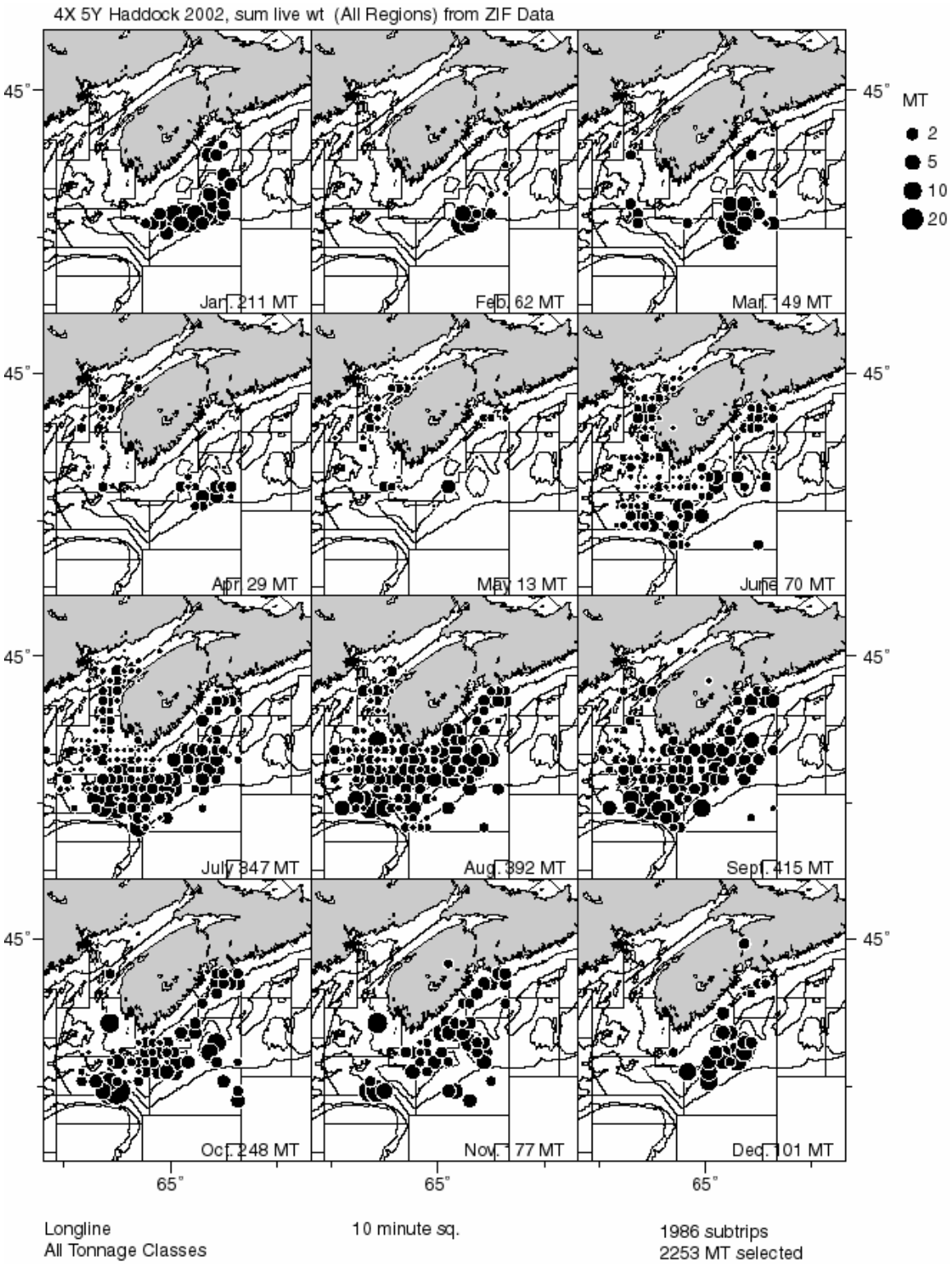


Figure 6b. Haddock catches by longline in NAFO Div. 4X/5Y by month in 2002, aggregated by 10x10 minute squares (where catch position was reported).

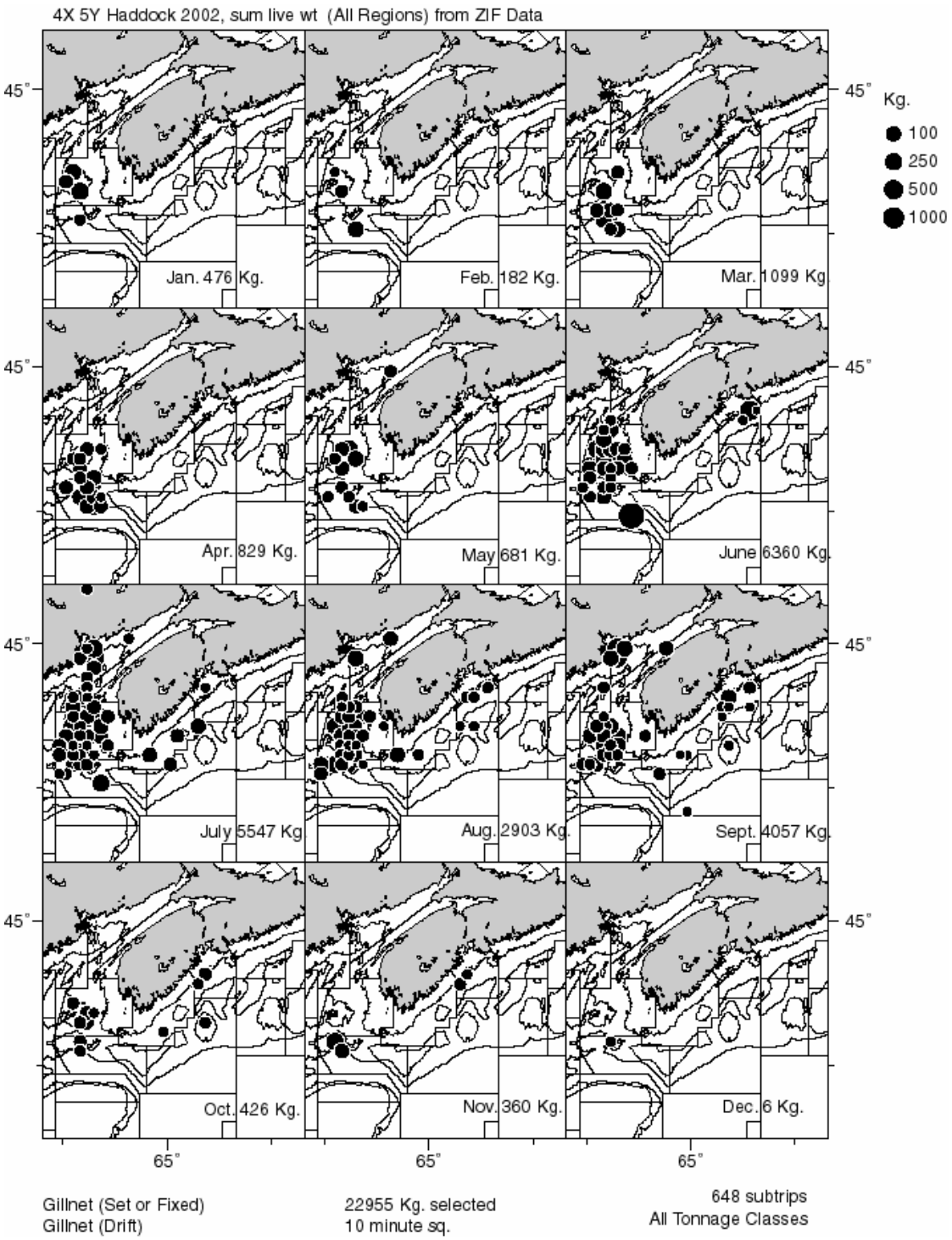


Figure 6c. Haddock catches by gillnets in NAFO Div. 4X/5Y by month in 2002, aggregated by 10x10 minute squares (where catch position was reported).

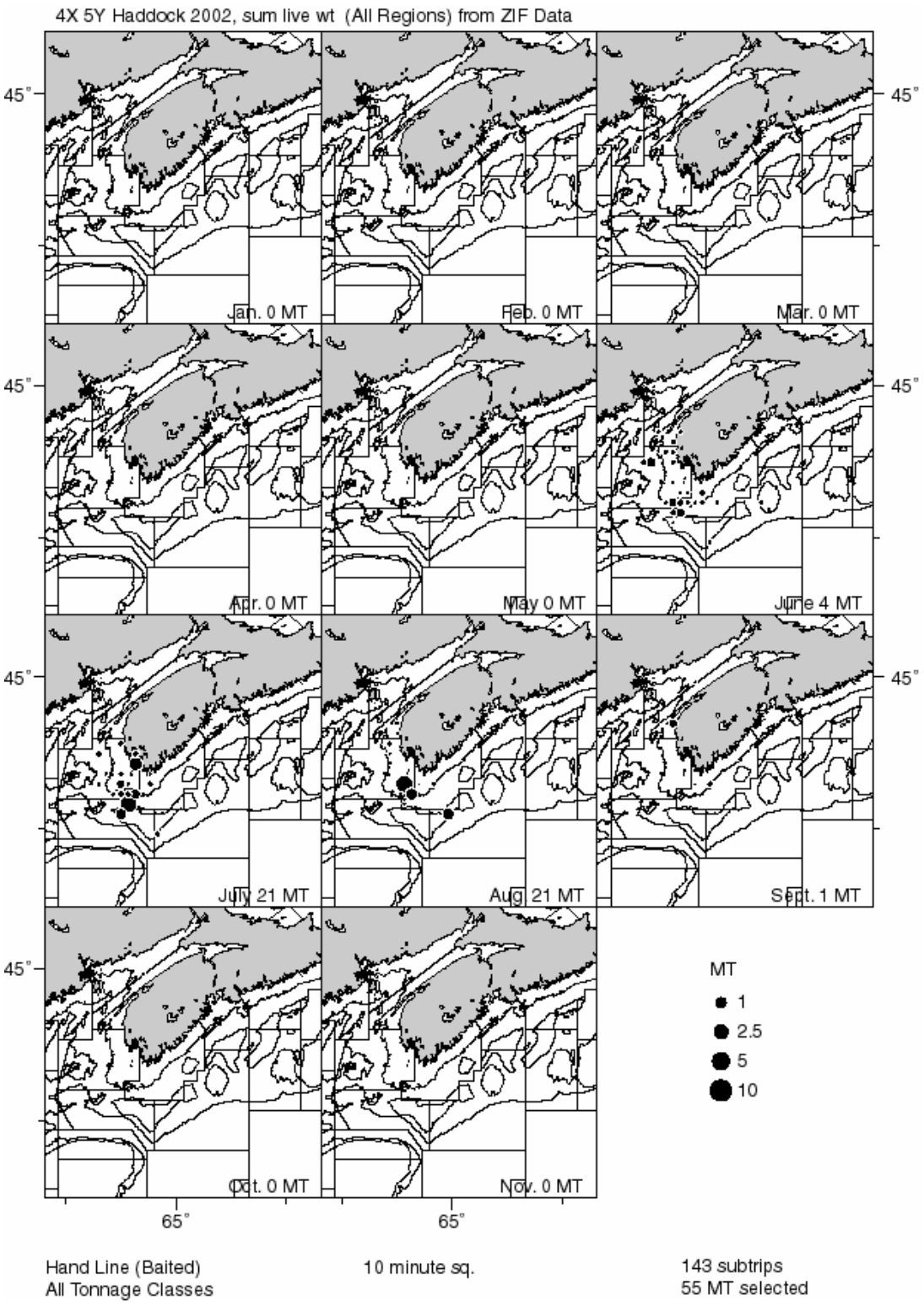


Figure 6d. Haddock catches by handlines in NAFO Div. 4X/5Y by month in 2002, aggregated by 10x10 minute squares (where catch position was reported).

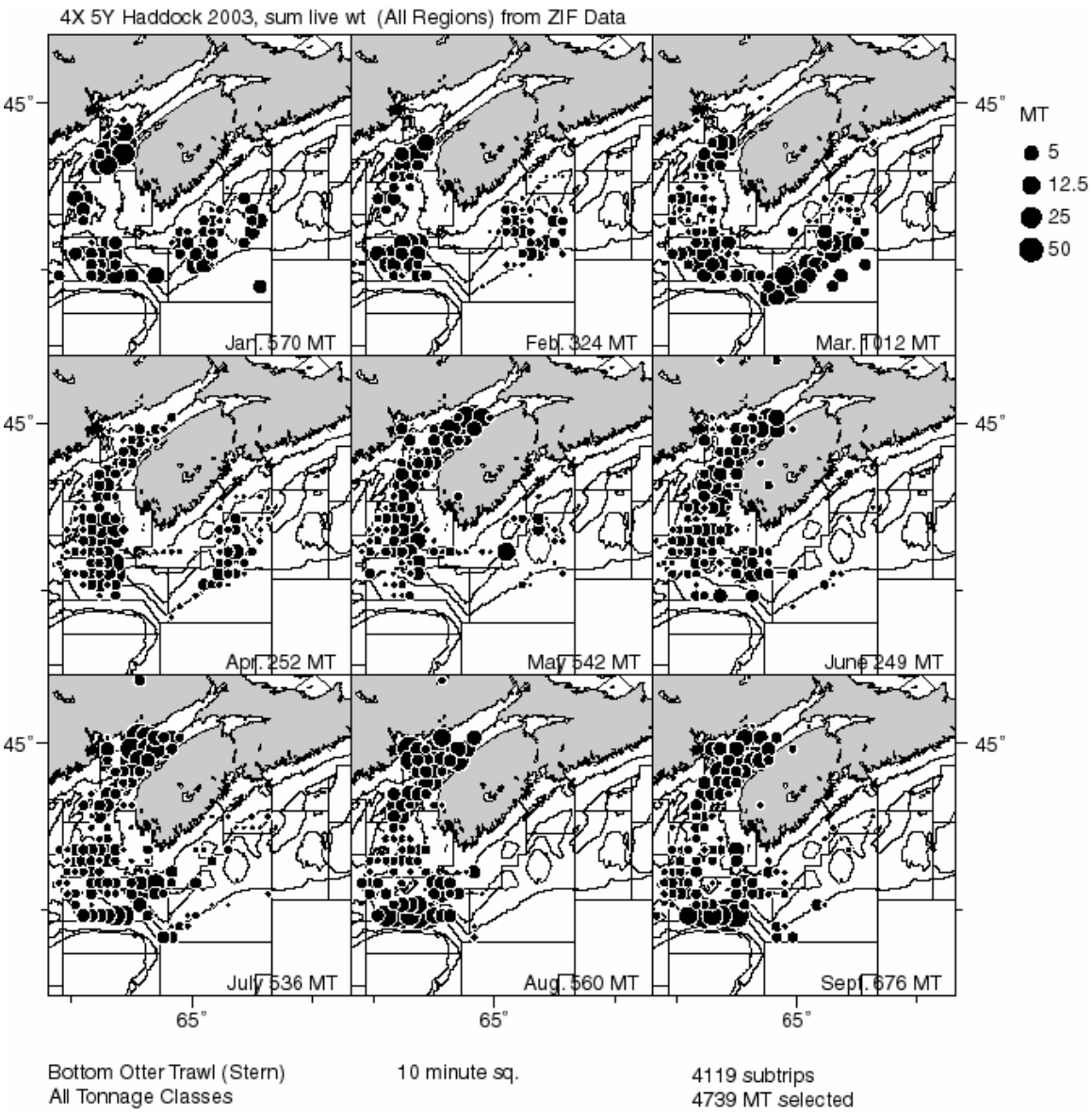


Figure 7a. Haddock catches by otter trawlers in NAFO Div. 4X/5Y by month in 2003, aggregated by 10x10 minute squares (where catch position was reported).

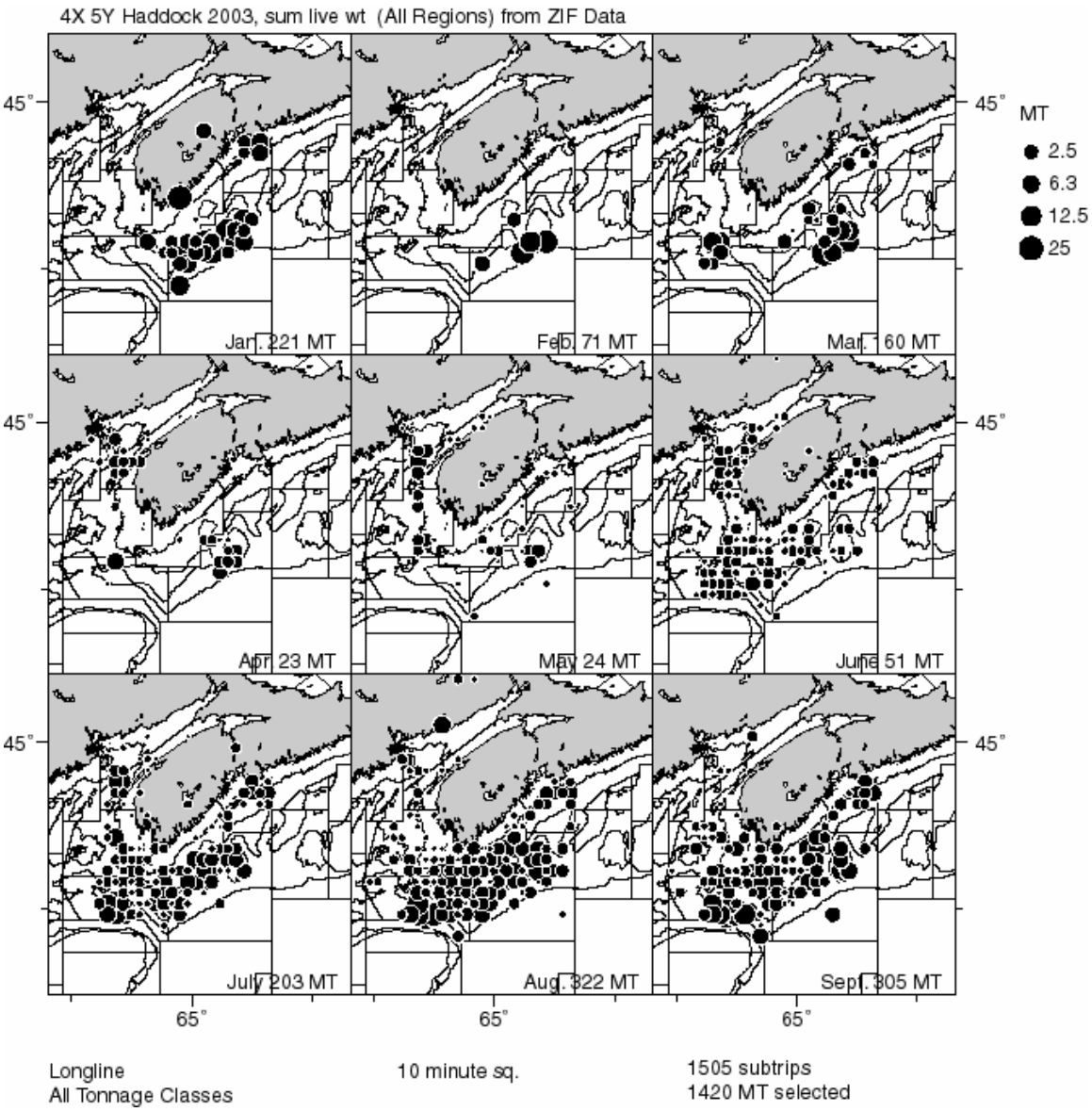
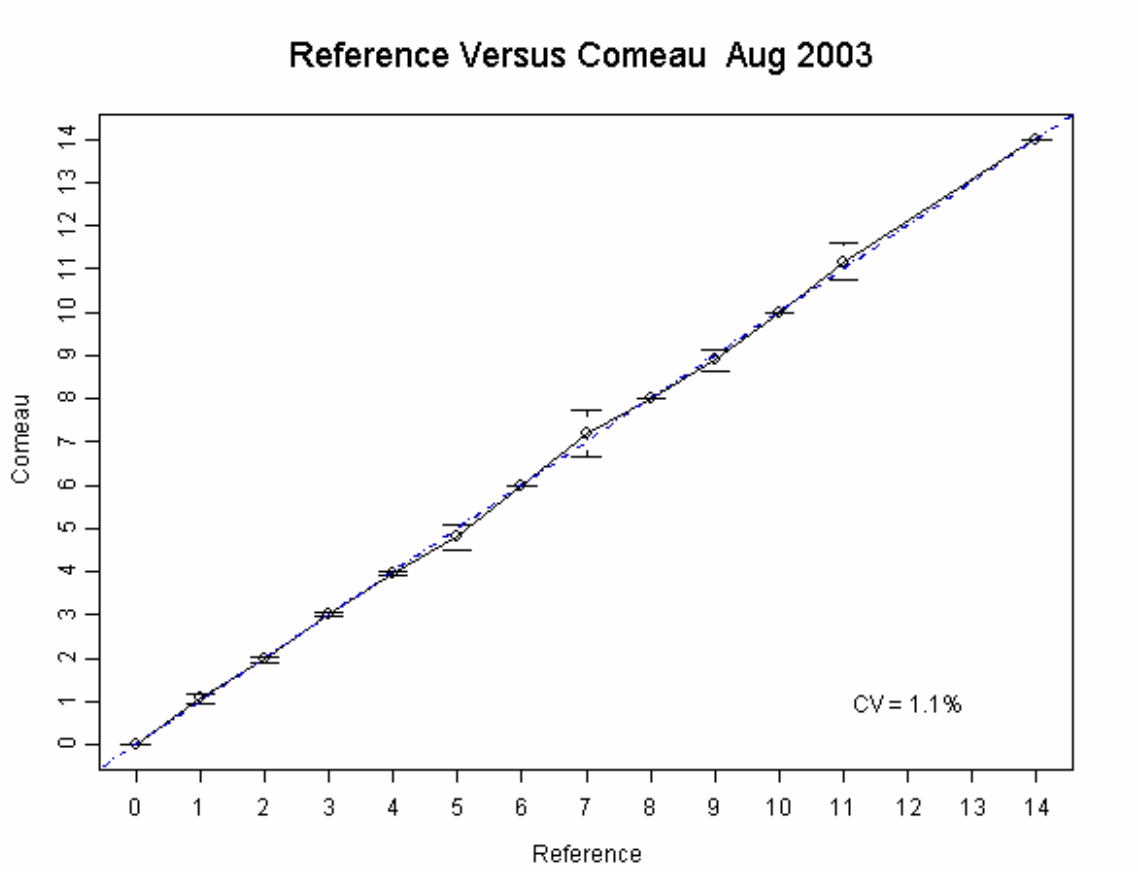


Figure 7b. Haddock catches by longliners in NAFO Div. 4X/5Y by month in 2003, aggregated by 10x10 minute squares (where catch position was reported).



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Reference	0	1	2	3	4	5	6	7	8	9	10	11	12	14	Total
0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
1	0	24	2	0	0	0	0	0	0	0	0	0	0	0	26
2	0	1	35	0	0	0	0	0	0	0	0	0	0	0	36
3	0	0	0	55	1	0	0	0	0	0	0	0	0	0	56
4	0	0	0	1	50	0	0	0	0	0	0	0	0	0	51
5	0	0	0	0	2	8	0	0	0	0	0	0	0	0	10
6	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5
7	0	0	0	0	0	0	0	4	1	0	0	0	0	0	5
8	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4
9	0	0	0	0	0	0	0	0	1	8	0	0	0	0	9
10	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
11	0	0	0	0	0	0	0	0	0	0	0	5	1	0	6
14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Total	3	25	37	56	53	8	5	4	6	8	2	5	1	1	214

Figure 8. Comparison of primary ager against the haddock reference collection in August 2003.

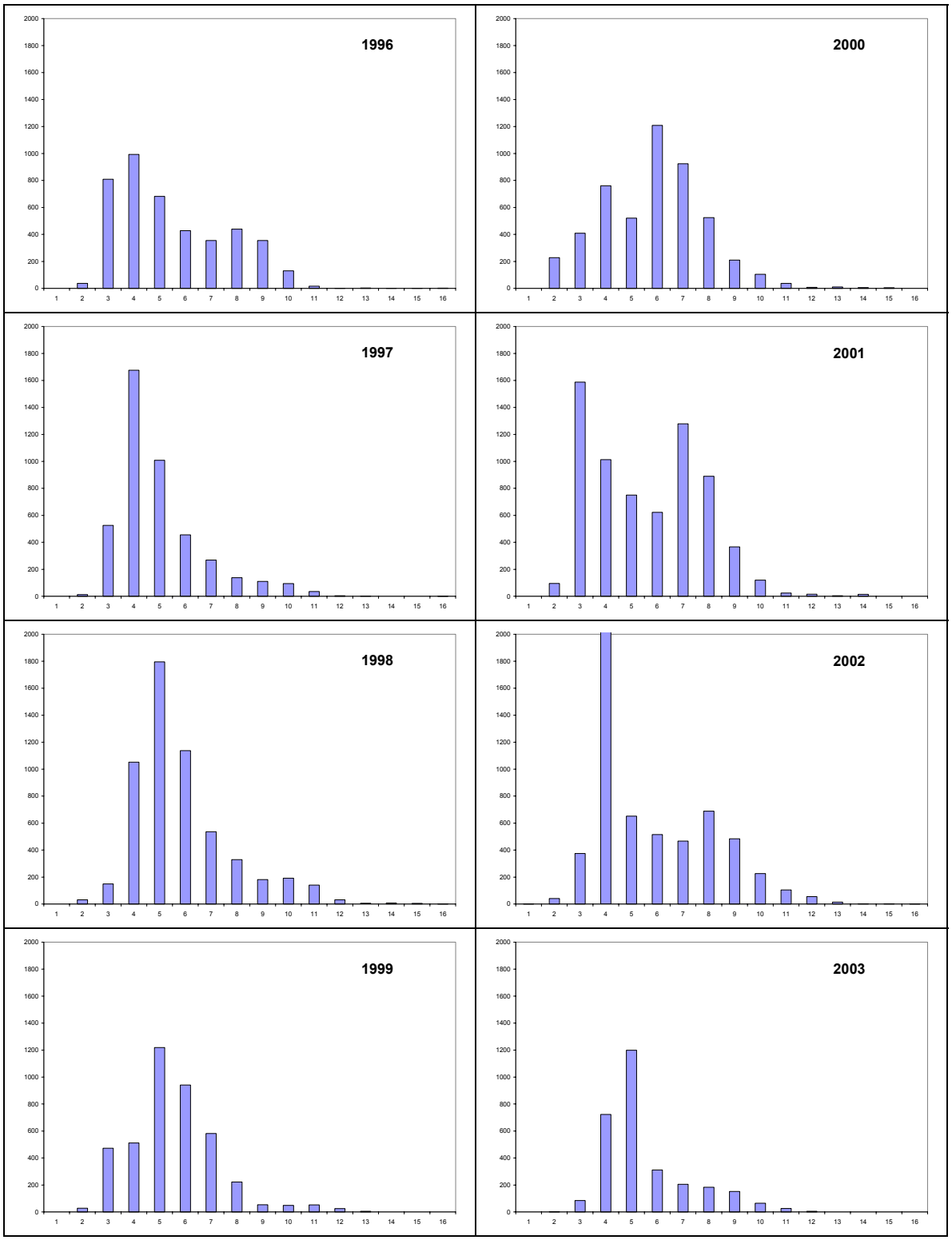


Figure 9. Age composition (000s) of NAFO Div. 4X/5Y haddock landings, 1996-2003 (2003 are half-year).

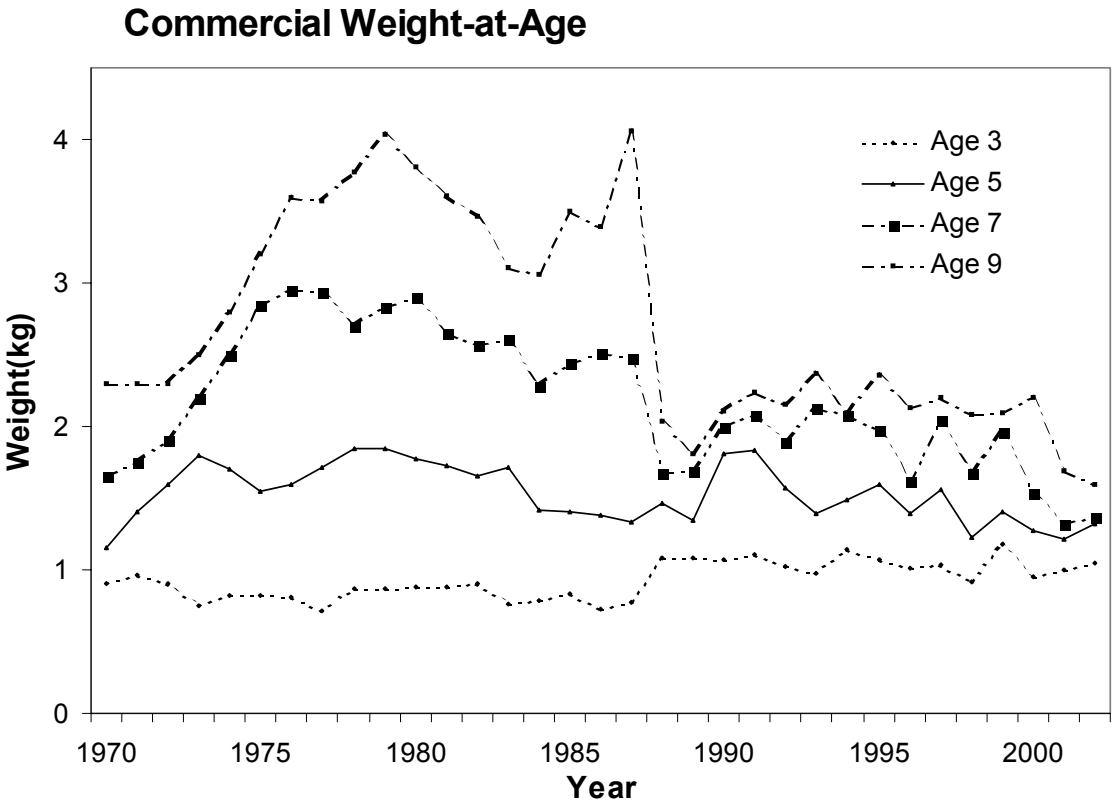


Figure 10. NAFO Div. 4X/5Y haddock commercial mean weight-at-age (kg) for ages 3,5,7 and 9.

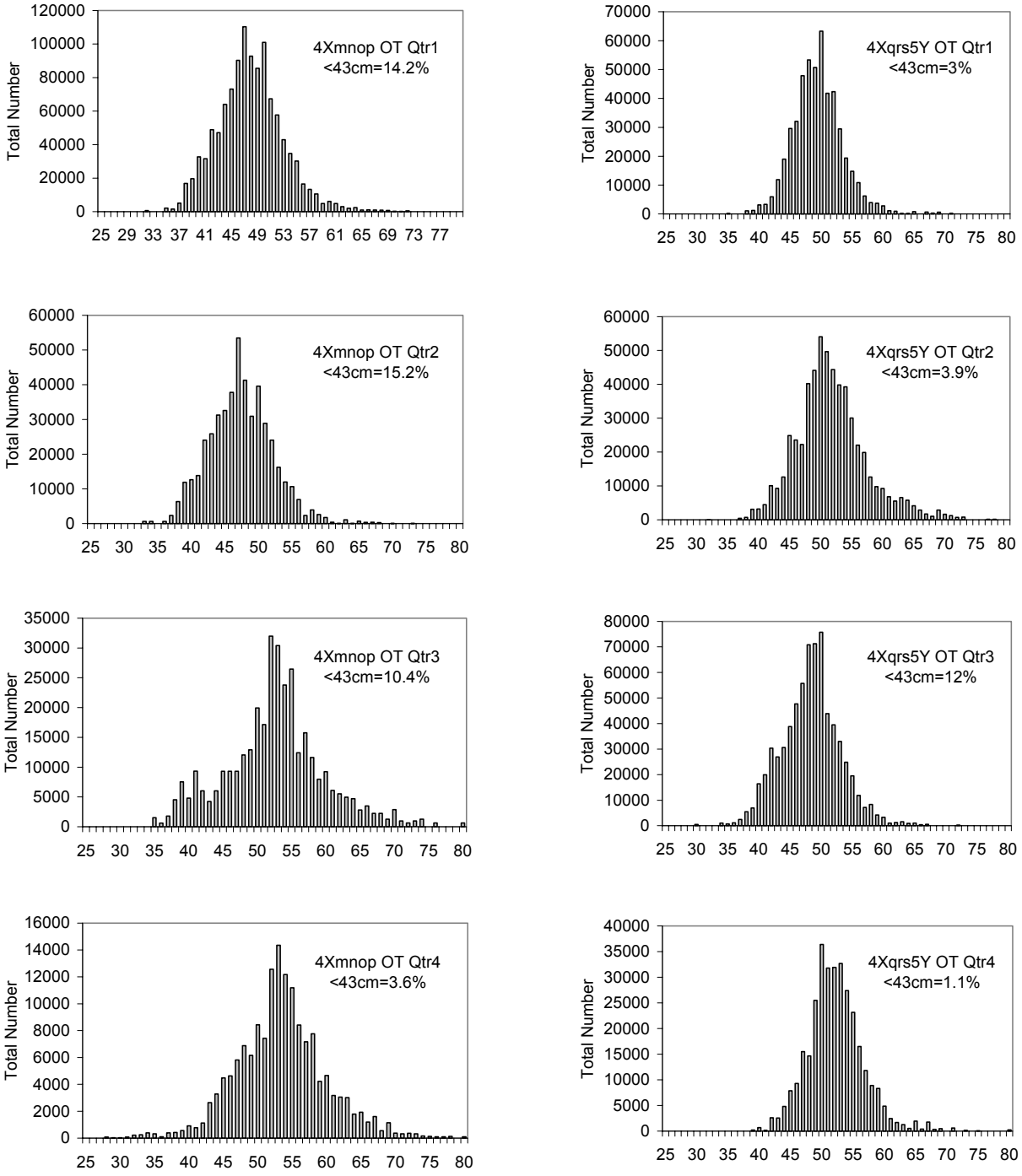
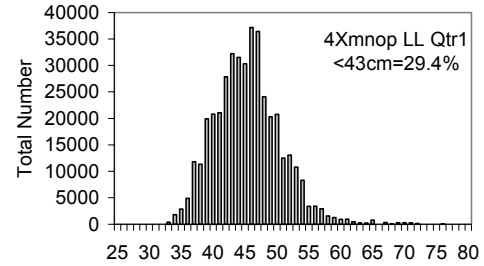
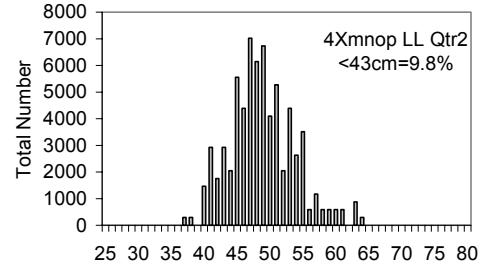
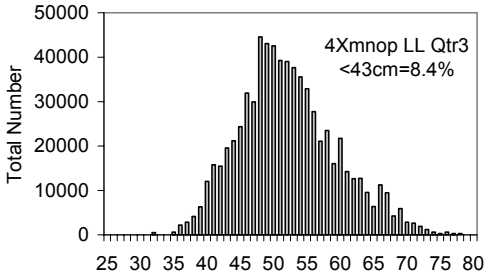
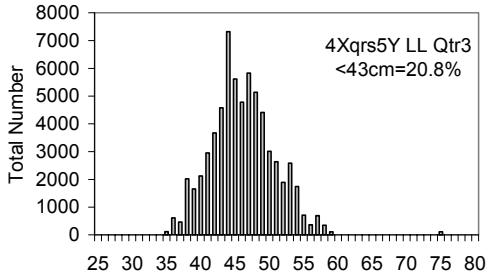


Figure 11. Length composition of haddock caught by otter trawls in NAFO Div. 4X/5Y in 2002.









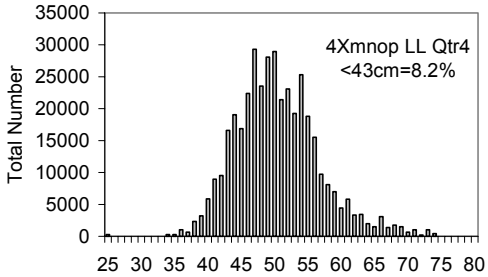


Figure 12. Length composition of haddock caught by longliners in NAFO Div. 4X/5Y in 2002.

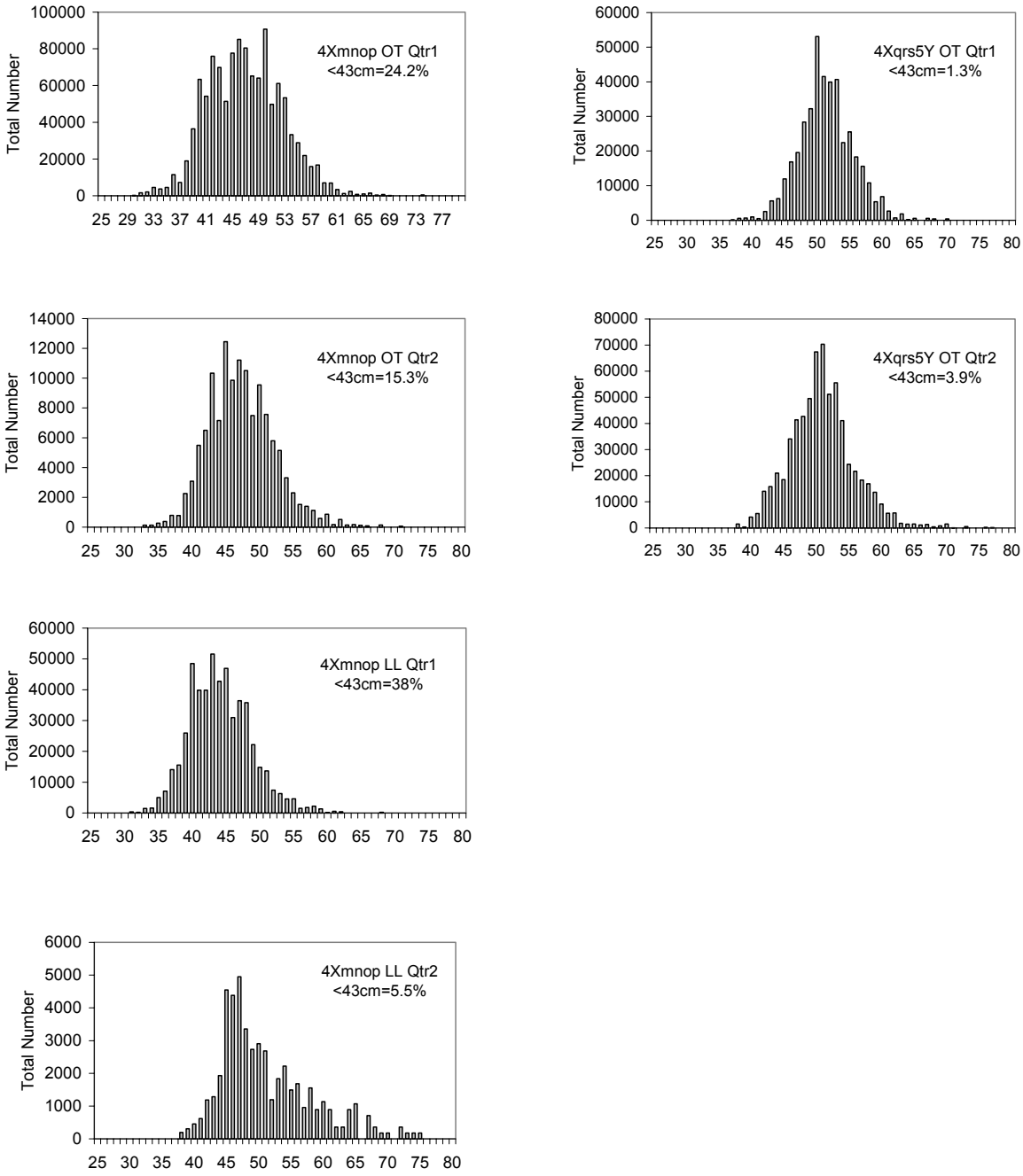


Figure 13. Length composition of haddock caught at length by otter trawls and longliners in NAFO Div. 4X/5Y in 2003.

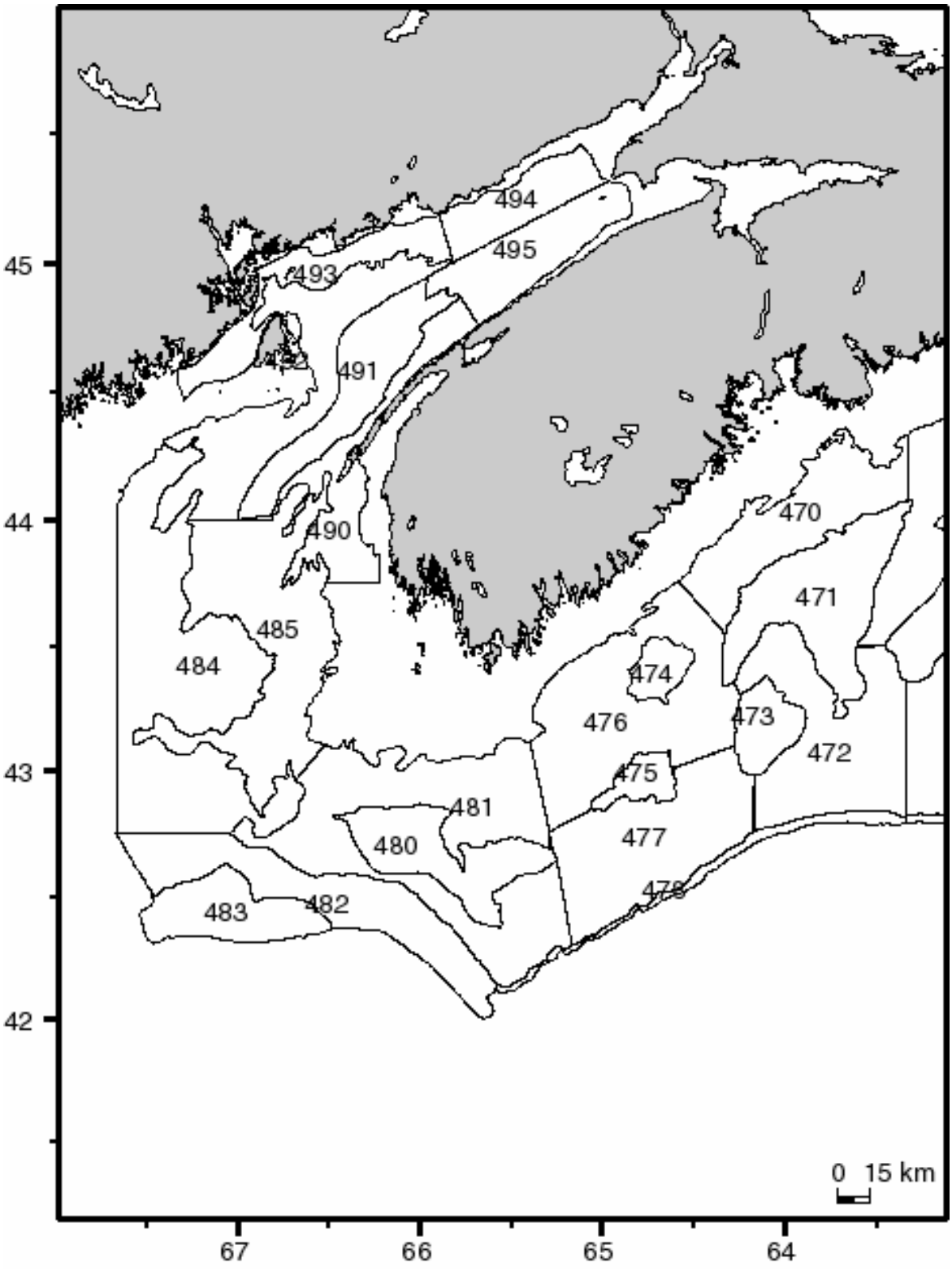


Figure 14. Stratification scheme for the summer RV survey in Div. 4X.

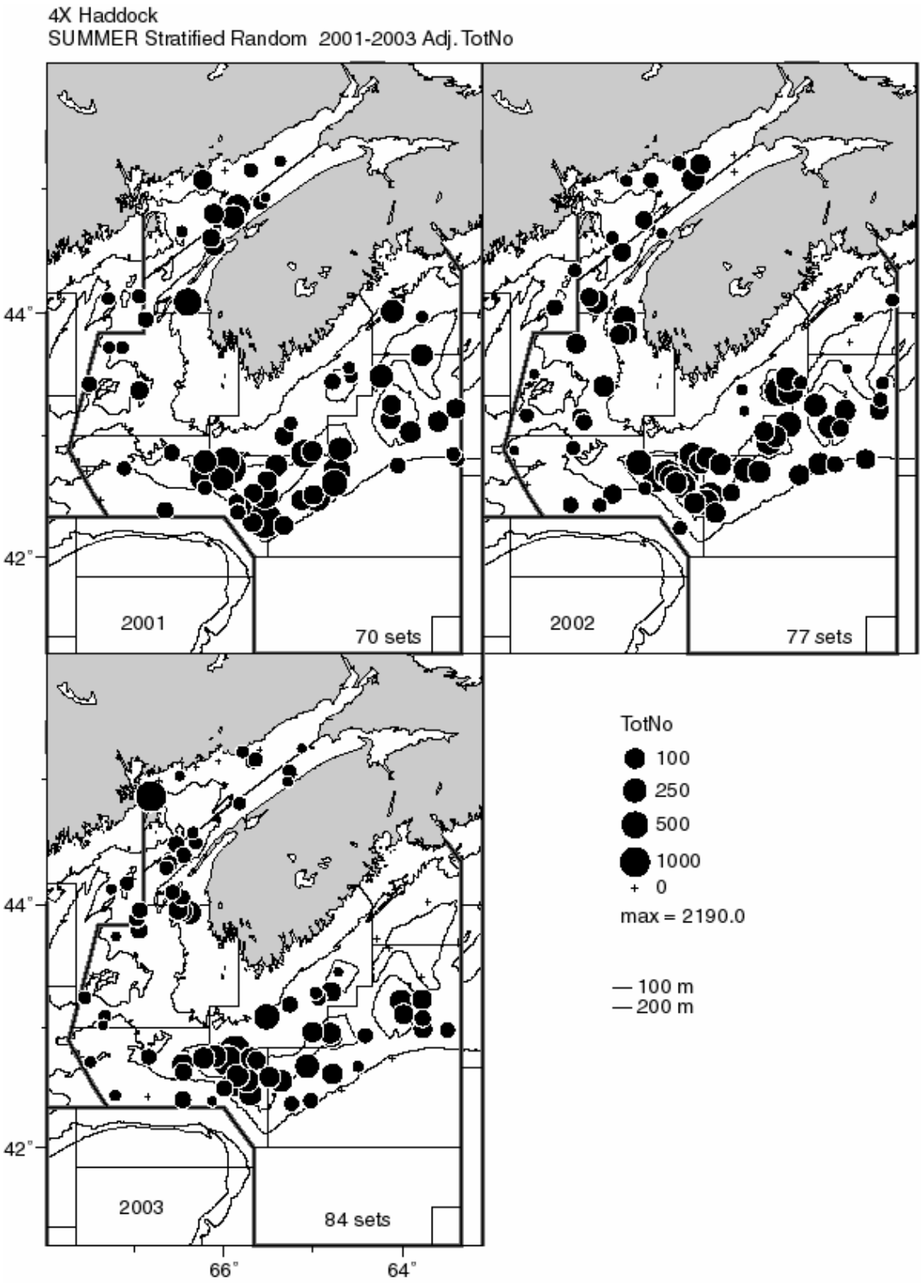


Figure 15. NAFO Div. 4X/5Y haddock number per standard tow from the 2001-2003 summer RV survey.

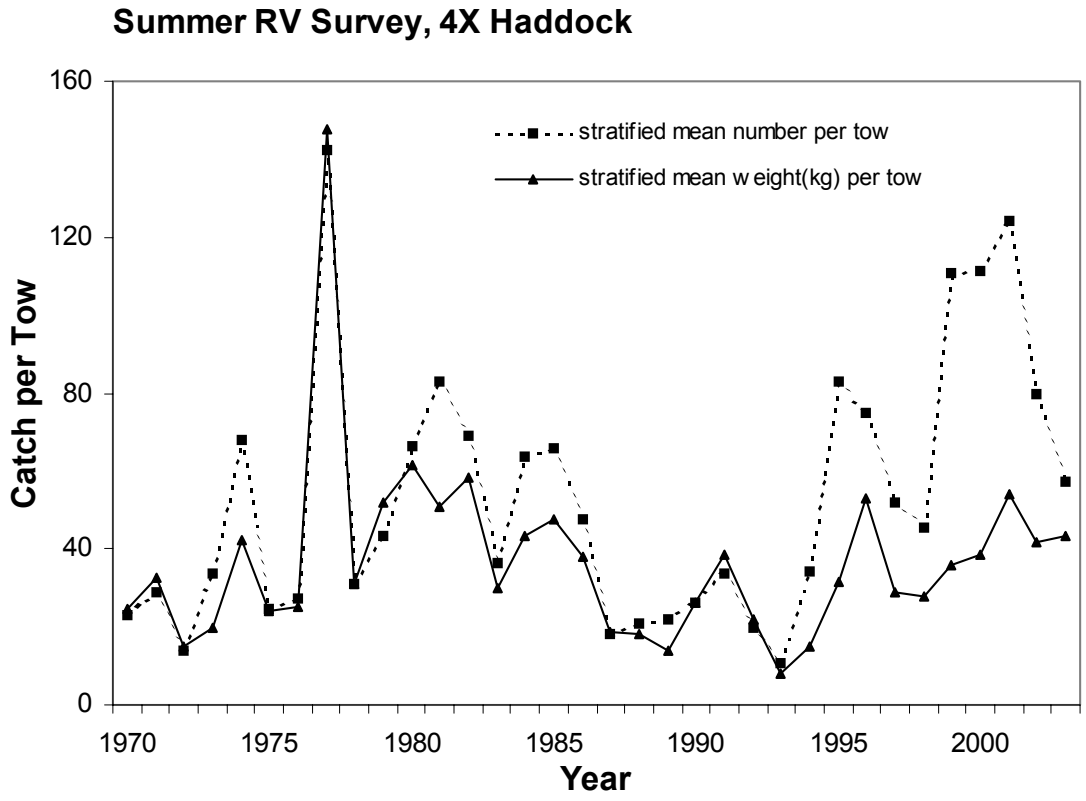
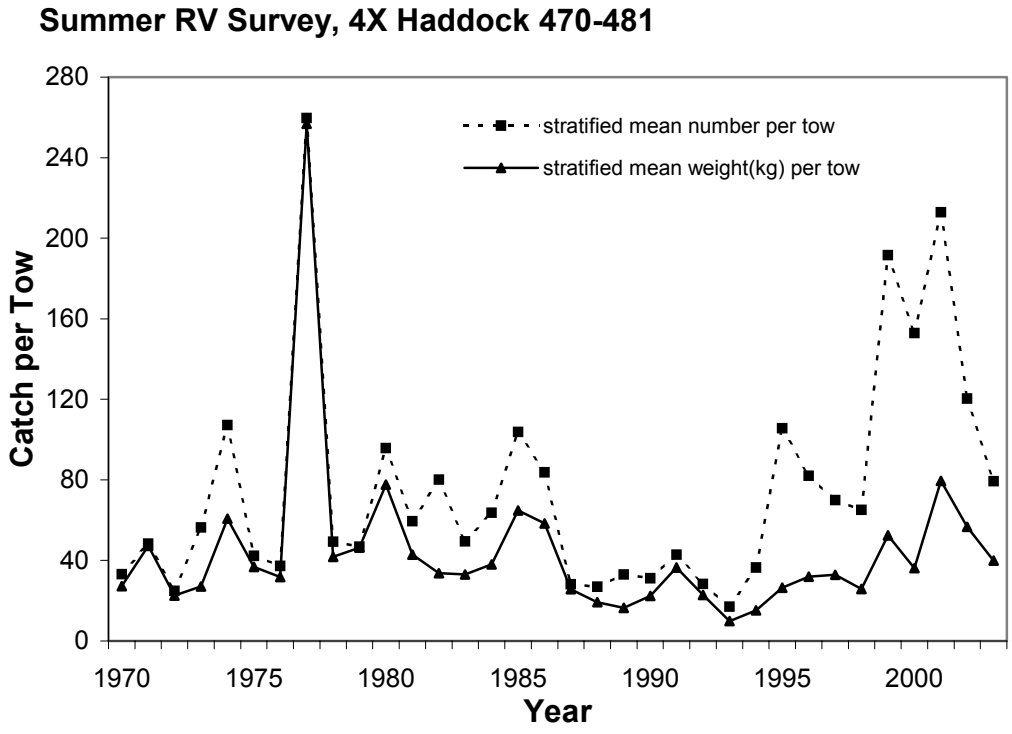


Figure 16. Stratified mean catch per tow of NAFO Div. 4X/5Y haddock from the summer RV survey.



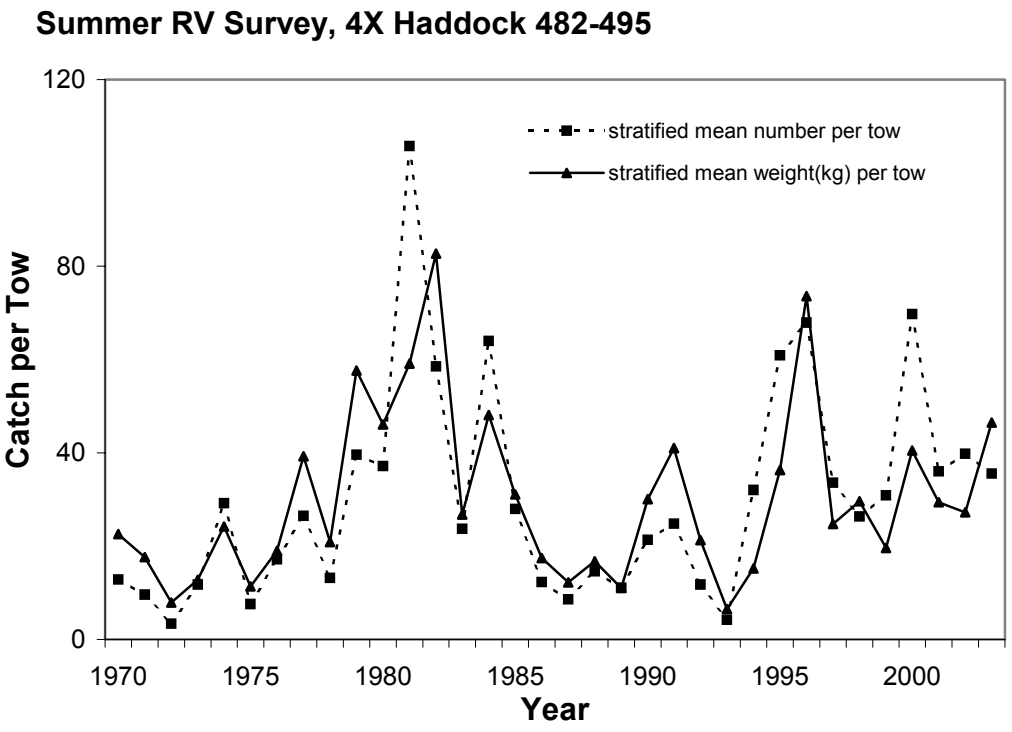


Figure 17. Stratified catch per tow of NAFO Div. 4X/5Y haddock from the summer RV survey in strata 470-481(Scotian shelf) and strata 482-495(Bay of Fundy).

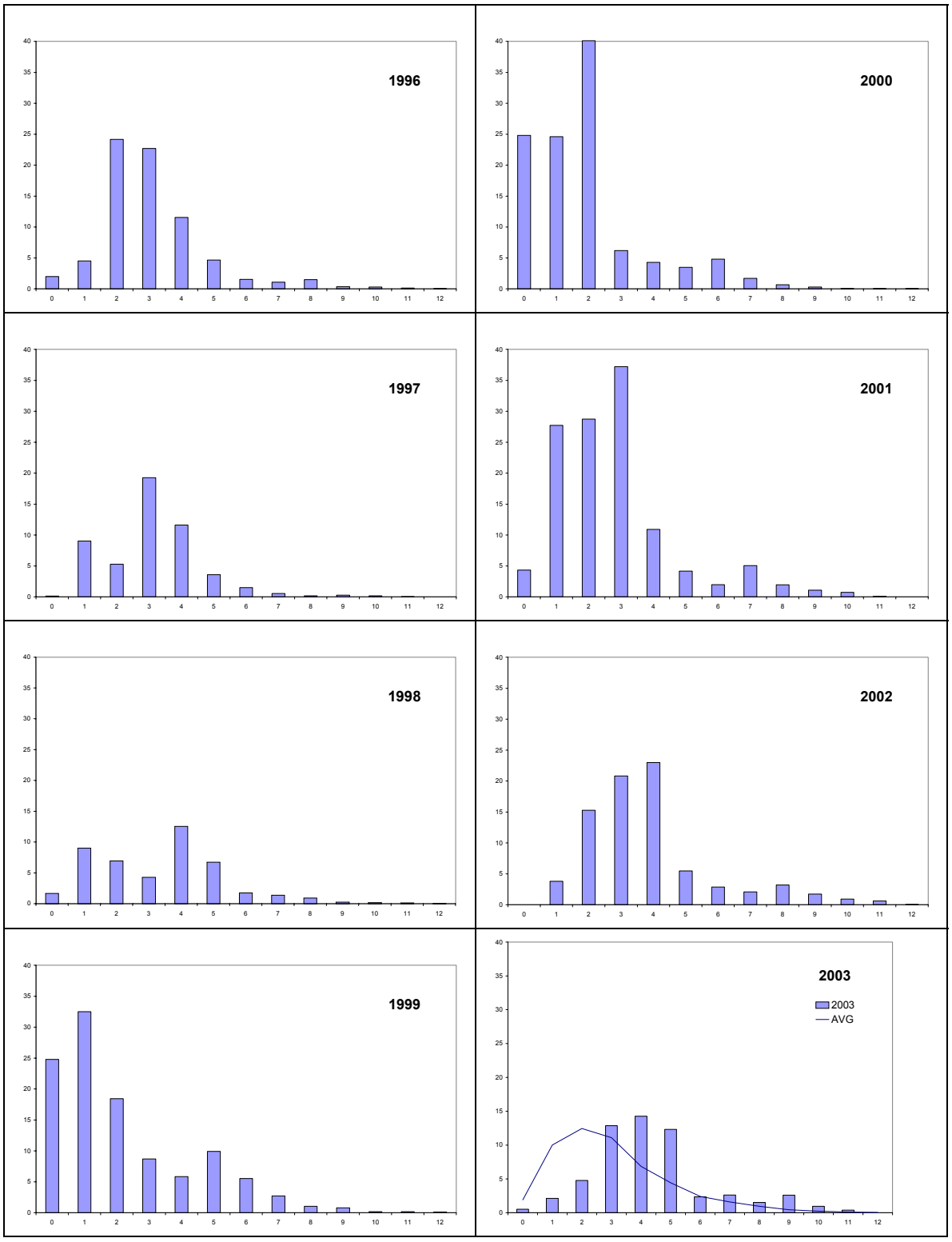
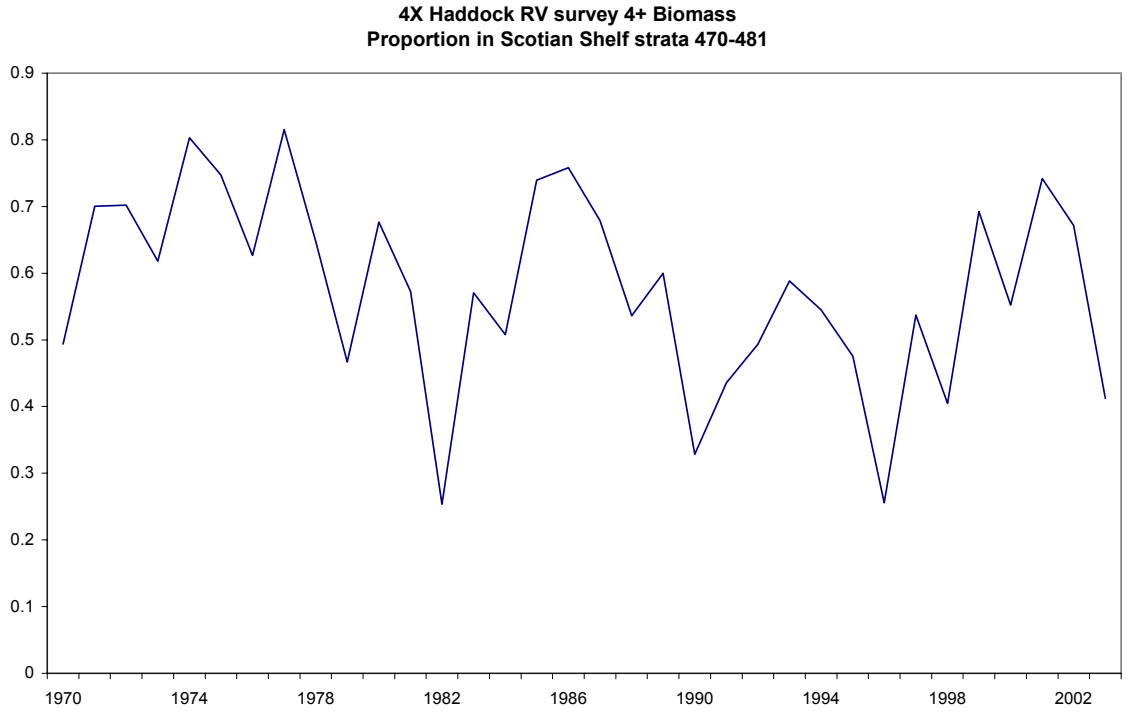


Figure 18. Age composition (stratified mean number-at-age per tow) of NAFO Div. 4X/5Y haddock in the summer RV survey, 1996-2003, strata 470-495.



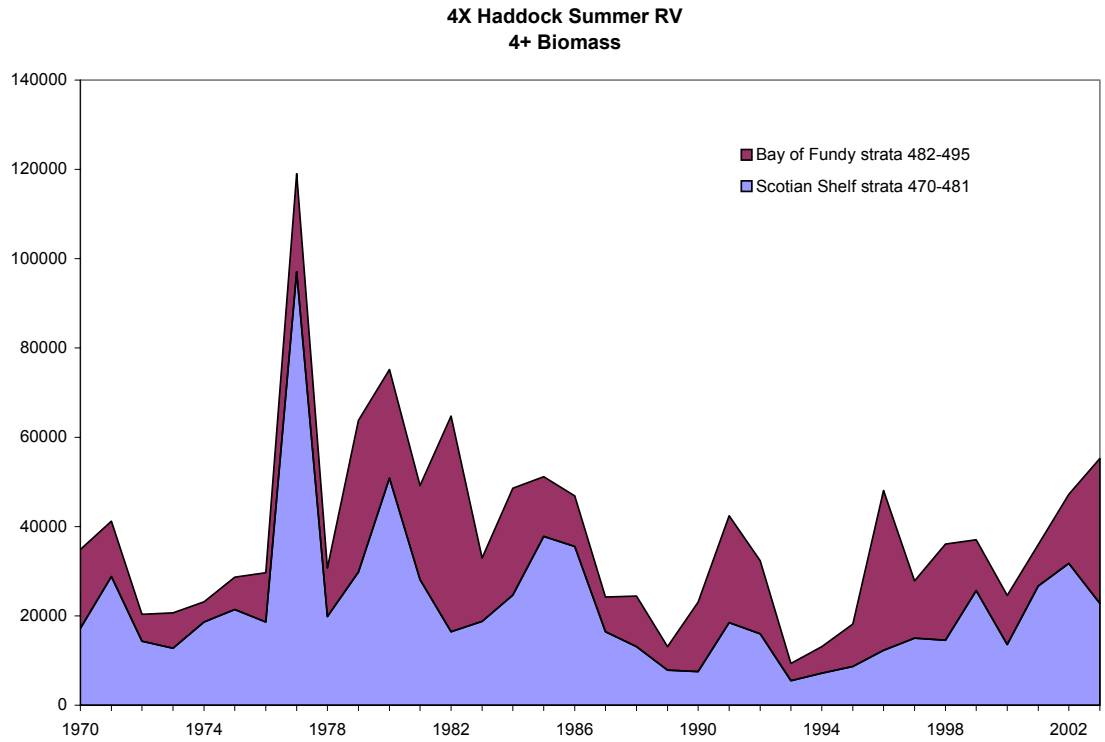


Figure 19. 4X haddock summer RV survey 4+ biomass, by area.

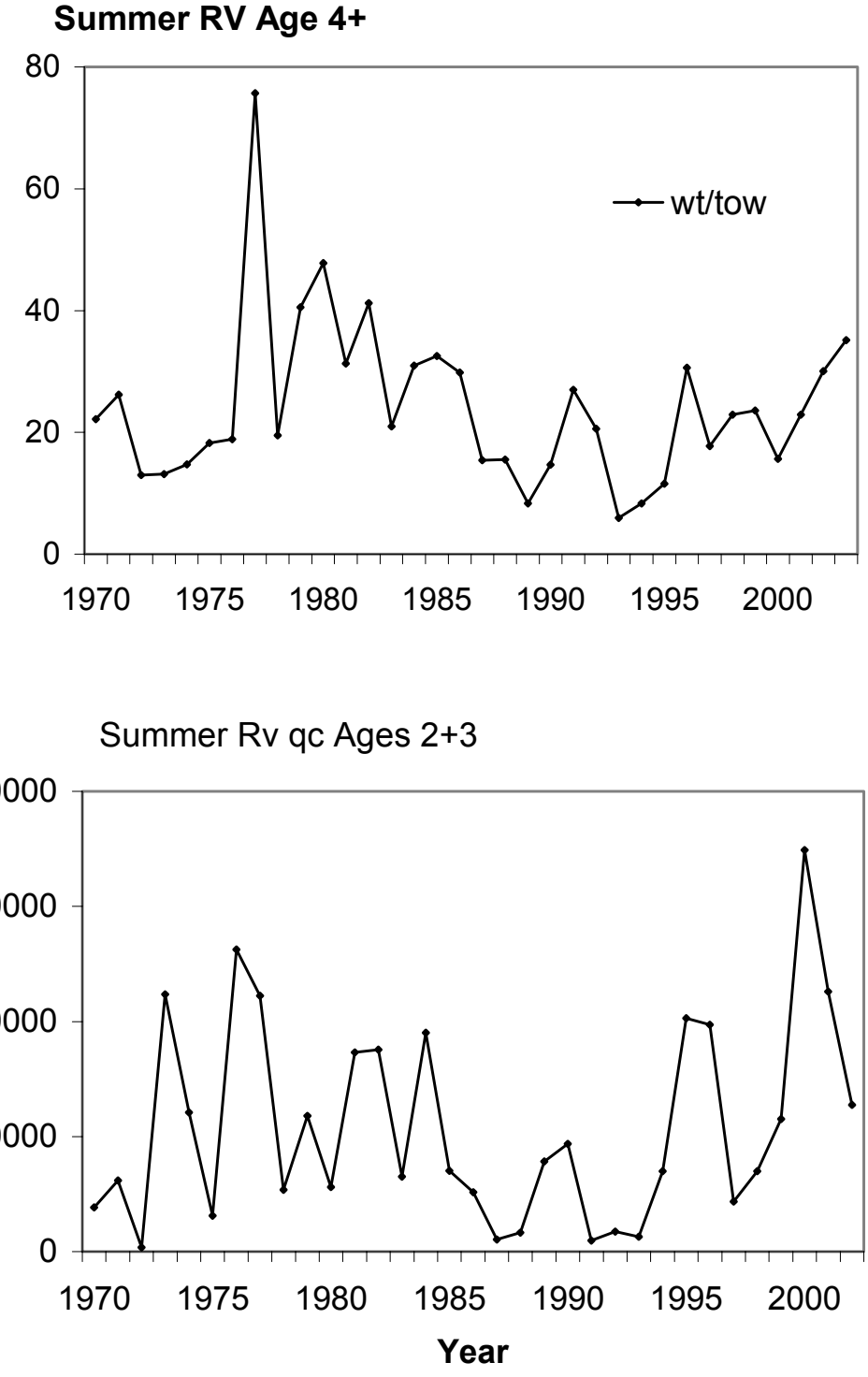


Figure 20. NAFO Div. 4X/5Y haddock weight per tow (kg) of ages 4+ and q-adjusted catch per tow of ages 2+3 in the summer RV survey, 1970-2003.

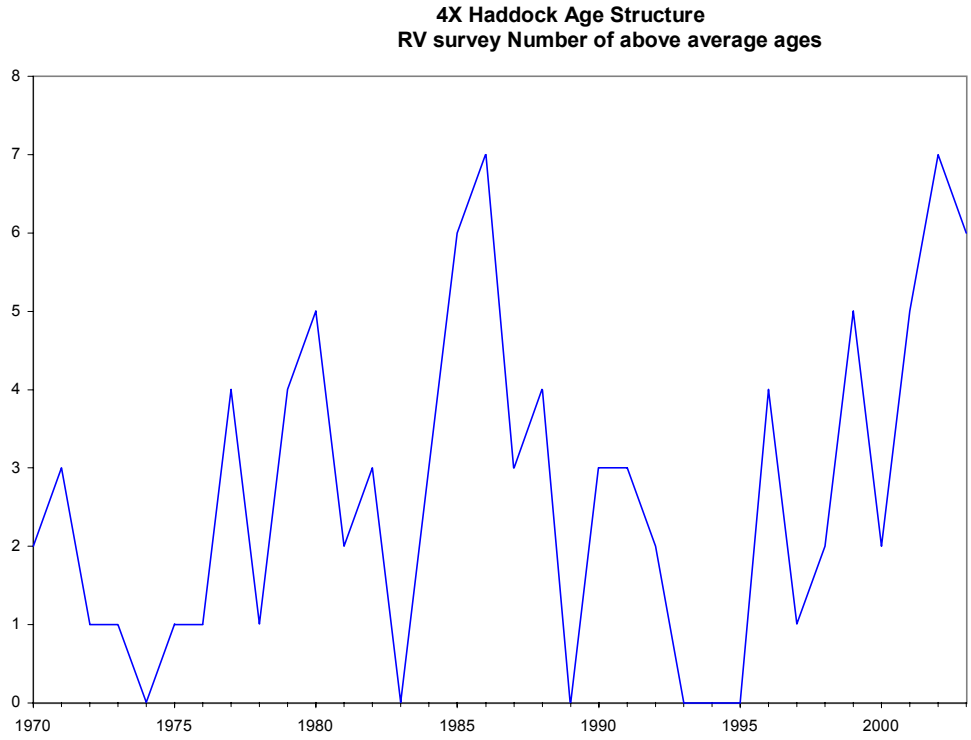


Figure 21. NAFO Div. 4X/5Y haddock age structure indicator calculated from the summer RV survey.

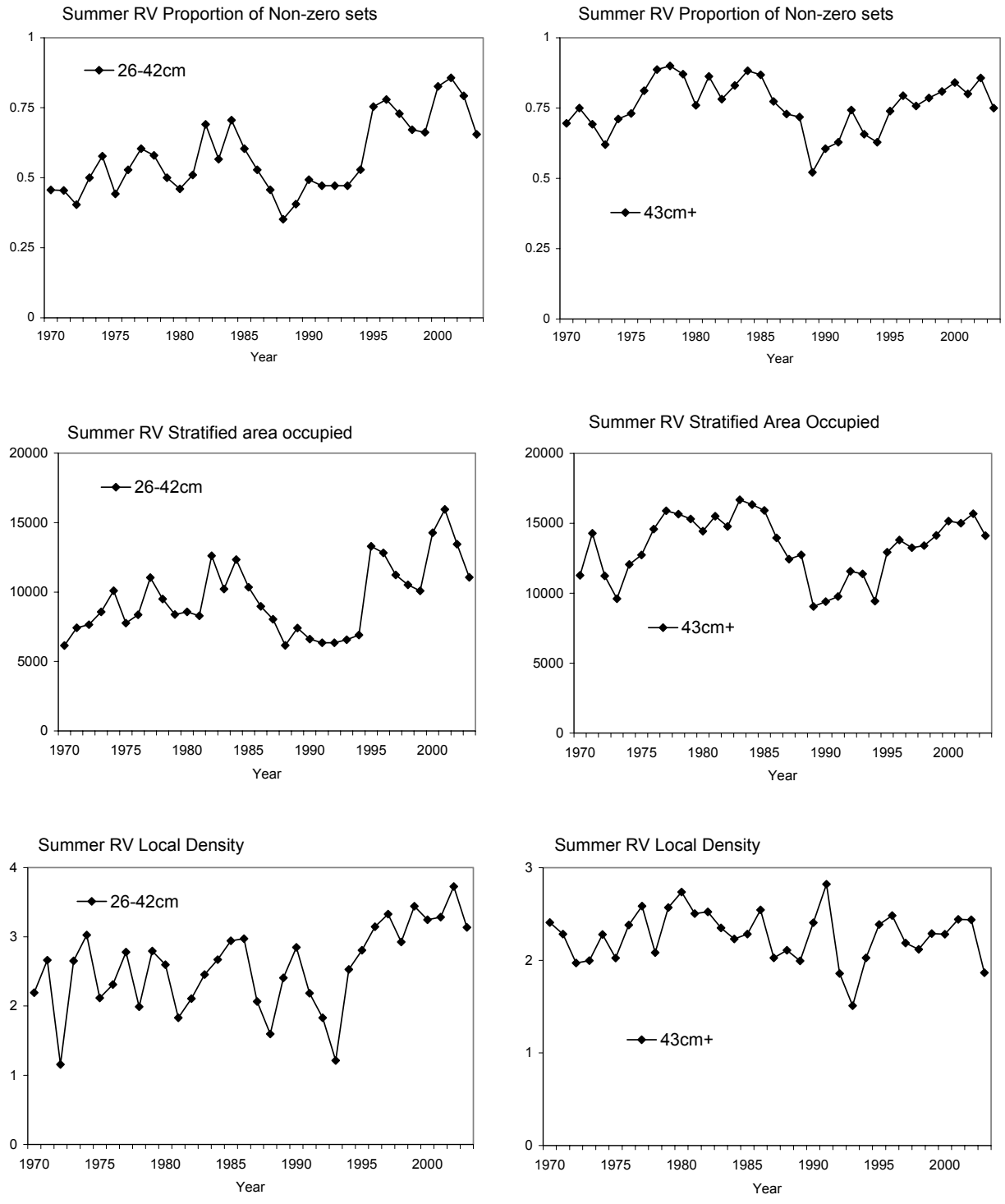


Figure 22. Distribution indices for NAFO Div. 4X/5Y haddock, 26-42cm and >43cm in length calculated from the summer RV survey.

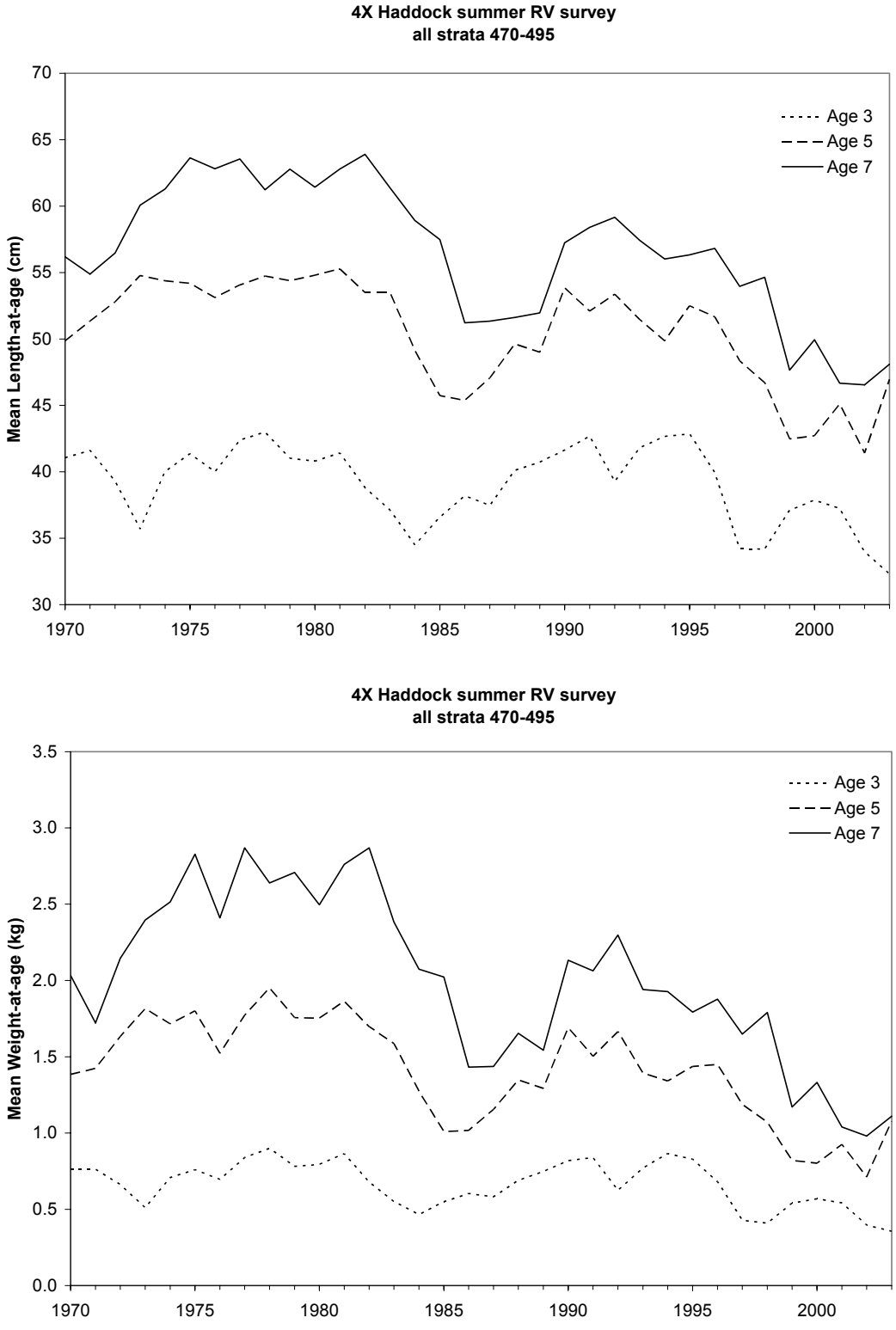


Figure 23. NAFO Div. 4X/5Y haddock summer RV survey mean length-at-age (cm) (upper) and mean weight-at-age (kg) (lower), all strata 470-495.

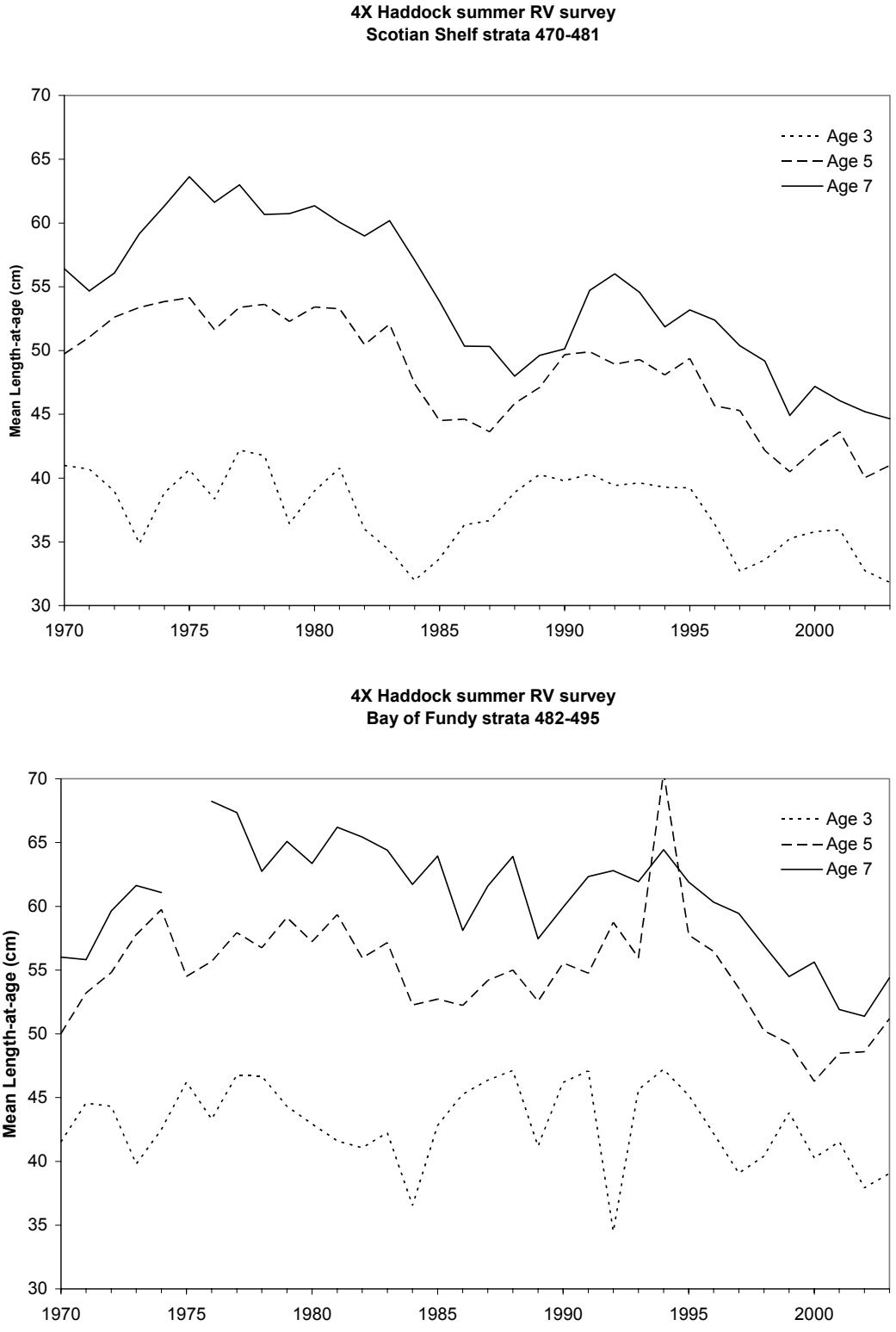


Figure 24. NAFO Div. 4X/5Y haddock summer RV survey mean length-at-age (cm) for Scotian Shelf, strata 470-481 (upper) and Bay of Fundy, strata 482-495 (lower).

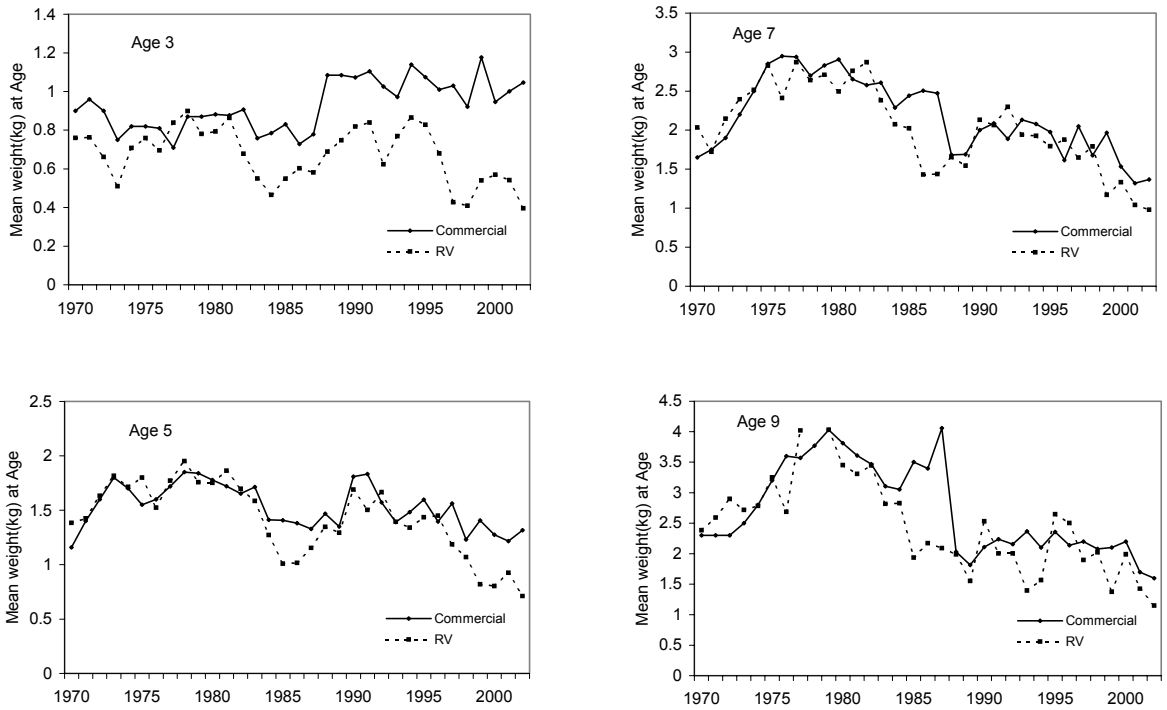


Figure 25. Comparison of NAFO Div. 4X/5Y haddock mean weight-at-age (kg) from the summer RV survey and the commercial fishery, 1970-2002.

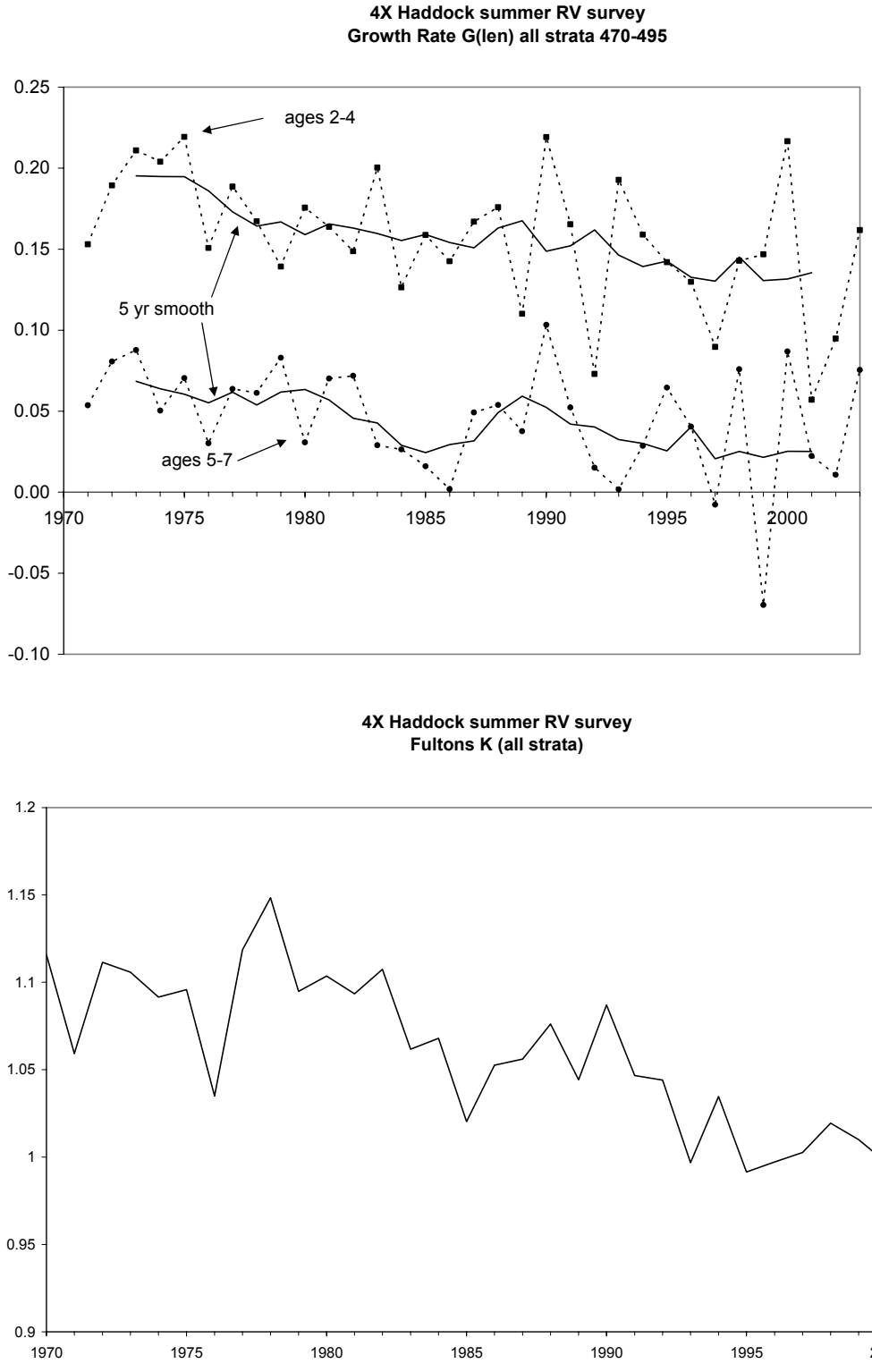


Figure 26. NAFO Div. 4X/5Y haddock growth rate (G) calculated using length at ages 2-4 and 5-7 (upper) and condition index Fulton's K (lower) from the summer RV survey, all strata (470-495).

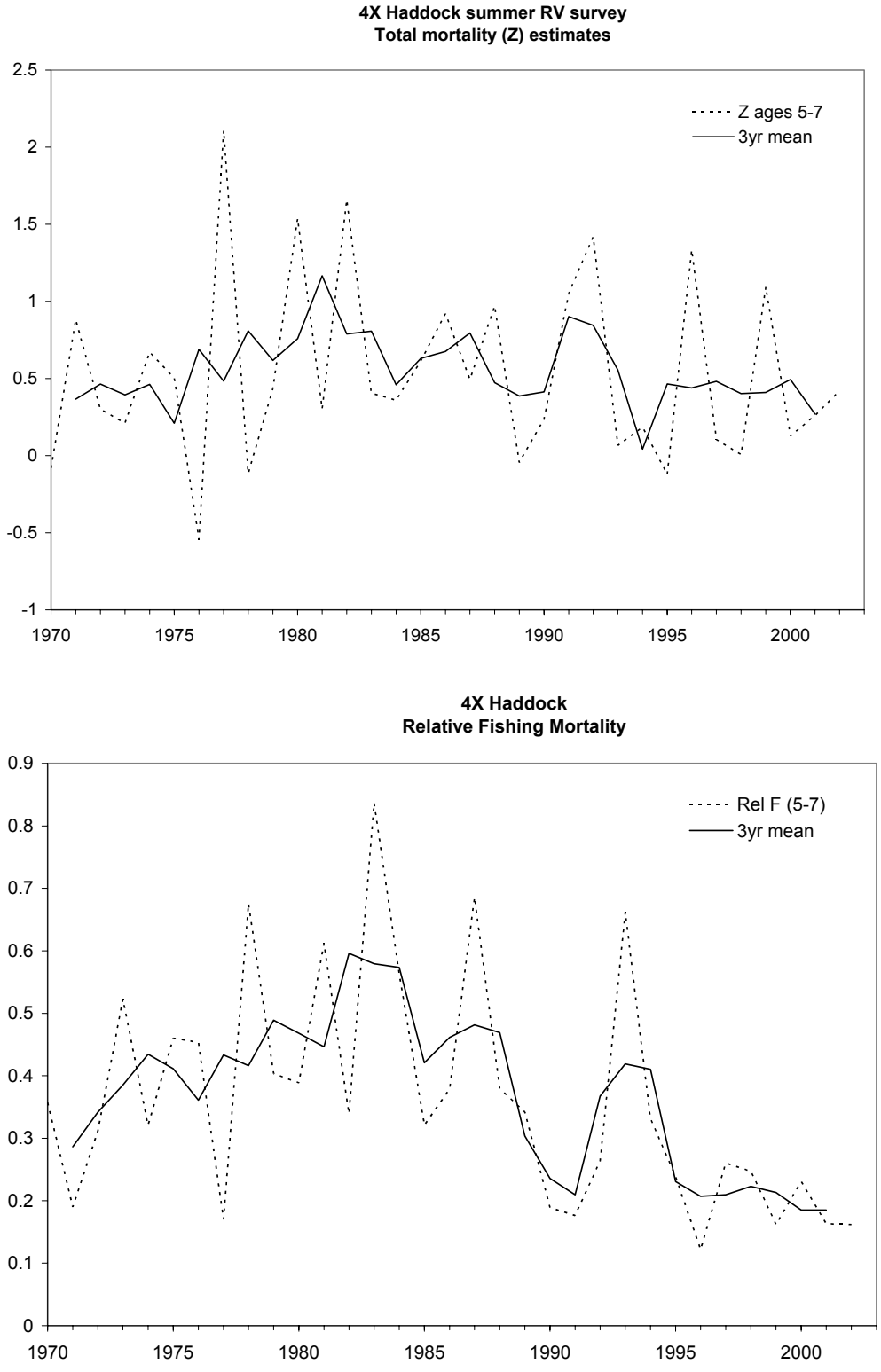


Figure 27. NAFO Div. 4X/5Y haddock total mortality (Z) estimates ages 5-7 calculated from the summer RV survey (upper) and relative F ages 5-7 (lower).

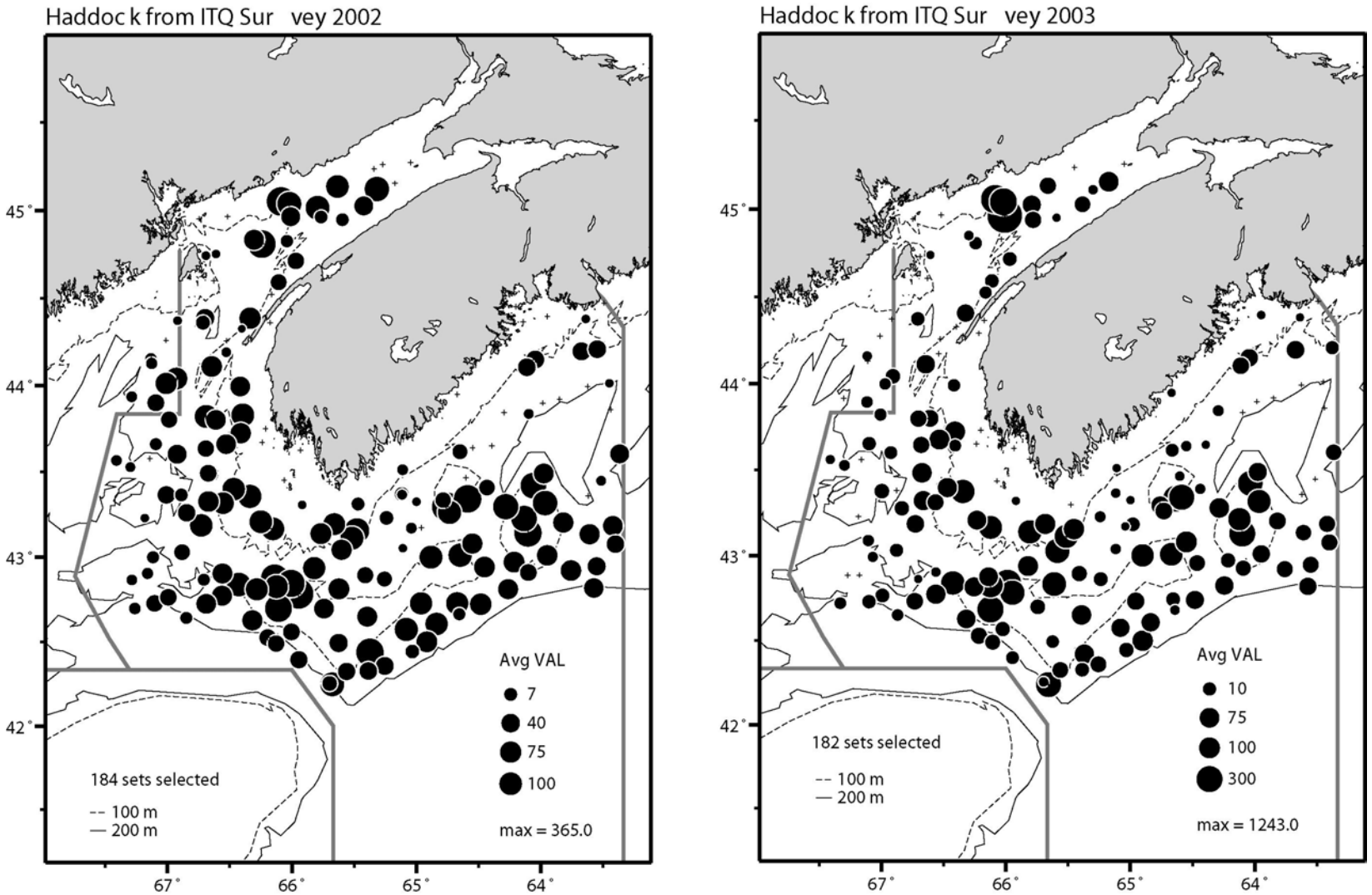


Figure 28. NAFO Div. 4X/5Y haddock number per standard tow from the ITQ surveys in 2002 and 2003.

AGE	1996	1997	1998	1999	2000	2001	2002	2003	AVG
0	0.5	0	0.3	3.6	5.4	0.6	0	0.1	1.3
1	6.9	14.7	14.9	98.8	75.7	58.9	17.3	6.2	36.7
2	41.3	9.5	29.3	39.7	75.7	54.5	29.3	17.1	37.1
3	25.1	33.1	8.3	18.2	12	56.5	30.4	30.6	26.8
4	9	19.4	21.5	7.1	8.5	13.5	29.9	26.3	16.9
5	3.5	5	8	11.1	7.2	5	6.5	13.9	7.5
6	0.9	1.6	1.2	4.6	8.1	2.1	3	2.4	3.0
7	0.7	0.6	0.8	2.1	2.6	5.3	2.2	2.4	2.1
8	0.8	0.2	0.4	0.6	1	1.9	3	1.2	1.1
9	0.2	0.3	0.2	0.5	0.3	1	1.6	2	0.8
10	0.2	0.2	0.2	0.1	0.1	0.7	0.9	0.8	0.4
11	0	0	0.1	0.1	0	0.1	0.8	0.3	0.2
12	0	0	0	0.1	0	0	0	0	0.0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
unknown	0.2	0.1	0.3	0.5	2.1	0.6	0.5	0.3	0.6
SUM	89.3	84.7	85.5	187.1	198.7	200.7	125.4	103.6	134.4

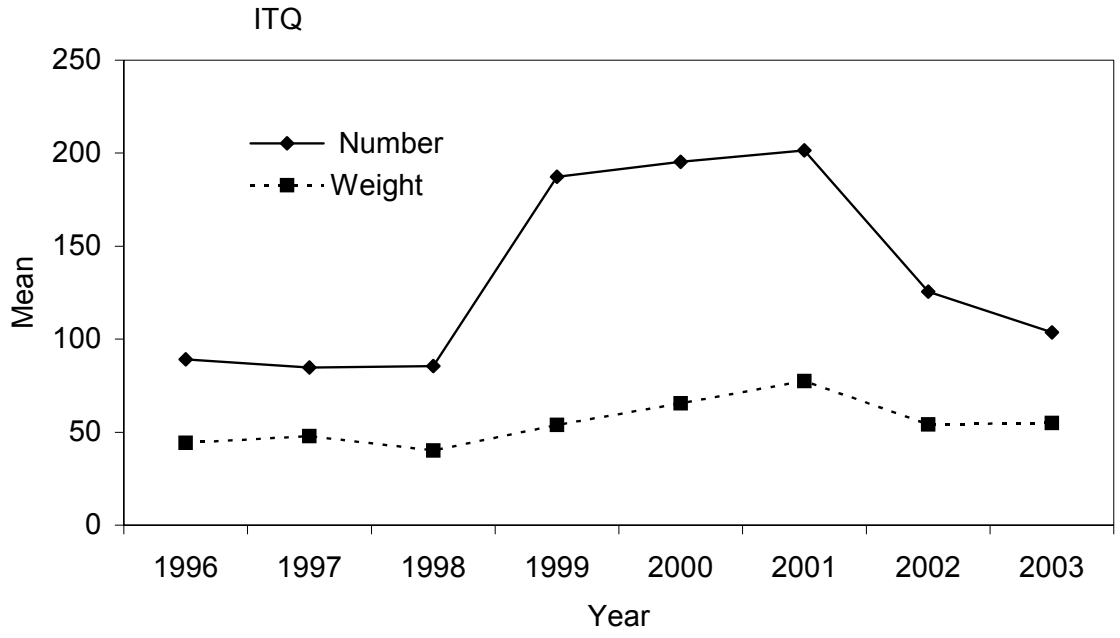


Figure 29. NAFO Div. 4X/5Y haddock mean number-at-age, mean number and weight (kg) per tow from the ITQ survey, 1996-2003.

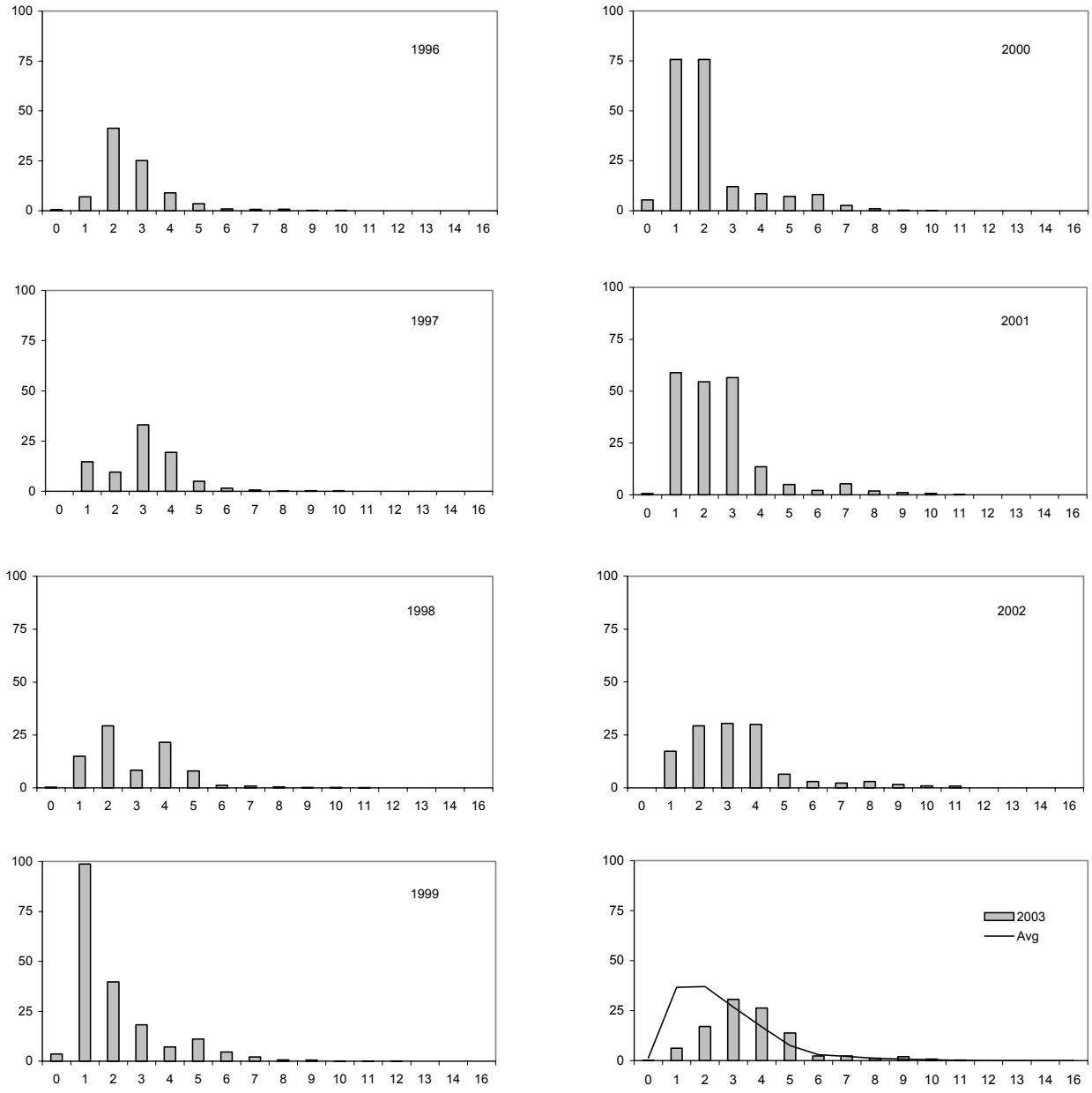


Figure 30. Age composition (mean number-at-age per tow) of NAFO Div. 4X/5Y haddock in the ITQ survey, 1996-2003.

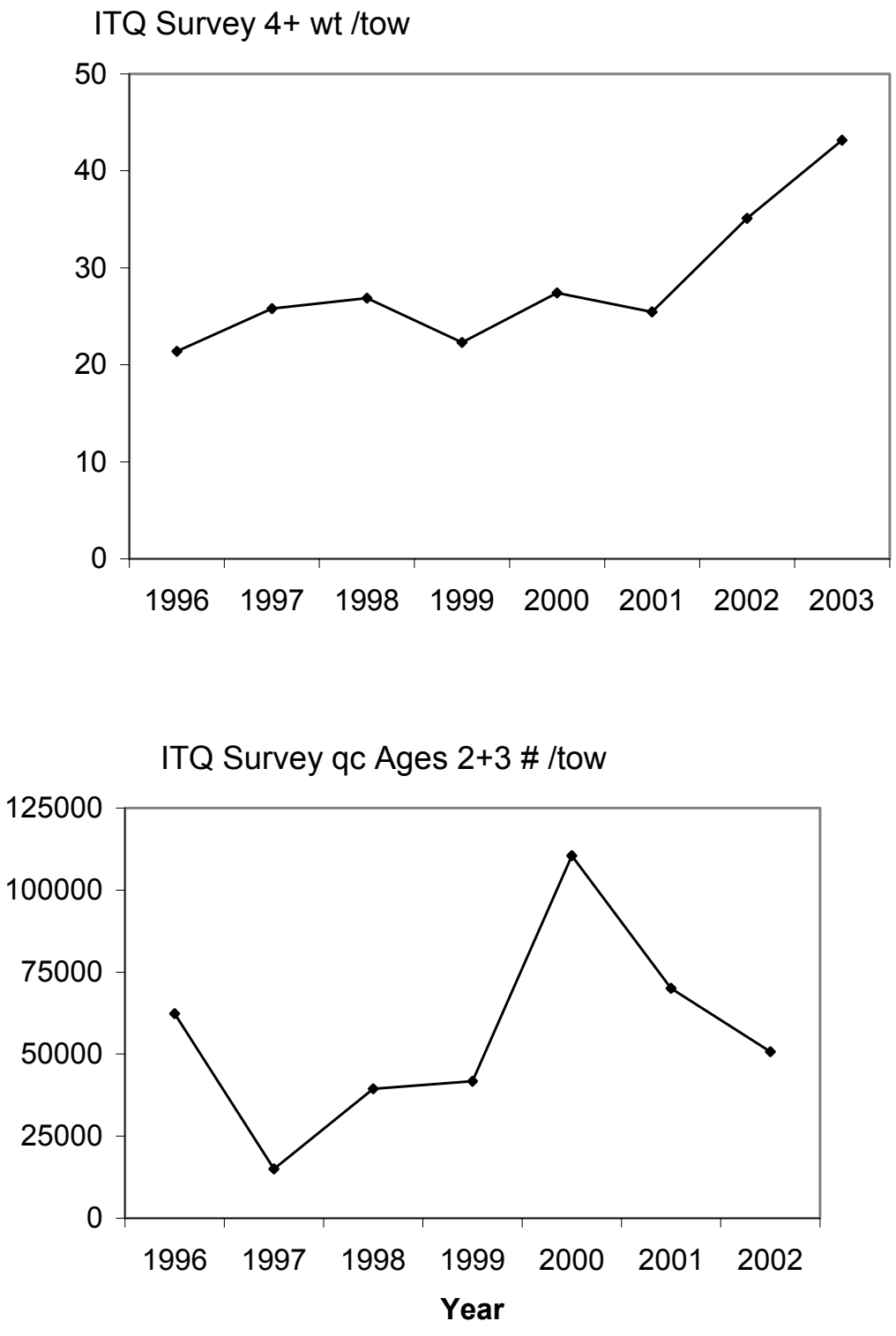


Figure 31. NAFO Div. 4X/5Y haddock weight per tow (kg) of ages 4+ and q-adjusted catch per tow of ages 2+3 in the ITQ survey.

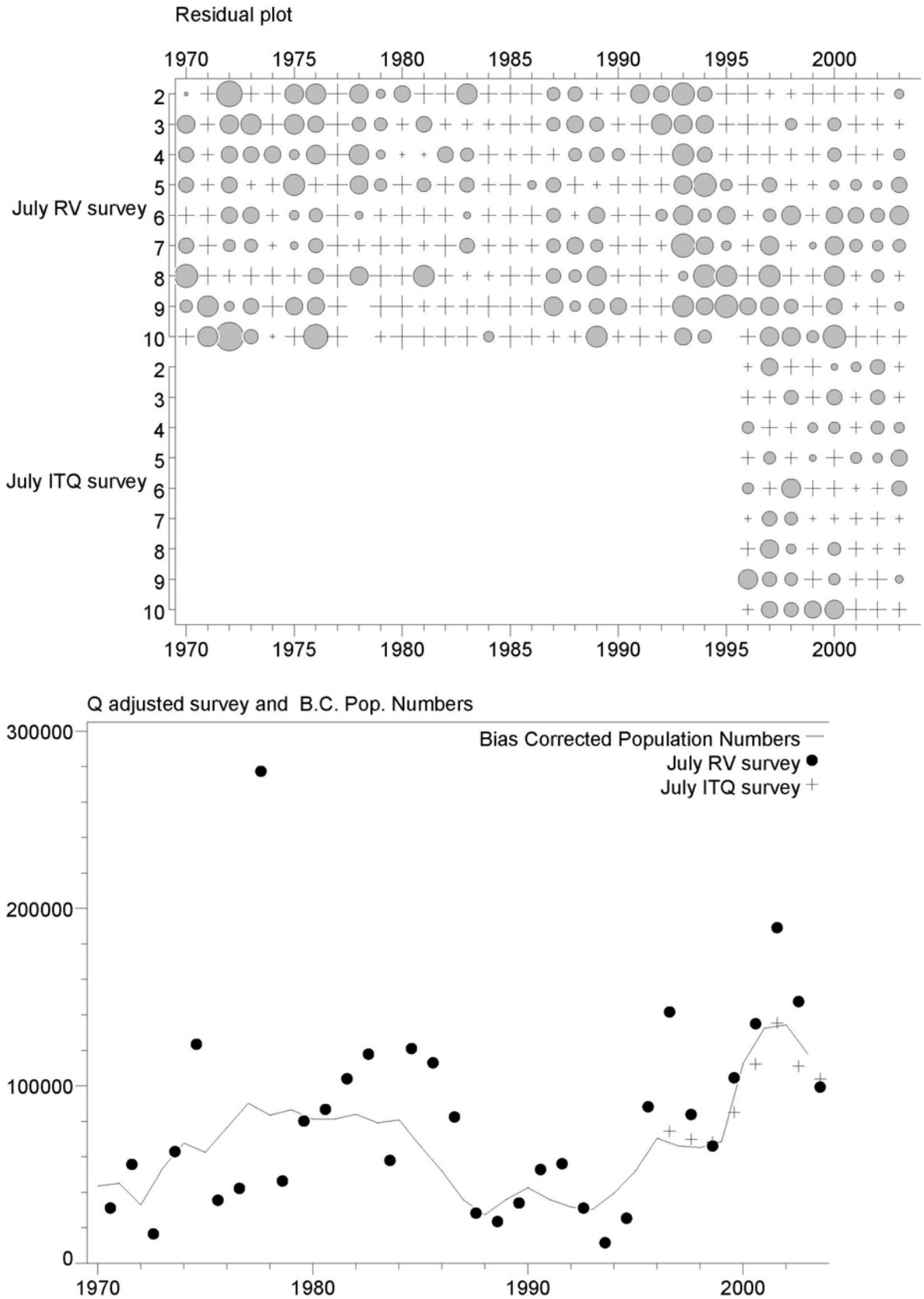
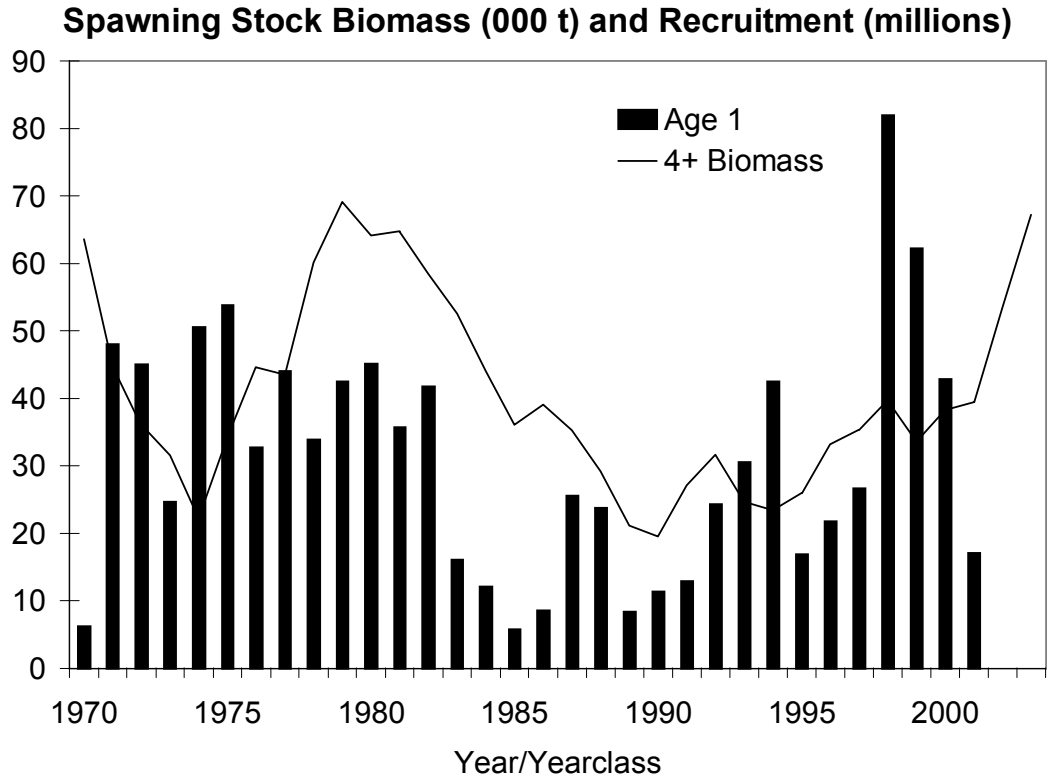


Figure 32. Residuals at age (upper) and population numbers (ages 2-10) estimated from the model and the q-adjusted survey indices (lower).



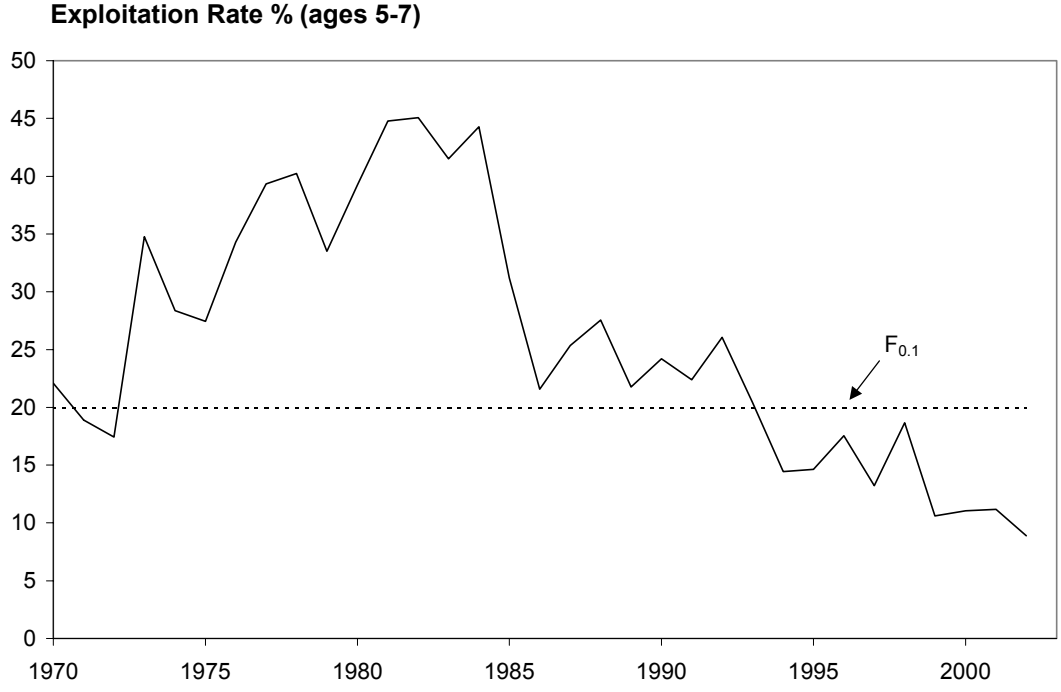


Figure 33. Spawning stock biomass (ages 4+) and age 1 recruitment in the subsequent year (upper) and exploitation rate ages 5-7 (lower) from the SPA.

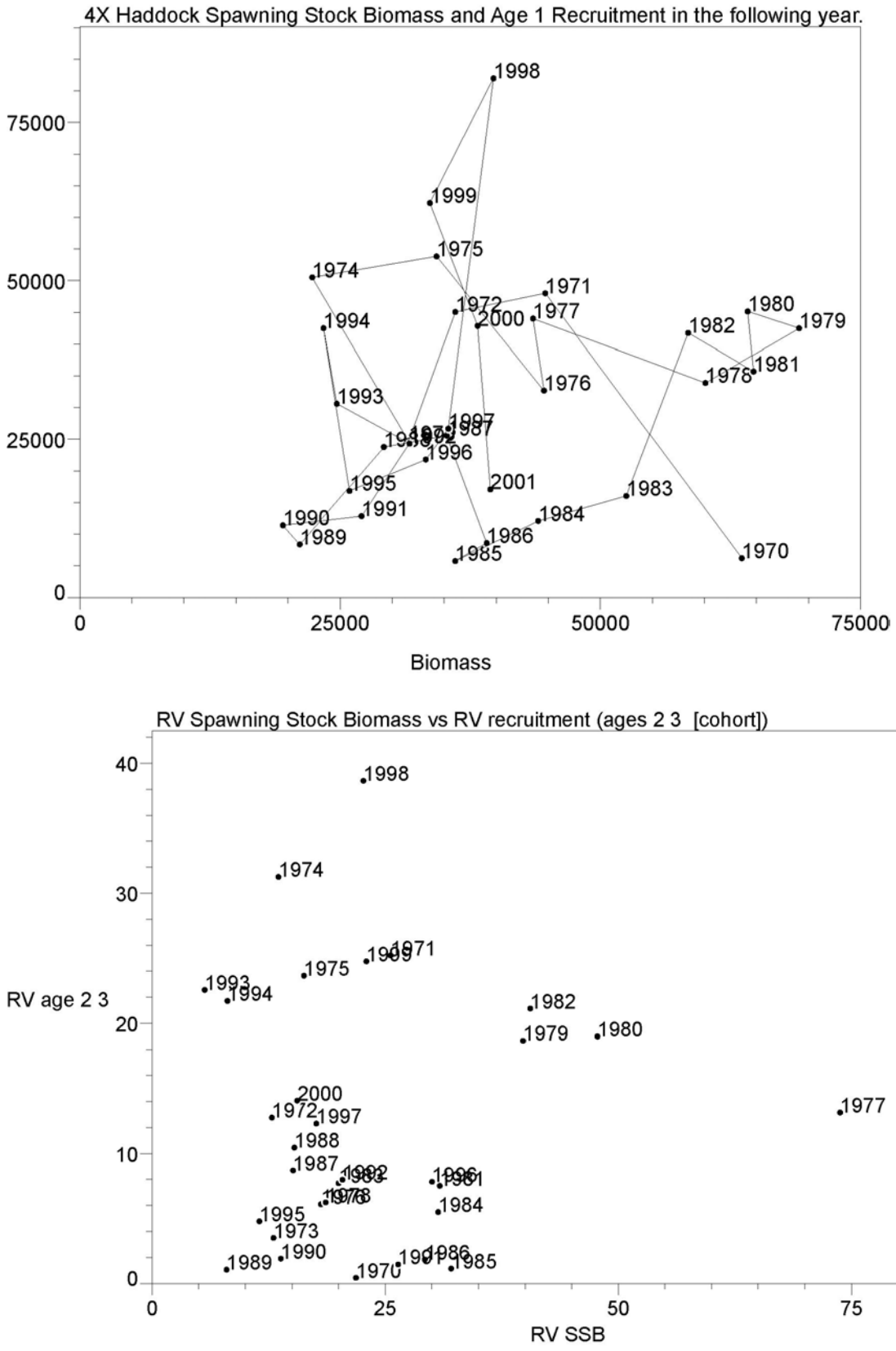


Figure 34. Spawning stock biomass (ages 4+) and age 1 recruitment in the subsequent year from the SPA (upper) and RV survey age 4+ biomass and RV survey ages 2+3. Labels are yearclass.

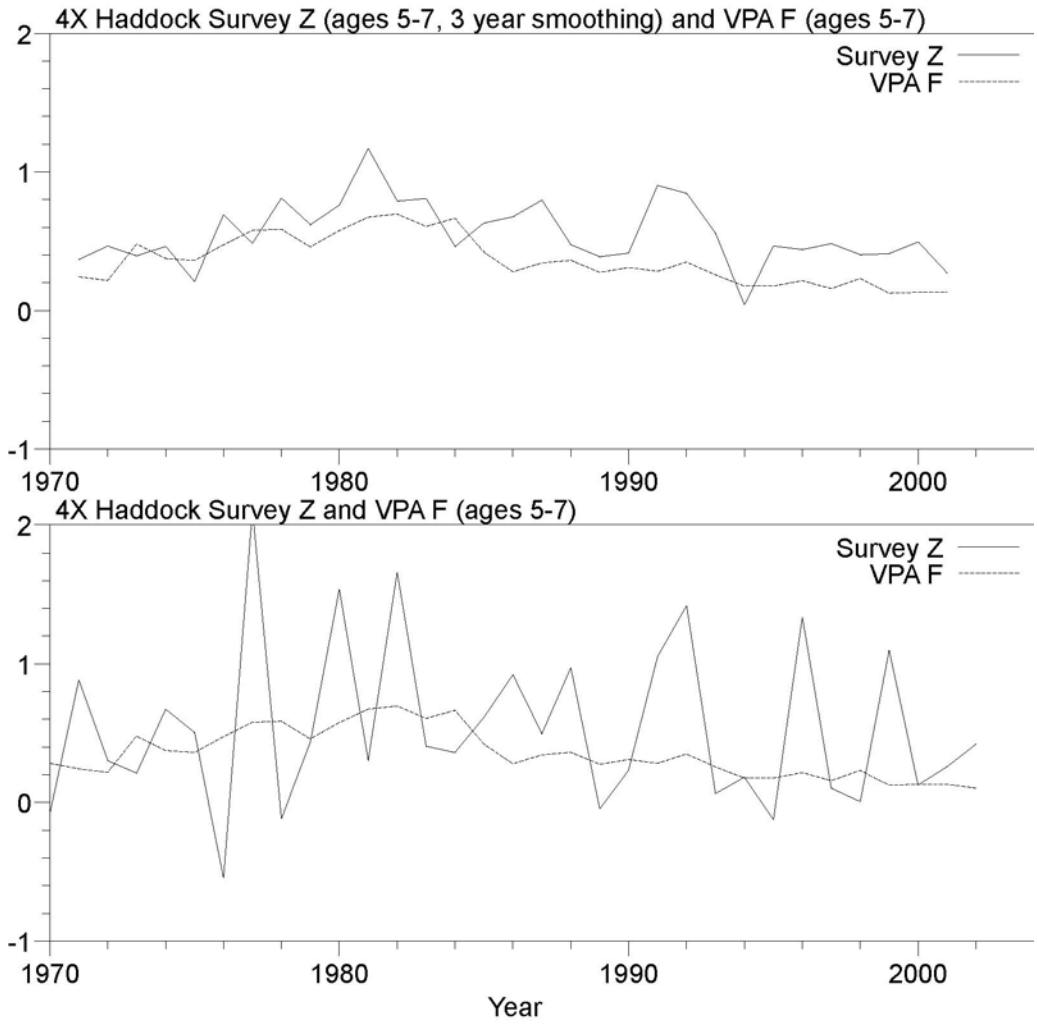


Figure 35. Comparison of total mortality (Z) for ages 5-7 calculated from the RV survey and fishing mortality (F) for ages 5-7 from the SPA. Three year running means of RV Zs in upper panel.

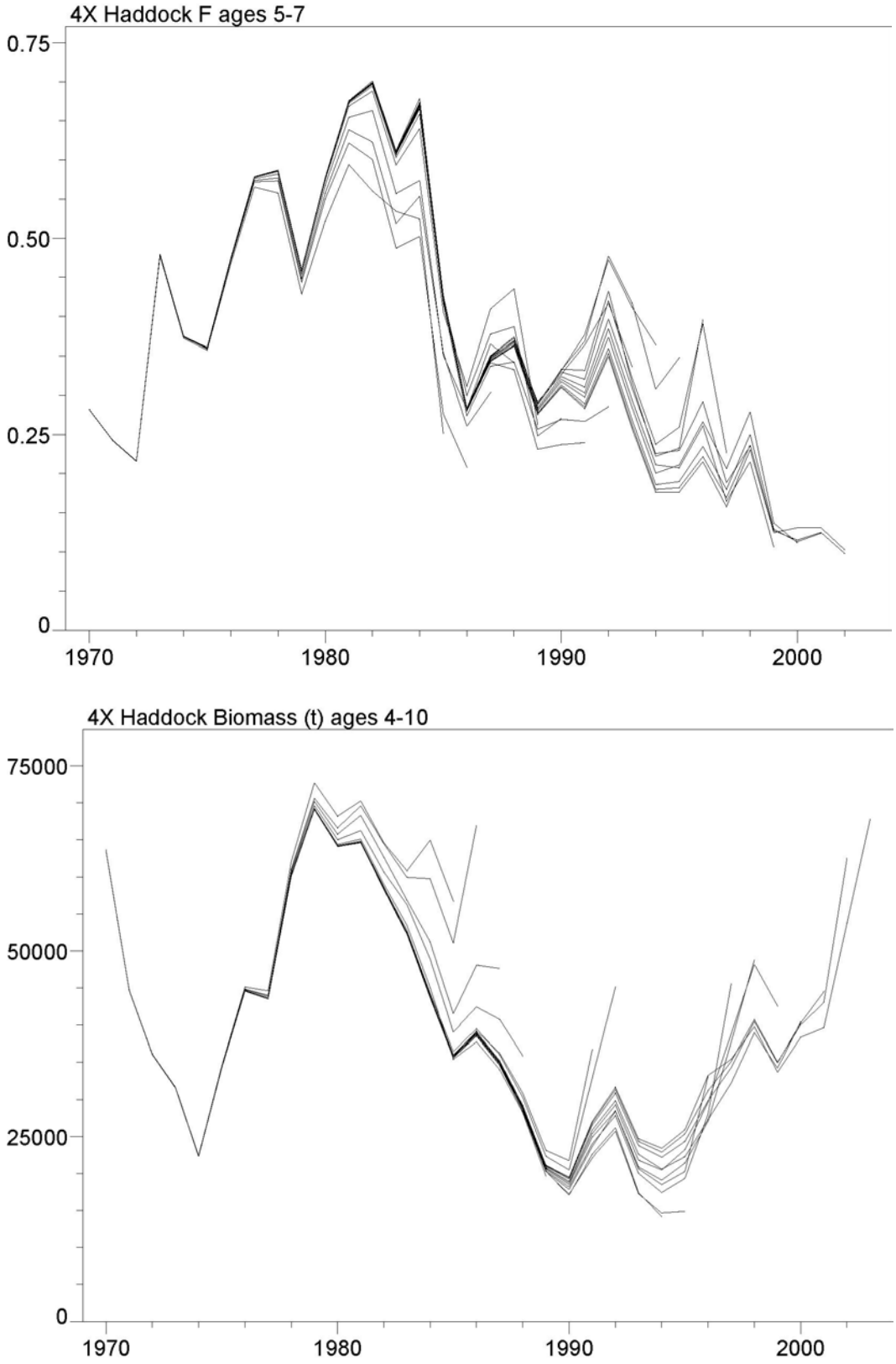


Figure 36. Retrospective pattern.

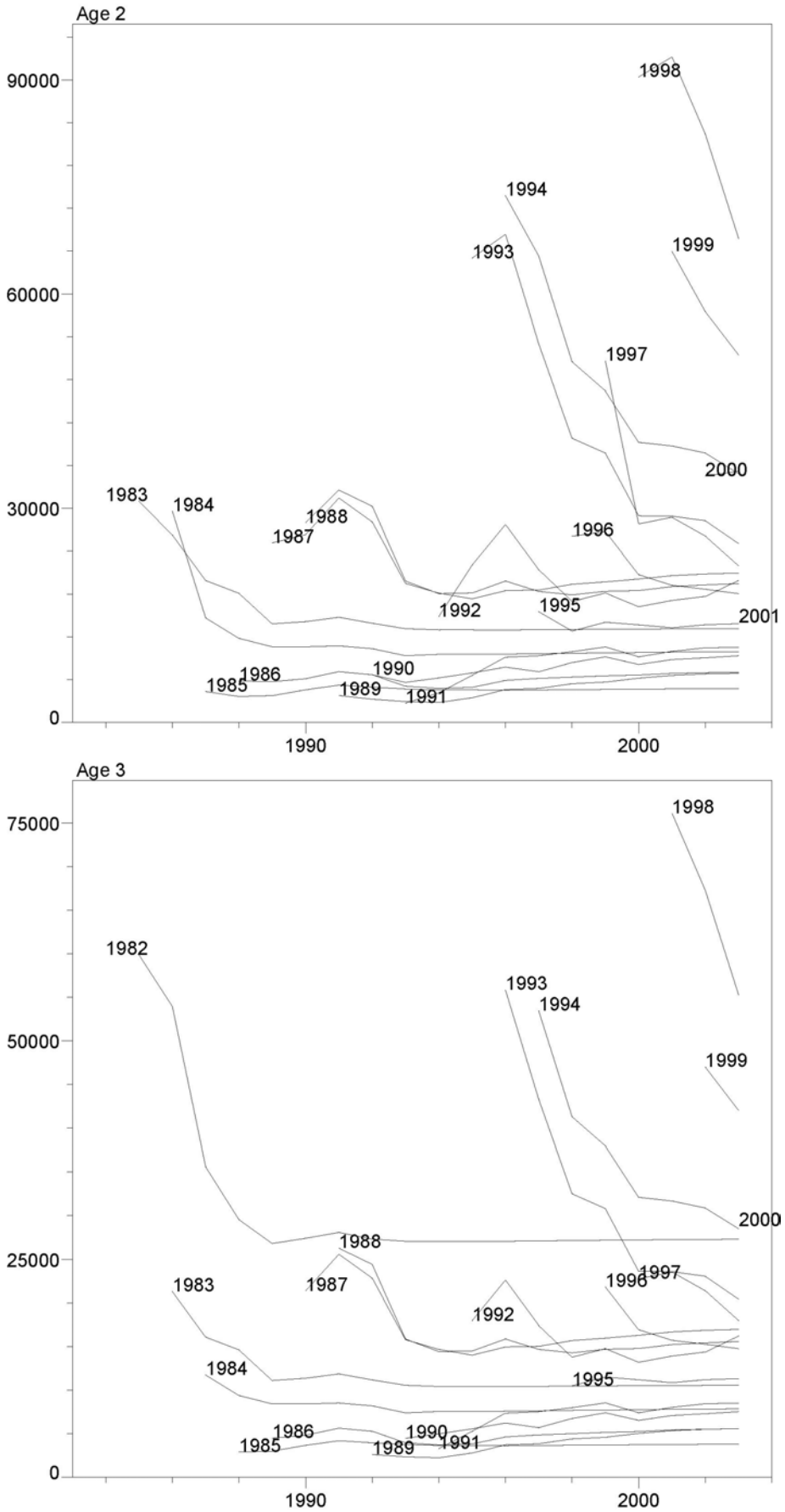


Figure 37a. Retrospective estimates of yearclass size at ages 2 and 3.

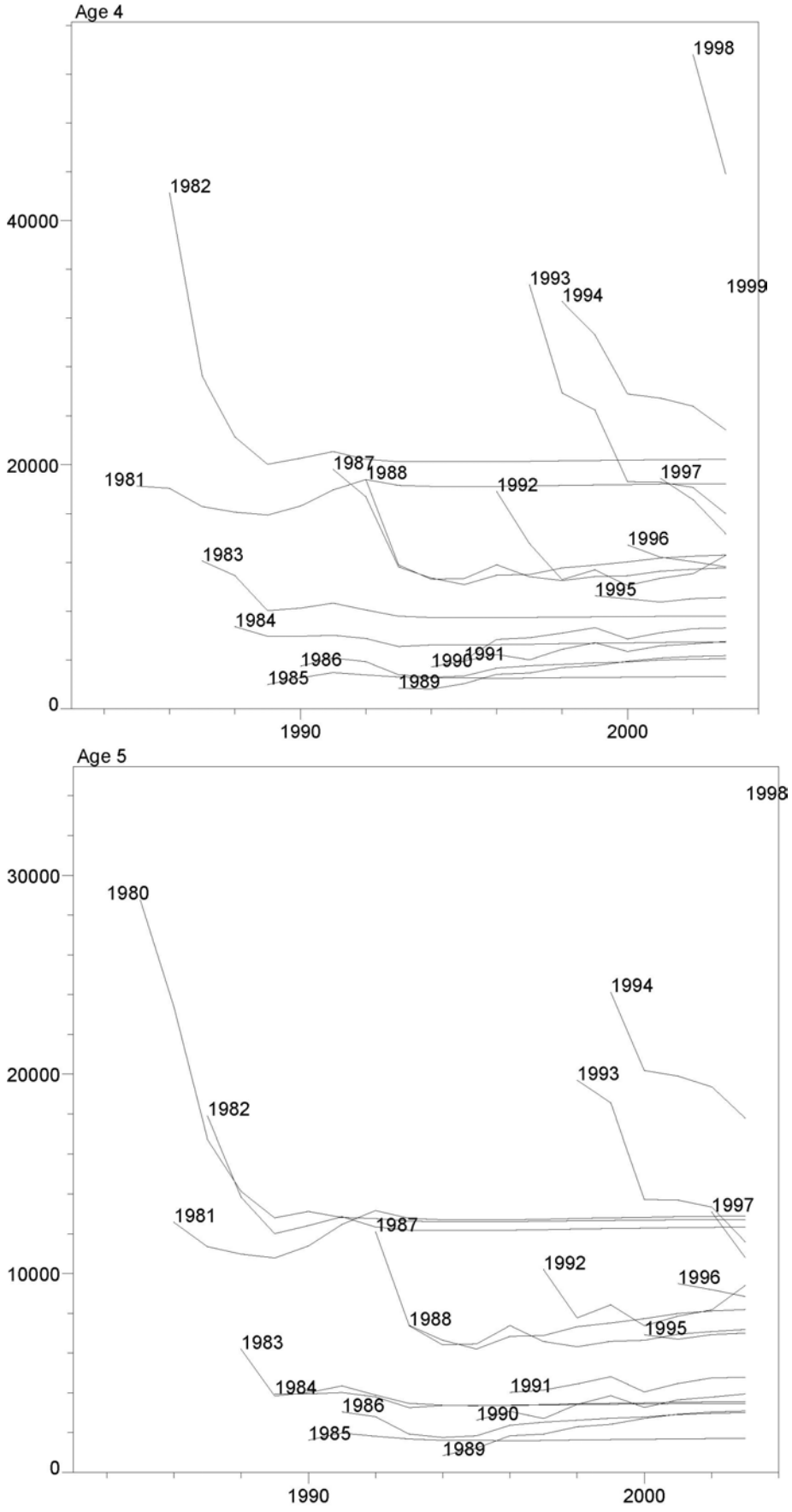


Figure 37b. Retrospective estimates of yearclass size at ages 4 and 5.

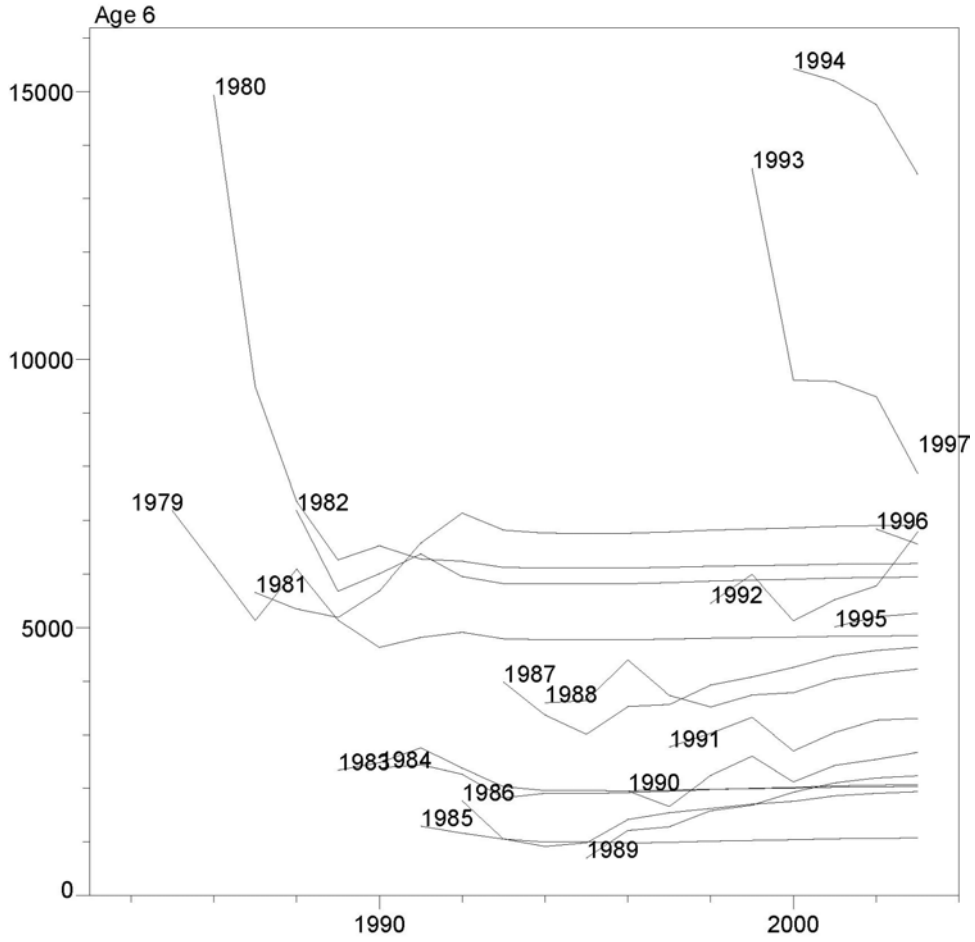


Figure 37c. Retrospective estimates of yearclass size at age 6.

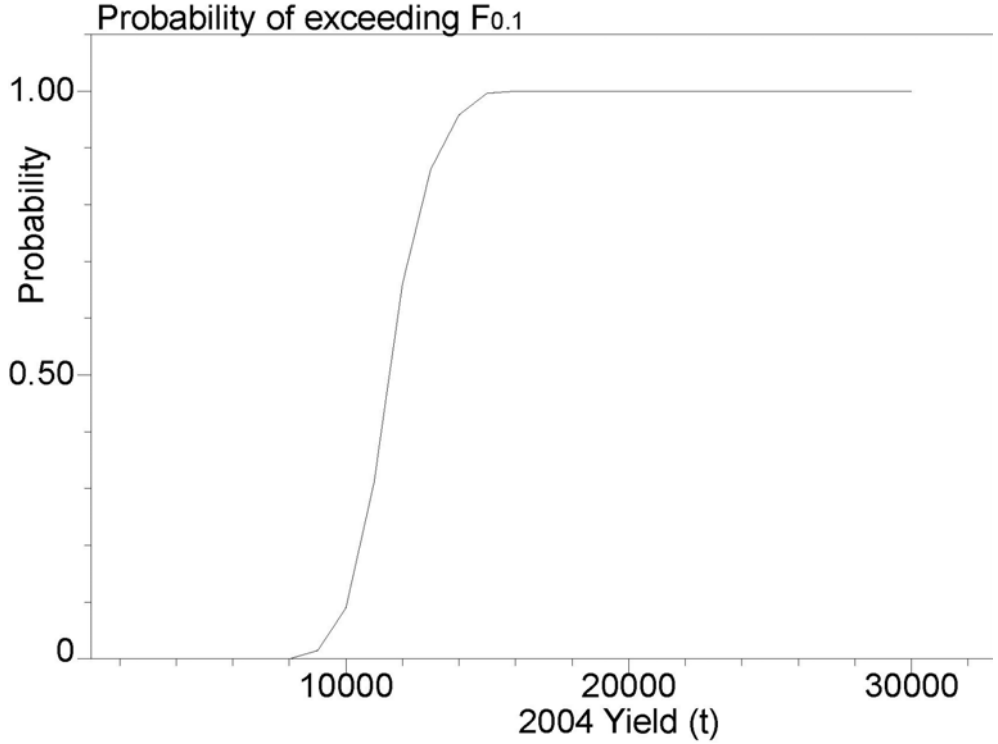


Figure 38. Risk plot – probability that $F_{0.1}$ will be exceeded at various levels of yield.