Department of Fisheries and Oceans
Canadian Stock Assessment Secretariat
Research Document 97/105

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Ministère des pêches et océans
Secrétariat canadien pour l'évaluation des stocks
Document de recherche 97/105

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Status of 4X winter flounder, yellowtail flounder and American plaice

by

W.T. Stobo, G.M. Fowler and G.A. Black

Marine Fish Division
Bedford Institute of Oceanography
P.O. Box 1006, Dartmouth
Nova Scotia, B2Y 4A2

and

S.J. Smith
Invertebrates Fisheries Division
P.O. Box 550, Halifax
Nova Scotia, B3J 2S7

Abstract

The management of Scotian Shelf flatfish (winter flounder, American plaice, yellowtail flounder and witch flounder) during the past several years has largely been based on an evaluation of the resilience of the stock complex to commercial catch levels. In 1994 the flatfish stocks were split into a 4VW and a 4X unit for management purposes, although there was not a strong biological basis for that partitioning. The current evaluation considers only winter flounder, American plaice and yellowtail flounder, although the TAC for 4X in the past always included witch flounder in the management complex. Comparison of distributions of winter flounder, American plaice and yellowtail flounder as derived from research vessel surveys conducted in the spring, summer and fall from 1978-84 suggest such a partition is appropriate for winter flounder, but does not provide as strong an indication of the appropriateness for the other two species. Partitioning the species into two management units is however, a more conservative approach and distributes the fishery across the shelf.

Stock status evaluations were based on research vessel survey abundance indices and size compositions and commercial catch rates. A new time series, the ITQ annual survey, was reviewed, but the time series was too short (3 years) to provide trend information.

Total landings of flatfish in 4X in 1996 was 2453t, a slight decrease from 1994. To mid-summer 1997, catches appeared to cover a similar geographic range. The proportion of the total landings reported as 'unspecified flounder' continues to be problematic with this fishery. Although that proportion has been decreasing since 1993 (>80%), it was >36% in 1996 and >25% to mid-summer 1997. Research vessel survey results for winter flounder, American plaice and yellowtail flounder suggest that all three populations are not undergoing serious declines in their abundance. While there has been a decline in the abundance of large fish and no signs of significant recruitment for any of the three species, for yellowtail, the RV surveys indicate a modest overall increase in abundance. This increase was in contrast to the decline observed in the commercial catch rate for yellowtail, which indicates a decline over the last few years, as did the catch rates for the other two flounder species.

Résumé

Depuis bon nombre d'années, la gestion des poissons plats (plie rouge, plie canadienne, limande à queue jaune et plie grise) du plateau néo-écossais était en grande partie fondée sur l'évaluation de la résilience du complexe de stocks aux taux d'exploitation commerciale. En 1994, les stocks de poissons plats ont été répartis dans les unités 4VW et 4X à des fins de gestion, mais cette répartition n'avait pas de fondement biologique bien défini. L'évaluation actuelle ne porte que sur la plie grise, la plie canadienne et la limande à queue jaune, mais le TAC antérieurement fixé pour l'unité 4X avait toujours englobé la plie rouge au complexe. La comparaison des répartitions de la plie rouge, de la plie canadienne et de la limande à queue jaune obtenues à partir des relevés par navires de recherche réalisés au printemps, à l'été et à l'automne de 1978 à 1984 porte à croire que cette répartition est appropriée pour la plie rouge, mais sa pertinence n'est pas aussi bien démontrée pour les deux autres espèces. La répartition de ces espèces en deux unités de gestion constitue cependant une démarche plus prudente et permet de répartir la pêche sur l'ensemble du plateau.

Les évaluations de l'état des stocks reposaient sur les indices d'abondance et la répartition des tailles déterminées par relevés par navires de recherche et les taux de prises commerciales. Une nouvelle série chronologique, le relevé annuel des QIT, a été analysée, mais elle était trop courte (3 ans) pour qu'il soit possible de dégager des tendances.

Les débarquements totaux de poissons plats de 4X ont atteint 2453 t en 1996, soit une légère baisse par rapport à 1994. Les captures semblent avoir été faites dans une zone géographique semblable jusqu'au milieu de l'été 1997. La proportion des débarquements totaux signalés comme « poissons plats » continue de poser un problème. Bien que cette proportion décline depuis 1993 (>80 %), elle atteignait quand même >36 % en 1996 et >25 % à la mi-été de 1997. Les relevés par navires de recherche de la plie rouge, de la plie canadienne et de la limande à queue jaune portent à croire que ces trois populations ne subissent pas de baisse d'abondance importante. Bien que l'on ait noté une réduction du nombre de gros poissons et l'absence d'indice de recrutement appréciable chez ces trois espèces, les relevés par navires de recherche indiquent une légère augmentation de l'abondance de tous les groupes de longueur chez la limande à queue jaune. Cela contredit la baisse des taux de prises commerciales de cette espèce qui, comme pour les plies rouge et grise, sont à la baisse ces dernières années.

Introduction

Five species of flatfish are exploited commercially in 4X. Traditionally, the Atlantic halibut (*Hippoglossus hippoglossus*) fishery has been distinct from that of the other flatfish species, and the status of the resource has also been evaluated separately (eg. Annand and Beanlands, 1993, 1994, 1995). The four remaining species, winter flounder (*Pseudopleuronectes americanus*), American plaice (*Hippoglossoides platessoides*), yellowtail flounder (*Limanda ferruginea*) and witch flounder (*Glyptocephalus cynoglossus*) have generally been managed as a species complex.

The first TAC (total allowable catch) was established in 1974 for combined flatfish in 4VWX (Table 1) and set at 32,000t; that TAC excluded winter flounder, probably due to the fact that most of the winter flounder fishery was prosecuted inside the Canadian 12-mile territorial limit by Canadian fishermen. The landings of these three species were combined and reported against this TAC. The TAC was reduced in 1976 to 28,000t, and a further substantial reduction, to 14,000t, occurred in 1978 when effort directed at these species was assumed to have declined with the removal of most of the foreign fishing activities from the Scotian Shelf. In 1994, the management area was divided into 4VW and 4X based on an examination of biological parameters (Neilson, Stobo, Annand, unpublished). The biological basis for this division was not strong, but industry supported this division, as well as the inclusion of winter flounder. It was considered to be a more conservative way of managing exploitation of individual stocks by limiting the extent of transferring effort between stocks on the eastern and western portions of the Scotian Shelf. Pro-rating the TAC between areas was based on fishing activity in the two areas. Since that time, the annual TAC has been declining. The current format sets an annual 4VWX TAC which is then partitioned into the two management areas and between fleet sectors.

It is important to note that the catch limits (TAC) set for this complex of species/areas has never been limiting to the fishery sectors. The biological basis for advising on TAC levels for these stock complexes throughout the management history has not been based on the same kind of quantitative population analyses generally applied to the cod and haddock stocks on the Scotian Shelf. The first TAC was based on yield-per-recruit calculations (Halliday 1973). Subsequent TAC levels have been based on examinations of research vessel survey biomass and catch rate estimates, fishery catch and catch-per-unit-effort information, and recently an additional cautionary approach due to the concern expressed by industry of the declining nature of the fisheries. The less rigorous approach to assessment of these stocks has been necessitated by the absence of data to develop age-length keys, the paucity of length frequency data from the commercial fishery, and the large proportion of the catch not identified to species. In 1996 it was decided to evaluate witch flounder independently of the other flounders in both 4VW and 4X. This report summarizes the biological evaluation of winter flounder, yellowtail flounder and American plaice in 4X (including that portion of 5Y east of the Canada-USA International Boundary Line); evaluation of the status of these three species in 4VW is planned for fall, 1998.

Description of the Fishery

Total reported landings of 4X flatfish in 1996 were 2453t, including witch flounder landings of 404t (Table 2). This represents a continuation of the decrease in landings observed since the peak recorded catch of 6092t in 1990. The 1997 reported catch of 857t includes only the January to July period; those figures must be considered tentative since updates to the catch reporting system often occur throughout the year. The landings reported against catch allocations for the various fleet sectors in 1994-1996 and for the period to September, 1997, are given in Table 3. The annual catches reported in the quota management summary differ somewhat from that derived from the DFO commercial landings database due to the different reporting sources and editing procedures. The ITQ Mobile <65' has always had the largest allocation and taken the majority of the total catch. The fixed gear component and the Mobile vessels 65'-100' have relatively small allocations in 4X. The fixed gear sector has taken less than 50% of its allocation since 1995, and the large Mobile vessels >100' less than 15%, of their allocations. To September, 1997, the Generalists had exceeded their allocation while the ITQ and fixed gear <65' sectors were at about 50%. The larger vessels had taken less than 10% of their allocation. Figure 1 illustrates the seasonal distribution of the catch, based on identified species, arbitrarily grouped into 5-year periods. Generally the fishery is prosecuted throughout the year, but with peak activity occurring during April to October. Tables 4 and 5 provide the recorded landings by country and gear, and by tonnage class for otter trawl, for the four flatfish species in the 4X fishery complex. It should be noted that in 1993 the total American plaice identified catch is listed as foreign catch; it is believed however, to be erroneously listed Canadian landings. All vessel/gear categories have a substantial proportion of the catch recorded as 'unidentified flounder' in all years, highest in 1993, which may explain the extra-ordinarily low catch identified for plaice in that year.

Of continuing concern is the 'unspecified' portion of the catch (Figure 2); in 1993 that component represented over 80% of the catch. Although the decline in the proportion 'unspecified' since 1993 is encouraging, stock assessments use both current and historical catch data in evaluating resource status. Without reliable catch data, any calculations on exploitation will contain high and unquantifiable levels of uncertainty. Consequently there is a need to consider reviewing the historical catch record with a view to pro-rating it into species. In the 1960s, substantial levels of unspecified catch were also reported, but were pro-rated, on the basis of 'best guesses' by ICNAF (International Commission for the Northwest Atlantic Fisheries) staff and designated country experts. That process was discontinued in the early 1970s. It is unlikely that pro-rating of the catch data from the 1970s and 1980s would provide a satisfactory catch history due to various confounding factors (potential mis-reporting of other species as flounder to avoid catch restrictions, extent of conversion of landings from local names to proper species, absence of the original documentation). Most industry representatives (see below) felt that it would be futile to attempt to pro-rate catch data prior to the 1990s.

Industry Consultation

Discussions were held with industry representatives in Yarmouth on 11 September to obtain their input pertaining to fishery dynamics and its import to stock abundance. Three main subjects were discussed: catch statistics, catch rates, and overall stock abundance.

Catch statistics: Since the 1970s a very significant portion of the catch was reported as unspecified flounder. Some of the industry representatives stated that there was inadequate space in the logbooks to list flatfish catches by species, so they entered all flatfish species as 'flounder'; substantial amounts of roundfish were mis-reported in order to avoid quota limits, making the landing figures inaccurate; and, at dockside, weighout of the catch often wasn't entered in the purchase slip by species, either due to unwillingness or inability of the agents to distinguish species. Instances were recalled in which even when the catch had been sorted and boxed by species, the catch was recorded as mixed flatfish. Industry felt that it would not be worthwhile to attempt to pro-rate the unspecified portion of the catch into species for years prior to 1991 due to the amount of mis-reporting of species landed. Generally the industry representatives felt that by 1991, the year that the Dockside Monitoring Program (DMP) was initiated, mis-reporting was probably not significant and pro-rating the unspecified flounder catch into the other species would be reasonable, if a pro-rating system could be developed. Industry felt that the witch landings could be considered correct, thus the unspecified category could be pro-rated to the other three species, winter flounder, yellowtail and American plaice. Industry also expressed the opinion that the decline in the proportion of unspecified catch since 1993 was a trend likely to continue. They encouraged DFO to motivate DMP to document weight by species.

Several possible methods of pro-rating from 1991 to the present were discussed. It was not known to what extent local names for the species, when designated in the logs, were converted by Statistics Branch at data entry. Thus some questions were raised related to the extent of the 'unspecified' portion of the catch. Use of the log records was felt to be of questionable value since many fishermen have not specified catch by species; it was noted that the log records had been previously reviewed by DFO from this aspect. The possibility of using fishermen's knowledge of the species historical presence and catch within the 4X area to approximate the relative prevalence of the flatfish species within each unit area in 4X, was not considered feasible due to the large size of the unit areas. There is too much localized variation in species mix within a unit area associated with depth and temperature. Similarly the possibility of using 'port of landing' as a localizing factor to determine species mix and pro-rating was considered unfeasible due to the range of movement of boats from their home port. The possibility of using the existing proportions of known landings of winter flounder, yellowtail and plaice to pro-rate the unspecified was discussed. Industry felt that the 1988 catches of those three species best represented the proportions in 4X. The fishermen suggested that using research survey species composition to pro-rate the unspecified catch might provide as good a result as any other potential method, but suggested that the ITQ survey would be more suitable for this purpose than the RV survey because of its greater geographic and detailed coverage.

Catch Rates: The fishermen appeared satisfied by the analysis of generalized and vessel-specific catch rates for winter flounder (either data set gave the same trend). They all agreed that the decline in CPUE was real. They stressed that the increase in CPUE in 1989 was related to catch restrictions on other species in 4X that caused re-direction of effort to flatfish. They also pointed out that although the CPUE appears to be relatively unchanged since about 1993, the efficiency of their electronic and fishing gear has improved. They were unanimous in stating that the abundance had declined. Some stated that essentially no effort had been exerted in some areas because there weren't enough fish to make a trip worthwhile.

Abundance: All the industry representatives felt that the flatfish stocks were in serious trouble; both numbers and size of individuals had decreased. Most felt that a substantial reduction in the catch level was imperative. Many felt a reduction of 25-50% was in order. Some stated that considerable discarding of cod was occurring because there was flounder quota available, but insufficient cod quota to allow it to be caught without discarding. They felt this was another reason that the allowable catch of flounder should be reduced.

Review of Options to Address 'Unspecified Catch'

1. *Log records*: Annand and Beanlands (1994) previously examined the DFO log record computer database to determine what additional species information might be available to partition the 'unspecified' portion of the catch. The results pertaining to 4X flatfish in 1993 and 1994 are given in Table 6. There are dramatically more instances of flatfish being reported by species in the log records than get incorporated into the purchase slip or the ZIF landings record. As these two years illustrate, most identified flatfish become 'unspecified flounder' on the purchase slip which is then transferred into the ZIF landings database. Of note also are the landings that are not identified to species in the log but do get weighed as individual species.

It would appear that further investigation of this database is warranted to determine if an acceptable partitioning of the historical unspecified catch can be achieved by using the log record entries to estimate species proportions.

2. *Pro-rating of 'unspecified flounders' using identified portion of the catch*: This exercise was performed on the 1995 and 1996 catch data (Table 7, upper panel). Since the catch proportions differ dramatically in different areas of 4X, the pro-rating was done on a unit area basis. Witch flounder were not used since industry felt those catch figures were reliable. After pro-rating the unspecified catch by the proportion of winter flounder, American plaice and yellowtail flounder identified, the witch catches were added back in and proportional contributions calculated. When the calculations were summed to 4X totals again, winter flounder represented 75% and 68% of the catch in 1995 and 1996

respectively, with American plaice and yellowtail representing between 2-5% and 11% respectively; witch flounder stayed at 12-16%.

3. *Pro-rating the commercial catch using ITQ survey*: In this exercise no attempt was made to adjust for pre-recruits taken in the survey (due to the liner in the gear). Any adjustment for small fish would be difficult since only total weight and numbers caught are recorded for American plaice and yellowtail, thus the proportion of small fish is not identifiable. The ITQ catches were standardized to the RV (i.e. adjusted to standard distance towed and to RV trawl wingspread). The results of the pro-rationing indicate certain similarities to the catch pro-rating. Both pro-rationing procedures indicate that, overall, winter flounder is the dominant species in the 4X commercial catch, and that plaice, witch and yellowtail are seldom caught in 4Xr,s. But there are also substantial differences, especially in estimating the proportions of the four species in each unit area between years and methods.

The extent to which any or all of these methods could be used to pro-ration the historical catch needs further investigation. Only once the log record data is more thoroughly analyzed will we be able to assess the possibility of pro-rationing the historical catch.

Species Distribution

Although the winter flounder, American plaice and yellowtail flounder populations on the Scotian Shelf have been divided into 4VW and 4X management units, the biological basis for that separation has not been well established. Additional research information is provided here to further elucidate the distributions of these species.

Winter flounder - The distribution of winter flounder in spring, summer and fall (Figure 3) from the 1978-84 RV surveys (spring and fall surveys canceled in 1985) indicates two, possibly three, areas of concentration. The largest and most consistent concentration is in the Bay of Fundy, with a second major concentration on Sable Island Bank and a smaller one on Browns Bank. Further examination of these concentrations (Figure 4) using the 1993-97 summer RV surveys indicates that, while adult (>27cm) winter flounder are found in all three areas, juveniles are found only in the Bay of Fundy and Sable Island Bank. Data collected during the 1995-97 ITQ surveys (Figure 5) show a continuous distribution from the Bay of Fundy across Lobster Bay to Browns Bank. The Lobster Bay area is not sampled by the RV survey, giving the incorrect impression of a break in the distribution. This suggests a connection between the Bay of Fundy and Browns Bank concentrations, but no relationship with the Sable Island Bank (4W) concentration. An inshore survey conducted in 1985 (Figure 6) indicates quantities of winter flounder at depths under 60m, much shallower than the areas surveyed by either the RV or ITQ surveys. Winter flounder have generally been thought to exist as numerous small inshore populations. The observations from the research surveys are not inconsistent with that view, but they do not provide sufficient detail on the distribution to further resolve that issue. Winter flounder prefer shallow water as shown by their presence on offshore banks

and the shallow areas of the Bay of Fundy. Scott and Scott (1988) note that the depth range for this species is primarily between 2-37m; thus the RV surveys sample only the greatest depths of that range. Comparison of cumulative frequency plots of winter flounder catches at depth with the range of depths sampled by the summer RV survey (Figure 7) shows a significant depth effect, supporting the shallow water preferences of this species. In this exploratory analysis, we arbitrarily picked 1975, 1985 and 1995 to test for a depth effect.

The presence of winter flounder in nearshore areas in 4W and 4V cannot be confirmed at this time since no surveys have been conducted in those nearshore areas. The large catch nearshore in 4V (Figure 3), and anecdotal information from fishermen on abundances in Bras d'Or Lake suggests such distributions exist. The absence of evidence of winter flounder connecting eastern 4X with western 4W suggests that the current management split is appropriate for this species.

American plaice - The spring, summer and fall RV surveys (1978-84) indicate that the major concentration of this species occurs in 4VW throughout the year (Figure 8), with a continuous distribution over the Scotian Shelf. The distribution of pre-recruit (≤31cm) fish (Figure 9) during the summer RV surveys, 1993-97 suggest a continuity of distribution between 4X and 4W; that connection is not obvious for the larger fish. In general, the RV surveys indicate that American plaice are not abundant in 4X, particularly the Bay of Fundy. Some concentrations occur in the deeper water just inshore of Browns Bank. This distribution is also indicated by the ITQ surveys (Figure 10) which caught very few plaice in the Bay of Fundy, but consistently caught them inshore of Browns Bank, and in lesser numbers, up to the 4X-4W boundary (eastern end of the ITQ survey area). The 1985 inshore survey rarely found American plaice at depths shoaler than 60m. American plaice is a deeper water species than winter flounder or yellowtail flounder, and was seldom caught in the shallow water stations of the RV or ITQ surveys and showing little or no relationship with depth in the cumulative frequency plot of catches at depth compared to stations at depth (Figure 11).

Yellowtail flounder - The spring, summer and fall RV surveys indicate the major concentration of this species occurs in 4VW throughout the year (Figure 12), with minor concentrations in the area of Browns Bank and in the Bay of Fundy. All three survey seasons indicate a degree of discreteness between the distribution in 4VW and 4X, as well as between Browns Bank and the Bay of Fundy within 4X. The distribution of pre-recruit (≤30cm) and recruited fish during the summer RV surveys, 1993-97 indicate concurrence of distributions of juvenile and adult fish (Figure 13). The 1993-97 RV surveys indicate few yellowtail flounder in the Bay of Fundy of either size group. The ITQ surveys also indicate the virtual absence of yellowtail flounder from the Bay of Fundy, the relative absence in the eastern part of 4X, and the overall low occurrence in 4X (Figure 14). The 1985 inshore survey only occasionally found yellowtail in shallow water (Figure 15). In general, the RV and the ITQ surveys suggest an offshore distribution of yellowtail flounder, but preference for depths shoaler than 100m. The cumulative frequency plot of

catches and station depths indicates a significant depth effect (Figure 16), with most yellowtail caught by sets made in shallow water.

Resource Status

Winter Flounder

Winter flounder are not routinely caught in most of the RV survey strata in 4X (Table 8). They are most prevalent in the Bay of Fundy strata (490-95) and on Browns Bank (480). Since 1990 their prevalence has also increased inside of Browns Bank (stratum 481).

Survey length frequency distributions (1970 -1997) indicate fewer fish greater than 40cm in length than in the 1980s and early 1990s (Figure 17). One-year olds (upper size limit: 12cm) have rarely been caught in the RV survey and 2 or 3-yr olds (modal length of 3-yr olds: 19cm). are not represented well in the time series. In the 1980s and early 1990s, there was a much larger proportion of fish in the 20-30cm range than that observed in 1996 or 1997. This suggests that there will be no significant new recruitment entering the fishable biomass in the next few years. It is also notable that the overall distribution of lengths is being compressed into the 30-40cm size range.

Research vessel catch rates (kg/tow) for 1994-97 (Figures 18 and 19) indicate that the distribution and relative concentration of this resource has changed little in the last four years. Changes in RV catch in kg and numbers per tow (Figure 20) indicate a gradual increase since the 1970s, with a peak in the late 1980s and early 1990s, and a relatively stable situation since 1994; but comparison of pre- and post-1987 may be misleading due to an unexplained jump after 1987 which may not be due to changes in abundance. Factors which could have contributed to this shift in abundance are under investigation.

Estimates of stratified mean number per tow and minimum trawable biomass, along with associated standard errors and 95% confidence intervals are presented in Table 9a-c. Confidence intervals were calculated using the bootstrap method (Smith 1997). The efficiency estimates evaluate the performance of the survey stratified random design, with respect to the reduction in the variance of the mean from that expected for a simple random sampling design. Reduction in variance may be due to having sets allocated to strata in proportion to strata variance or by having the strata boundaries defined such that the variance within strata is smaller than that between strata.

Overall, the stratified random design currently used was efficient for winter flounder. This suggests that the current design is fairly efficient for obtaining estimates of stratified mean number per tow or total biomass of winter flounder in the survey area.

In order to examine changes in abundance which would immediately impact the fishery, the RV data were partitioned into two size groups, which we will refer to as pre-recruits ($\leq$30cm) and recruits(>30cm), and the abundances recalculated. The results are given in Figures 21 and 22. The 95% confidence intervals are included in the graphs to give a

measure of the uncertainty in the estimates. Notable are the overall jumps in estimates which occur in 1979 and again in 1987; in both cases, the reason for these jumps are unknown, but may not be indicative of changes in abundance. Until the effects of these changes can be evaluated, comparisons prior to 1987 will not be made. The biomass of pre-recruit winter flounder shows a slight but continuing decline since 1987. The biomass of the recruited group shows little change during the past decade.

The distribution of the fishery catches of winter flounder, using that portion of the catch with species indicated, is given annually for 1994-97 in Figure 23. The catch data from Sub-area 5 is given for completeness. Although the 1997 fishery was not finished when these data were extracted, the distribution and magnitude of the fishery was similar for all years, and emphasizes the limited nature of the fishery in eastern 4X. The commercial catch distribution is quite similar to that shown by the RV and ITQ survey data. To improve that comparison, the commercial catch during only July and August (corresponding to the months in which the RV surveys were conducted) was plotted for each year (Figure 24); They were also similar to the survey distributions.

The commercial catch rates were also examined as indicators of abundance. Commercial catch rates are not routinely used in resource evaluation because they can be difficult to interpret. Fishing efficiency is constantly improving in various ways, vessels enter and leave the fishery, the different vessel sizes and gear types have different fishing power, and the nature of the data entry (main species caught) are all factors which could confound the interpretation of trends. However we examined the catch rate series for tonnage class 1-3 trawlers considered to be directing for winter flounder (based on main species caught) in 4X (Table 10). A subset of catch rates for 22 vessels which had a sustained presence in the fishery during the 1989-96 period were analyzed using a multiplicative model. The catch rates for both the general series of tonnage 1-3 trawlers and the 22 vessels selected for further analysis are depicted in Figure 25 using box-and-whisker plots. The boxes bound the most central 50% of the catch rates, the vertical lines (whiskers) represent 1.5 times the inter-quartile range (the distribution of the data excluding outliers), and the horizontal bars inside the boxes are median catch rates. Comparing the two sets of catch rates for the 1989-96 period shows that they are essentially identical, suggesting that any conclusions drawn about the catch rates of the 22 'index' vessels would likely be applicable to the rest of the tonnage class 1-3 trawler fishery as well.

A more detailed analysis (Table 11a, with the derived mean CPUE in Table 12a) of catch rates demonstrated that interpretation of annual trends could be confused by month and unit area interactions. Separate analyses for each unit area showed that month interactions might seriously confound interpretations of catch rates in 4Xq (Tables 11d and 12c) and 4Xr (Tables 11f and 12e), perhaps can be disregarded in 4Xo (Tables 11c and 12b), and may be of no concern in 4Xp (Tables 11e and 12d). Thus model predictions of CPUE trends over time could be influenced by the month of the year used. In all cases we generated predicted mean CPUE for the month of June (Table 12), since the largest catches were usually made in the mid-summer period. More detailed analyses of this data will be necessary to draw firm conclusions, but the general repetition of declining catch

rates in three of the unit areas (4Xp unclear) does suggest that winter flounder is becoming less available to the fishery. Complicating the picture may be the occurrence of two separate trends for the 1989 to 1993 and 1994 to 1996 periods. If considered separately we see two sets of declining catch rate series for both 4Xo and 4Xp. The 1994-96 trend correlates with observations by fishermen in 4X of declining abundance and substantially reduced catch rates. The fishermen also emphasized that they have increased their fishing efficiency, and since no increases in catch rates occurred, the abundance must have declined.

In summary, the survey length frequency data suggest a reduction in the numbers of large (>40cm) winter flounder, and no signs of significant new recruitment. Although there are signs of compression of the length range in the population, the overall abundance of winter flounder does not appear to have changed dramatically in the last few years. However the commercial catch rate has declined, and the fishermen in 4X have reported declines in abundance and the virtual disappearance of winter flounder from certain fishing grounds.

American Plaice

American plaice is caught in most of the RV survey strata (Table 13). The most notable exceptions are at the head of the Bay of Fundy (strata 494, 495). They are more prevalent in the deeper water strata (476, 477, 481, 484, 485, 492, 493) than elsewhere, but in all catches in all strata exhibit high fluctuations from year to year.

Survey length frequencies (1970-1997) indicate substantial reductions in the numbers of plaice greater than 40cm in length compared to the period between 1970 and the mid-1980s (Figure 26). In the past, there were routine occurrences of large pulses of 2 or 3-yr old fish (modal length of 3-yr olds: 19cm) taken in the RV surveys. During the last three years, there has been an overall decline in the proportionate representation of these smaller fish compared to earlier years. Although the numbers caught per standard tow were lower in 1997 than in previous years, the length range has been relatively stable in the last few years. The length frequency modes in the annual surveys do not track year classes well over the time series however. Thus the RV provides poor estimates of plaice abundance over time in 4X.

RV catch rates (kg/tow) for 1994-97 (Figures 27 and 28) suggest little change in the distribution and relative concentration of this resource in the last four years, although some decline in the western part of unit areas 4Xp,q was suggested. The trends in kg and numbers per tow (Figure 29) indicate substantial fluctuations, but no consistent changes since the 1970s which could be described as a sustained trend. Since the late 1980s, little change in kg/tow is indicated, although in numbers/tow a decline has been occurring since 1994.

Estimates of minimum trawlable biomass and abundance, and associated catch rates for American plaice were calculated as for winter flounder in the previous section, and are summarized in Table 14. The efficiency estimates indicate that the current strata

boundaries improved the estimates for American plaice in most years over that which would be obtained from a simple random survey, but set allocation did not. Hence, the American plaice survey abundance estimates are much less precise than they could be and this loss of precision is a function of the current survey design. Improved estimates of abundance could be achieved by changing the current set allocation scheme, but such a change could be detrimental to the precision of the estimates for other species.

The RV data was again partitioned into pre-recruit (≤30cm) and recruit (>30cm) size groups in order to obtain an estimate of abundances and potential recruits to the fishery. The results are given in Figures 30 and 31, with the 95% confidence intervals. The RV data was again partitioned into pre-recruit (≤30cm) and recruit (>30cm) size groups in order to obtain an estimate of abundances and potential recruits to the fishery. The results are given in Figures 39 and 40, with the 95% confidence intervals. Due to the unexplained change in abundance observed for winter flounder in 1987 as noted earlier, and the potential that RV estimates for other flounder species could be affected by the same factors, comparisons are restricted to the post-1987 period. No overall trend in the abundance of pre-recruit plaice is evident since 1987. The initial signs of increased recruitment in the 1993-96 survey length frequency plots have not resulted in significant increases in larger pre-recruit fish. In fact the abundance estimates suggest a decline has occurred since 1994. The abundance of the recruited group of fish has shown no changes over the last decade.

The distribution of the fishery catches of American plaice is given annually for 1994-97 (Figure 32) and during the July-August period (Figure 33) for closer comparison with the RV data. The annual distributions suggest that plaice had not declined in unit areas 4Xp,q in fishable quantities. The annual and July-August distributions differ from both the RV (Figures 27, 28) and ITQ (Figure 10) surveys in that the fishery data suggest the species is found in the Bay of Fundy to a greater extent than either the RV surveys or the ITQ surveys would suggest. The veracity of this fishery information is questionable however. Both the port technician for the area and industry representatives indicated that the flounder fishery did not catch plaice in the inner part of the Bay of Fundy; rather those plaice catches were really mis-reported winter flounder catches.

The commercial catch rates for American plaice were also examined. The catch rates from 1989-96 for tonnage class 1-3 trawlers fishing American plaice in 4X (Table 10) were used. The results are given in Figure 34, along with the 95% confidence intervals. Throughout the period, the catch rate has declined from approximately 0.12t/hr to less than 0.05t/hr. Although commercial catch rates are not routinely used in resource evaluation due to the inherent problems in interpretation, the declines observed support the contention of many 4X fishermen that catch rates have declined.

In summary, the survey length frequencies suggest a reduction in the number of large (>40cm) American plaice, but the RV abundance estimates indicate little change in the abundance of recruited plaice (>30cm). However there are indications of a decrease in the

abundance of plaice less than 30cm, and a substantial decline in the commercial catch rate is indicated.

Yellowtail Flounder

Yellowtail flounder are routinely caught in relatively few of the RV survey strata (Table 15). They are more prevalent on Browns Bank and other shallow water areas (strata 480, 481, 490) than elsewhere, but in recent years have been appearing eastward of Browns Bank in strata 474 and 477.

The length frequency modes in the survey length frequencies (1970-1997) do not track yellowtail year classes well over the time series (Figure 35), suggesting that the RV provides poor estimates of yellowtail abundance in 4X. The RV surveys have generally been unsuccessful in catching 1-yr olds (upper size limit: 12cm) and even 2 or 3-yr old fish (modal length of 3-yr olds: 19cm) are poorly represented. In 1996 and 1997 a small pulse of 1-yr olds was observed, but the 1996 pulse did not appear as 2-yr olds in 1997. The virtual absence of fish in the 10-20cm range in the 1997 survey suggests no new recruitment will be entering the population in the near future. The 1997 survey suggests that the distribution of lengths in the yellowtail concentration in 4X has been compressed in recent years, with the majority of fish in the 20-40cm range. Associated with that is a decline in the number of fish greater than 40cm in length compared to the 1970s through to the early 1990s.

RV catch rates (kg/tow) for 1994-97 (Figures 36 and 37) suggest little change in the distribution and relative concentration of this resource in the last four years, although the ITQ survey (Figure 14) suggests a wider distribution. The trends in kg and numbers per tow in the RV survey (Figure 38) indicate an increasing trend since 1990. Comparison of the total numbers at length during 1994-97 to earlier periods emphasizes the reduction in the overall length range. Thus the reason for the increases noted in the mean weight and numbers per tow in recent years are associated with increased abundance of fish in the intermediate length range relative to earlier years.

Estimates of minimum trawlable biomass and abundance, and associated catch rates for yellowtail flounder were calculated as for winter flounder, and are summarized in Table 16. The efficiency estimates indicate that both the stratification scheme and set allocation of the survey design gave improved estimates of abundance for yellowtail flounder over that which would be obtained from a simple random survey, especially since 1991. However, since yellowtail are caught consistently in only 6-8 strata and most of the stratified estimate is a result of the catches in a single stratum (480), the efficiency measures may be inadequate indicators of the suitability of the current survey design for yellowtail.

The RV data was again partitioned into pre-recruit (≤30cm) and recruit (>30cm) size groups in order to obtain an estimate of abundances and potential recruits to the fishery.

The results are given in Figures 39 and 40, with the 95% confidence intervals. Due to the unexplained change in abundance observed for winter flounder in 1987 as noted earlier, and the potential that RV estimates for other flounder species could be affected by the same factors, comparisons are restricted to the post-1987 period. The RV abundance estimates of pre-recruit (≤30cm) and recruit (>30cm) size groups (Figures 39 and 40) suggest an increase in both size groups during the last decade. However, the range shown by the 95% confidence intervals around the pre-recruit estimates, suggests only a modest increase in abundance during the last decade. The abundance of the recruited fish has however shown an increase during that same period. Although a decrease has been occurring since 1994, the average abundance during 1994-97 is higher than that observed in the late 1980s .

The distribution of the fishery catches of yellowtail flounder is given annually for 1994-97 (Figure 41) and during the July-August period (Figure 42) for closer comparison with the RV data. The annual distributions suggest that yellowtail were fished more extensively across 4X in 1995-97 than in 1994. A limited fishery existed, however, in the eastern part of 4X. The distribution of the fishery in July and August indicates concentrations of fish off southwest Nova Scotia in areas not covered by the RV survey (see Figures 36 and 37), but comparable to the ITQ survey distributions (Figure 14).

The commercial catch rates for yellowtail were also examined. The catch rates from 1991-96 for tonnage class 1-3 trawlers fishing yellowtail flounder in 4X (Table 10) were used. The results are given in Figure 43, along with the 95% confidence intervals. The catch rates are generally quite low, probably reflecting the limited availability of this resource. Between 1991 and 1996, the catch rates declined from over 0.05t/hr to about 0.03t/hr. They have however remained similar from 1993 to 1996. Although commercial catch rates are not routinely used in resource evaluation due to the inherent problems in interpretation, the declines observed support the contention of many 4X fishermen that catch rates have declined.

In summary, the survey length frequencies suggest a compression of the length range, a reduction in the number of large (>40cm) yellowtail flounder and no signs of significant new recruitment. Nevertheless, the RV abundance estimates indicate a modest increase in the abundance of both the pre-recruit (≤30cm) and recruited (>30cm) length groups. This contrasts with the indications of abundance decline from the commercial catch rate and observations from industry.

Conclusions and Prognosis

Review of the survey information suggests that the split in the management areas from 4VWX into 4X and 4VW has various degrees of appropriateness. In the case of winter flounder the discreteness of the concentrations is considerable and the current management structure is likely an improvement. However, even this level of partitioning is unlikely to reflect the full complexity of stock structure. Yellowtail abundance in 4X has been quite low, historically, in comparison with that in 4VW. The distributions are

fairly distinct between 4X and 4VW, but whether the size of the 4X concentration is sufficient to be self-sustaining is uncertain. In the case of American plaice, the discreteness of populations is not as clear. Plaice are primarily concentrated in 4VW with relatively minor concentrations in 4X, but the distribution appears to be a continuous one across 4VWX. Overall, there was no strong biological evidence for or against the current assessment units for these three species. However, distinction between 4X and 4VW areas provides for conservative assessments in the event that distinct stocks do exist on the Scotian Shelf.

RV survey results for winter flounder, American plaice and yellowtail flounder suggest that all three populations have not undergone serious declines in their abundance in the last decade. There has however been a decline in the abundance of large fish and no signs of significant recruitment for any of the three species.

Industry representatives have expressed greater concern for the depleted state of these resources than the survey data would support. They expressed the opinion that abundance of all 4X flatfish resources are depleted with catch rates in some traditional fishing areas being insufficient to warrant fishing there. Our preliminary analysis of commercial catch rates supports this view. The industry representatives suggested that a reduction in catch levels in the range of 25-50% should be considered. Some industry representatives expressed concern about particular localised aggregations of winter flounder, because they are considered to consist of numerous, fairly discrete sub-groups.

Although the current evaluation deals with winter flounder, American plaice and yellowtail flounder, the portion of the 4VWX flatfish TAC that has been assigned to the 4X area since partitioning of the TAC began in 1994 has included witch flounder. Thus any changes in the level of the 4X flatfish allocation or TAC should explicitly include, or exclude, the witch flounder resource in 4X.

Changes in the quantity of landings have not been considered in the current evaluation of status of these species because such a large component of the landings are not identified. Thus the interpretation of trends using the identified landings will be compromised by the extent to which particular species are represented in the unidentified component. Separation of flatfish catch by species continues to be a problem. Reliable estimation of the exploitation rates on these resources will not be possible until this problem is resolved. Existing measures must be enforced effectively or alternative measures such as the incorporation of the plant weighout by species into the log/purchase slip documents through the use of the Dockside Monitoring Program (DMP) must be implemented.

Acknowledgments

We thank the members of the cod, haddock and flatfish working group of the Scotian Shelf Section who reviewed preliminary analyses and made suggestions to improve the analyses. Special thanks go to P. Comeau for providing the ITQ survey data in graphics

form and to R.G. Halliday for his review and comments on the manuscript. We also thank the Industry representatives for their input on the state of the resources and the ITQ sector for permission to present their survey results.

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Table 1. History of total allowable catches (TAC) set for the Scotian Shelf management area for winter flounder, American plaice, yellowtail flounder and witch flounder.

YEAR(S)	ANNUAL TAC (t)	MANAGEMENT AREA	SPECIES
1974 - 75	32,000	4VWX	plaice, yellowtail, witch
1976 - 77	28,000	4VWX	plaice, yellowtail, witch
1978 - 93	14,000	4VWX	plaice, yellowtail, witch
1994	10,000*	4VWX	winter flounder, plaice, yellowtail, witch
	* partitioned between 4X (4,500t, allocated as 3,000t for winter flounder and 1,500t for plaice, yellowtail and witch) and 4VW (5,500t, all allocated as plaice, yellowtail and witch since winter flounder is not fished to any extent in 4VW.		
1995	7,500*	4VWX	winter flounder, plaice, yellowtail, witch
	* partitioned between 4X (3,375t) and 4VW (4,125t)		
1996	6,875*	4VWX	winter flounder, plaice, yellowtail, witch
	* partitioned between 4X (3,375t) and 4VW (3,500t)		
1997	6,000*	4VWX	winter flounder, plaice, yellowtail, witch
	* partitioned between 4X (3,000t) and 4VW (3,000t)		

Table 2. Reported Landings in metric tons of 4X Flatfish by Species. Both Canadian and foreign landings as reported by NAFO for 1961-92, Canadian landings only as reported by DFO Statistics for 1993-97. Preliminary landings data for 1997 inclusive of July.

Year	Winter Flounder	Witch Flounder	American Plaice	Yellowtail Flounder	Other Flatfish	Unspecified Flatfish	Total	Percent Unspecified
61	699	59	198	9	.	25	990	-
62	449	61	242	24	.	120	896	-
63	614	75	250	84	.	.	1023	-
64	1280	257	512	150	.	.	2199	-
65	1128	421	694	224	.	.	2467	-
66	1257	224	726	166	.	.	2373	-
67	902	383	1106	225	.	.	2616	-
68	1143	735	946	205	.	1	3030	-
69	1400	792	870	201	.	.	3263	-
70	1478	807	635	326	.	2	3248	-
71	1483	1141	545	218	.	1	3388	-
72	825	698	566	164	.	681	2934	23.21
73	774	535	339	139	.	806	2593	31.08
74	974	498	458	236	.	716	2882	24.84
75	670	331	296	213	3	834	2347	35.53
76	717	341	309	230	.	496	2093	23.70
77	1022	421	449	302	.	898	3092	29.04
78	884	188	512	387	.	1027	2998	34.26
79	847	290	828	291	.	1212	3468	34.95
80	1134	331	681	255	.	1858	4259	43.63
81	1411	462	514	227	.	1556	4170	37.31
82	1144	583	377	212	.	1763	4079	43.22
83	915	659	584	321	.	2023	4502	44.94
84	877	593	335	172	.	1995	3972	50.23
85	795	525	317	73	.	2200	3910	56.27
86	1034	631	592	111	.	3234	5602	57.73
87	1044	492	262	109	.	2380	4287	55.52
88	1460	541	366	79	.	2205	4651	47.41
89	1289	527	481	50	.	976	3323	29.37
90	1886	645	470	79	.	3012	6092	49.44
91	607	608	979	143	.	3473	5810	59.78
92	567	831	422	120	.	3985	5925	67.26
93	344	375	9	53	.	3287	4069	80.78
94	520	390	82	96	.	2189	3277	66.80
95	924	306	27	133	.	1173	2563	45.77
96	934	404	64	149	.	903	2453	36.79
97	248	281	94	14	.	220	857	25.67

TABLE 3. Quota management summary (mt) for 4X/5Y flounder.

Year	Fleet	Allocation	Reported Catch	% Taken
1994	Fixed < 65'	100	182	182%
	Mobile < 65' (ITQ)	3105	1887	61%
	Mobile < 65' (Generalist)	510	460	90%
	Mobile 65'-100'	20	5	25%
	Vessels > 100'	766	42	5%
	Total	4501	2576	57%
1995	Fixed < 65'	75	26	35%
	Mobile < 65' (ITQ)	2373	2082	88%
	Mobile < 65' (Generalist)	337	335	99%
	Mobile 65'-100'	15	14	93%
	Vessels > 100'	575	38	7%
	Total	3375	2495	74%
1996	Fixed < 65'	75	35	47%
	Mobile < 65' (ITQ)	2345	2006	86%
	Mobile < 65' (Generalist)	365	355	97%
	Mobile 65'-100'	15	2	13%
	Vessels > 100'	575	65	11%
	Total	3375	2463	73%
1997 (to Sept 10)	Fixed < 65'	67	35	52%
	Mobile < 65' (ITQ)	2170	1021	47%
	Mobile < 65' (Generalist)	239	267	112%
	Mobile 65'-100'	13	1	8%
	Vessels > 100'	511	18	4%
	Total	3000	1342	45%

Table 4. NAFO Reported Landings in metric tons for 1961-94 4X flatfish. Values in parentheses indicate the catch taken in 5Y by Canada and is included in the Canadian total.

	AMERICAN PLAICE					WINTER FLOUNDER				
Year	Canada	USA	Russia	Other	Total	Canada	USA	Russia	Other	Total
61	151	47	.	.	198	696	3	.	.	699
62	187	55	.	.	242	443	6	.	.	449
63	150	100	.	.	250	586	28	.	.	614
64	335	176	.	1	512	1265(14)	29	.	.	1294
65	289	170	235	.	694	1106(3)	4	21	.	1131
66	449(2)	107	172	.	728	937	8	312	.	1257
67	951(6)	161	.	.	1112	884	18	.	.	902
68	872(5)	67	10	2	879	1115	13	15	.	1143
69	822(7)	51	4	.	829	1388	7	5	.	1400
70	578	50	7	.	635	1470	8	.	.	1478
71	430(5)	67	53	.	550	1418	6	59	.	1483
72	476	33	57	.	566	792	13	20	.	825
73	273	6	60	.	339	633	2	139	.	774
74	305(2)	9	146	.	460	751	7	216	.	974
75	262	30	4	.	296	615	45	10	.	670
76	238	26	45	.	309	696	13	8	.	717
77	414	35	.	.	449	1009	13	.	.	1022
78	519(30)	20	3	.	549	880(1)	5	.	.	885
79	818	10	.	.	828	844	3	.	.	847
80	666	15	.	.	681	1133	1	.	.	1134
81	438(1)	77	.	.	515	1411	.	.	.	1411
82	311	66	.	.	377	1139	5	.	.	1144
83	480(7)	104	.	.	591	917(5)	3	.	.	920
84	222(2)	115	.	.	337	871(1)	7	.	.	878
85	283(1)	35	.	.	318	794	1	.	.	795
86	560	32	.	.	592	1031	3	.	.	1034
87	251	11	.	.	262	1024	20	.	.	1044
88	362	4	.	.	366	1459	1	.	.	1460
89	480	1	.	.	481	1289	.	.	.	1289
90	464	6	.	.	470	1885	1	.	.	1886
91	970	5	.	4	979	606	1	.	.	607
92	414	3	.	5	422	567	.	.	.	567
93	.	.	.	9	9	345	.	.	.	345
94	82	.	.	.	82	522	.	.	.	522

Table 4 (con't). NAFO Reported Landings in metric tons for 1961-94 4X flatfish. Values in parentheses indicate the catch taken in 5Y by Canada and is included in the Canadian total.

	YELLOWTAIL FLOUNDER					UNIDENTIFIED FLATFISH				
Year	Canada	USA	Russia	Other	Total	Canada	USA	Russia	Other	Total
61	.	9	.	.	9	25	.	.	.	25
62	4	20	.	.	24	116	4	.	.	120
63	25	30	29	.	84	.	.	.	.	.
64	57	36	57	.	150	.	.	.	.	.
65	83	20	121	.	224	.	.	.	.	.
66	59(1)	14	94	.	167	.	.	.	.	.
67	202(6)	29	.	.	231	.	.	.	.	.
68	173	23	9	.	205	.	.	.	1	1
69	180	19	2	.	201	.	.	.	.	.
70	219(7)	20	94	.	333	.	.	.	2	2
71	208	10	.	.	218	.	.	.	1	1
72	155(1)	4	6	.	165	681	.	.	.	681
73	121	1	17	.	139	804	.	.	2	806
74	216(1)	3	18	.	237	722(6)	.	.	.	722
75	174	35	.	4	213	834	.	.	.	834
76	218	12	.	.	230	496	.	.	.	496
77	289	13	.	.	302	898	.	.	.	898
78	386(2)	3	.	.	389	1031(6)	.	.	2	1033
79	289	2	.	.	291	1218(6)	.	.	.	1218
80	251	4	.	.	255	1867(9)	.	.	.	1867
81	225	2	.	.	227	1561(5)	.	.	.	1561
82	211	1	.	.	212	1854(91)	.	.	.	1854
83	323(3)	1	.	.	324	2122(101)	2	.	.	2124
84	165	7	.	.	172	2054(61)	2	.	.	2056
85	73	.	.	.	73	2262(62)	.	.	.	2262
86	111	.	.	.	111	3287(62)	9	.	.	3296
87	109	.	.	.	109	2375	5	.	.	2380
88	79	.	.	.	79	2205	.	.	.	2205
89	50	.	.	.	50	976	.	.	.	976
90	78	1	.	.	79	3012	.	.	.	3012
91	143	.	.	.	143	3473	.	.	.	3473
92	120	.	.	.	120	3985	.	.	.	3985
93	54	.	.	.	54	3298	.	.	1	3299
94	96	.	.	.	96	2197	.	.	.	2197

Table 5. Canadian Commercial Landings in metric tons as reported by DFO Statistics for 1968-97 by major gear types and tonnage classes. Preliminary landings data for 1997 inclusive of July.

	Otter Trawl, Tonnage Classes 0-1					Otter Trawl, Tonnage Class 2				
Year	American Plaice	Yellowtail Flounder	Witch Flounder	Winter Flounder	Unidentified Flatfish	American Plaice	Yellowtail Flounder	Witch Flounder	Winter Flounder	Unidentified Flatfish
68	100	15	.	690	2	4	10	20	2	288
69	151	8	.	905	6	5	11	17	5	352
70	102	6	.	994	0	3	17	29	6	390
71	93	20	0	880	0	3	29	41	136	256
72	188	5	5	716	15	3	24	15	4	403
73	128	.	.	555	3	1	20	14	4	557
74	155	2	3	699	5	3	108	31	27	503
75	96	1	4	486	46	2	84	39	53	469
76	46	46	1	595	37	19	96	43	41	289
77	103	7	.	767	17	35	119	61	81	558
78	101	23	2	677	12	90	154	33	83	689
79	360	32	19	664	142	112	170	14	51	606
80	393	44	89	926	20	29	115	62	0	1029
81	237	70	143	1271	16	59	60	127	9	1178
82	122	44	124	1037	9	94	122	93	12	1271
83	135	23	107	753	1	137	187	99	51	1332
84	49	42	90	708	4	85	83	178	74	1380
85	86	19	75	674	1	110	21	117	64	1605
86	295	21	26	744	4	120	29	124	183	2398
87	85	7	26	755	89	75	40	164	130	1466
88	64	17	31	733	14	235	28	243	580	1274
89	35	15	34	636	11	269	10	275	428	716
90	120	16	96	321	75	189	39	226	996	1599
91	128	37	43	73	413	318	54	257	386	1753
92	68	19	82	96	528	188	44	422	370	2105
93	0	2	14	53	518	.	23	155	149	1777
94	29	5	18	56	267	21	48	148	271	1245
95	9	12	8	69	195	5	67	162	537	664
96	10	18	17	99	190	30	89	266	501	474
97	4	1	9	3	71	67	7	196	157	86

Table 5 (con't). Canadian Commercial Landings in metric tons as reported by DFO Statistics for 1968-97 by major gear types and tonnage classes. Preliminary landings data for 1997 inclusive of July.

	Otter Trawl, Tonnage Class 3					Otter Trawl, Tonnage Classes 4+				
Year	American Plaice	Yellowtail Flounder	Witch Flounder	Winter Flounder	Unidentified Flatfish	American Plaice	Yellowtail Flounder	Witch Flounder	Winter Flounder	Unidentified Flatfish
68	4	5	18	0	569	420	72	145	11	120
69	12	8	20	2	431	357	88	270	8	93
70	23	19	53	.	323	168	65	90	9	66
71	4	2	35	41	302	176	80	203	5	15
72	4	16	23	5	228	226	48	105	5	3
73	1	15	21	2	230	99	17	85	1	10
74	5	3	11	9	202	78	30	49	8	7
75	32	3	15	11	307	83	10	57	8	17
76	19	7	19	8	135	115	13	58	4	5
77	79	2	30	3	306	142	48	105	21	.
78	87	17	15	1	305	84	69	48	30	0
79	96	5	27	3	439	101	6	104	6	19
80	48	24	34	.	765	86	15	93	28	2
81	18	22	16	9	363	27	1	32	3	.
82	22	13	95	1	569	19	10	49	12	1
83	67	61	57	4	765	29	3	55	6	22
84	56	13	54	0	659	6	1	4	0	9
85	56	4	75	14	653	3	1	11	2	.
86	79	23	215	42	883	2	0	6	0	.
87	57	9	137	41	785	5	3	6	.	.
88	17	14	119	63	908	2	1	6	.	.
89	155	9	102	138	243	1	0	8	4	.
90	97	17	218	395	1336	16	0	2	2	1
91	522	43	106	138	1136	2	0	13	3	22
92	156	44	176	93	1044	2	1	9	5	11
93	.	12	83	81	882	9	0	2	2	4
94	21	23	122	170	511	1	0	4	1	6
95	11	36	85	292	260	0	0	2	1	11
96	15	29	82	331	215	1	0	3	2	1
97	22	4	55	88	45	0	1	1	0	0

Table 5 (con't). Canadian Commercial Landings in metric tons as reported by DFO Statistics for 1968-97 by major gear types and tonnage classes. Preliminary landings data for 1997 inclusive of July.

	Seines					Other Gears				
Year	American Plaice	Yellowtail Flounder	Witch Flounder	Winter Flounder	Unidentified Flatfish	American Plaice	Yellowtail Flounder	Witch Flounder	Winter Flounder	Unidentified Flatfish
68	16	2	285	1	2	37	19	3	37	0
69	24	8	179	.	1	33	14	58	58	98
70	4	23	319	.	.	113	26	58	44	87
71	9	20	303	1	1	50	12	38	42	55
72	1	50	386	.	.	55	13	30	62	33
73	1	50	263	2	0	43	19	0	69	2
74	1	41	279	2	9	59	30	1	41	6
75	.	27	151	4	4	52	48	14	51	3
76	4	37	170	19	6	44	26	1	35	25
77	18	93	197	5	12	37	20	9	132	5
78	67	105	71	26	7	90	17	4	62	17
79	50	39	116	29	3	96	37	3	90	10
80	35	27	35	59	.	70	25	7	119	50
81	8	65	63	22	.	88	7	41	97	5
82	7	11	89	8	2	47	11	82	69	3
83	28	24	121	30	2	90	24	54	72	0
84	0	16	100	2	0	26	9	13	87	2
85	4	24	156	7	0	24	4	23	34	4
86	9	24	178	1	.	54	14	18	61	3
87	8	39	135	1	.	22	10	6	64	2
88	5	15	121	4	1	37	3	9	79	7
89	6	13	104	9	.	13	2	0	73	6
90	1	3	52	2	.	39	3	44	167	0
91	1	5	182	2	14	.	3	0	3	127
92	0	1	141	0	12	.	9	1	3	275
93	.	4	121	1	5	.	11	0	57	101
94	.	0	90	.	15	10	20	9	22	145
95	.	2	47	9	2	1	17	3	15	41
96	1	1	36	.	7	7	10	0	1	15
97	0	.	21	0	2	.	1	0	1	15

Table 6. The number of fishing vessel trips with the species identified on the Log Record only; identified on the corresponding Purchase Slip only; identified on the Log Record and corresponding Purchase Slip; ZIF landings (tonnes). The value below each trip represents the number of trips found in the ZIF data. (Excerpted from Annand and Beanlands 1995).

Species Code	Species Name	Log Record Only	Purchase Slip Only	Log Record and Purchase Slip	ZIF Landings
Division 4X in 1993					
140	Plaice	1,674	0	0	
		0	0	0	0
141	Yellowtail	397	40	89	
		0	0	85	35.8
142	Witch	681	138	323	
		0	130	323	362.3
143	Winter flounder	413	106	151	
		0	96	150	243.5
149	Unspecified flounder	26	3,233	587	
		0	3,151	548	3,099.2
Division 4X in 1994					
140	Plaice	1,177	33	109	
		0	33	90	61.8
141	Yellowtail	348	119	70	
		0	119	70	90.2
142	Witch	674	138	468	
		0	138	468	373.9
143	Winter flounder	428	383	214	
		0	371	214	487.1
149	Unspecified flounder	55	2,190	266	
		1	2,163	254	2,004.7

Table 7. Prorations of 1995-96 Commercial Landings unidentified flatfish based on proportions of identified winter flounder, American plaice, and yellowtail flounder in Landings and ITQ Survey catches. Witch flounder is neither prorated or used to prorate other species, and is included to provide a relative index for comparison of post-proration proportions. The 4X TOTAL field includes 5Y, unknown unit areas, non-survey areas, and sparsely represented areas (the totals will always exceed the sum of the unit areas portrayed in the table).

		COMMERCIAL LANDINGS (metric tons)					APPROXIMATE LANDINGS (metric tons) - UNIDENTIFIED FLATFISH PRORATED BY LANDINGS				PROPORTIONS LANDED - UNIDENTIFIED FLATFISH PRORATED BY LANDINGS			
Year	Area	Winter Flounder	American Plaice	Witch Flounder	Yellowtail Flounder	Unidentified Flatfish	Winter Flounder	American Plaice	Witch Flounder	Yellowtail Flounder	Winter Flounder	American Plaice	Witch Flounder	Yellowtail Flounder
1995	4X TOTAL	924	27	306	133	1173	1924	56	306	277	0.75	0.02	0.12	0.11
	4XM	12.0	0.2	50.0	3.9	8.0	18.0	0.2	50.0	5.9	0.24	0.00	0.68	0.08
	4XN	1.6	0.3	40.5	3.7	57.3	18.4	3.0	40.5	41.4	0.18	0.03	0.39	0.40
	4XO	102.4	9.3	37.9	56.6	186.1	215.6	19.7	37.9	119.1	0.55	0.05	0.10	0.30
	4XP	141.9	2.3	19.3	24.1	129.1	250.7	4.1	19.3	42.6	0.79	0.01	0.06	0.13
	4XQ	398.5	10.7	133.4	38.6	329.4	691.6	18.6	133.4	66.9	0.76	0.02	0.15	0.07
	4XR	215.2	2.2	5.2	1.1	350.3	560.2	5.8	5.2	2.9	0.98	0.01	0.01	0.01
	4XS	47.8	0.5	14.4	2.5	95.2	137.2	1.5	14.4	7.3	0.86	0.01	0.09	0.05
1996	4X TOTAL	934	64	404	149	903	1669	114	404	266	0.68	0.05	0.16	0.11
	4XM	0.6	0.9	44.5	3.8	9.0	1.6	2.6	44.5	10.2	0.03	0.04	0.76	0.17
	4XN	3.4	1.6	56.1	3.1	24.2	13.6	6.4	56.1	12.4	0.15	0.07	0.63	0.14
	4XO	138.8	8.7	67.7	60.3	121.9	220.2	13.8	67.7	95.7	0.55	0.03	0.17	0.24
	4XP	201.2	5.8	19.5	18.9	75.2	268.2	7.7	19.5	25.2	0.84	0.02	0.06	0.08
	4XQ	264.3	25.0	173.5	58.6	223.2	433.9	41.1	173.5	96.1	0.58	0.06	0.23	0.13
	4XR	246.9	15.0	17.9	1.3	314.4	541.8	32.9	17.9	2.9	0.91	0.06	0.03	0.00
	4XS	64.8	5.4	21.1	0.3	106.3	162.6	13.6	21.1	0.7	0.82	0.07	0.11	0.00

		ITQ SURVEY ADJUSTED CATCH (kg)				APPROXIMATE LANDINGS (metric tons) - TOTAL FLATFISH CATCH PRORATED BY ITQ SURVEY PROPORTIONS				PROPORTIONS LANDED - TOTAL FLATFISH CATCH PRORATED BY ITQ SURVEY CATCH			
Year	Area	Winter Flounder	American Plaice	Witch Flounder	Yellowtail Flounder	Winter Flounder	American Plaice	Witch Flounder	Yellowtail Flounder	Winter Flounder	American Plaice	Witch Flounder	Yellowtail Flounder
1995	4X TOTAL	989	154	65	45	1739	343	188	187	0.71	0.14	0.08	0.08
	4XM	NA	NA	NA	NA	-	-	-	-	-	-	-	-
	4XN	0.0	4.3	11.9	2.2	0.0	24.3	66.8	12.2	0.00	0.23	0.65	0.12
	4XO	119.9	111.2	0.0	7.4	197.2	182.9	0.0	12.2	0.50	0.47	0.00	0.03
	4XP	26.5	5.4	1.1	35.1	123.5	25.2	4.9	163.1	0.39	0.08	0.02	0.51
	4XQ	209.8	32.9	27.6	0.0	707.0	110.7	92.9	0.0	0.78	0.12	0.10	0.00
	4XR	261.8	0.0	9.9	0.0	553.1	0.0	21.0	0.0	0.96	0.00	0.04	0.00
	4XS	350.7	0.0	5.0	0.0	158.2	0.0	2.2	0.0	0.99	0.00	0.01	0.00
1996	4X TOTAL	1012	288	84	75	1674	442	161	126	0.70	0.18	0.07	0.05
	4XM	0.0	4.2	4.2	1.1	0.0	26.1	26.1	6.5	0.00	0.44	0.44	0.11
	4XN	2.2	27.7	14.8	22.6	2.9	36.4	19.5	29.7	0.03	0.41	0.22	0.34
	4XO	123.5	180.0	22.5	30.8	137.5	200.5	25.1	34.3	0.35	0.50	0.06	0.09
	4XP	60.9	19.9	3.3	11.1	205.0	67.1	11.2	37.3	0.64	0.21	0.03	0.12
	4XQ	254.3	49.4	28.1	8.3	556.7	108.2	61.4	18.2	0.75	0.15	0.08	0.02
	4XR	253.1	0.0	7.0	0.0	579.6	0.0	15.9	0.0	0.97	0.00	0.03	0.00
	4XS	290.6	5.6	2.8	0.0	192.4	3.7	1.8	0.0	0.97	0.02	0.01	0.00

Table 8. Mean numbers per tow (not stratified) of Research Vessel survey catches of 4X winter flounder by year and strata.

Stratum	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
470	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
471	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
472	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
473	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
474	0	0	0	0	0	0	0	0	0	0	0	0	0	0.50	NA	0	0
475	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
476	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0	0
477	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
478	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
480	0	0	0	0	0	2.67	0	3.25	0	0	0	0	9.50	0	9.80	0	0
481	0	0	0	0	0	0.33	0	0	0	0	1.00	0	0	0	0	0	1.00
482	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
483	0	0	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0
484	0	0	0	0	0	0	0	0	0.50	0	0	0	0	0	0	0	0
485	0	0	0	0	0	0	0	5.33	2.00	0	1.50	0.67	0	0	0	1.00	0.67
490	6.50	5.50	5.00	5.00	17.50	2.67	11.00	22.00	2.00	82.50	47.00	52.00	107.30	66.67	63.30	23.30	43.67
491	0	0.50	0	0	0	0.33	0.33	0	0	3.00	0.33	1.67	1.00	1.67	3.30	0	16.67
492	0.33	0	0	0	0	0	0.67	0	0	0.33	0	0	5.00	0.67	0	1.00	1.00
493	0	0.50	1.30	0	0.33	9.33	5.33	0.67	0.67	4.00	5.67	0	9.70	4.33	7.70	9.70	20.67
494	1.00	0	2.50	10.50	1.00	5.50	0	12.50	2.00	11.50	4.50	13.50	11.50	4.00	16.00	15.00	1.50
495	0.50	1.50	0	3.50	16.00	0	2.50	4.50	2.00	11.00	6.00	25.50	5.50	7.50	23.00	14.50	14.00

Stratum	87	88	89	90	91	92	93	94	95	96	97
470	0	0	0	0	0	0	0	0	0	0	0
471	0	0	0	0	0	0	0	0	0	0	0
472	0	0	0	0	0	0	0	0	0	0.33	0
473	0	0	0	0	0	0	0	0	0	0	0
474	0	0	0	0	0	0	0	0	0	0	0
475	0	0.50	0	0	0	0	0	0	0	0	0
476	0	0	0	0	0	0	0	0	0	0	0
477	0	0	0	0	0	0	0	0	0	0	0
478	0	0	0	0	0	0	0	0	0	0	0
480	5.25	16.75	10.50	11.00	20.50	9.62	6.50	2.50	37.10	23.00	42.00
481	0	0	0	0.00	0.11	0.11	0.11	0.11	3.40	0.44	0.11
482	0	0	0	0	0	0	0	0		0	0
483	0	0	0	0	0	0	0	0		0	0
484	0	0	0	0	0	0	0	0		0	0
485	0.17	10.14	0	4.00	8.33	25.00	10.67	0	1.00	12.67	0
490	74.75	104.00	107.80	45.00	80.75	51.50	43.50	124.25	56.00	51.25	68.25
491	0.25	12.00	17.00	6.00	0	8.67	0.33	2.00	1.00	1.00	0.33
492	0.75	0.75	1.50	0	0	6.33	0	0	0	0	3.67
493	34.67	1.33	22.30	16.00	21.00	12.00	17.00	6.00	2.00	13.50	49.00
494	36.50	4.50	30.50	47.00	6.50	91.50	67.00	19.50	27.00	51.50	9.50
495	23.00	35.00	26.50	144.00	50.00	92.50	32.50	20.50	65.50	36.00	25.50

Table 9a. Overall mean weights and numbers per tow, trawlable abundance and biomass estimates, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X winter flounder.

Year	Mean Number per Tow	Mean Weight per Tow (kg)	Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate	Biomass Estimate (metric tons)	Biomass Standard Error	Bootstrap Lower Confidence Interval	Bootstrap Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	0.31	0.23	0.16	0.04	0.64	446611	328	235	59	632	17.7	21.0	38.7
71	0.29	0.14	0.12	0.00	0.27	424230	202	180	0	405	26.4	-0.5	25.9
72	0.24	0.11	0.02	0.09	0.14	377102	170	26	134	222	5.0	88.8	93.8
73	0.54	0.26	0.12	0.07	0.46	841928	414	186	106	723	19.0	23.8	42.8
74	1.06	0.47	0.31	0.03	0.92	1641677	747	492	54	1439	16.1	6.7	22.8
75	0.60	0.39	0.11	0.17	0.58	948809	620	164	268	918	23.6	45.8	69.3
76	0.68	0.44	0.16	0.21	0.81	1043974	666	239	313	1235	28.6	30.6	59.2
77	1.75	1.34	0.54	0.44	2.61	2746804	2106	851	697	4104	23.0	15.9	38.9
78	0.32	0.23	0.11	0.06	0.50	494800	354	170	97	762	-50.7	4.0	-46.6
79	3.91	2.54	1.65	0.61	4.41	5655665	3677	2115	882	6386	5.5	24.4	29.9
80	2.06	1.28	0.52	0.46	2.34	3235043	2016	795	729	3687	27.6	36.4	64.0
81	3.35	2.16	0.71	1.30	3.61	5259965	3403	1096	2038	5676	23.2	48.1	71.3
82	4.32	2.61	1.19	0.69	5.15	6799746	4103	1865	1083	8097	31.2	24.2	55.3
83	2.69	0.95	0.60	0.21	2.19	4234289	1491	941	324	3443	38.9	8.6	47.5
84	4.01	2.22	0.71	1.26	3.84	6263766	3453	1083	1937	5987	25.9	41.6	67.5
85	1.88	0.76	0.26	0.36	1.39	2949982	1195	419	562	2180	31.6	22.4	53.9
86	3.42	1.79	0.47	0.97	2.81	5373321	2813	764	1522	4626	25.1	38.2	63.3
87	5.60	1.75	0.38	1.06	2.53	8805327	2750	588	1666	3983	16.2	52.9	69.1
88	7.08	3.56	0.84	1.72	5.04	11128774	5560	1286	2698	7928	12.6	51.4	64.0
89	6.57	2.90	0.73	1.59	4.44	10327288	4560	1130	2502	6988	18.9	51.3	70.2
90	8.98	4.41	2.31	1.31	7.33	14127118	6935	3641	2058	11532	-6.4	8.5	2.1
91	6.02	3.01	0.72	1.87	4.90	9470988	4729	1147	2944	7698	39.1	28.7	67.9
92	10.29	4.14	0.90	2.77	6.23	16179935	6512	1372	4356	9789	-4.6	52.4	47.8
93	5.44	2.04	0.64	0.87	3.32	8560332	3211	989	1369	5219	5.3	26.7	32.0
94	5.44	1.97	0.73	1.00	3.85	8558152	3093	1153	1578	6046	24.8	41.8	66.6
95	6.38	2.79	0.71	1.67	4.60	10030910	4395	1096	2619	7240	44.2	27.7	71.9
96	6.80	2.81	0.77	1.51	4.60	10118832	4178	1162	2263	6842	16.1	23.7	39.9
97	6.37	2.85	0.81	1.30	4.53	10012724	4477	1261	2062	7131	34.8	29.1	63.9

Table 9b. Mean numbers per tow, trawlable abundance, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X winter flounder pre-recruits (30cm or smaller).

Year	Mean Number per Tow		Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate		Abundance Standard Error	Lower Confidence Interval	Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	0.10		0.07	0.00	0.20	145187		98255	0	290374	27.7	-2.0	25.7
71	0.13		0.04	0.06	0.21	197860		58119	89127	306593	8.2	68.5	76.7
72	0.13		0.03	0.08	0.20	206491		46697	127912	309466	10.9	73.0	84.0
73	0.26		0.09	0.11	0.40	405941		144171	176685	634997	9.2	58.1	67.3
74	0.41		0.28	0.00	0.81	637490		443732	0	1274980	16.9	-1.7	15.2
75	0.17		0.05	0.09	0.27	260873		74375	144019	419410	19.8	54.2	74.0
76	0.14		0.05	0.06	0.24	219550		80077	59418	361559	13.7	60.2	73.9
77	0.55		0.27	0.18	0.93	857597		426449	285753	1464211	37.4	5.7	43.1
78	0.04		0.03	0.00	0.11	66548		47067	0	167097	17.2	-1.7	15.5
79	1.16		0.63	0.32	2.15	1678583		910077	456124	3117619	7.8	29.5	37.4
80	0.52		0.21	0.16	0.98	816648		329913	247465	1546229	33.4	27.2	60.6
81	0.66		0.35	0.20	1.38	1030185		547051	320187	2177478	34.7	22.1	56.8
82	1.44		0.71	0.63	3.08	2269083		1088388	673695	4842270	32.0	20.5	52.5
83	1.15		0.89	0.13	2.98	1808178		1424637	209499	4692595	41.4	3.3	44.7
84	1.40		0.69	0.33	3.08	2175359		1093371	518603	4797097	31.8	21.2	53.0
85	0.81		0.24	0.20	1.21	1280629		383080	316386	1906797	22.8	44.5	67.2
86	1.12		0.52	0.39	2.27	1765707		830168	615839	3565354	32.8	23.1	55.8
87	4.16		1.32	1.76	6.99	6539776		2101881	2763386	10992545	22.1	35.8	57.9
88	3.43		1.65	0.92	7.55	5398658		2599326	1442199	11866160	31.8	24.1	55.9
89	3.02		0.66	1.91	4.41	4741295		1014781	2996350	6940232	16.0	59.1	75.0
90	3.47		1.79	0.73	6.20	5448773		2813047	1155562	9867975	-3.8	9.0	5.2
91	2.39		0.92	0.66	4.20	3765724		1439371	1035987	6606539	15.2	35.9	51.1
92	5.34		1.56	2.63	8.22	8393897		2413136	4141473	12932326	-5.0	44.8	39.8
93	3.00		0.87	1.54	4.91	4716320		1315821	2416570	7726952	8.4	38.5	46.9
94	3.10		1.05	1.66	5.28	4868724		1675637	2604234	8306122	23.2	45.0	68.2
95	2.75		0.91	1.40	5.26	4319587		1451759	2204764	8274292	40.8	23.6	64.4
96	2.84		0.93	1.17	4.82	4222705		1476050	1742463	7171784	7.2	18.6	25.8
97	2.26		0.83	1.03	4.15	3558715		1314988	1617614	6518590	28.3	25.7	54.0

Table 9c. Mean numbers per tow, trawlable abundance, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X winter flounder recruits (30cm or larger).

Year	Mean Number per Tow		Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate		Abundance Standard Error	Lower Confidence Interval	Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	0.21		0.15	0.04	0.40	301424		209295	59418	579219	17.1	23.2	40.4
71	0.15		0.12	0.00	0.31	226369		184631	0	452739	26.6	-0.9	25.7
72	0.11		0.02	0.09	0.14	170611		26659	133691	222167	2.1	93.0	95.1
73	0.32		0.14	0.10	0.54	509706		223068	164699	854712	15.5	28.3	43.8
74	0.64		0.40	0.07	1.22	1003987		626255	108257	1913584	15.3	11.1	26.4
75	0.44		0.13	0.15	0.65	687936		192124	239576	1014625	25.1	41.4	66.5
76	0.54		0.19	0.26	1.00	824424		294752	390114	1523016	30.4	30.3	60.7
77	1.20		0.51	0.40	2.38	1885207		804874	633334	3745989	15.3	20.8	36.1
78	0.27		0.13	0.08	0.59	418252		199255	122287	895626	-63.0	7.9	-35.1
79	2.75		1.53	0.68	4.79	3977082		2227063	980925	6937802	5.5	25.9	31.4
80	1.56		0.60	0.63	2.81	2448748		956902	989776	4415382	27.3	38.6	65.9
81	2.71		0.79	1.62	4.36	4263781		1237708	2548128	6860912	20.2	54.5	74.7
82	2.89		1.36	0.82	5.85	4548208		2191094	1289370	9205861	30.0	25.6	55.6
83	1.56		1.02	0.31	3.69	2455635		1612193	486308	5804337	39.2	8.1	47.3
84	2.61		0.79	1.42	4.43	4068407		1247484	2205832	6900090	25.0	41.7	66.6
85	1.06		0.35	0.48	1.83	1669354		551741	753005	2871475	30.9	22.1	53.0
86	2.29		0.63	1.24	3.85	3607615		991417	1946422	6056641	26.5	35.6	62.1
87	1.44		0.30	0.91	2.03	2265551		476037	1432720	3194170	18.4	49.0	67.4
88	3.56		0.93	2.02	5.56	5730116		1469635	3174258	8742787	10.1	38.7	48.8
89	3.56		0.97	1.81	5.63	5590503		1535620	2852681	8848621	23.2	40.3	63.5
90	5.51		3.06	1.55	9.47	8665179		4787197	2431734	14895515	-7.5	6.3	-1.2
91	3.63		0.93	2.20	5.92	5704651		1428642	3452102	9302588	34.7	29.5	64.2
92	4.95		1.11	3.14	7.50	7786038		1791980	4945364	11786653	-8.7	51.0	42.3
93	2.44		0.91	0.85	4.37	3844012		1433138	1330891	6875707	-2.1	14.1	11.9
94	2.35		0.96	1.09	4.80	3701491		1502931	1717355	7556654	25.4	40.5	65.9
95	3.64		0.92	2.22	6.05	5722638		1459780	3497996	9507661	44.5	26.6	71.1
96	3.96		1.11	1.93	6.19	5890953		1601850	2875617	9210042	17.7	25.0	42.7
97	4.10		1.27	1.95	6.92	6454008		1962035	3064477	10876085	37.2	22.9	60.1

Table 10. Summary of catch and effort data for 4X trawlers of tonnage classes 1-3. The proportions in bold flag the catch rate time series used to assess recent trends.

	IDENTIFIED CATCH			WITH DIRECTED EFFORT DATA			PROPORTION OF CATCH ASSOCIATED WITH DIRECTED EFFORT		
YEAR	American plaice	Yellowtail flounder	Winter flounder	American plaice	Yellowtail flounder	Winter flounder	American plaice	Yellowtail flounder	Winter flounder
68	8	15	3	0	0	0	0.00	0.00	0.00
69	17	19	7	0	0	0	0.00	0.00	0.00
70	26	36	6	0	0	0	0.00	0.00	0.00
71	7	31	176	0	0	0	0.00	0.00	0.00
72	7	39	9	0	0	0	0.00	0.00	0.00
73	2	35	6	0	0	0	0.00	0.00	0.00
74	8	112	36	0	25	0	0.00	0.22	0.00
75	34	87	64	3	11	5	0.09	0.13	0.08
76	38	103	49	8	2	14	0.21	0.02	0.28
77	114	121	84	37	10	63	0.33	0.08	0.74
78	148	169	83	41	19	32	0.28	0.11	0.38
79	208	175	54	36	45	26	0.17	0.26	0.48
80	77	139	0	3	29	0	0.05	0.21	0.81
81	76	82	18	13	14	0	0.17	0.17	0.00
82	111	136	13	31	39	2	0.28	0.29	0.12
83	186	179	51	12	60	29	0.07	0.33	0.58
84	131	81	71	20	22	41	0.15	0.27	0.58
85	220	39	651	17	0	29	0.08	0.00	0.04
86	430	60	837	20	3	109	0.05	0.05	0.13
87	197	55	739	6	4	44	0.03	0.07	0.06
88	303	57	1261	11	0	81	0.04	0.00	0.06
89	442	28	1144	123	0	185	**0.28**	0.00	**0.16**
90	382	68	1671	48	2	578	**0.13**	0.02	**0.35**
91	965	125	566	764	50	392	**0.79**	**0.40**	**0.69**
92	410	106	539	248	62	396	**0.61**	**0.58**	**0.74**
93	0	36	242	NA	10	163	NA	**0.28**	**0.67**
94	59	74	487	28	32	280	**0.47**	**0.44**	**0.58**
95	25	114	888	14	50	605	**0.57**	**0.44**	**0.68**
96	53	137	919	32	53	595	**0.61**	**0.38**	**0.65**
97(to July)	93	12	247	23	1	117	0.25	0.08	0.47

Table 11. Analyses of deviance of logged commercial catch rates of 4X winter flounder from 1989 to 1996. Degrees of freedom are denoted by Df, and significance of F by P(F).

a). Analysis of deviance of full model.

Gaussian Model	Df	Deviance Explained	Residual Df	Residual Deviance	F Statistic	P(F)
NULL			688	416.379		
Year	7	66.337	681	350.042	26.581	0.00000
Month	11	54.942	670	295.100	14.010	0.00000
Area	3	5.872	667	289.228	5.491	0.00102
Year:Month	61	51.571	606	237.657	2.371	0.00000
Year:Area	18	17.137	588	220.519	2.671	0.00024
Month:Area	27	18.467	561	202.052	1.918	0.00399
Year:Month:Area	67	25.934	494	176.118	1.086	0.30940

b). Analysis of deviance of main effects only.

Gaussian Model	Df	Deviance Explained	Residual Df	Residual Deviance	F Statistic	P(F)
NULL			688	416.379		
Year	7	66.337	681	350.042	21.854	0.00000
Month	11	54.942	670	295.100	11.519	0.00000
Area	3	5.872	667	289.228	4.514	0.00382

c). Analysis of deviance of 4XO.

Gaussian Model	Df	Deviance Explained	Residual Df	Residual Deviance	F Statistic	P(F)
NULL			211	134.647		
Year	7	39.192	204	95.455	15.494	0.00000
Month	11	21.515	193	73.941	5.412	0.00000
Year:Month	40	18.652	153	55.289	1.290	0.13878

d). Analysis of deviance of 4XQ.

Gaussian Model	Df	Deviance Explained	Residual Df	Residual Deviance	F Statistic	P(F)
NULL			233	130.252		
Year	7	20.689	226	109.563	8.746	0.00000
Month	10	25.062	216	84.501	7.416	0.00000
Year:Month	42	25.697	174	58.804	1.810	0.00432

e). Analysis of deviance of 4XP.

Gaussian Model	Df	Deviance Explained	Residual Df	Residual Deviance	F Statistic	P(F)
			132	82.25069		
Year	6	15.306	126	66.945	4.490	0.00052
Month	10	4.602	116	62.342	0.810	0.61967
Year:Month	29	12.909	87	49.434	0.783	0.76845

f). Analysis of deviance of 4XR.

Gaussian Model	Df	Deviance Explained	Residual Df	Residual Deviance	F Statistic	P(F)
			109	54.005		
Year	5	23.674	104	30.332	30.081	0.00000
Month	7	7.322	97	23.010	6.646	0.00000
Year:Month	17	10.417	80	12.592	3.893	0.00002

Table 12 a). Catch per unit effort of winter flounder predicted for 4XO in June by relatively dedicated fishers (directing in at least 6 of the last 11 years).

YEAR	MEAN LN(CPUE)	S.E.	RETRANSFORMED MEAN CPUE	TOTAL CATCH	STANDARDIZED EFFORT
89	-1.7679	0.2107	0.207	1288	267
90	-1.9936	0.1341	0.168	1884	316
91	-2.3215	0.1354	0.121	605	73
92	-2.4802	0.1351	0.103	566	58
93	-2.8397	0.1492	0.072	344	25
94	-2.7089	0.1358	0.082	520	43
95	-2.4940	0.1241	0.102	924	94
96	-2.9163	0.1225	0.067	934	62

Table 12 b). Catch per unit effort of 4XO winter flounder predicted for June by relatively dedicated fishers (directing in at least 6 of the last 11 years).

YEAR	MEAN LN(CPUE)	S.E.	RETRANSFORMED MEAN CPUE	TOTAL CATCH	STANDARDIZED EFFORT
89	-1.1171	0.5415	0.343	1288	441
90	-1.3740	0.4684	0.275	1884	518
91	-1.8073	0.4686	0.178	605	108
92	-1.9891	0.4714	0.148	566	84
93	-2.6773	0.4523	0.075	344	26
94	-2.1143	0.4680	0.131	520	68
95	-2.2896	0.4656	0.110	924	102
96	-2.4662	0.4523	0.093	934	87

Table 12 c). Catch per unit effort of 4XQ winter flounder predicted for June by relatively dedicated fishers (directing in at least 6 of the last 11 years).

YEAR	MEAN LN(CPUE)	S.E.	RETRANSFORMED MEAN CPUE	TOTAL CATCH	STANDARDIZED EFFORT
89	-2.0294	0.2585	0.155	1288	199
90	-2.4005	0.1886	0.108	1884	204
91	-2.4737	0.1947	0.101	605	61
92	-2.8260	0.2091	0.071	566	40
93	-2.8240	0.2172	0.071	344	24
94	-2.9532	0.2175	0.062	520	32
95	-2.3153	0.1848	0.118	924	109
96	-2.9311	0.1968	0.064	934	59

Table 12 d). Catch per unit effort of 4XP winter flounder predicted for June by relatively dedicated fishers (directing in at least 6 of the last 11 years).

YEAR	MEAN LN(CPUE)	S.E.	RETRANSFORMED MEAN CPUE	TOTAL CATCH	STANDARDIZED EFFORT
90	-1.8043	0.3328	0.204	1884	385
91	-2.3614	0.3307	0.117	605	71
92	-2.5568	0.3062	0.097	566	55
93	-2.8351	0.3331	0.073	344	25
94	-2.1756	0.2773	0.143	520	75
95	-2.4233	0.2496	0.113	924	104
96	-2.8002	0.2254	0.078	934	73

Table 12 e). Catch per unit effort of 4XR winter flounder predicted for June by relatively dedicated fishers (directing in at least 6 of the last 11 years).

YEAR	MEAN LN(CPUE)	S.E.	RETRANSFORMED MEAN CPUE	TOTAL CATCH	STANDARDIZED EFFORT
91	-2.5909	0.1603	0.083	605	50
92	-2.5963	0.1350	0.083	566	47
93	-3.1683	0.2425	0.046	344	16
94	-3.5968	0.1612	0.031	520	16
95	-3.3049	0.1637	0.041	924	38
96	-3.2955	0.1665	0.041	934	38

Table 13. Mean numbers per tow (not stratified) of Research Vessel survey catches of 4X American plaice by year and strata.

Stratum	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
470	10.00	6.00	9.50	9.00	28.67	4.50	1.50	3.50	7.00	12.50	12.50	11.50	3.00	10.00	10.00	1.00	10.50
471	1.00	7.00	0	2.00	6.50	1.00	1.50	0	5.00	4.00	2.50	2.50	1.50	2.50	5.50	0	2.50
472	0	4.00	23.50	4.50	0.50	1.00	1.00	1.00	4.50	0.33	1.50	0	15.50	1.00	3.50	10.50	0
473	0	1.00	0	0	2.50	1.00	0	0	4.00	0.50	0.50	0.50	0.50	0	0	0	0
474	2.50	2.00	4.00	0.50	2.00	0	2.00	5.00	0	3.00	0.50	3.50	0.50	6.00	NA	6.00	0
475	5.50	0	1.50	3.50	5.50	7.50	0	1.00	4.00	3.50	14.50	0.50	5.00	0.50	0	0	0
476	181.00	11.50	23.00	5.50	63.50	9.33	5.50	8.50	15.50	9.00	18.00	10.50	37.50	33.00	8.50	5.00	18.50
477	2.50	2.50	3.00	4.50	12.50	6.50	0	1.00	11.00	12.33	7.00	0.50	4.00	1.50	13.50	3.50	0
478	0	6.00	13.70	20.50	3.00	8.67	3.30	4.00	0.50	1.00	3.33	0.33	6.70	1.00	1.00	1.67	0
480	0	0.25	0.50	4.00	0.67	0.33	0.50	0.75	1.00	1.50	0	0	1.00	0.50	0.50	0	0.00
481	0.60	7.67	1.50	14.80	14.00	10.67	6.00	2.75	1.00	9.50	7.67	0.25	8.80	7.50	29.50	0	2.75
482	0	0	0.50	0	0	0	0	0	8.50	0	0	0	0	0	1.00	0	0
483	5.00	0.50	0.50	1.50	0.50	3.00	0	0	0	1.50	0	0	0.50	0	0	0	0
484	0.50	19.50	1.30	0	19.33	3.00	2.30	1.67	1.50	0.33	0.33	2.67	8.80	6.00	6.67	0.67	3.00
485	0.50	1.00	2.00	4.70	2.00	4.67	0	3.00	4.00	1.00	8.00	15.00	2.00	5.00	10.00	26.33	29.00
490	0	0	0	0.50	0	3.00	2.00	1.67	9.30	5.50	4.33	7.00	8.00	5.00	6.00	5.33	9.00
491	2.50	0	5.30	0	3.67	1.33	0	0	3.30	2.00	1.33	4.00	1.00	0.67	0.33	0	0.67
492	14.70	10.50	13.50	5.00	0.67	6.33	1.30	2.67	4.70	4.00	21.67	5.67	1.30	3.67	9.67	4.67	3.33
493	14.00	3.00	2.30	20.00	25.00	1.33	0	7.67	11.70	2.00	3.33	15.00	29.00	3.67	1.00	18.33	43.67
494	0	0	0	0	0	0	0	0.50	0.50	0	0	0	0	0	0	0.50	0
495	1.00	0	0	2.00	0	0	0	0	0	0	0.50	0	0	0	0	0	0

Stratum	87	88	89	90	91	92	93	94	95	96	97
470	10.67	0.67	3.00	0.50	1.50	6.50	16.50	5.00	13.00	6.00	14.00
471	1.50	0	2.00	4.00	3.50	0	0	1.50	1.00	3.00	0
472	5.75	11.00	13.25	2.17	0	0.50	2.75	12.75	2.75	0.33	3.25
473	0	0	0.50	0	0	0.50	0.50	1.50	12.00	0.50	3.00
474	1.00	0	1.00	0	5.00	1.50	10.50	6.50	0.50	11.00	0
475	0	6.00	2.00	0	0.50	2.00	0	2.00	4.00	4.00	3.00
476	39.25	51.50	82.75	8.25	74.25	91.50	37.50	115.50	57.25	62.00	25.25
477	3.40	3.50	9.25	6.40	3.00	0.60	1.60	6.60	5.00	6.20	1.00
478	0	0.50	7.50	3.00	3.50	0	0	0	2.00	1.00	2.00
480	0.25	0	0	0.38	0.12	0.88	0.12	1.00	2.62	1.38	1.25
481	11.67	35.14	0.17	5.38	15.22	11.33	5.33	16.44	11.29	15.00	14.78
482	1.67	0	0.33	0	0	0	0.33	6.67	0.33	1.00	0.33
483	0	0	0	0.50	1.00	0	0	0	1.50	1.50	1.00
484	2.75	0.25	0.75	0.33	0.33	2.33	0	4.33	10.67	4.33	10.67
485	5.67	8.71	2.50	4.50	0	5.00	0.67	0.67	3.67	13.33	0.67
490	3.25	0.75	3.50	0.75	0.25	0	3.25	5.50	3.20	0.50	0
491	0.25	1.00	0	1.00	0	0.67	0.33	0	0	0.67	0
492	4.00	2.00	1.50	2.00	3.67	1.33	1.33	5.33	15.00	0.67	0
493	19.33	0	3.67	1.67	0.67	8.67	6.67	13.33	0.67	6.50	12.00
494	0	0	0	0	0.50	0	0	0	0	0	0
495	0	0	0	0.50	0	0	0	0	0.50	0	0

Table 14a. Overall mean weights and numbers per tow, trawlable abundance and biomass estimates, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X American plaice.

Year	Mean Number per Tow	Mean Weight per Tow (kg)	Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate	Biomass Estimate (metric tons)	Biomass Standard Error	Lower Confidence Interval	Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	13.07	3.86	2.77	0.36	7.86	18936288	5597	4056	520	11389	-76.8	3.6	-73.2
71	6.44	1.97	0.87	0.63	3.63	9559335	2916	1307	941	5091	-137.4	2.3	-135.2
72	5.66	1.66	0.64	0.73	2.61	8899290	2615	1006	1145	4108	-67.1	9.4	-57.7
73	5.28	2.18	0.80	1.11	4.39	8296398	3425	1251	1743	6906	-16.2	-1.4	-17.5
74	13.47	3.76	0.91	2.02	5.53	21181562	5916	1405	3179	8696	-46.8	43.5	-3.3
75	4.51	1.45	0.28	0.92	2.02	7093088	2273	442	1441	3183	-17.2	14.0	-3.2
76	1.80	0.56	0.13	0.30	0.78	2746252	857	197	458	1195	-22.9	34.8	11.9
77	2.27	0.85	0.27	0.38	1.40	3569316	1329	408	594	2196	43.7	-7.6	36.1
78	5.20	1.31	0.33	0.71	1.88	7923743	1996	506	1079	2865	-14.5	3.9	-10.7
79	3.70	1.28	0.47	0.57	2.48	5357357	1856	671	829	3585	-33.0	7.0	-26.0
80	6.13	2.79	0.87	1.52	4.77	9638304	4394	1337	2385	7508	-55.1	13.6	-41.4
81	4.46	1.42	0.48	0.68	2.55	7009138	2230	736	1062	4008	-32.1	6.5	-25.6
82	8.15	2.37	0.68	1.19	3.90	12820988	3734	1087	1865	6130	-55.3	9.5	-45.9
83	6.01	1.87	0.38	1.27	2.73	9442643	2935	590	2001	4297	-45.6	35.5	-10.1
84	8.57	2.62	0.80	1.35	4.52	13361800	4082	1202	2105	7065	-76.1	4.1	-72.0
85	4.62	1.08	0.40	0.60	1.91	7270051	1695	635	630	2999	-28.0	20.1	-7.9
86	7.63	1.35	0.56	0.55	2.60	11998026	2118	841	862	4084	-11.1	6.0	-5.2
87	7.67	1.69	0.37	1.03	2.48	12058680	2659	575	1618	3892	-3.3	21.9	18.6
88	11.31	1.89	0.63	1.03	3.56	17783286	2973	982	1621	5599	-9.4	16.5	7.1
89	8.46	1.39	0.33	0.75	2.01	13296296	2186	520	1181	3166	-13.3	58.5	45.2
90	2.87	0.76	0.18	0.38	1.09	4505607	1192	296	592	1710	-47.5	13.8	-33.7
91	8.23	1.25	0.46	0.44	2.18	12933698	1971	743	685	3433	-17.4	26.6	9.2
92	9.32	2.17	0.77	1.01	4.05	14647861	3410	1202	1588	6361	-27.2	35.4	8.3
93	5.26	0.86	0.31	0.42	1.60	8268784	1359	484	661	2511	-0.2	14.8	14.6
94	14.45	2.01	0.46	1.25	2.95	22715540	3153	713	1968	4632	-16.4	47.4	31.0
95	10.08	1.70	0.35	1.01	2.35	15853903	2670	537	1592	3689	-56.6	26.5	-30.1
96	9.92	1.44	0.31	0.85	2.04	14751199	2137	461	1262	3028	-25.9	40.4	14.5
97	6.53	1.61	0.62	0.72	3.07	10268003	2528	982	1128	4822	-110.5	5.9	-104.6

Table 14b. Mean numbers per tow, trawlable abundance, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X American plaice pre-recruits (30cm or smaller).

Year	Mean Number per Tow		Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate		Abundance Standard Error	Lower Confidence Interval	Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	8.57		7.39	0.88	16.25	12426788		10723534	1281579	23545443	-82.4	8.5	-73.9
71	3.37		1.28	1.14	5.84	5007811		1868692	1686026	8669391	-111.4	-22.8	-134.2
72	2.93		1.19	1.15	4.73	4603106		1857974	1805940	7443077	-66.1	8.6	-57.4
73	2.58		0.82	1.42	4.69	4058026		1289631	2233516	7380315	-19.0	10.2	-8.8
74	9.21		2.45	4.84	13.21	14486212		3912662	7612161	20769270	-35.2	45.6	10.4
75	2.60		0.66	1.19	3.72	4081516		1054778	1878996	5846324	-45.2	22.9	-22.3
76	0.83		0.23	0.44	1.32	1266810		365911	677417	2012325	-18.5	-3.0	-21.5
77	1.06		0.33	0.55	1.80	1664158		500083	860038	2823462	-57.1	-16.0	-73.1
78	3.20		0.67	2.01	4.49	4866248		998296	3057136	6845637	-0.7	20.1	19.4
79	2.25		0.56	1.30	3.53	3257798		804725	1874531	5107898	-18.1	34.4	16.2
80	2.93		1.19	0.95	4.95	4612480		1881132	1488081	7776139	-80.1	0.8	-79.3
81	1.85		0.44	1.05	2.60	2909390		701875	1655901	4088328	-20.3	38.6	18.3
82	5.38		1.47	3.09	7.77	8457164		2309741	4855640	12224048	-41.3	36.7	-4.6
83	3.39		0.69	2.67	4.55	5325622		761953	4191652	7153705	-6.4	80.6	74.2
84	4.85		1.58	2.10	8.36	7565672		2454193	3270065	13036663	-34.2	9.2	-25.0
85	2.70		0.79	1.13	4.08	4239008		1231190	1777117	6422547	-2.3	12.1	9.7
86	5.39		1.86	2.39	9.48	8469698		2950103	3760702	14909268	-10.7	10.1	-0.6
87	5.33		1.11	3.10	7.52	8386363		1741896	4876104	11829337	-12.4	39.9	27.5
88	8.47		3.30	3.58	16.70	13316557		5170181	5627133	26267501	-20.1	18.4	-1.7
89	6.66		1.46	3.23	9.08	10480356		2288997	5083309	14276927	-10.8	67.0	56.3
90	1.87		0.57	0.88	3.07	2938799		884778	1378454	4831314	-56.2	2.7	-53.5
91	6.67		3.18	1.77	14.80	10495641		5023811	2787254	23272721	-25.4	23.0	-2.4
92	6.77		2.59	1.89	11.62	10652566		4131908	2971616	18267493	-23.2	38.1	14.9
93	4.02		1.01	2.09	5.99	6323026		1589836	3292274	9420312	-15.4	52.9	37.6
94	12.13		3.37	6.83	20.69	19079854		5256019	10733725	32527928	-16.7	50.2	33.5
95	7.86		1.89	4.05	11.24	12355812		2894672	6374511	17671304	-27.0	45.5	18.6
96	7.99		2.18	3.57	12.03	11888502		3236176	5310073	17900082	-21.2	40.4	19.2
97	4.14		1.07	2.13	6.36	6509800		1658651	3353140	9994068	-1.1	17.6	16.3

Table 14c. Mean numbers per tow, trawlable abundance, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X American plaice recruits (30cm or larger).

Year	Mean Number per Tow		Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate		Abundance Standard Error	Lower Confidence Interval	Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	4.59		3.45	0.52	8.95	6652787		4976345	755689	12971543	-85.7	0.7	-85.0
71	3.10		1.66	0.85	5.38	4600286		2446372	1255572	7985964	-151.4	5.6	-145.8
72	2.75		1.14	1.20	4.39	4318552		1813640	1888560	6897082	-78.2	16.5	-61.7
73	2.70		0.80	1.55	4.72	4238371		1269201	2442521	7415317	-4.5	0.6	-3.9
74	4.26		1.38	2.26	7.16	6695349		2114790	3551148	11264565	-73.7	20.0	-53.7
75	1.92		0.43	1.14	2.81	3011571		700389	1791818	4619316	-3.2	-0.9	-4.2
76	0.97		0.25	0.53	1.51	1479442		387602	816982	2311322	-34.1	36.5	2.4
77	1.21		0.47	0.38	2.02	1905157		757741	605118	3182949	-2.3	-5.9	-8.2
78	2.01		0.36	1.36	2.70	3057495		517696	2071395	4108801	3.6	16.8	20.4
79	1.45		0.42	0.65	2.28	2099560		591194	942570	3297331	-29.1	11.7	-17.4
80	3.27		0.81	1.94	5.09	5147725		1292310	3045679	7995952	-33.5	36.0	2.5
81	2.62		0.93	1.16	4.69	4119554		1435648	1822319	7374306	-38.9	5.0	-33.9
82	2.78		0.95	1.08	4.48	4363826		1493596	1691337	7040719	-80.2	-1.3	-81.5
83	2.62		0.69	1.79	3.71	4117020		782347	2809917	5826205	-34.6	28.4	-6.2
84	3.72		1.07	2.01	6.18	5796127		1669945	3128486	9638736	-60.4	4.5	-55.9
85	1.93		0.97	0.56	4.03	3031042		1489991	852540	6333079	-44.2	10.9	-33.3
86	2.24		0.85	0.93	4.21	3528327		1349272	1468523	6618838	-20.8	7.9	-12.9
87	2.41		0.65	1.33	3.79	3797172		1018776	2089189	5955678	-4.3	16.7	12.3
88	2.84		0.92	1.46	5.53	4466728		1421067	2294569	8696275	-5.3	17.0	11.6
89	1.80		0.44	1.06	2.76	2831929		706798	1663231	4337443	-13.2	56.3	43.1
90	1.00		0.27	0.50	1.53	1566808		417167	790528	2403071	-27.7	21.0	-6.7
91	1.55		0.63	0.53	2.98	2438047		1035151	835641	4679862	-20.4	17.5	-2.9
92	2.54		0.84	1.26	4.50	3995297		1369811	1974460	7075792	-25.9	30.5	4.7
93	1.24		0.50	0.52	2.63	1945758		784834	823128	4128611	-11.2	10.2	-1.0
94	2.32		0.52	1.45	3.43	3641948		787738	2286708	5400994	-13.3	38.6	25.3
95	2.22		0.48	1.35	3.18	3498091		771688	2125642	4992935	-63.9	15.8	-48.0
96	1.92		0.44	1.24	3.05	2862698		657937	1849440	4543643	-39.8	33.9	-5.9
97	2.39		1.07	0.86	4.80	3750204		1652634	1344606	7543050	-117.7	6.3	-113.4

Table 15. Mean numbers per tow (not stratified) of Research Vessel survey catches of 4X yellowtail flounder by year and strata.

Stratum	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
470	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
471	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
472	0	0	0	0	0	0	0	0	0	0	2.00	0	0	0	0	0	0
473	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
474	0	0	0.50	2.50	0	0	4.00	1.50	0	0	0	0	0	4.00	NA	0.50	2.00
475	0	0	0	0	0	0.50	0	0.50	0	1.00	0	0	1.00	0	0	0	0
476	0	0	0	0	0	0	0	0	0	0	0.50	0.50	0	0	0	0.50	0
477	0	0	6.50	0	2.50	0	0	2.00	0.50	0	0	0	0	0	0	0.50	1.50
478	0	0	0.33	0	0	1.00	0	2.00	0	0	0	0	0	0	0	0	0.33
480	5.80	9.50	11.00	3.00	2.70	9.33	4.50	17.75	2.30	27.80	7.30	39.30	24.75	0.75	18.00	1.00	0.25
481	1.80	2.70	9.25	0.75	1.00	0.33	13.00	0	1.00	2.20	11.30	1.00	5.50	0.25	1.25	0	7.75
482	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
483	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
484	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
485	0	0	0	0	0	0	0	0	1.30	0	0	0	0	0	0	2.00	0.67
490	0	0	0	0	1.00	0	0	0.33	4.30	13.50	2.70	1.30	3.67	2.00	4.33	0	7.67
491	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0
492	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
493	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0.33	0	0
494	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.50
495	0.50	0	0	0	0	0	0.50	0	0	0	0	0	1.00	0	0	0	0

Stratum	87	88	89	90	91	92	93	94	95	96	97
470	0	0	0	0	0	0	0	0	0	0	0
471	0	0	0	0	0	0	0	0	0	0	0
472	0	0	0.25	0	0	0.25	0.75	0.75	0	3.67	0
473	0	0	0	0	0	0	0	0	0.50	0.50	0
474	1.50	0.50	0	0	0.50	0	0.50	7.00	0	15.00	0
475	0	2.00	0	0	0	0	0	0.50	0	0	1.00
476	0	0	0	0	0	0	0	0	0	0.75	0.25
477	0.60	0	0.25	0.60	1.60	1.60	1.80	5.20	5.60	4.80	0.20
478	0	0	0	0	0	0	0	0	0	0	0
480	9.50	9.20	19.50	2.20	30.20	10.38	15.75	35.12	35.50	36.50	54.75
481	0.50	9.30	4.33	3.00	7.00	12.33	7.67	28.44	2.10	3.56	6.56
482	0	0	0	0	0	0	0	0	0	0	0
483	0	0	0	0	0	0	0	0	0	0	0
484	0	0	0	0	0	0	0	0	0	0	0
485	0.33	14.00	0	0.50	1.00	0	2.33	0	0	0.33	0
490	5.50	2.00	6.00	2.20	3.50	0	3.00	3.25	4.20	0.25	8.25
491	0	0	0	0	0	0	0	0	0	0	0
492	0	0	0	0	0	0	0	0	0	0	0
493	0	0	0	0	0	0	0.67	0	0	0	0
494	0	0	0	0	0	2.50	0	0	0	0	0
495	0.50	0	0	3.50	0	0	0	0	0	0	0

Table 16a. Overall mean weights and numbers per tow, trawlable abundance and biomass estimates, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X yellowtail flounder.

Year	Mean Number per Tow	Mean Weight per Tow (kg)	Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate	Biomass Estimate (metric tons)	Biomass Standard Error	Lower Confidence Interval	Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	0.40	0.16	0.10	0.00	0.42	586242	228	155	0	604	12.7	6.3	19.0
71	0.56	0.16	0.11	0.02	0.44	829462	240	157	32	648	49.4	14.1	63.5
72	1.64	0.31	0.15	0.10	0.68	2578530	493	241	162	1068	-12.5	19.2	6.7
73	0.21	0.06	0.03	0.02	0.15	337471	94	54	26	231	-3.8	15.5	11.7
74	0.35	0.14	0.07	0.03	0.27	548861	219	106	46	422	-32.0	-0.3	-32.3
75	0.43	0.19	0.06	0.07	0.26	672025	298	93	108	416	10.3	73.9	84.1
76	1.54	0.45	0.39	0.01	1.52	2346989	686	586	13	2317	-30.0	-0.4	-30.4
77	1.02	0.45	0.09	0.27	0.61	1603868	700	138	419	953	6.9	82.3	89.3
78	0.44	0.18	0.09	0.03	0.38	676292	278	131	53	579	28.4	4.7	33.2
79	1.77	0.54	0.13	0.31	0.80	2566812	786	190	453	1155	12.8	59.1	71.9
80	1.74	0.99	0.64	0.14	2.27	2729217	1555	1002	217	3572	-55.7	10.2	-45.4
81	1.48	0.85	0.52	0.14	1.93	2334892	1330	788	217	3031	29.2	25.5	54.7
82	1.61	0.42	0.16	0.21	0.77	2531393	667	238	326	1215	26.8	35.9	62.7
83	0.15	0.07	0.03	0.02	0.15	238551	108	50	39	230	4.0	25.4	29.3
84	0.93	0.19	0.08	0.06	0.36	1467882	296	117	95	557	30.9	40.2	71.1
85	0.27	0.16	0.10	0.00	0.39	421821	251	149	0	618	-62.7	-5.9	-68.6
86	1.32	0.38	0.18	0.10	0.80	2073088	602	272	150	1261	-19.0	14.7	-4.3
87	0.67	0.17	0.08	0.05	0.40	1060402	262	127	84	627	35.8	6.5	42.3
88	2.77	0.89	0.52	0.13	2.30	4361463	1400	824	207	3610	5.3	0.0	5.3
89	1.28	0.29	0.16	0.07	0.77	2014429	460	243	112	1216	22.3	4.5	26.7
90	0.66	0.20	0.09	0.04	0.34	1031536	307	138	67	538	-23.0	-1.3	-24.3
91	2.07	0.51	0.21	0.25	1.21	3257966	807	342	389	1900	63.2	5.8	69.0
92	1.76	0.48	0.18	0.19	0.93	2775386	752	277	294	1467	19.4	20.4	39.8
93	1.85	0.46	0.14	0.23	0.79	2907650	726	230	360	1235	26.3	17.3	43.6
94	4.66	0.94	0.29	0.43	1.59	7332909	1477	454	672	2501	33.6	26.3	59.8
95	2.02	0.49	0.11	0.29	0.71	3177863	762	179	451	1117	29.2	51.7	80.9
96	2.56	0.73	0.22	0.39	1.28	3808155	1080	325	573	1898	46.7	25.9	72.6
97	2.91	0.54	0.13	0.33	0.88	4572274	856	208	524	1378	33.5	47.4	80.9

Table 16b. Mean numbers per tow, trawlable abundance, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X yellowtail flounder pre-recruits (30cm or smaller).

Year	Mean Number per Tow		Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate		Abundance Standard Error	Lower Confidence Interval	Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	0.25		0.11	0.07	0.52	355772		156909	99536	780481	31.3	19.2	50.5
71	0.39		0.22	0.09	0.89	575523		317355	129514	1323637	-7.8	27.8	20.0
72	1.27		0.76	0.19	3.18	1990559		1194682	300527	4995469	-18.4	2.8	-15.6
73	0.11		0.03	0.06	0.18	171127		51326	93088	280545	11.5	62.5	74.0
74	0.04		0.03	0.00	0.13	70733		50022	0	200614	17.8	-1.6	16.2
75	0.10		0.06	0.00	0.21	151556		89994	0	325145	29.5	29.0	58.5
76	0.60		0.55	0.00	1.56	920411		850677	0	2303449	-34.1	-0.4	-34.4
77	0.19		0.09	0.02	0.35	301497		138290	32379	554945	31.0	42.8	73.8
78	0.12		0.05	0.03	0.24	187960		80673	40891	360078	28.4	7.6	36.0
79	0.79		0.37	0.12	1.49	1147618		532325	167116	2150023	32.4	31.5	63.9
80	0.21		0.16	0.00	0.56	324326		249534	0	880367	-70.0	-2.4	-72.4
81	0.12		0.12	0.00	0.36	187454		187449	0	562363	40.0	0.0	40.0
82	0.89		0.36	0.28	1.65	1392764		526671	436783	2592781	16.8	34.8	51.6
83	0.04		0.03	0.01	0.11	69843		50118	12566	176636	38.6	13.7	52.3
84	0.58		0.20	0.17	0.95	897259		300771	272605	1486514	22.3	54.6	76.9
85	0.01		0.01	0.00	0.02	12781		12781	0	36093	53.2	0.0	53.2
86	0.49		0.20	0.16	0.96	771960		302128	253640	1473813	22.7	16.4	39.1
87	0.32		0.21	0.05	0.76	503425		331298	81187	1196211	36.9	3.0	39.9
88	0.92		0.61	0.19	2.53	1440235		956459	291399	3976555	13.7	0.5	14.2
89	0.83		0.58	0.06	2.43	1309787		891177	91560	3821012	31.3	-0.2	31.1
90	0.37		0.15	0.13	0.78	582201		261005	201267	1229090	12.6	13.3	25.9
91	1.19		0.64	0.34	3.21	1867089		1004061	539044	5051432	64.5	2.1	66.6
92	0.92		0.48	0.30	2.55	1448074		766493	473261	4015481	19.9	11.0	30.9
93	0.91		0.42	0.41	2.42	1437125		652245	638384	3810535	24.8	10.4	35.2
94	3.03		0.97	1.51	5.40	4770208		1563334	2381383	8483568	21.7	24.8	46.4
95	0.83		0.29	0.40	1.60	1309589		434968	636424	2510728	48.2	29.0	77.2
96	1.10		0.35	0.55	1.94	1640228		515266	817801	2889397	46.7	19.1	65.8
97	2.06		0.72	1.11	4.33	3238588		1136761	1747169	6809866	47.8	30.0	77.8

Table 16c. Mean numbers per tow, trawlable abundance, and associated bootstrapped standard errors, 95% confidence intervals and survey design efficiency estimates for 1970-97 4X yellowtail flounder recruits (30cm or larger).

Year	Mean Number per Tow		Standard Error	Lower Confidence Interval	Upper Confidence Interval	Abundance Estimate		Abundance Standard Error	Lower Confidence Interval	Upper Confidence Interval	Set Allocation per Strata Efficiency	Stratification versus Random Efficiency	Overall Efficiency
70	0.13		0.08	0.02	0.39	193336		123090	35976	563403	20.1	8.7	28.8
71	0.17		0.11	0.00	0.43	253939		172047	0	642647	50.9	12.2	63.1
72	0.37		0.20	0.12	0.89	587970		317893	186156	1405965	-19.5	8.8	-10.7
73	0.11		0.07	0.01	0.29	166344		104319	22738	449662	-8.9	8.4	-0.4
74	0.30		0.17	0.03	0.60	478128		255879	51492	941580	-26.2	-3.5	-29.7
75	0.38		0.08	0.21	0.52	596918		128517	323785	813614	4.6	85.6	90.2
76	0.93		0.77	0.03	2.35	1426578		1170717	40546	3587673	-30.7	-0.7	-31.4
77	0.83		0.26	0.39	1.26	1302352		412978	613915	1975531	1.5	63.1	64.5
78	0.32		0.14	0.09	0.63	488332		215786	143521	957358	31.2	0.3	31.5
79	1.00		0.36	0.41	1.58	1445620		527262	595443	2284340	11.6	35.6	47.2
80	1.54		0.93	0.29	3.53	2422878		1304967	463077	5556256	-54.2	10.3	-44.0
81	1.37		0.76	0.22	2.91	2147438		1186366	340019	4583324	27.1	30.9	58.0
82	0.74		0.26	0.35	1.39	1165695		419617	549076	2180572	26.6	37.7	64.3
83	0.11		0.04	0.04	0.22	168709		71487	56744	339793	23.2	24.8	48.1
84	0.36		0.15	0.11	0.70	564908		231483	169133	1085769	33.6	32.5	66.1
85	0.26		0.17	0.02	0.64	409040		260661	34083	1005379	-54.0	-2.6	-56.6
86	0.80		0.37	0.14	1.67	1259969		606129	224237	2619207	-17.5	18.2	0.7
87	0.35		0.15	0.15	0.82	556978		232719	230627	1282723	34.5	8.4	42.9
88	1.86		1.06	0.25	4.23	2921228		1756112	389075	6659289	4.7	-0.4	4.3
89	0.45		0.21	0.13	1.04	704642		322820	206083	1633179	16.5	9.0	25.5
90	0.29		0.13	0.08	0.50	449336		190321	132803	789295	-10.3	3.6	-6.6
91	0.88		0.35	0.44	2.06	1390875		553812	694332	3242546	61.9	7.0	68.9
92	0.84		0.33	0.38	1.71	1327310		522189	596548	2695594	19.3	18.7	38.0
93	0.94		0.30	0.43	1.58	1470525		479392	676805	2485692	32.6	15.3	47.9
94	1.63		0.69	0.80	2.88	2562701		766010	1260337	4521732	39.1	26.5	65.6
95	1.19		0.29	0.66	1.82	1868274		457354	1043285	2868938	31.7	46.5	78.3
96	1.66		0.69	0.71	2.68	2170748		714605	1057922	3979221	51.1	22.1	73.2
97	0.85		0.29	0.47	1.66	1333687		465330	742379	2585573	28.6	33.3	62.0

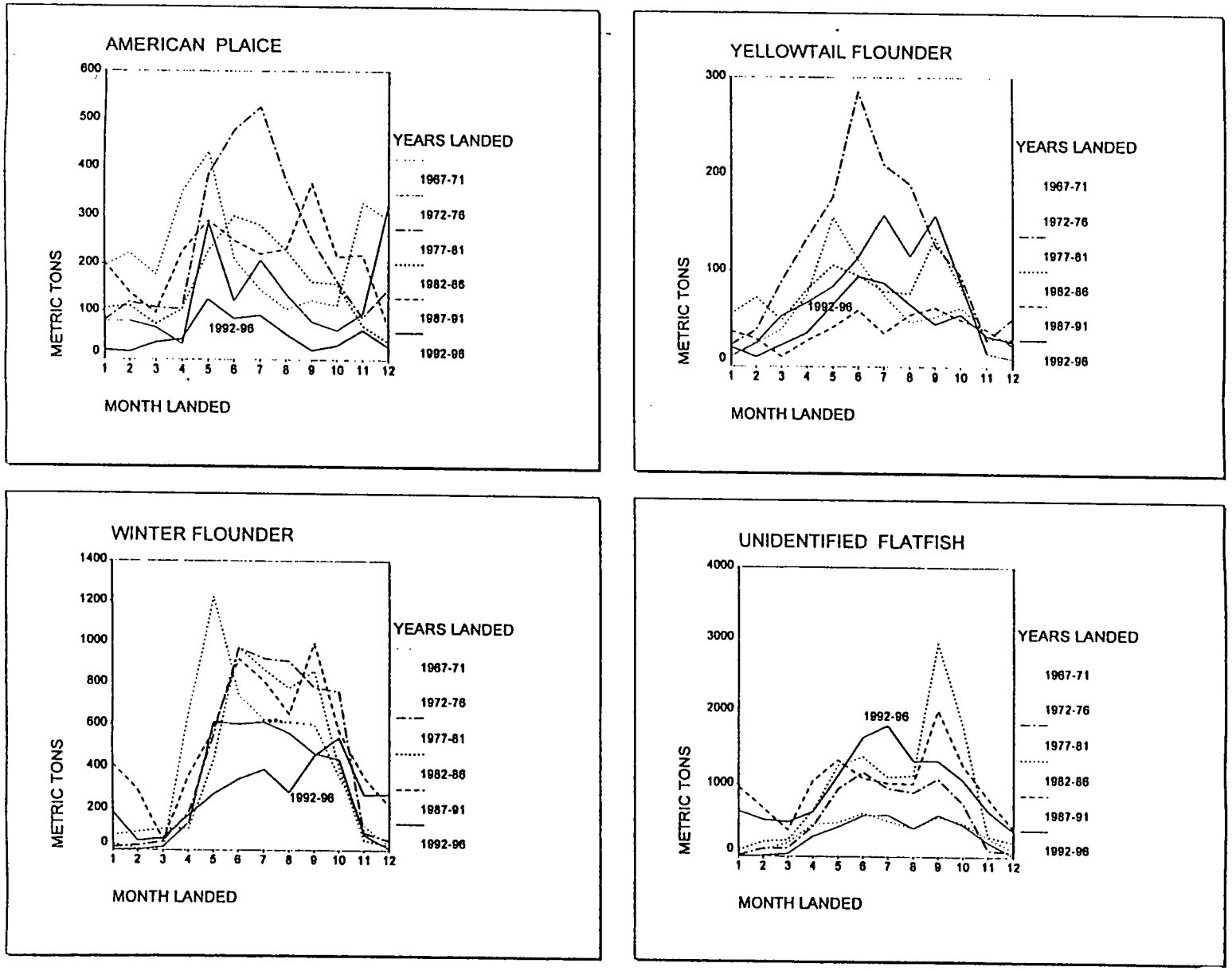


Figure 1. Distribution of monthly 4X landings of identified American plaice, yellowtail flounder, winter flounder and 'unidentified flatfish' by 5-year time periods. The 1992-96 seasonal pattern is labelled on each chart.

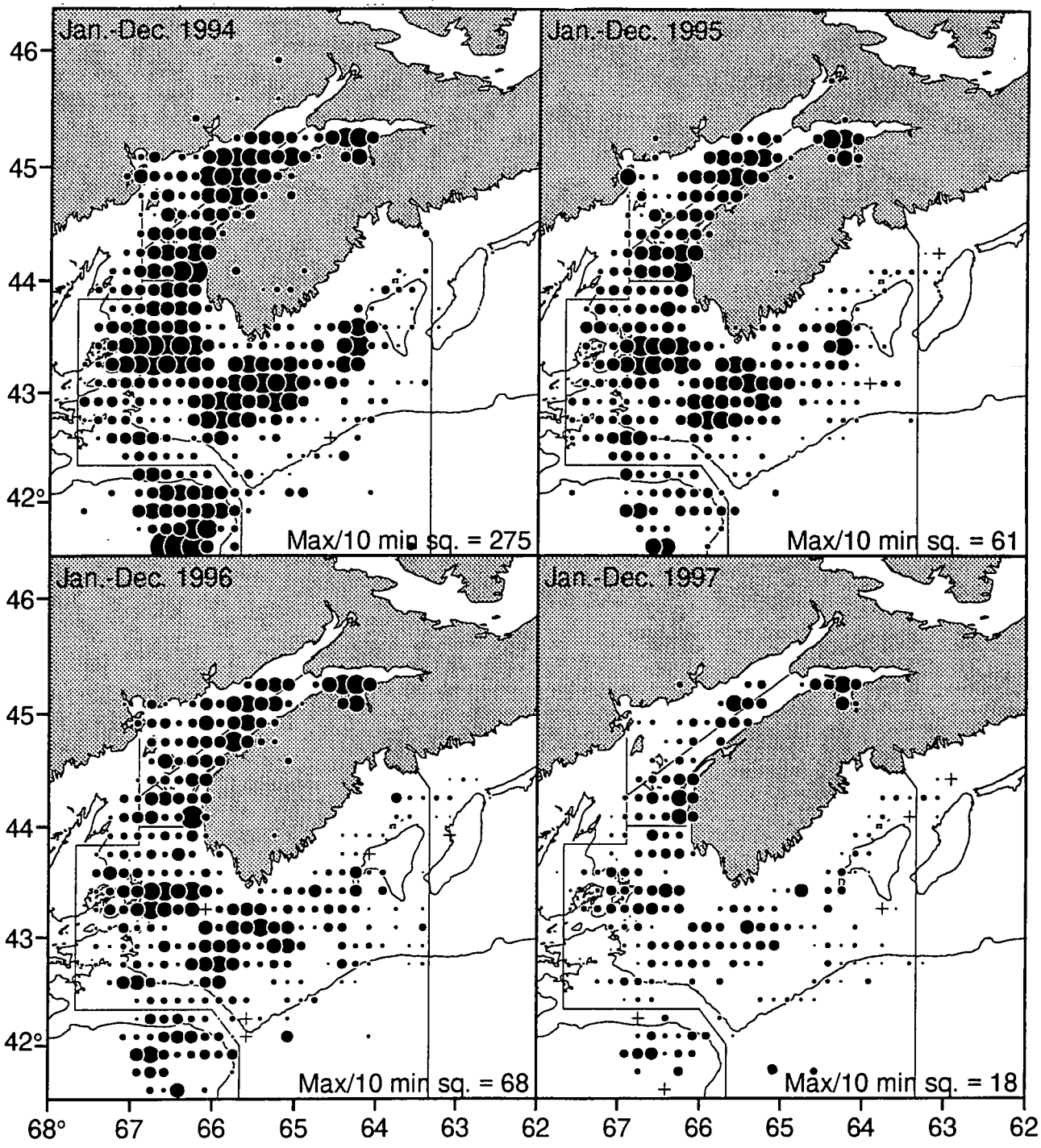
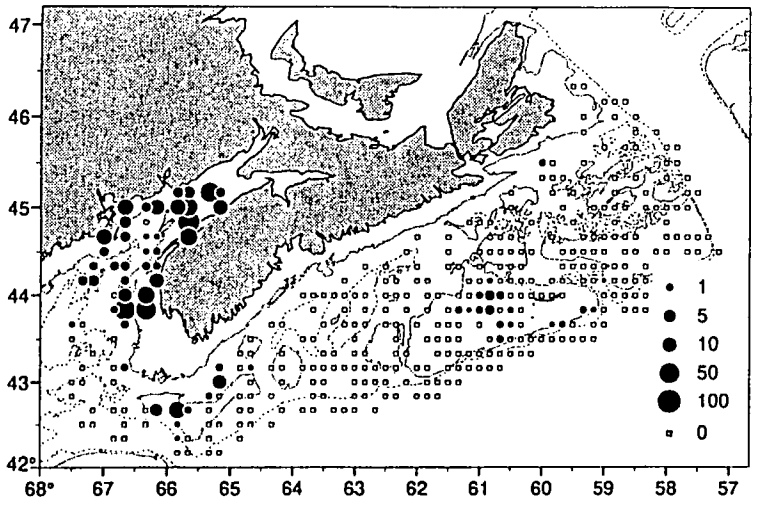
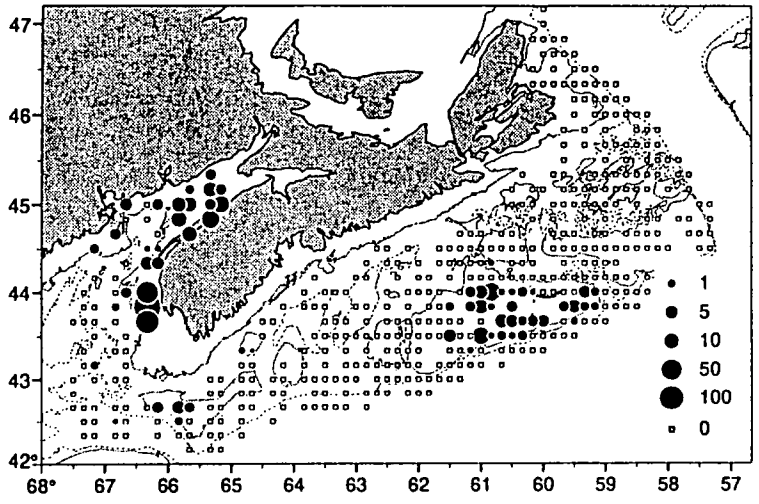


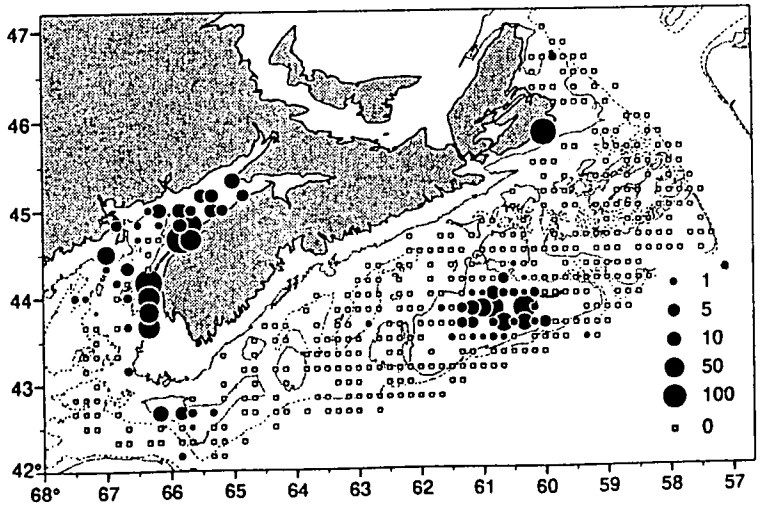
Figure 2. Distribution of 'unspecified flounder' catch (mt) in Div. 4X from 1994 to 1997 aggregated into 10 minute longitude/latitude squares. Catch information from Sub-area 5 are provided for comparative value. The 1977 data are incomplete since only 6-months of the fishery had been completed. The maximum catch in any given square for each year is given at the bottom of each panel.



Spring Groundfish Survey WinterFlounder Ave Totno / 10 min 1979-1984

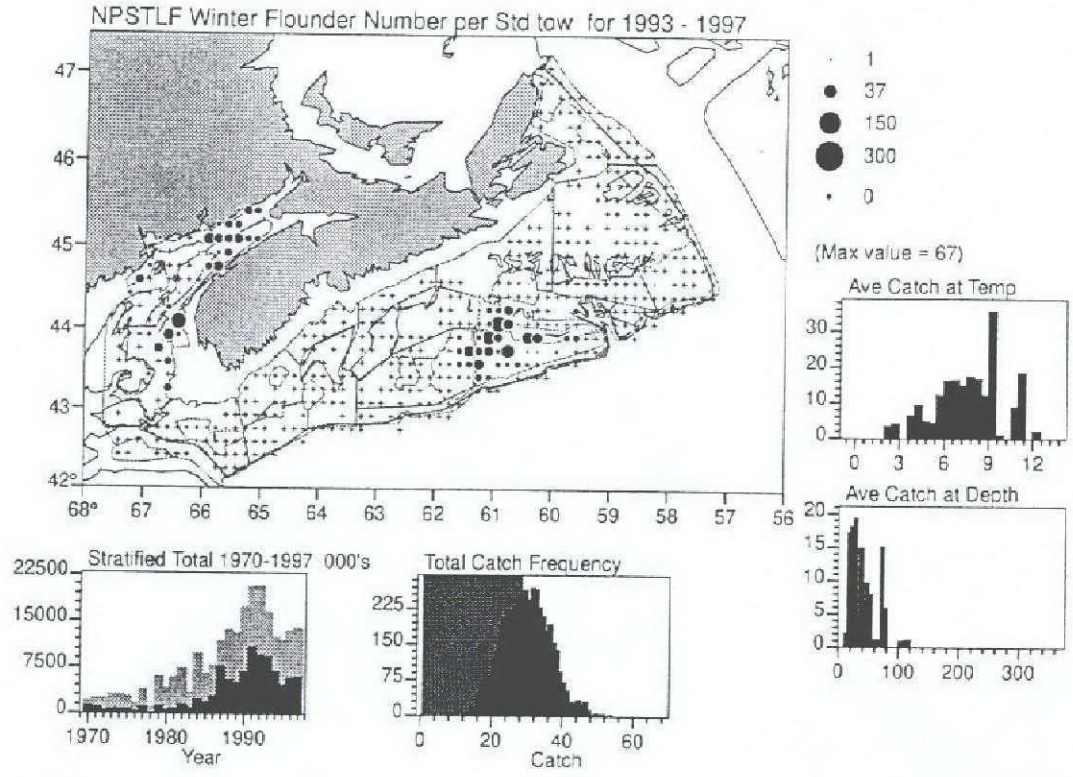


Summer Groundfish Survey WinterFlounder Ave Totno / 10 min 1978-1984



Fall Groundfish Survey WinterFlounder Ave Totno / 10 min 1978-1984

Figure 3. Distribution of winter flounder on the Scotian Shelf during the RV spring, summer and fall surveys from 1978-84. Total numbers caught were averaged over all years and aggregated into 10 minute square areas.



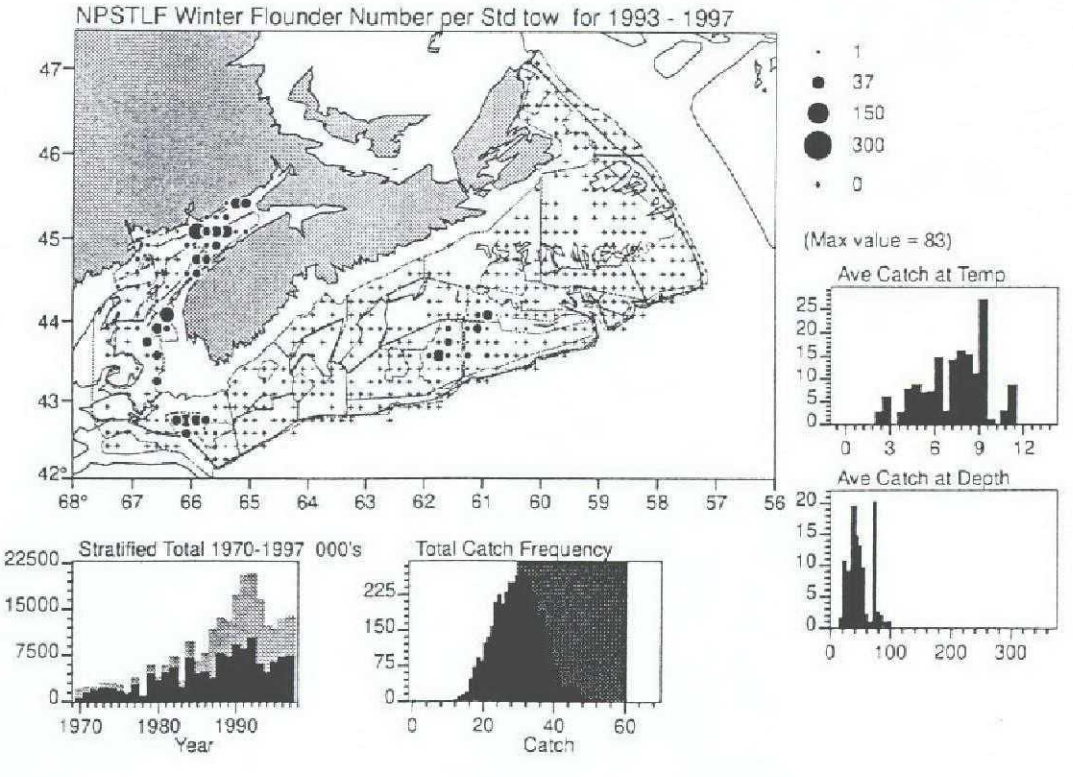


Figure 4. Distribution of pre-recruit (≤27cm) and larger winter flounder (top and bottom panels respectively) on the Scotian Shelf during the 1993-97 summer RV surveys.

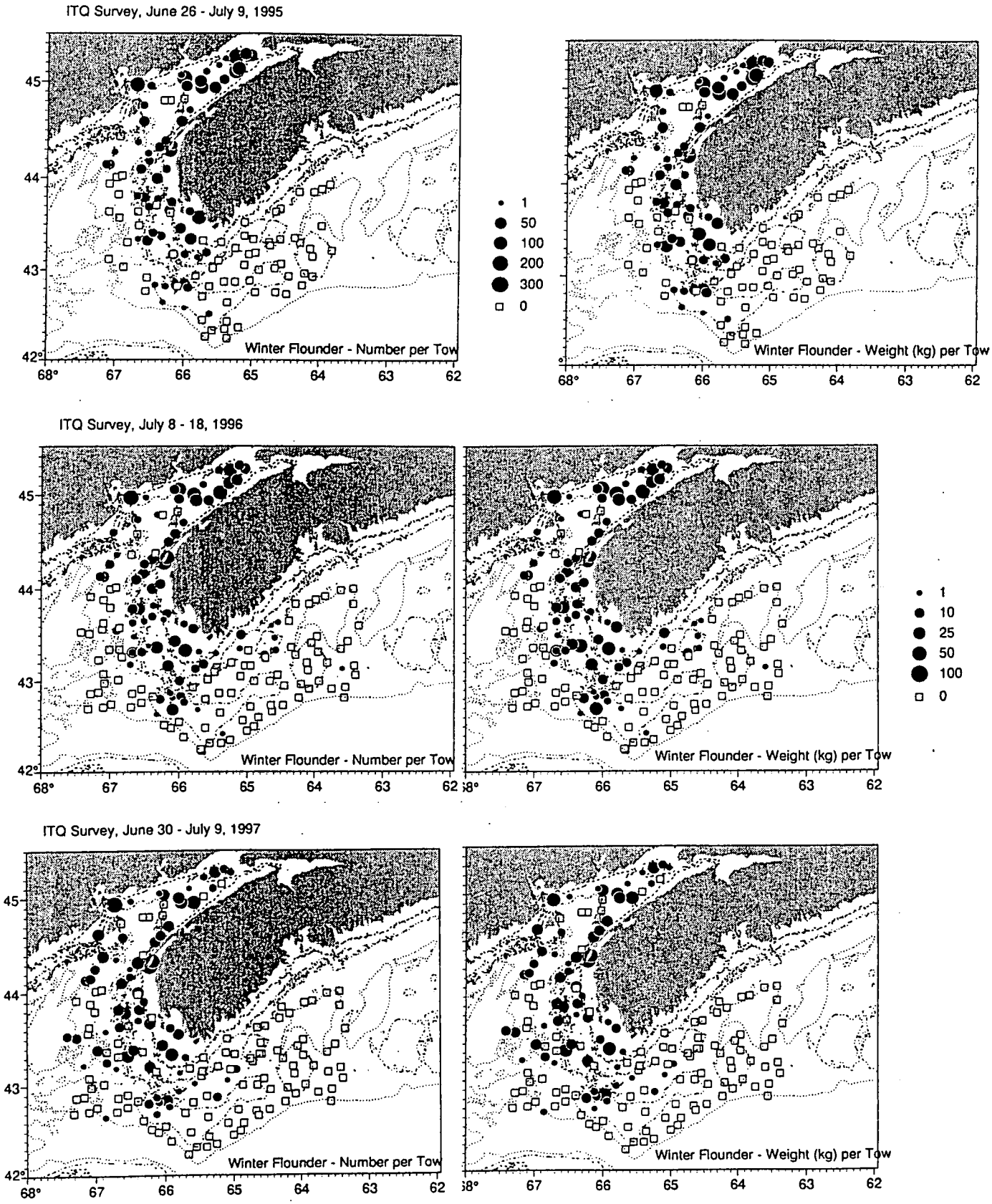


Figure 5. Distribution of winter flounder in Div. 4X during the 1995-97 ITQ surveys. The scaling for nos./tow is shown in the upper panel, that for wt./tow in the middle panel.

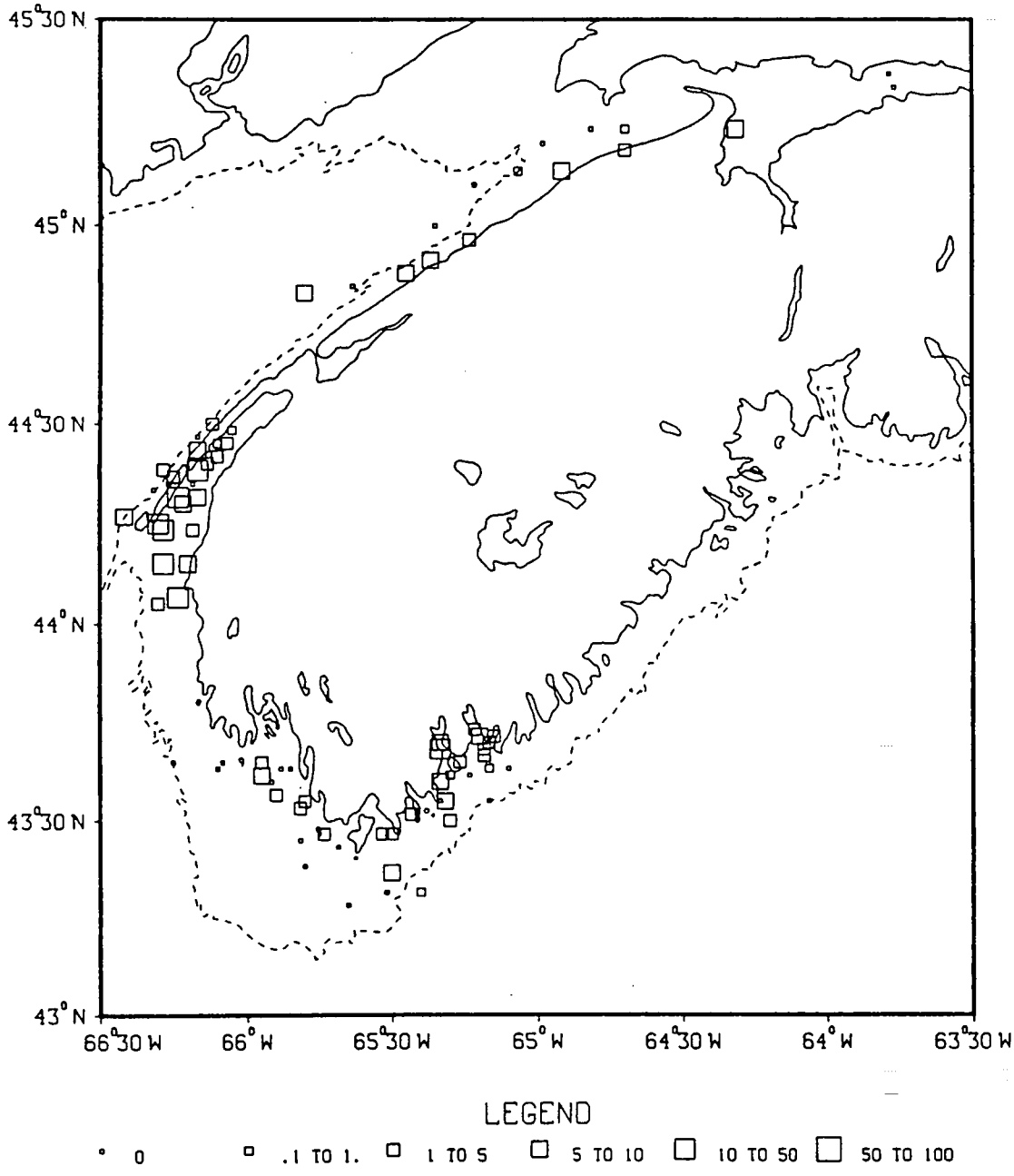


Figure 6. Distribution of winter flounder (numbers per tow) in Div. 4X during an inshore survey in 1985 (after Simon and Campana, 1987). The 60m contour line is shown.

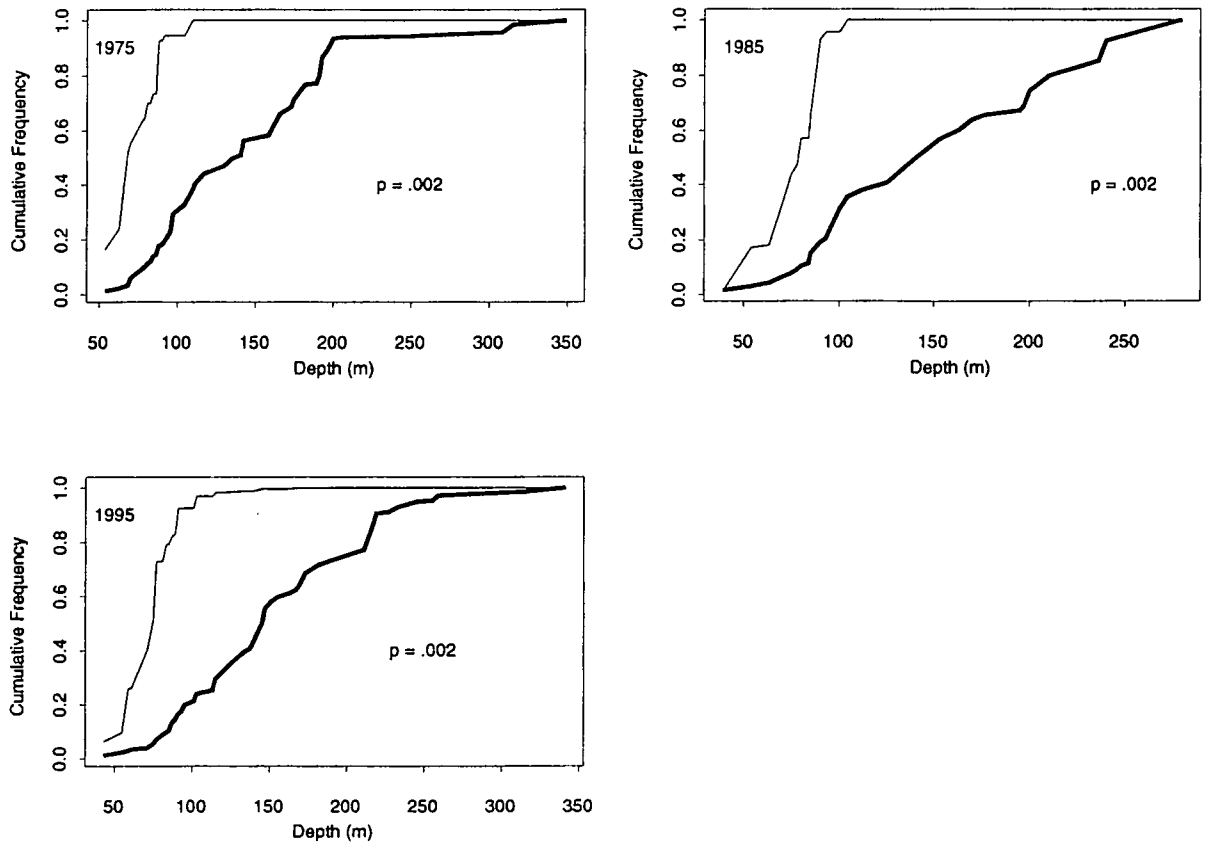
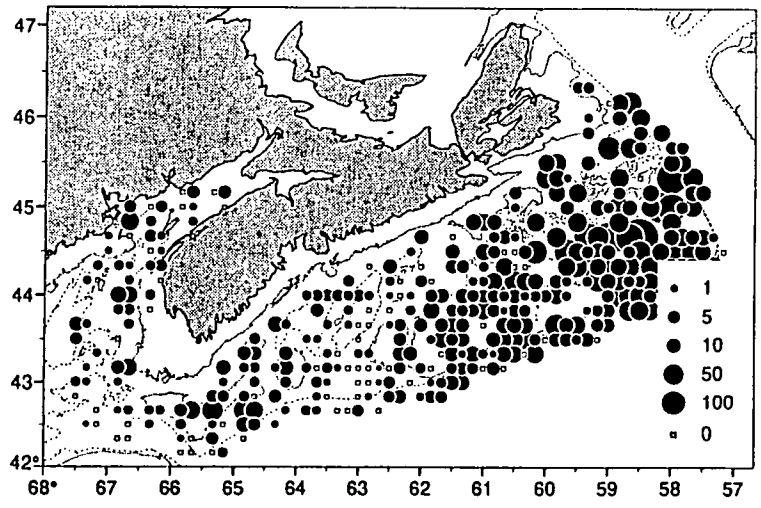
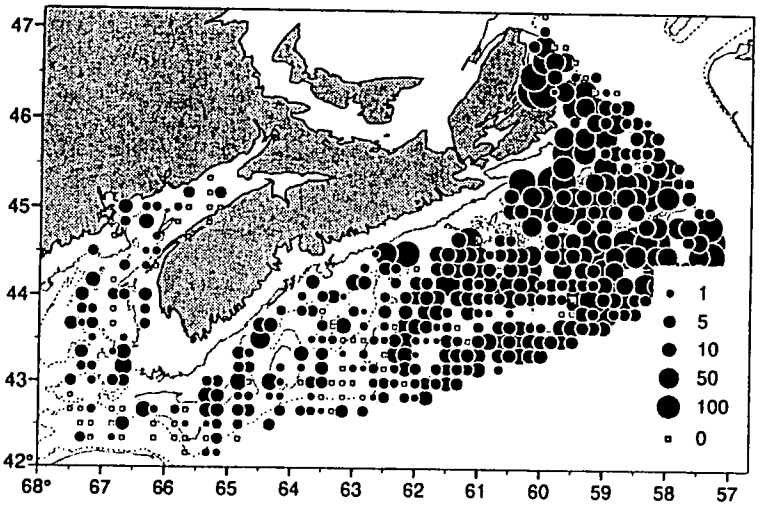


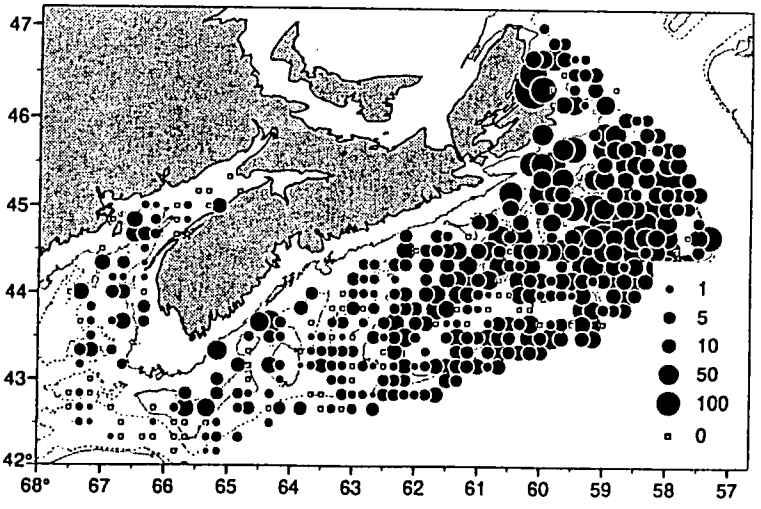
Figure 7. Cumulative frequency plot of winter flounder caught at depth (light line), and of tow depths (dark line), during the summer RV surveys in 1975, 1985 and 1995. The p-level for the randomization test (Perry and Smith 1994) of the null hypothesis of no depth association is given for each year.



Spring Groundfish Survey Plaice Totno 1979-1984



Summer Groundfish Survey Plaice Totno 1978-1984



Fall Groundfish Survey Plaice Totno 1978-1984

Figure 8. Distribution of American plaice on the Scotian Shelf during the RV spring, summer and fall surveys from 1978-84. Total numbers caught were averaged over all years and aggregated into 10 minute square areas.

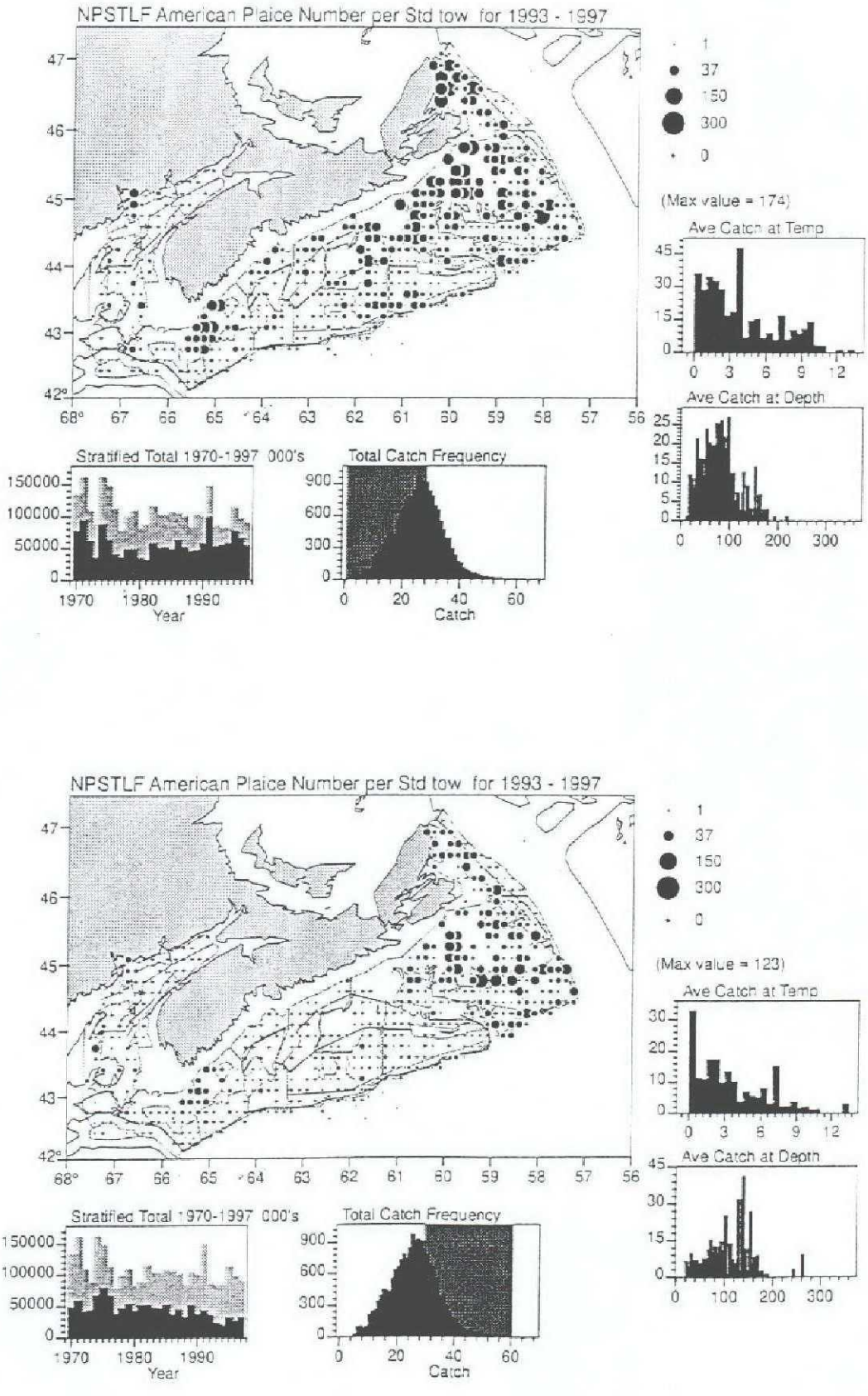


Figure 9. Distribution of pre-recruit (≤31cm) and larger American plaice (top and bottom panels respectively) on the Scotian Shelf during the 1993-97 summer RV surveys.

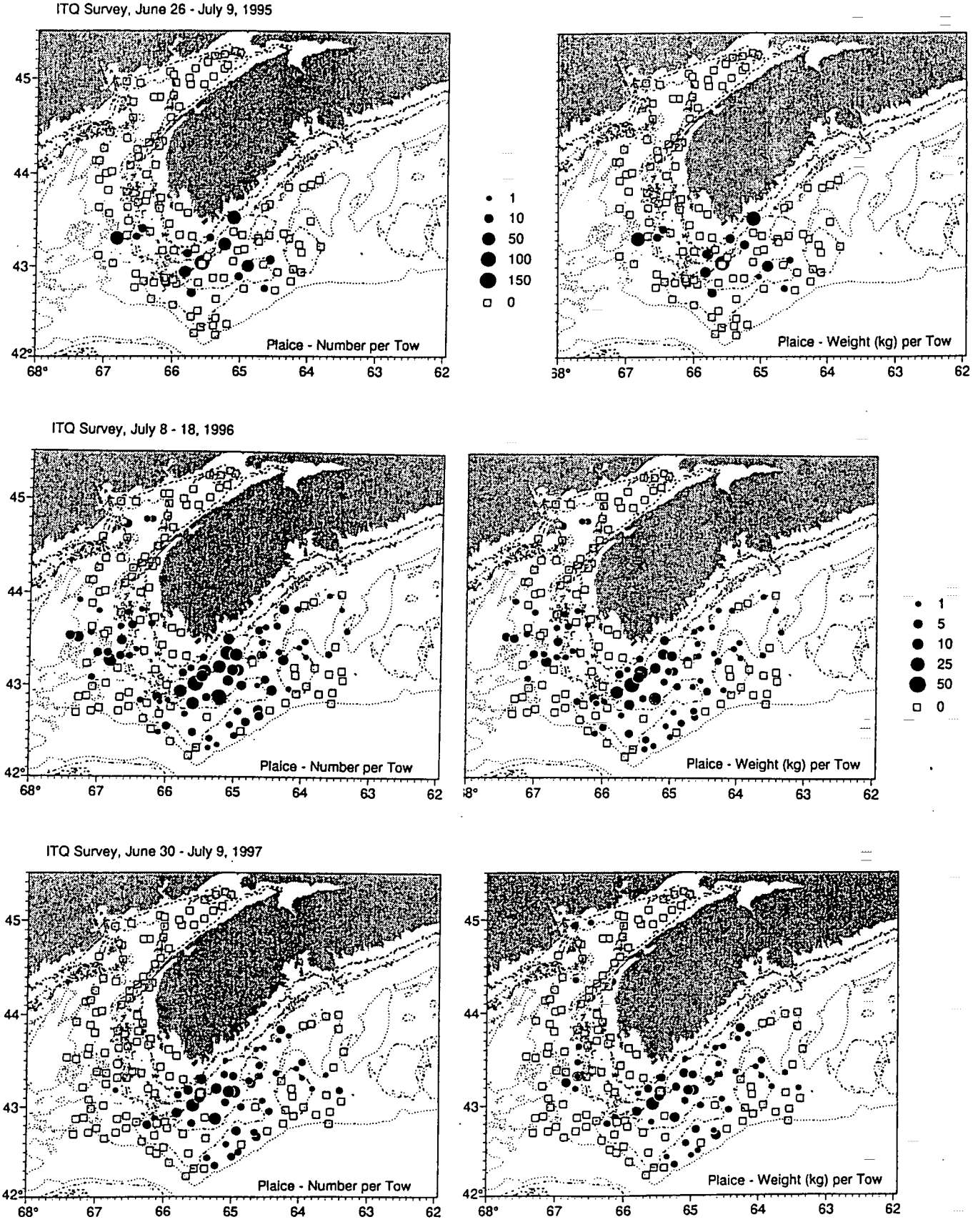


Figure 10. Distribution of American plaice in Div. 4X during the 1995-97 ITQ surveys. The scaling for nos./tow is shown in the upper panel, that for wt./tow in the middle panel.

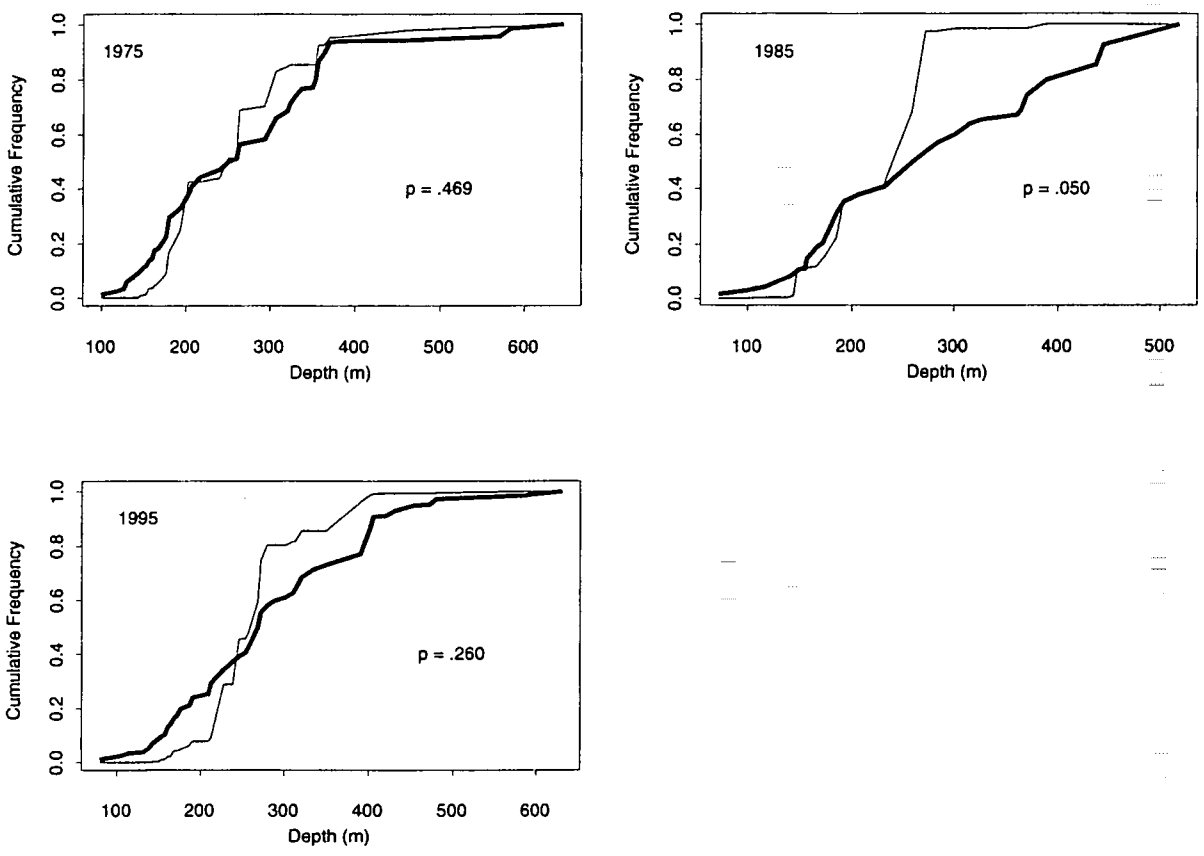
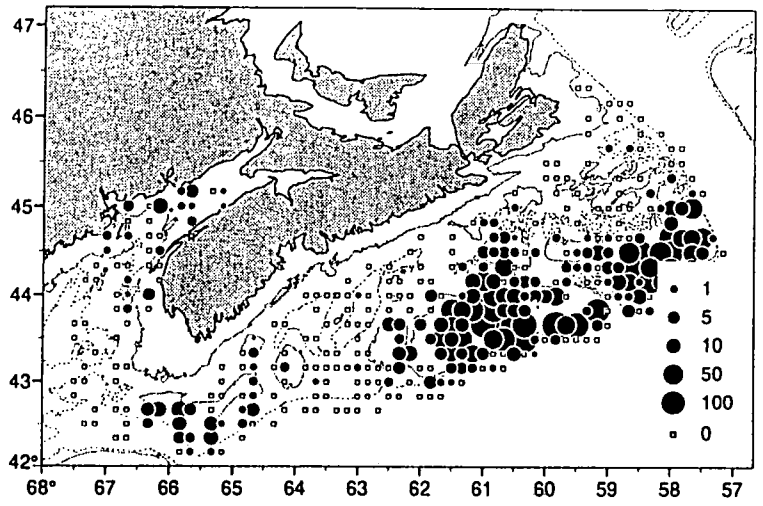
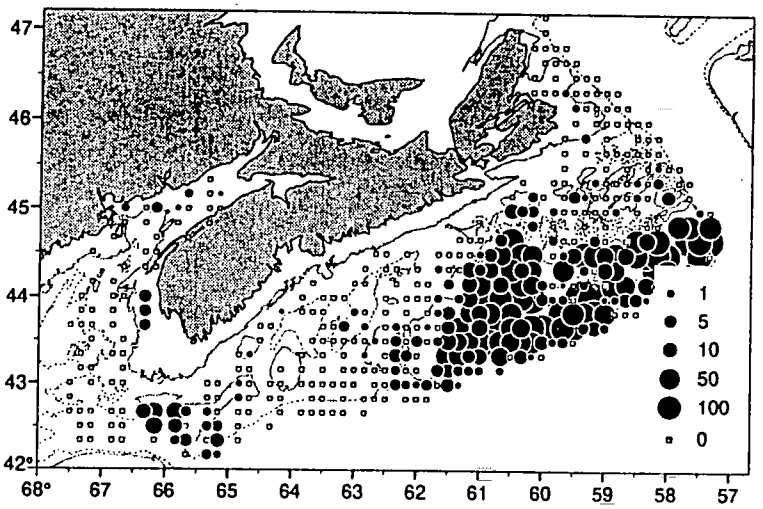


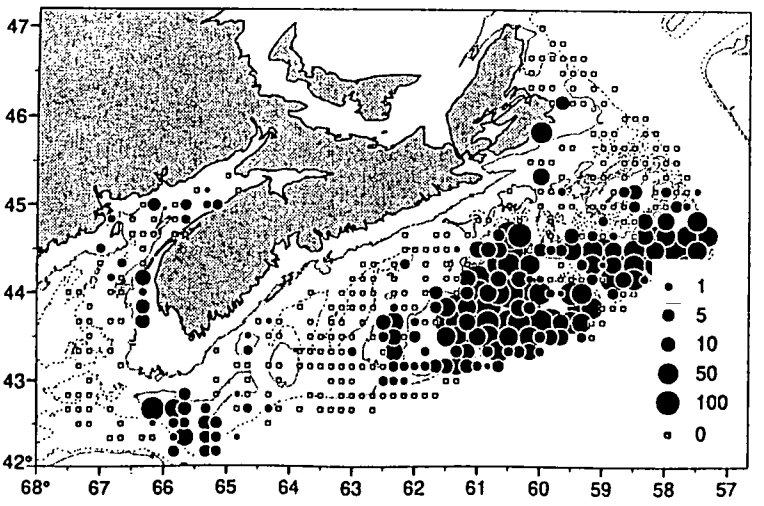
Figure 11. Cumulative frequency plot of American plaice caught at depth (light line), and of tow depths (dark line), during the summer RV surveys in 1975, 1985 and 1995. The p-level for the randomization test (Perry and Smith 1994) of the null hypothesis of no depth association is given for each year.



Spring Groundfish Survey Yellowtail Totno 1979-1984



Summer Groundfish Survey Yellowtail Totno 1978-1984



Fall Groundfish Survey Yellowtail Totno 1978-1984

Figure 12. Distribution of yellowtail flounder on the Scotian Shelf during the RV spring, summer and fall surveys from 1978-84. Total numbers caught were averaged over all years and aggregated into 10 minute square areas.

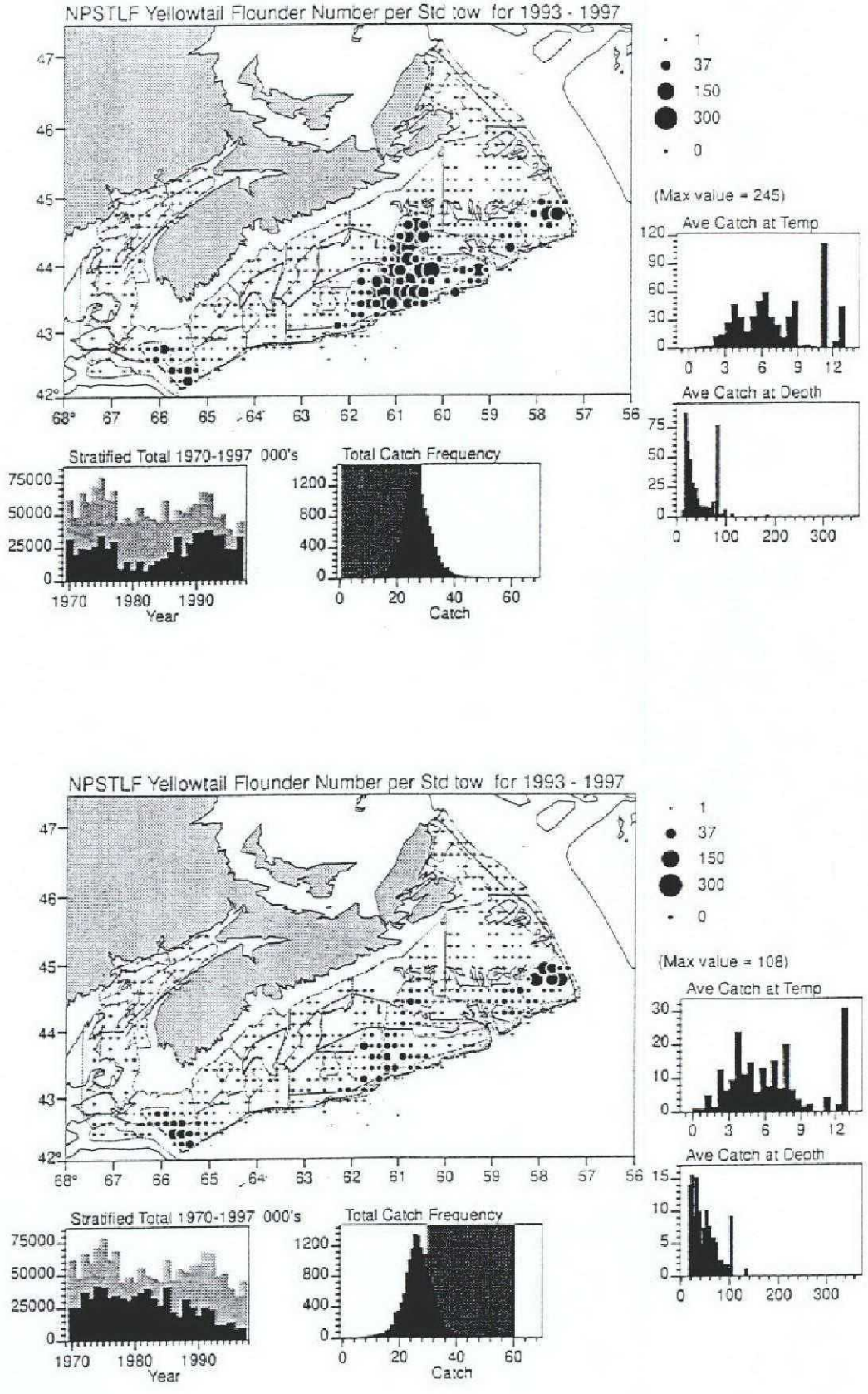


Figure 13. Distribution of pre-recruit (≤30cm) and larger yellowtail flounder (top and bottom panels respectively) on the Scotian Shelf during the 1993-97 summer RV surveys.

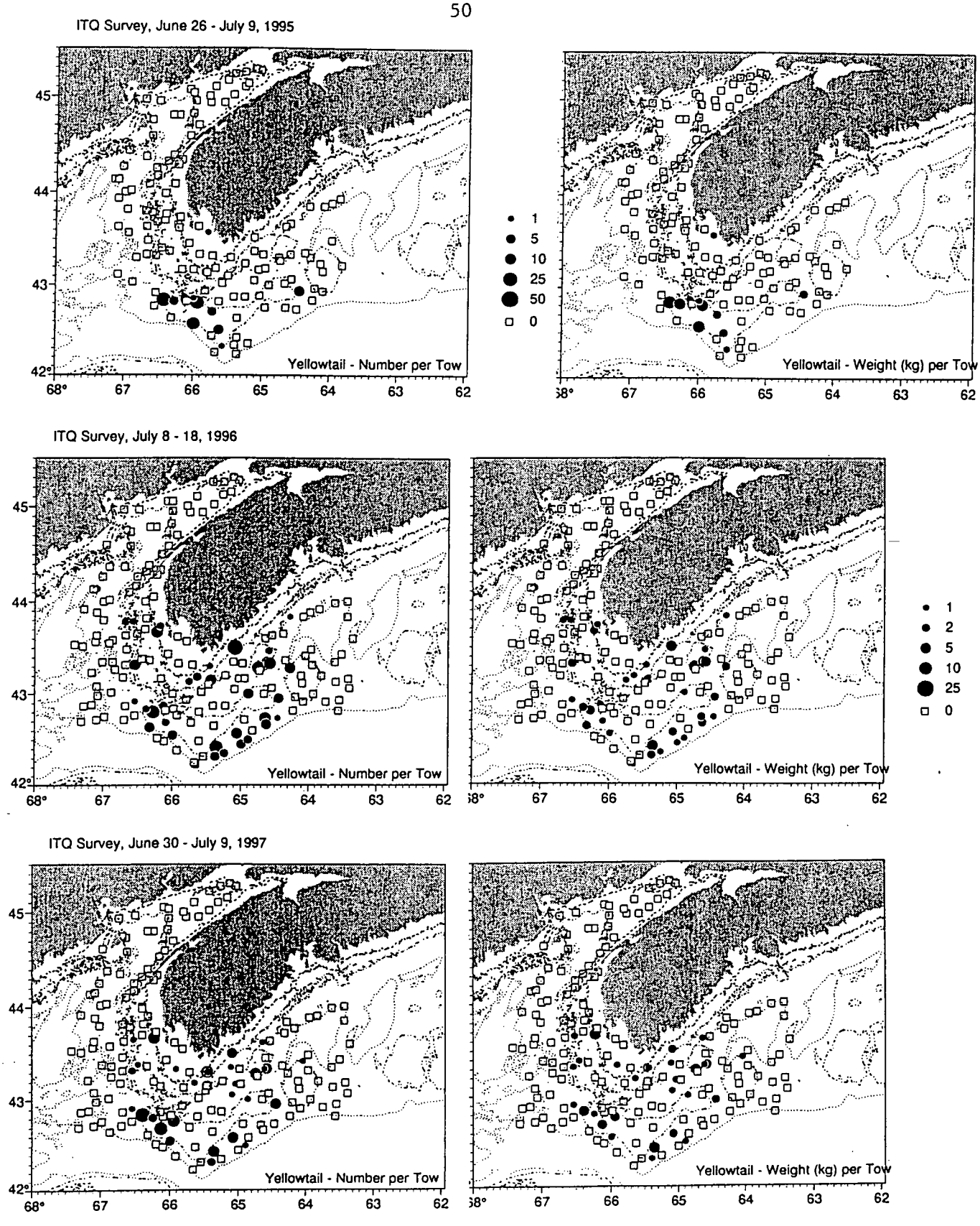


Figure 14. Distribution of yellowtail flounder in Div. 4X during the 1995-97 ITQ surveys. The scaling for nos./tow is shown in the upper panel, that for wt./tow in the middle panel.

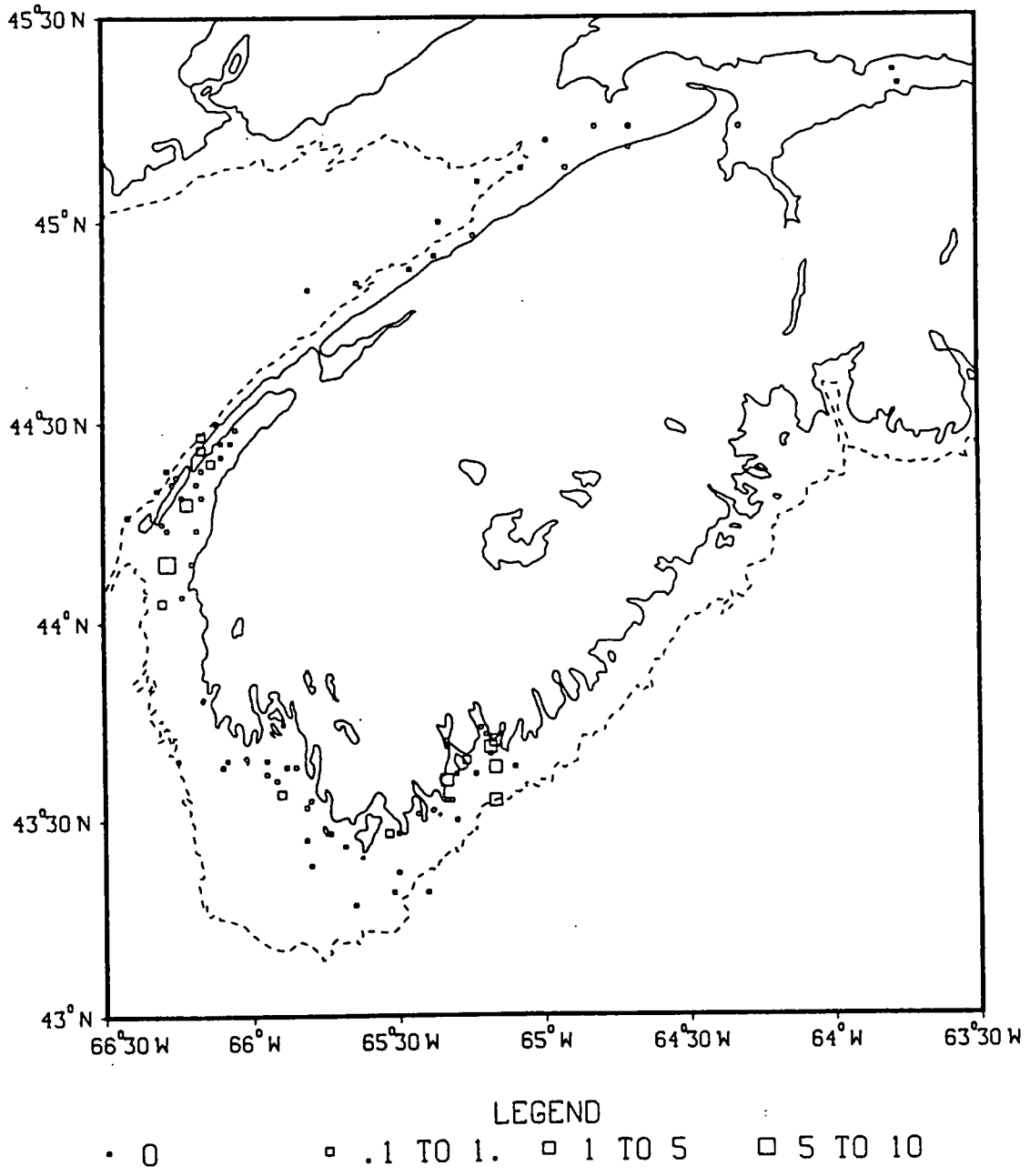


Figure 15. Distribution of yellowtail flounder (numbers per tow) in Div. 4X during an inshore survey in 1985 (after Simon and Campana, 1987). The 60m contour line is shown.

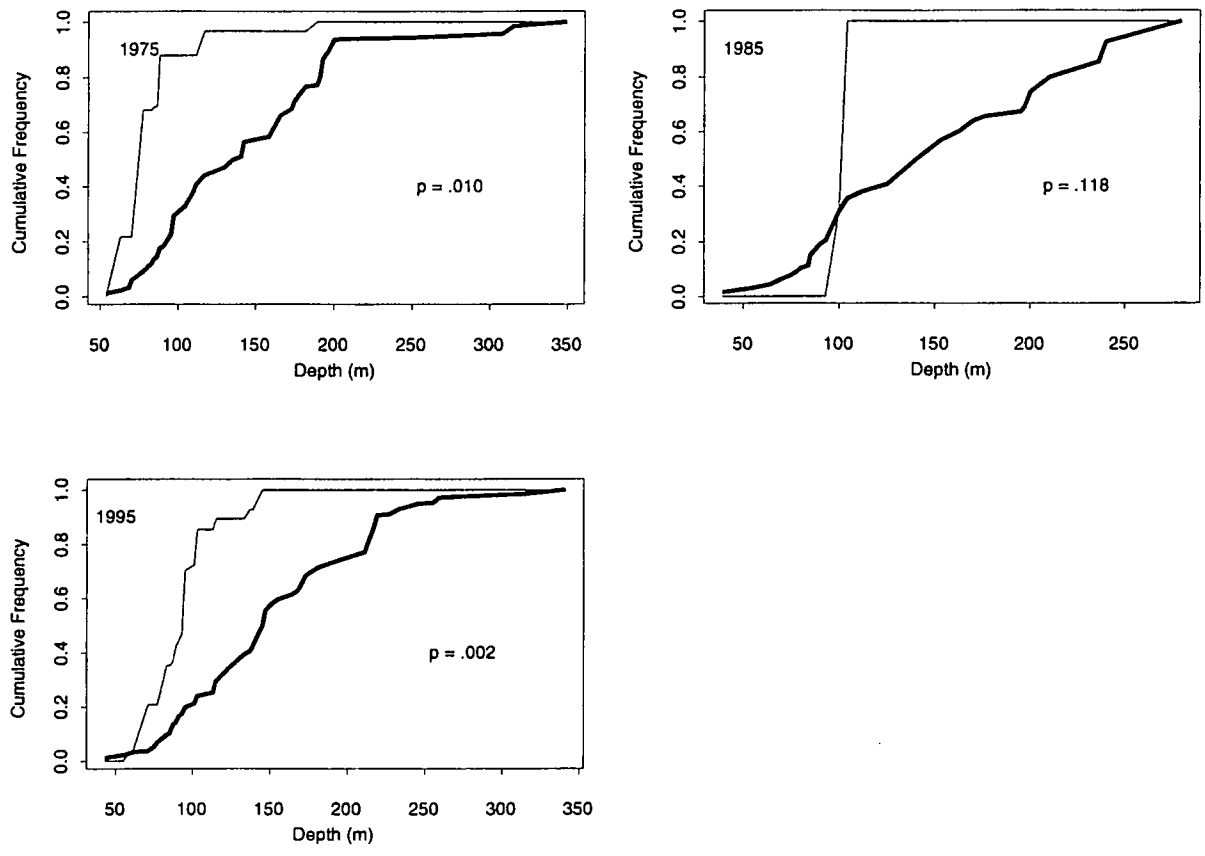


Figure 16. Cumulative frequency plot of yellowtail flounder caught at depth (light line), and of tow depths (dark line), during the summer RV surveys in 1975, 1985 and 1995. The p-level for the randomization test (Perry and Smith 1994) of the null hypothesis of no depth association is given for each year.

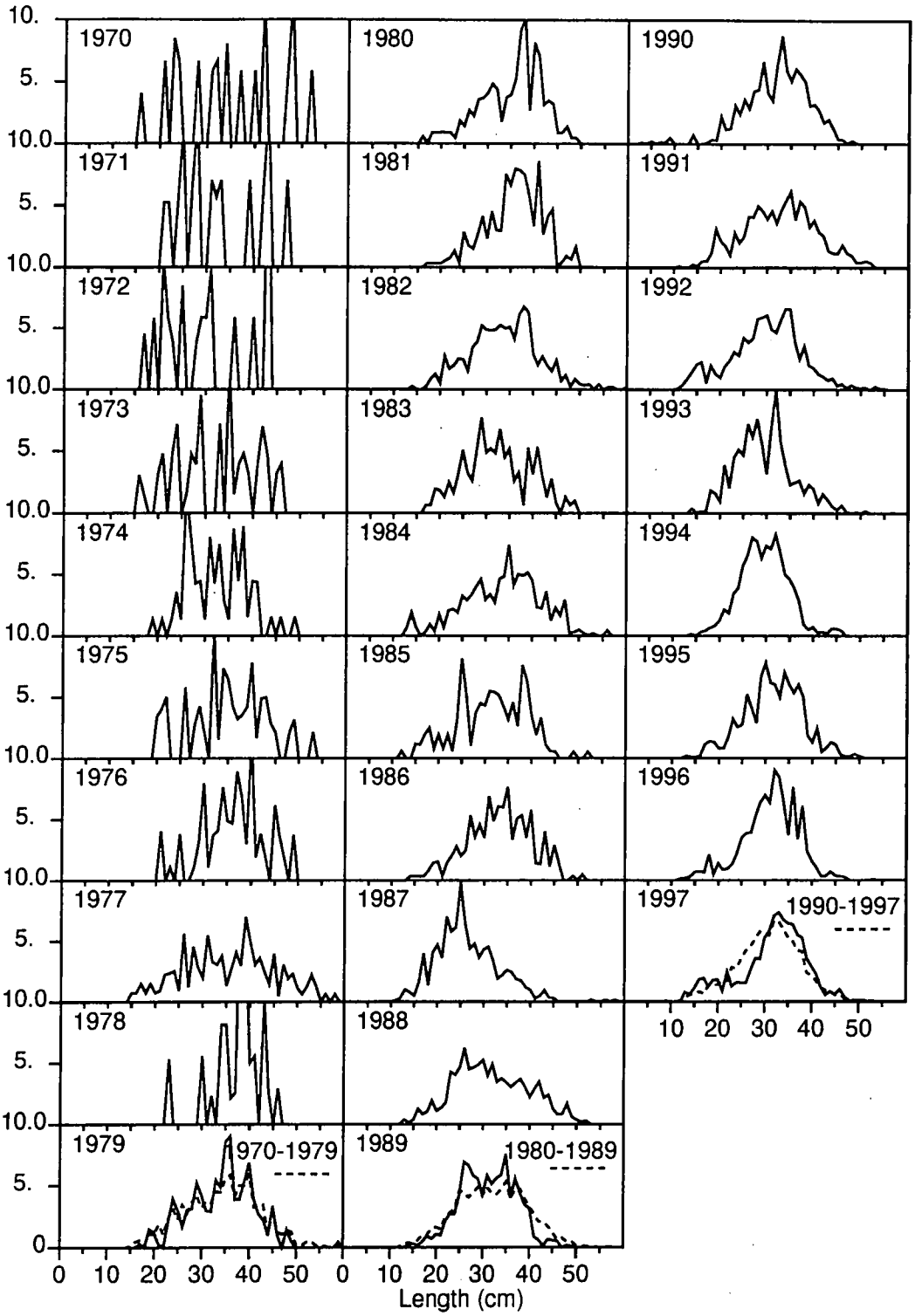


Figure 17. Summer RV survey percent length frequency distributions for winter flounder in 4X (1970-97). Samples were weighted by stratum size, then combined.

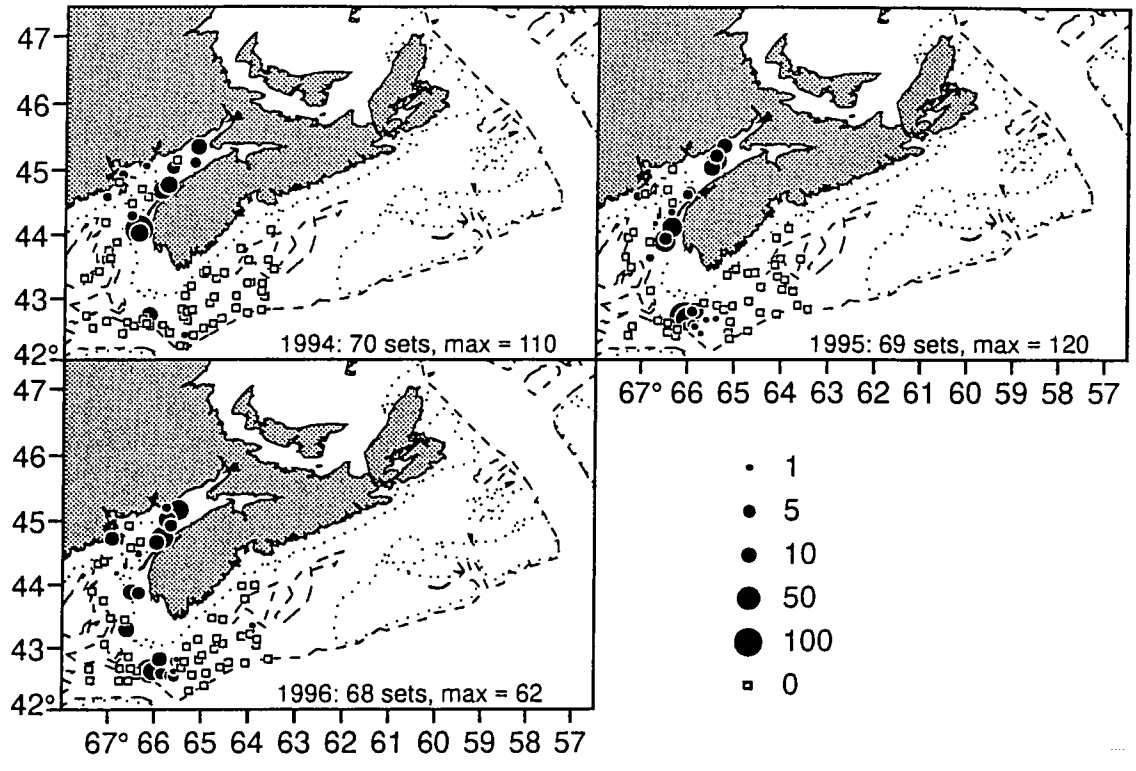


Figure 18. 4X Winter Flounder Biomass (kg/tow) from the 1994-1996 Summer Groundfish Survey.

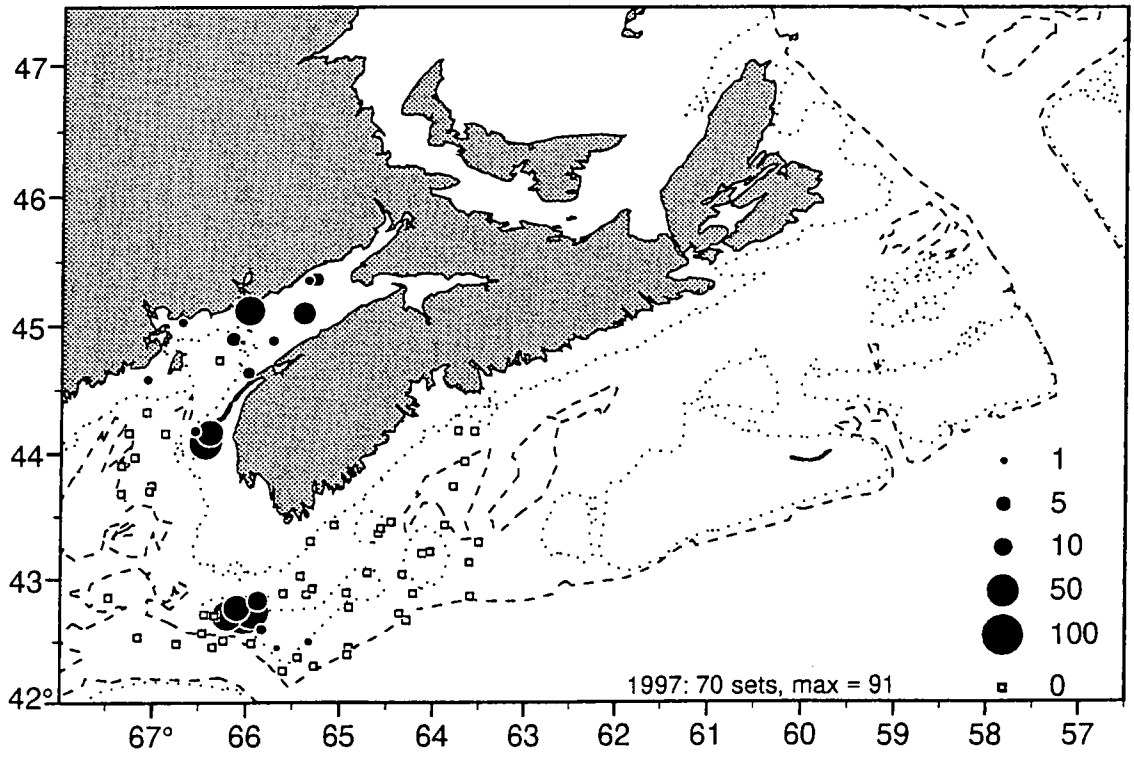


Figure 19. 4X Winter Flounder Biomass (kg/tow) from the 1997 Summer Groundfish Survey.

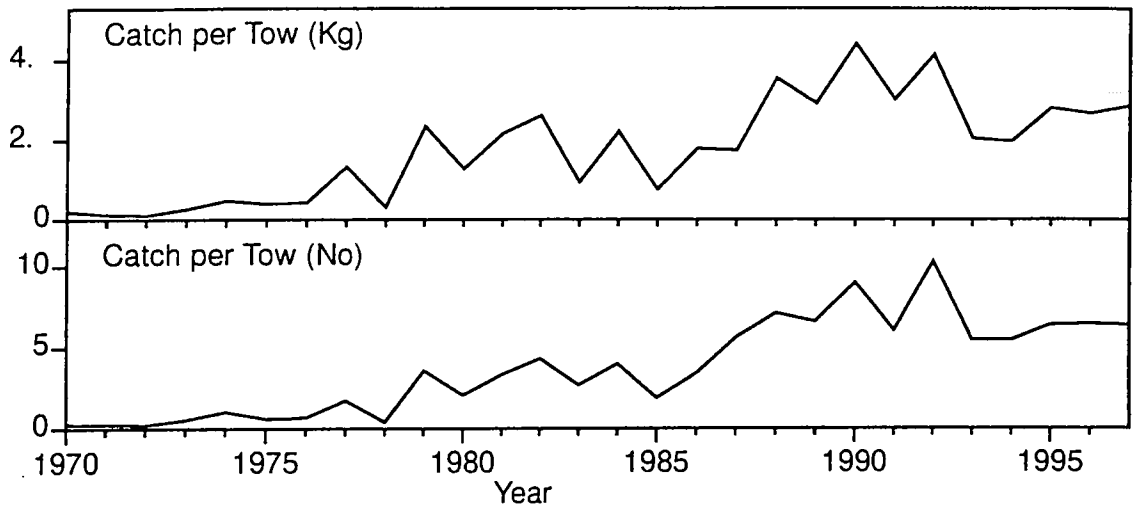


Figure 20. 4X Winter Flounder stratified mean Weight and Number caught per tow from the Summer surveys.

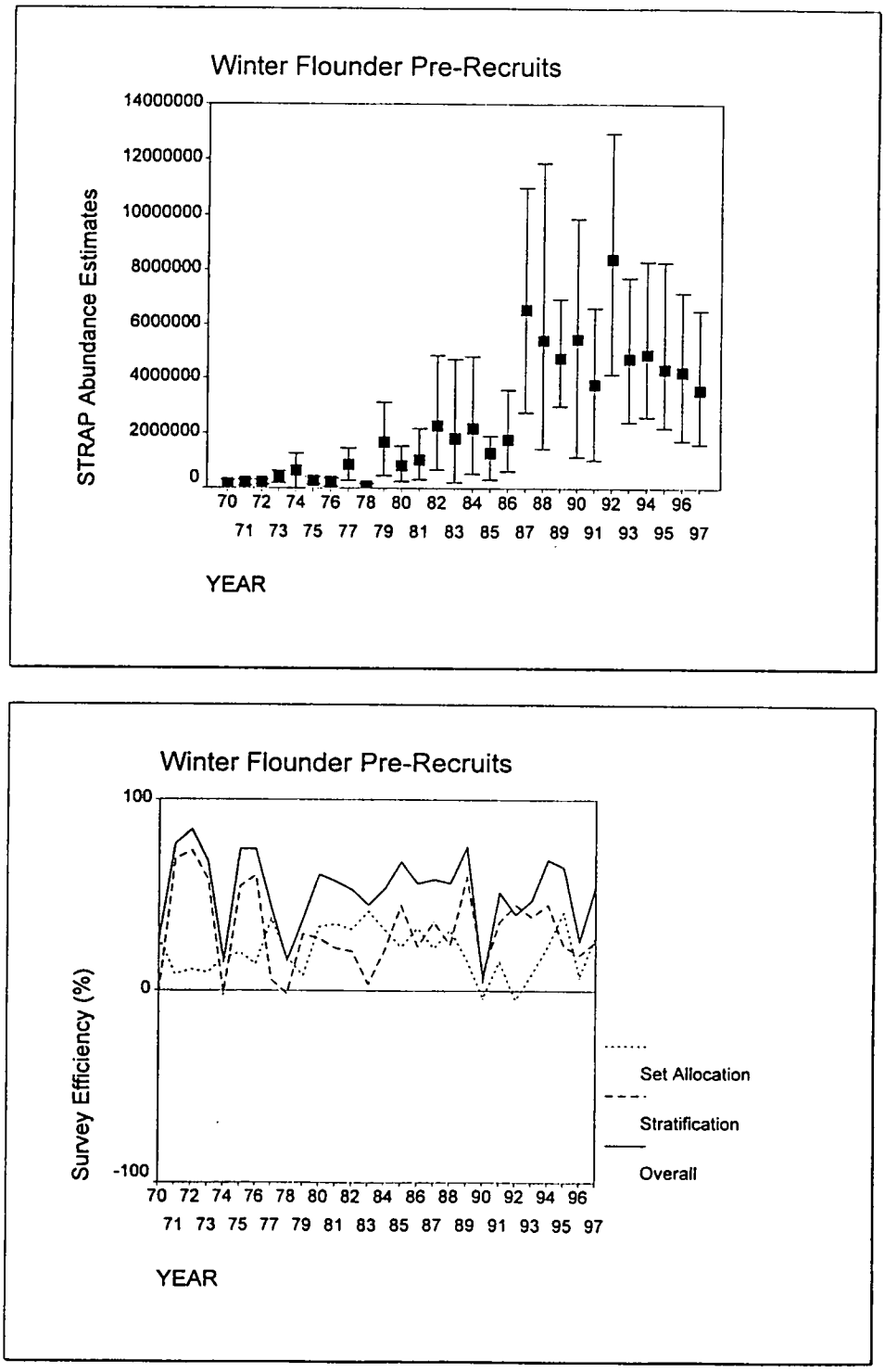


Figure 21. Research vessel abundance estimates of winter flounder (≤30cm) from 1970 to 1997 (upper panel). The 95% confidence intervals are also given. Estimates of survey efficiency for this species in terms of set allocation and the stratification scheme, compared to a random survey are given in the lower panel.

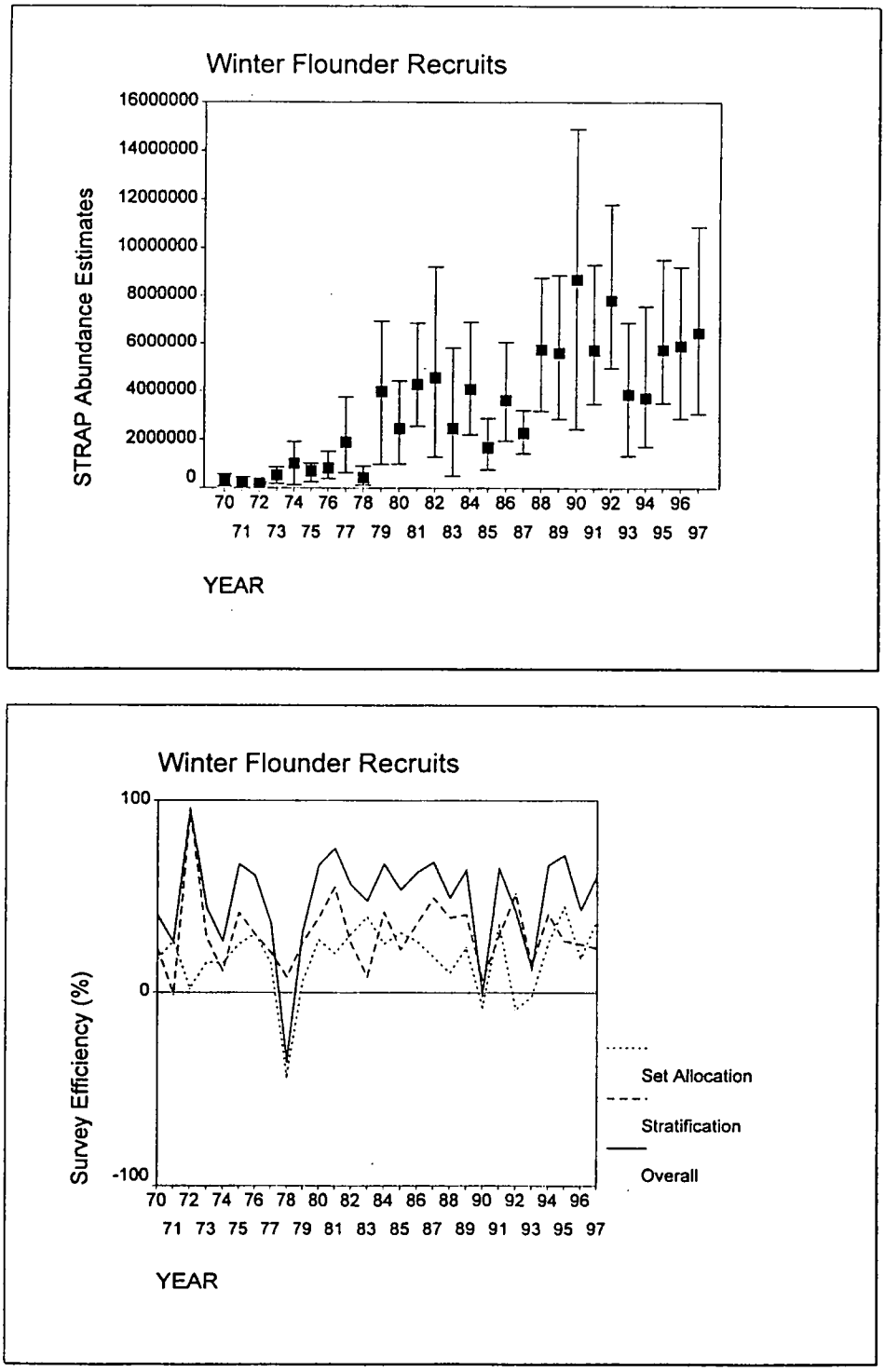


Figure 22. Research vessel abundance estimates of winter flounder (>30cm) from 1970 to 1997 (upper panel). The 95% confidence intervals are also given. Estimates of survey efficiency for this species in terms of set allocation and the stratification scheme, compared to a random survey are given in the lower panel.

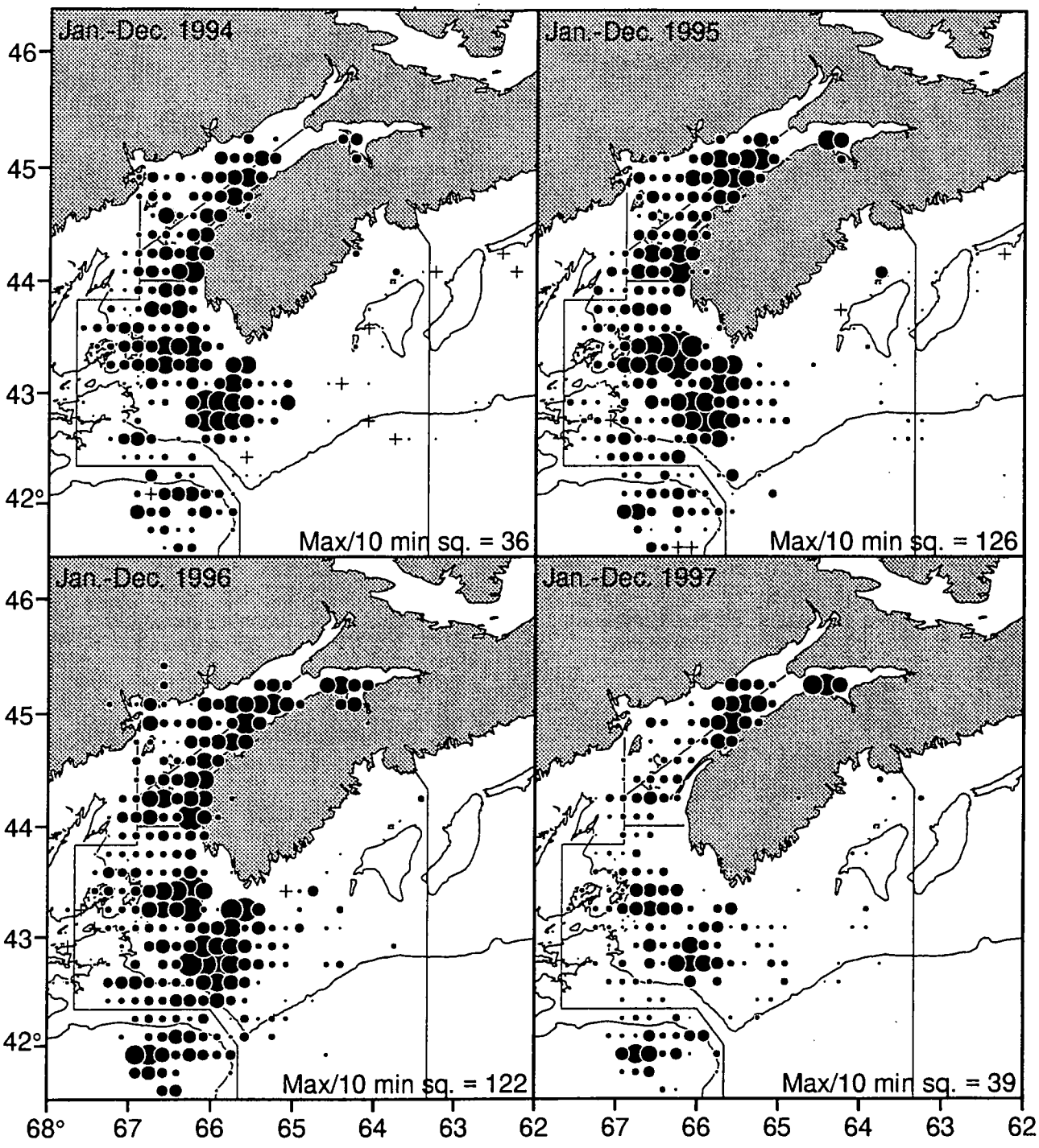


Figure 23. Distribution of the Div. 4X catch (mt) identified as winter flounder in the catch-effort statistical database from 1994 to 1997. Catch information from Sub-area 5 are provided for comparative value. The 1997 data are incomplete since only 6-months of the fishery had been completed. The maximum catch in any given square for each year is given at the bottom of each panel.

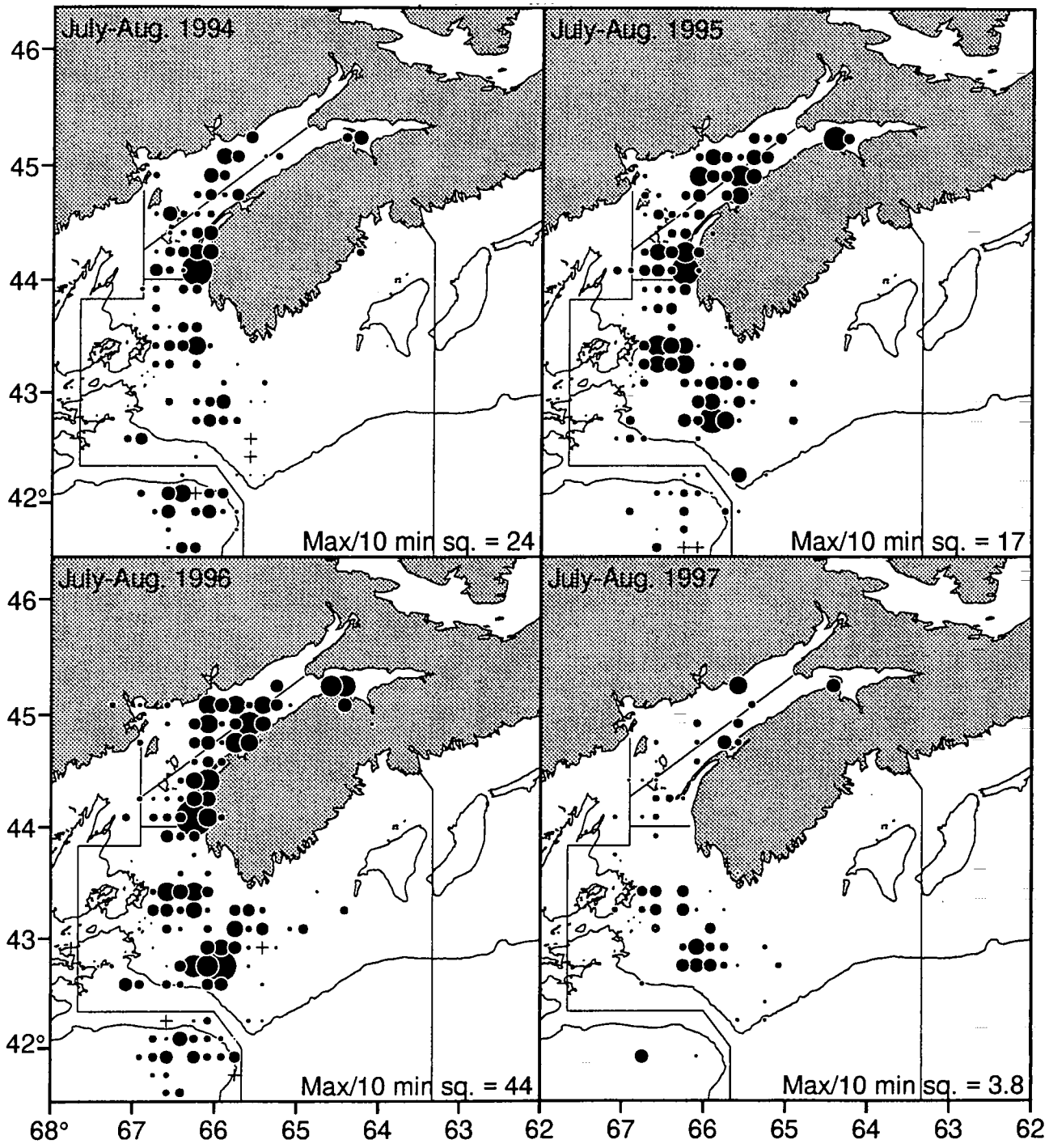
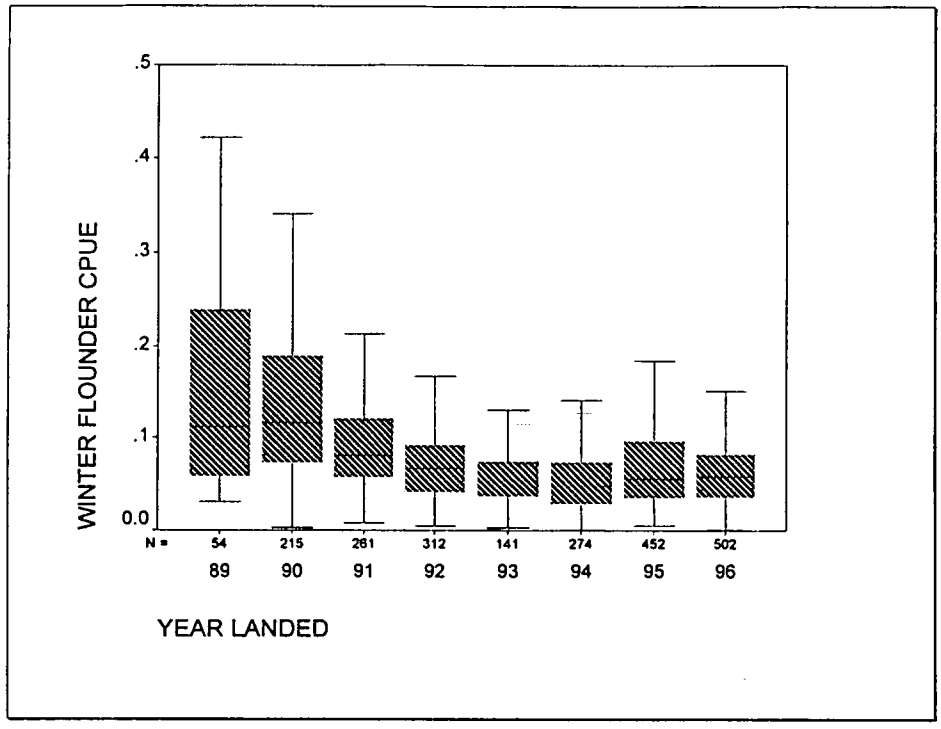


Figure 24. Distribution of the Div. 4X catch (mt) identified as winter flounder in the catch-effort statistical database in July-August for 1994 to 1997. Catch information from Sub-area 5 are provided for comparative value. The 1997 data are incomplete since only 6-months of the fishery had been completed. The maximum catch in any given square for each year is given at the bottom of each panel.



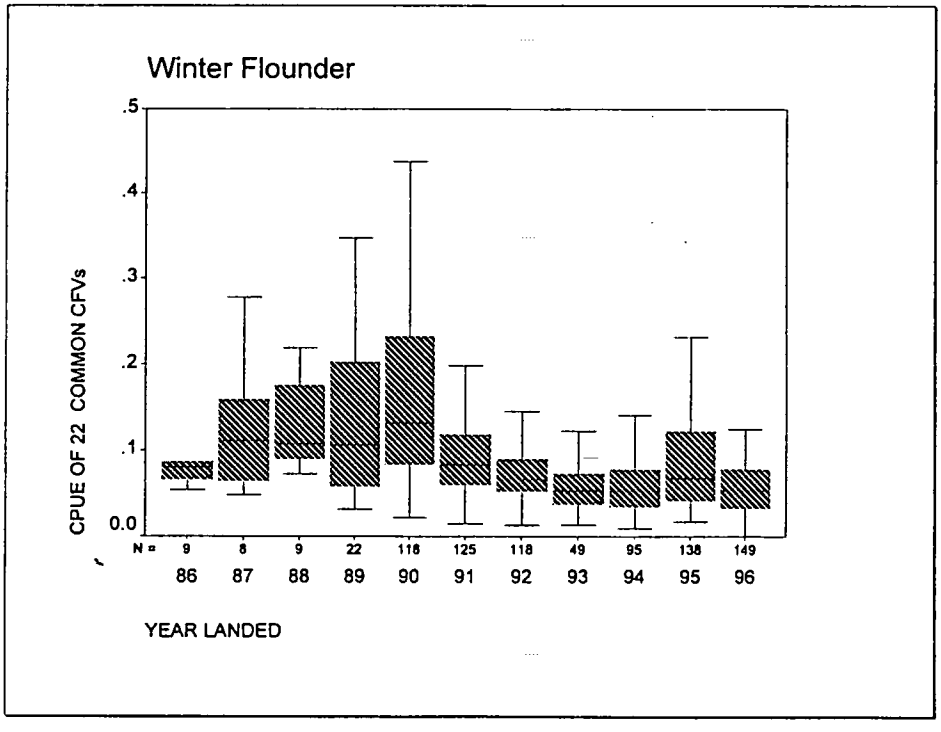


Figure 25. Commercial catch rates (t/hr) of tonnage class 1-3 stern trawlers fishing for winter flounder in Div. 4X, 1989-96, as 'Main Species' (top panel) and of 22 selected vessels with a sustained involvement in the winter flounder fishery, 1986-96, (bottom panel). Note the different time scales for the two panels.

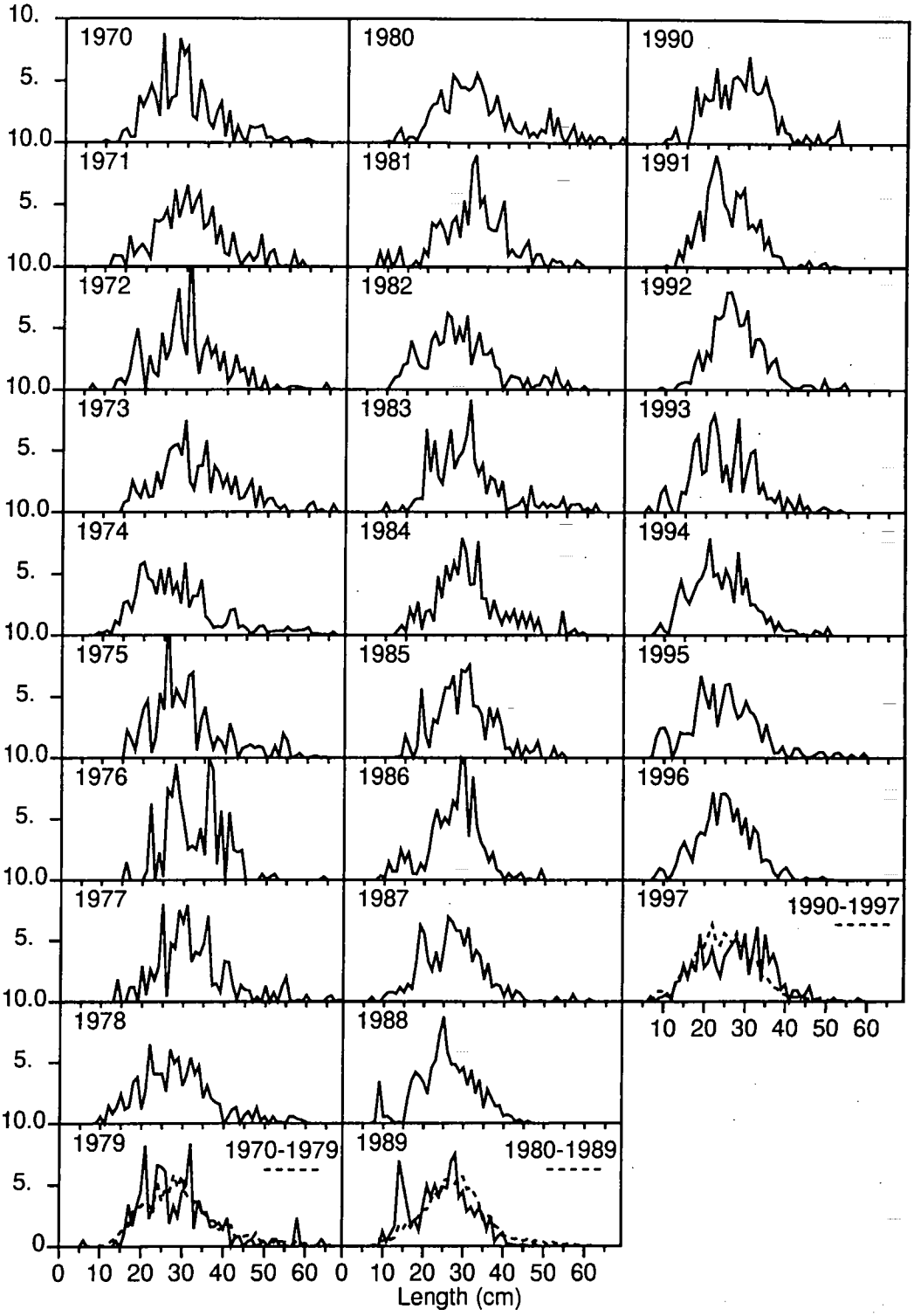


Figure 26. Summer RV survey percent length frequency distributions for American plaice in 4X (1970-97). Samples were weighted by stratum size, then combined.

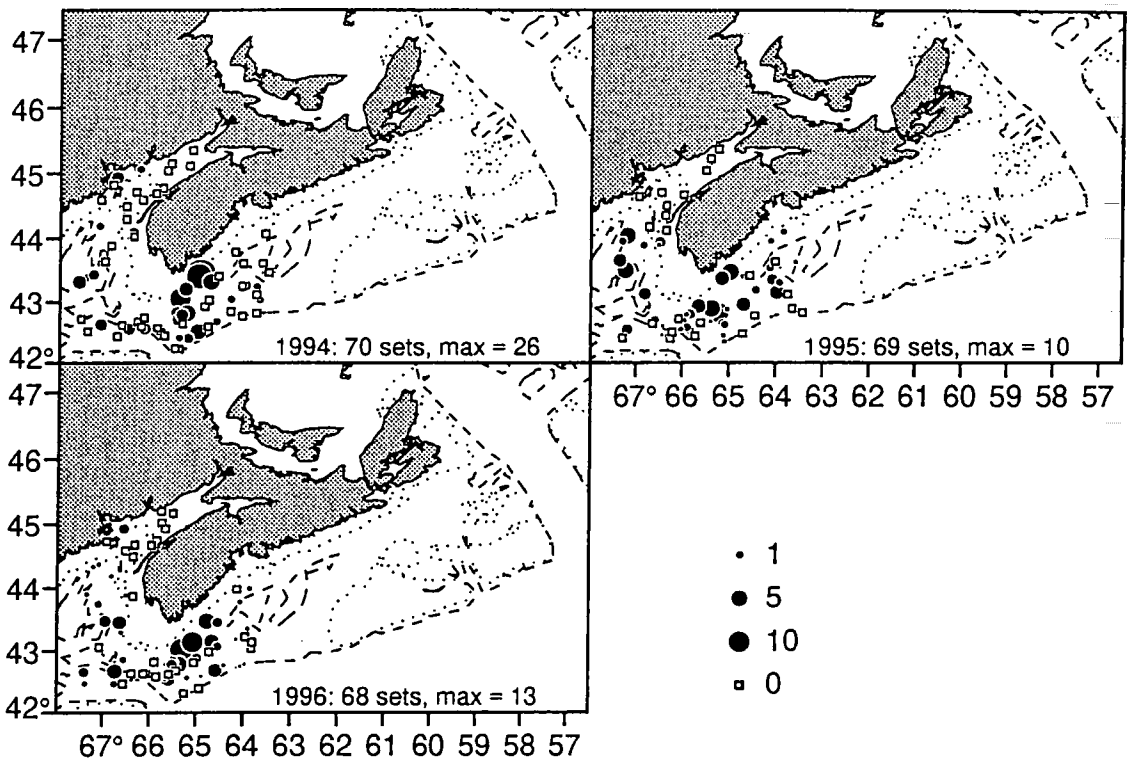


Figure 27. 4X Plaice Biomass (kg/tow) from the 1994-1996 Summer Groundfish Survey.

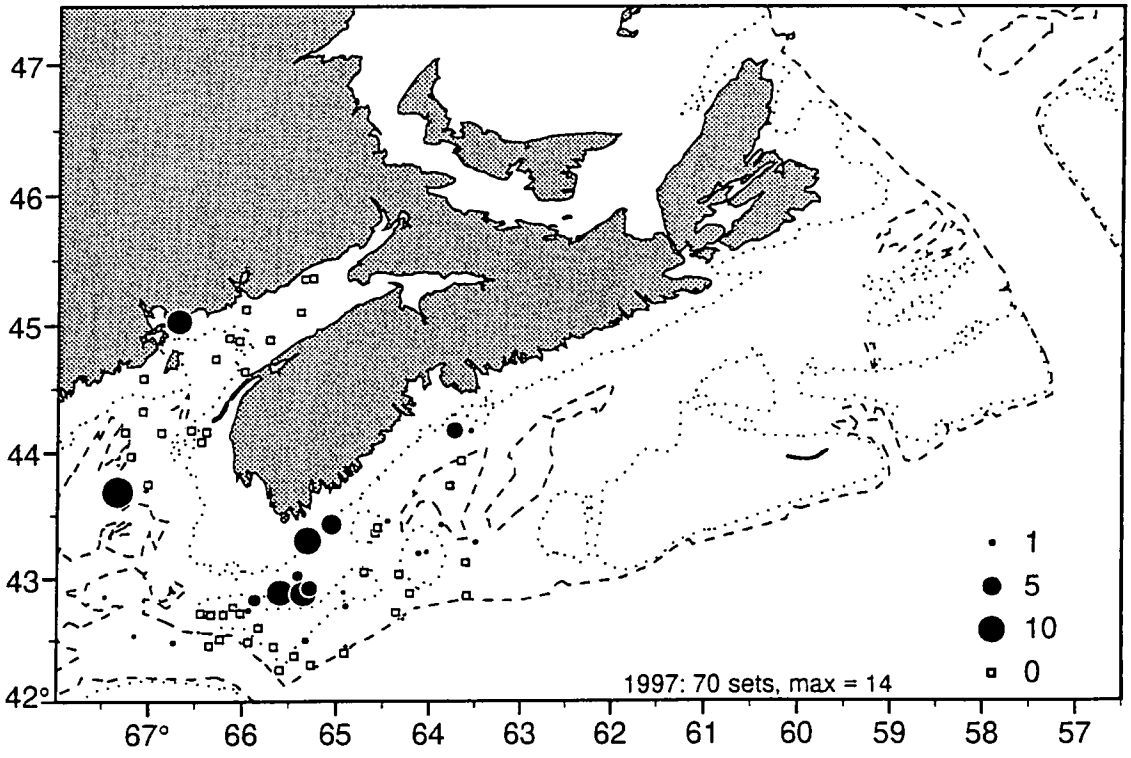


Figure 28. 4X Plaice Biomass (kg/tow) from the 1997 Summer Groundfish Survey.

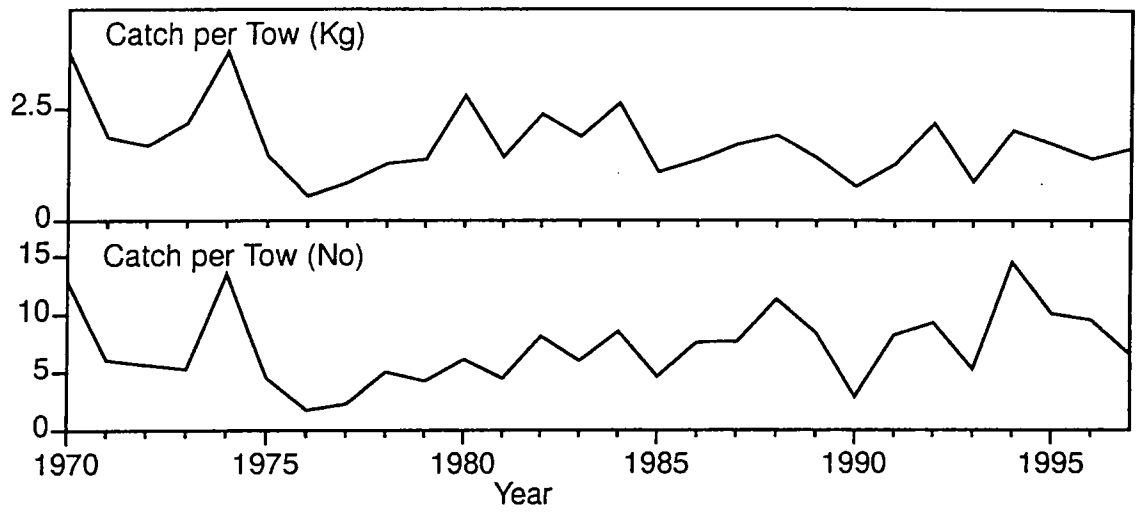


Figure 29. 4X Plaice stratified mean Weight and Number caught per tow from the Summer surveys.

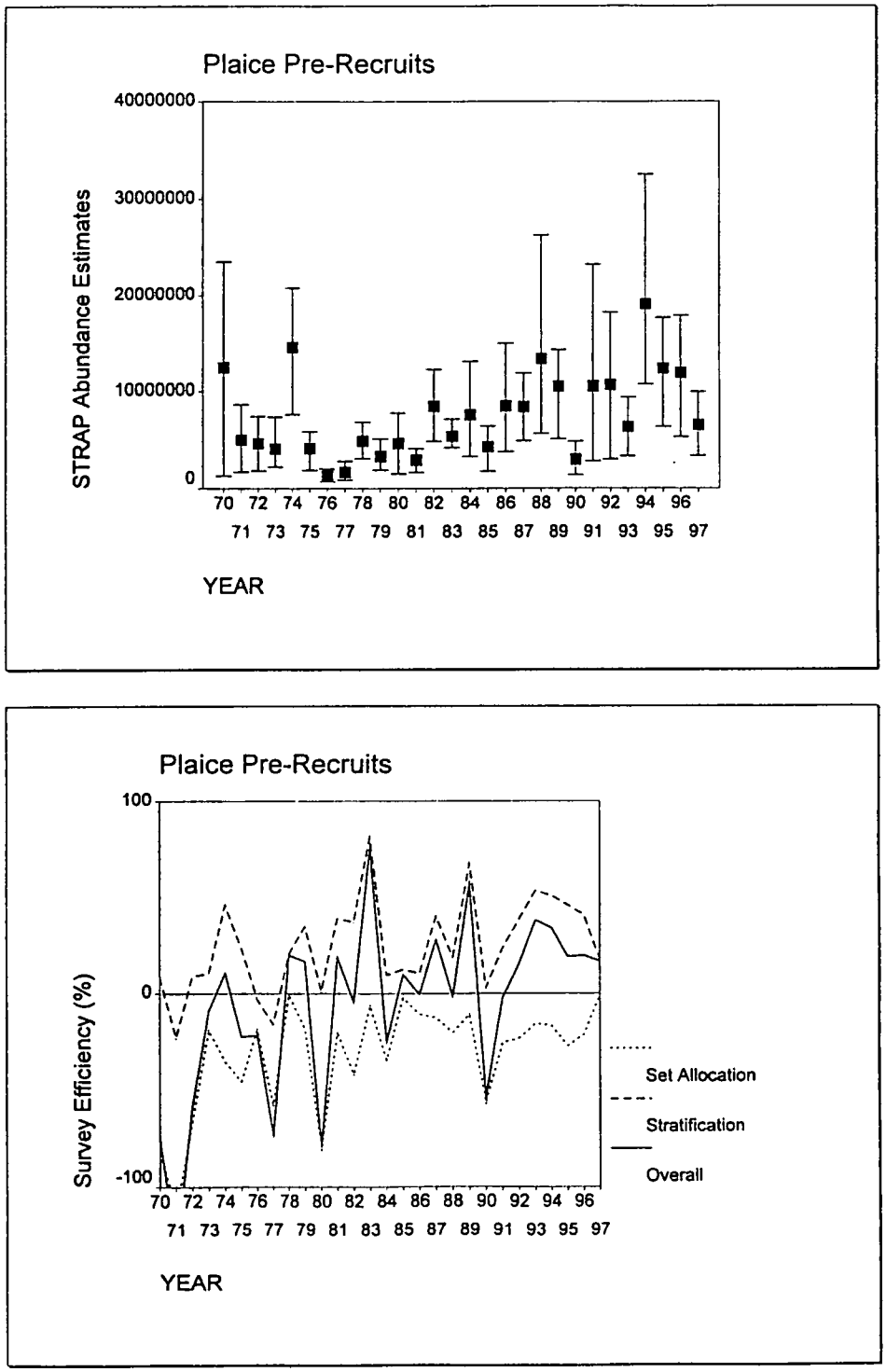


Figure 30. Research vessel abundance estimates of American plaice (≤30cm) from 1970 to 1997 (upper panel). The 95% confidence intervals are also given. Estimates of survey efficiency for this species in terms of set allocation and the stratification scheme, compared to a random survey are given in the lower panel.

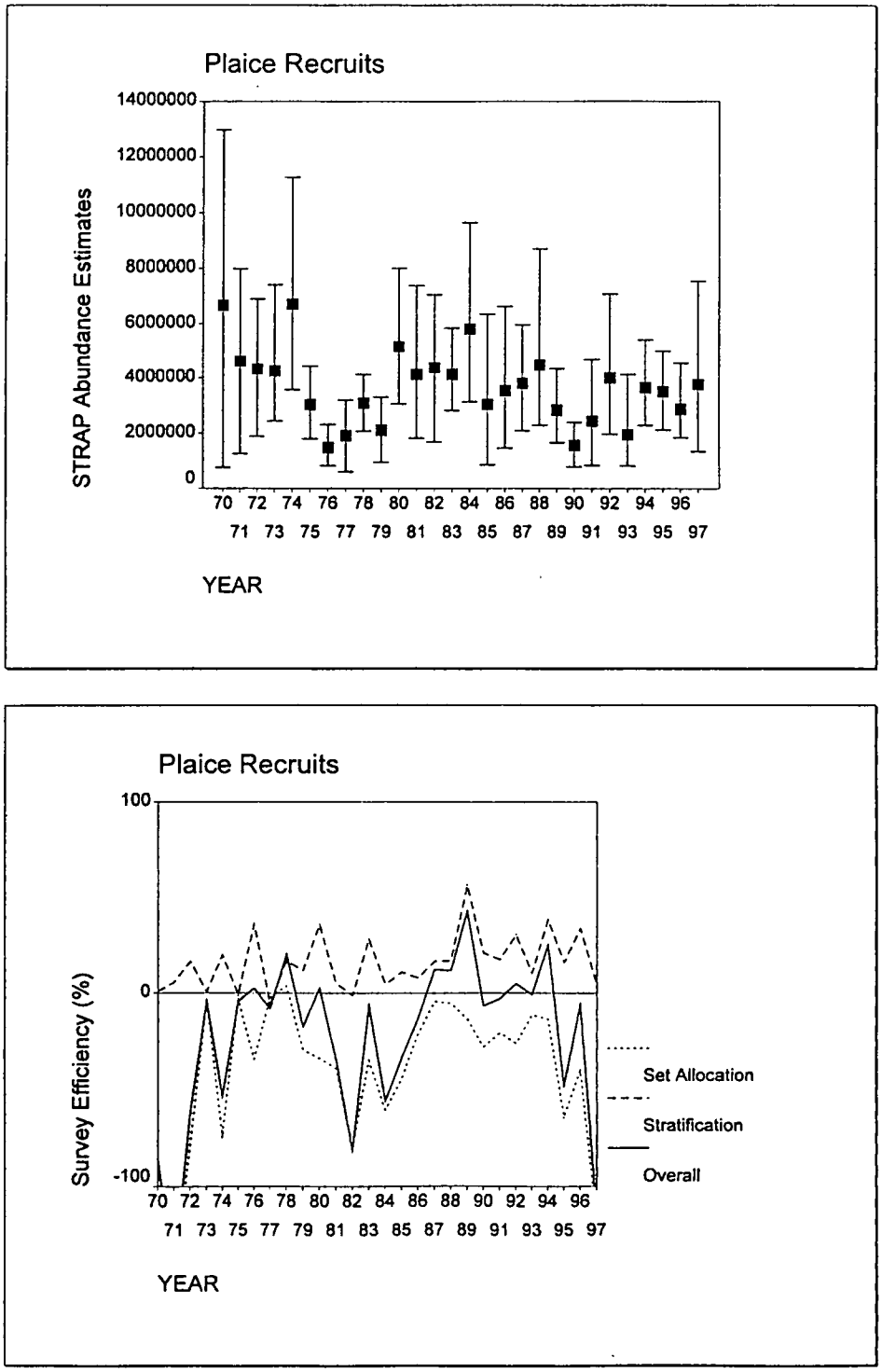


Figure 31. Research vessel abundance estimates of American plaice(>30cm) from 1970 to 1997 (upper panel). The 95% confidence intervals are also given. Estimates of survey efficiency for this species in terms of set allocation and the stratification scheme, compared to a random survey are given in the lower panel.

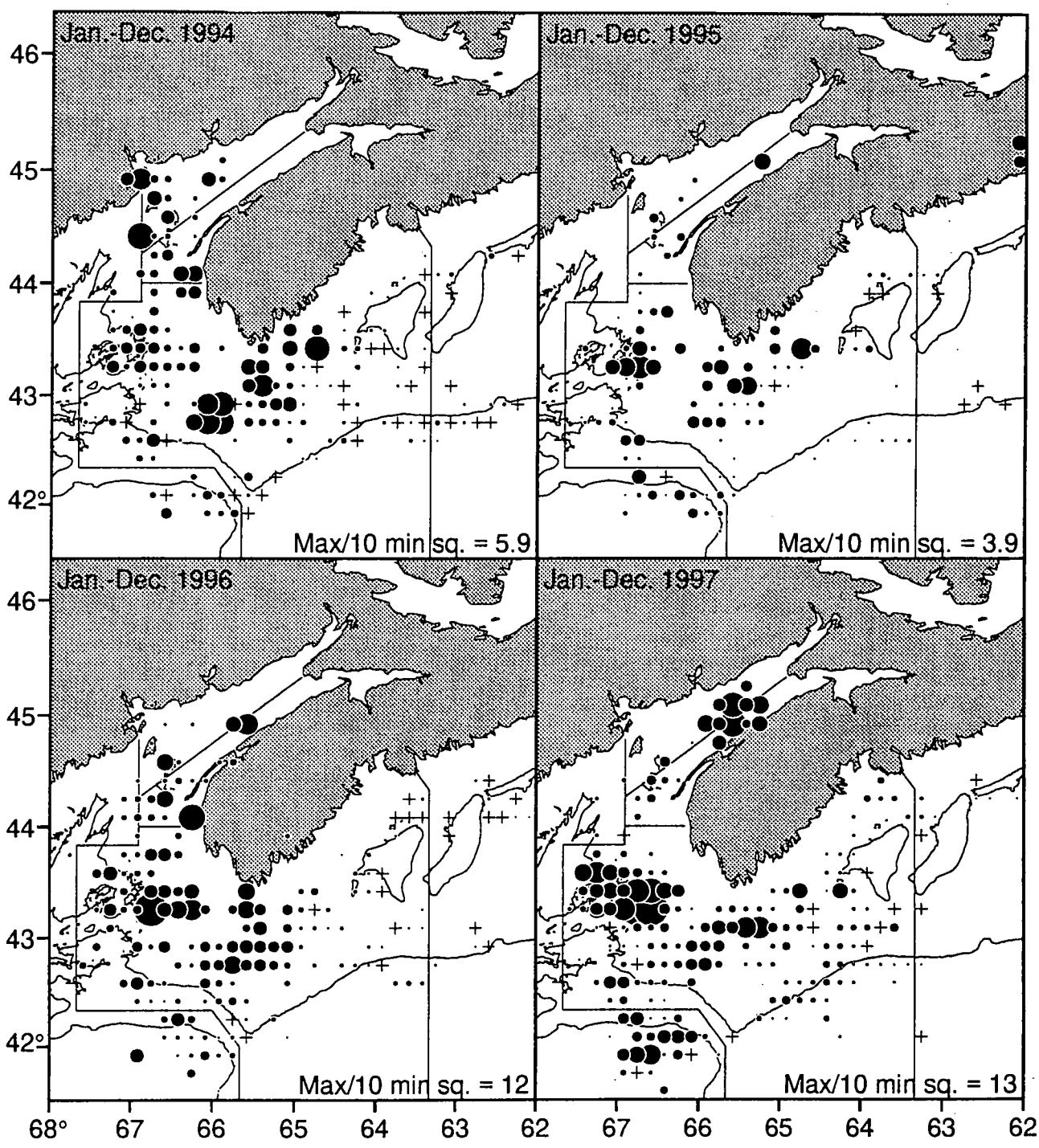


Figure 32. Distribution of the Div. 4X catch (mt) identified as American plaice in the catch-effort statistical database from 1994 to 1997. Catch information from Sub-area 5 are provided for comparative value. The 1997 data are incomplete since only 6-months of the fishery had been completed. The maximum catch in any given square for each year is given at the bottom of each panel.

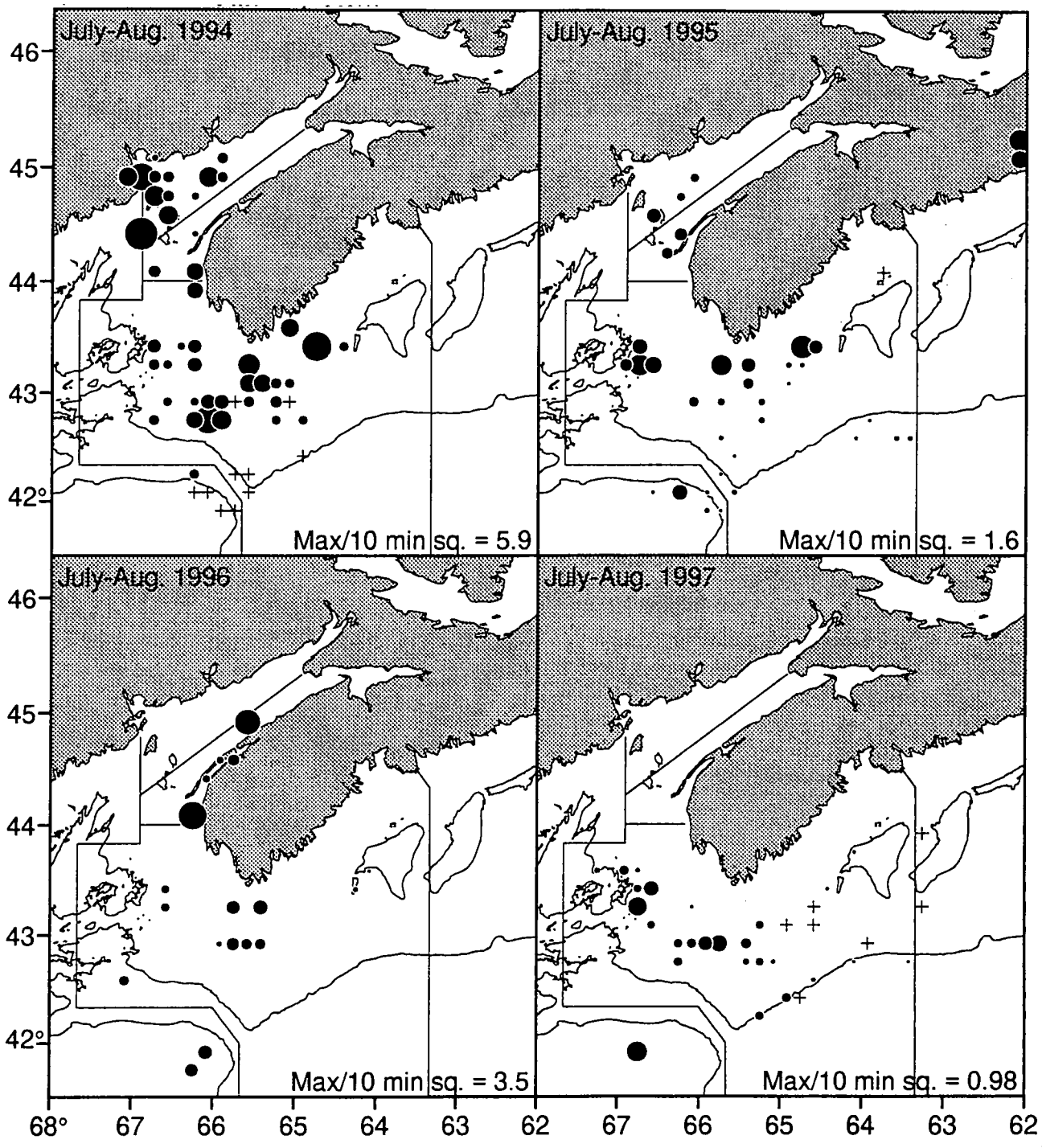


Figure 33. Distribution of the Div. 4X catch (mt) identified as American plaice in the catch-effort statistical database in July-August for 1994 to 1997. Catch information from Sub-area 5 are provided for comparative value. The 1997 data are incomplete since only 6-months of the fishery had been completed. The maximum catch in any given square for each year is given at the bottom of each panel.

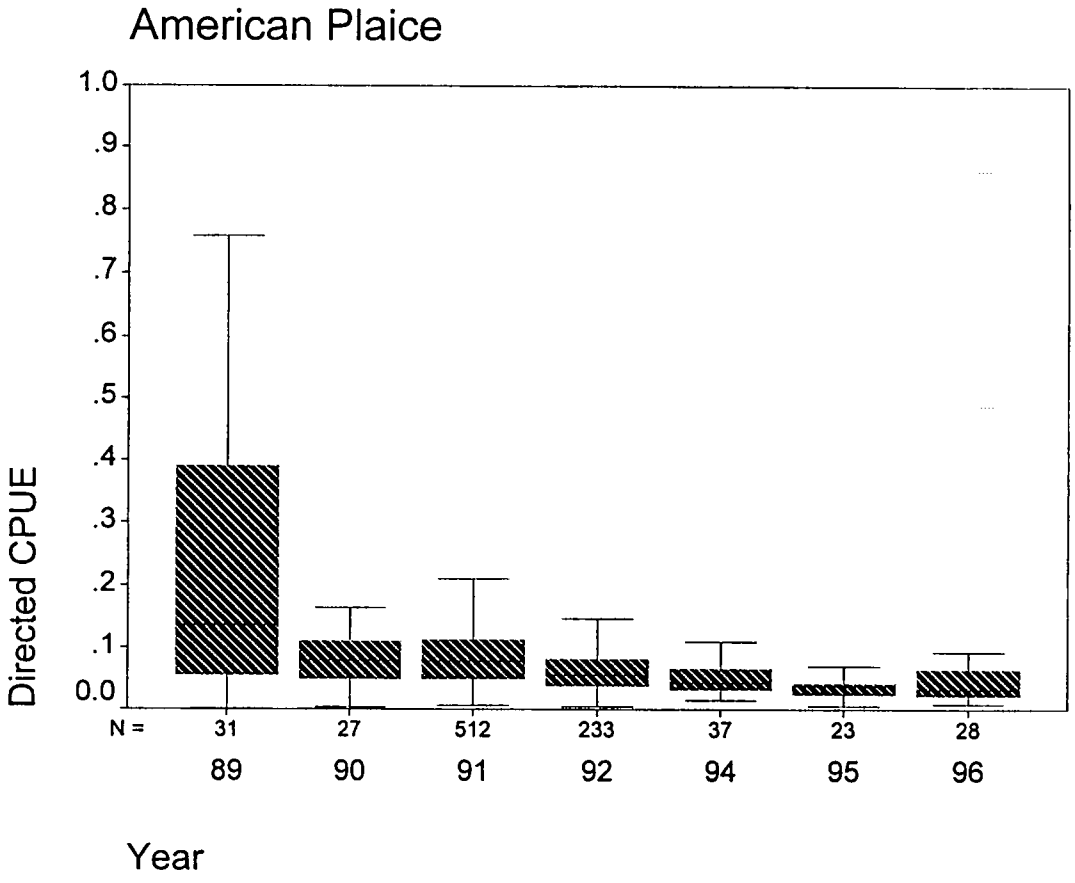


Figure 34. Commercial catch rates (t/hr) of all tonnage class 1-3 stern trawlers fishing for American plaice in Div. 4X, 1989-96, as 'Main Species'.

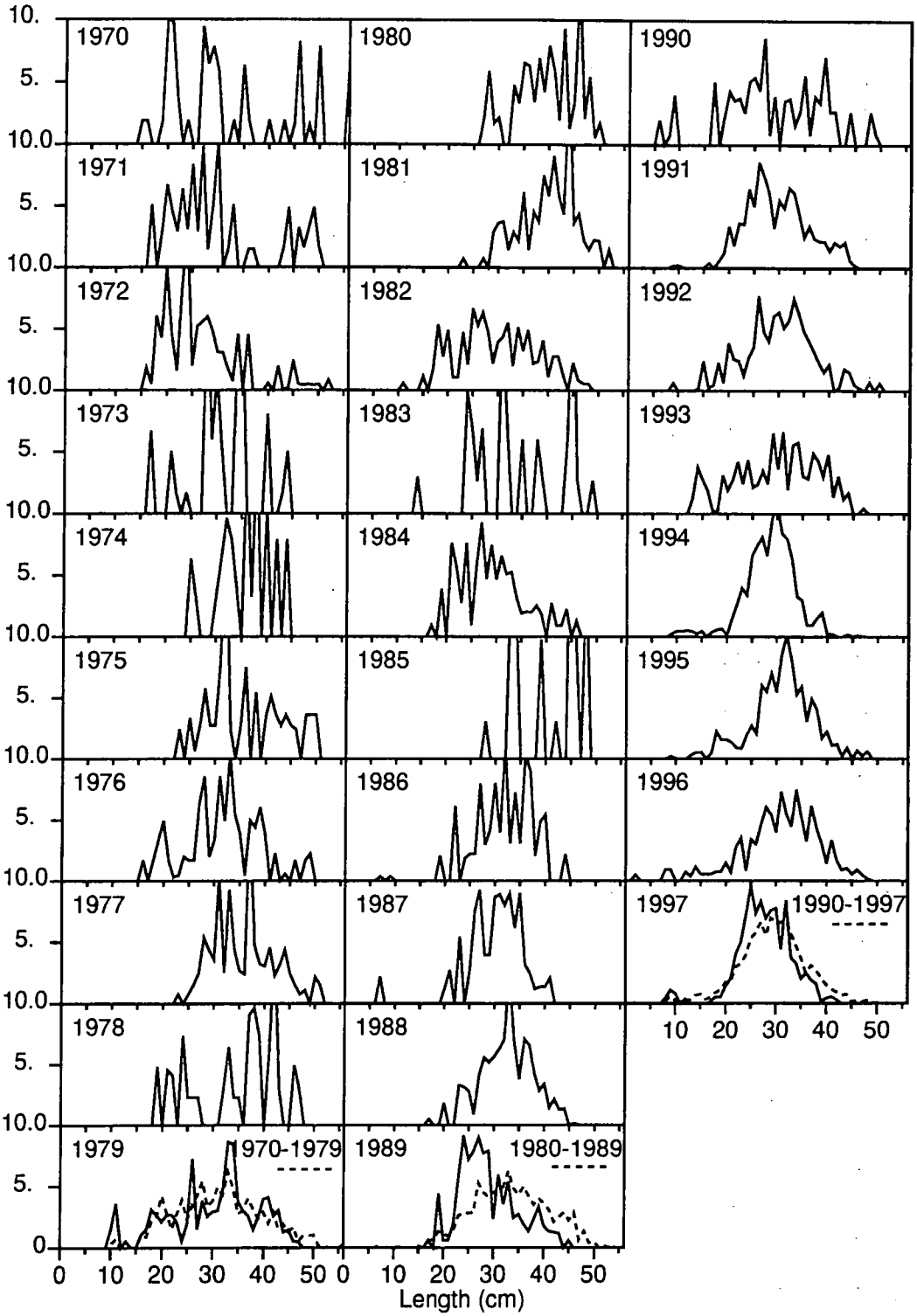


Figure 35. Summer RV survey percent length frequency distributions for yellowtail flounder in 4X (1970-97). Samples were weighted by stratum size, then combined.

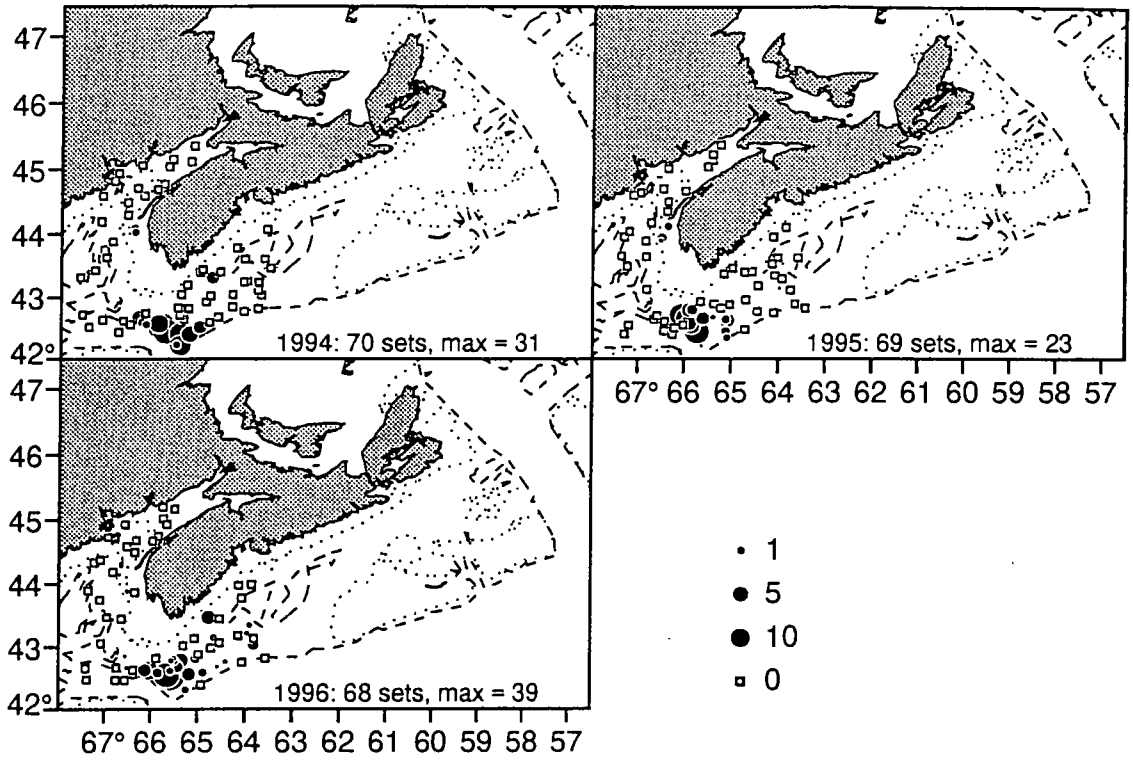


Figure 36. 4X Yellowtail Flounder Biomass (kg/tow) from the 1994-1996 Summer Groundfish Survey.

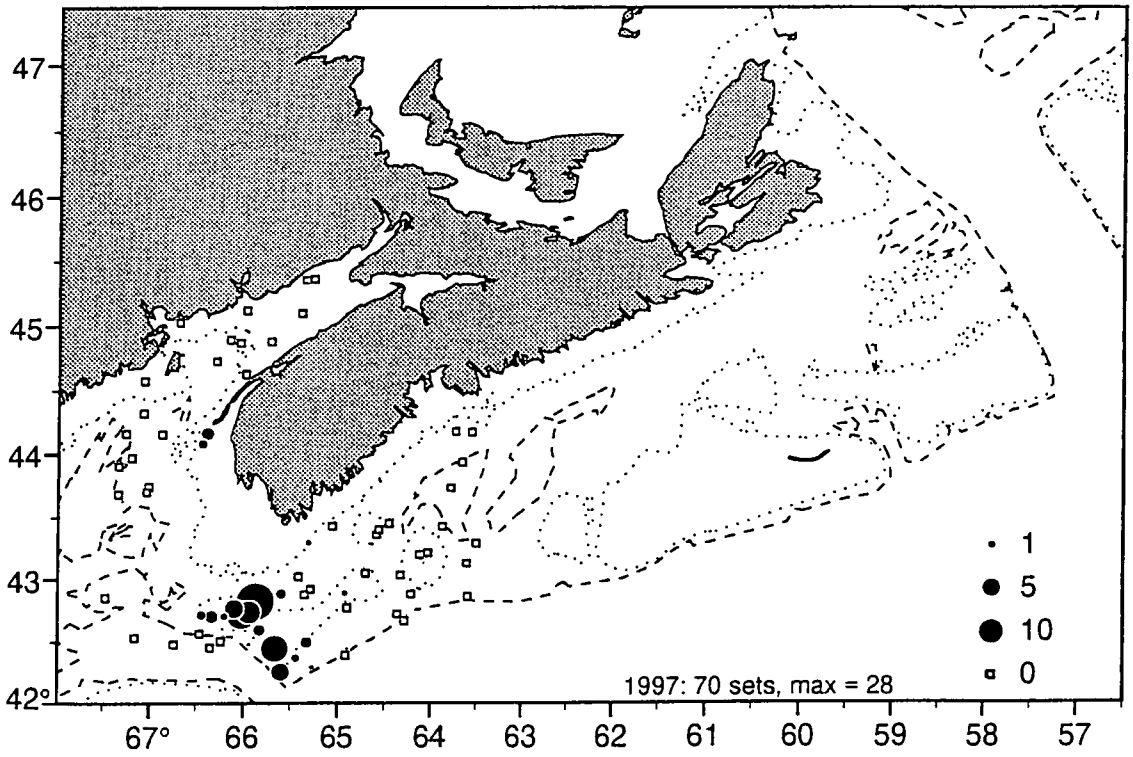


Figure 37. 4X Yellowtail Flounder Biomass (kg/tow) from the 1997 Summer Groundfish Survey.

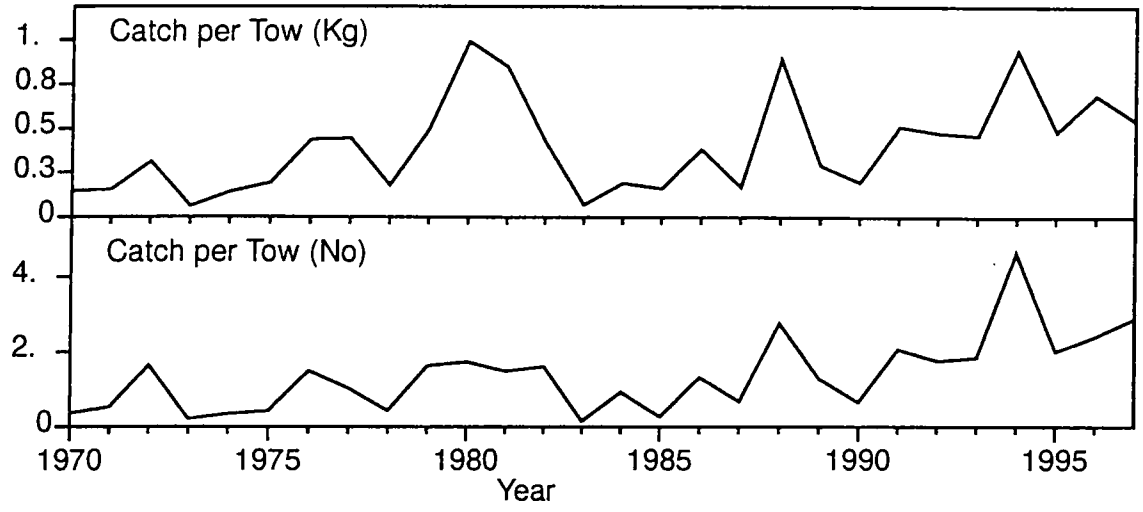
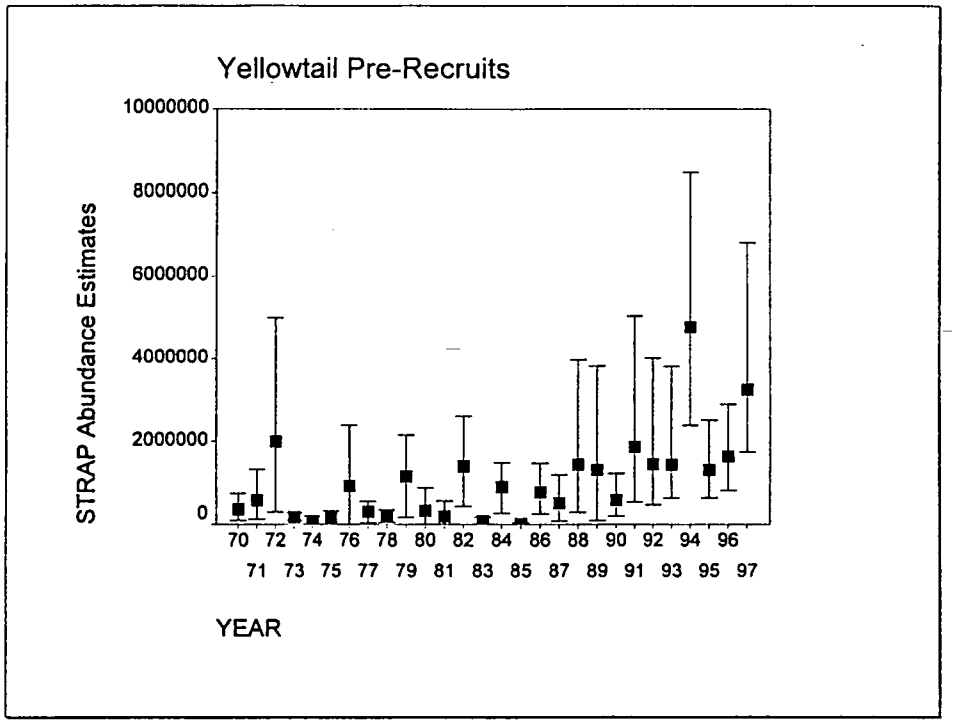


Figure 38. 4X Yellowtail Flounder stratified mean Weight and Number caught per tow from the Summer surveys.



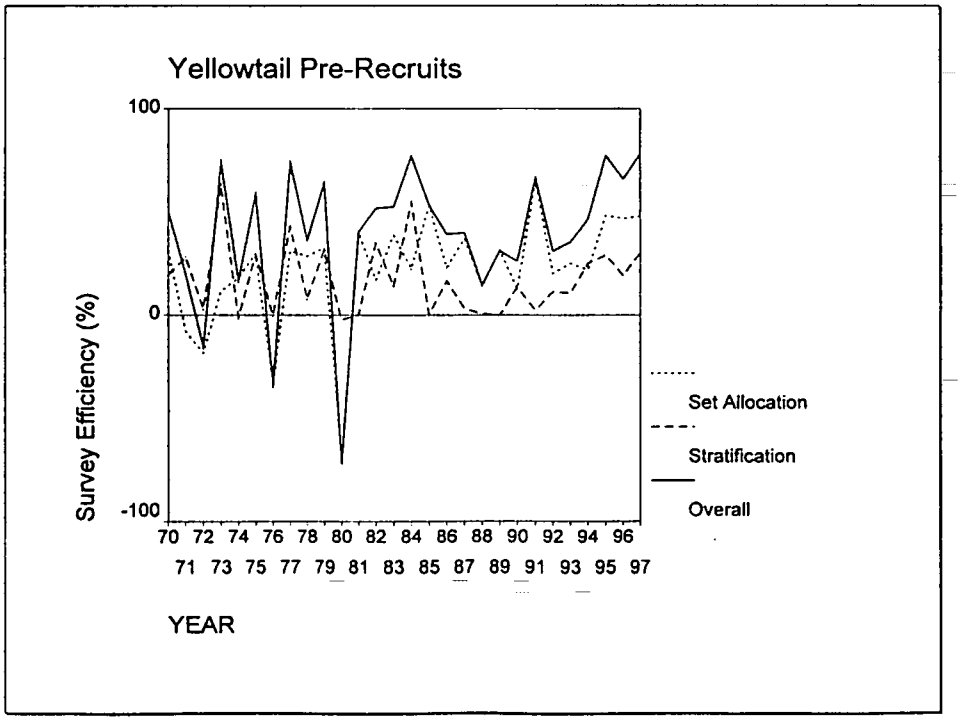


Figure 39. Research vessel abundance estimates of yellowtail flounder (≤30cm) from 1970 to 1997 (upper panel). The 95% confidence intervals are also given. Estimates of survey efficiency for this species in terms of set allocation and the stratification scheme, compared to a random survey are given in the lower panel.

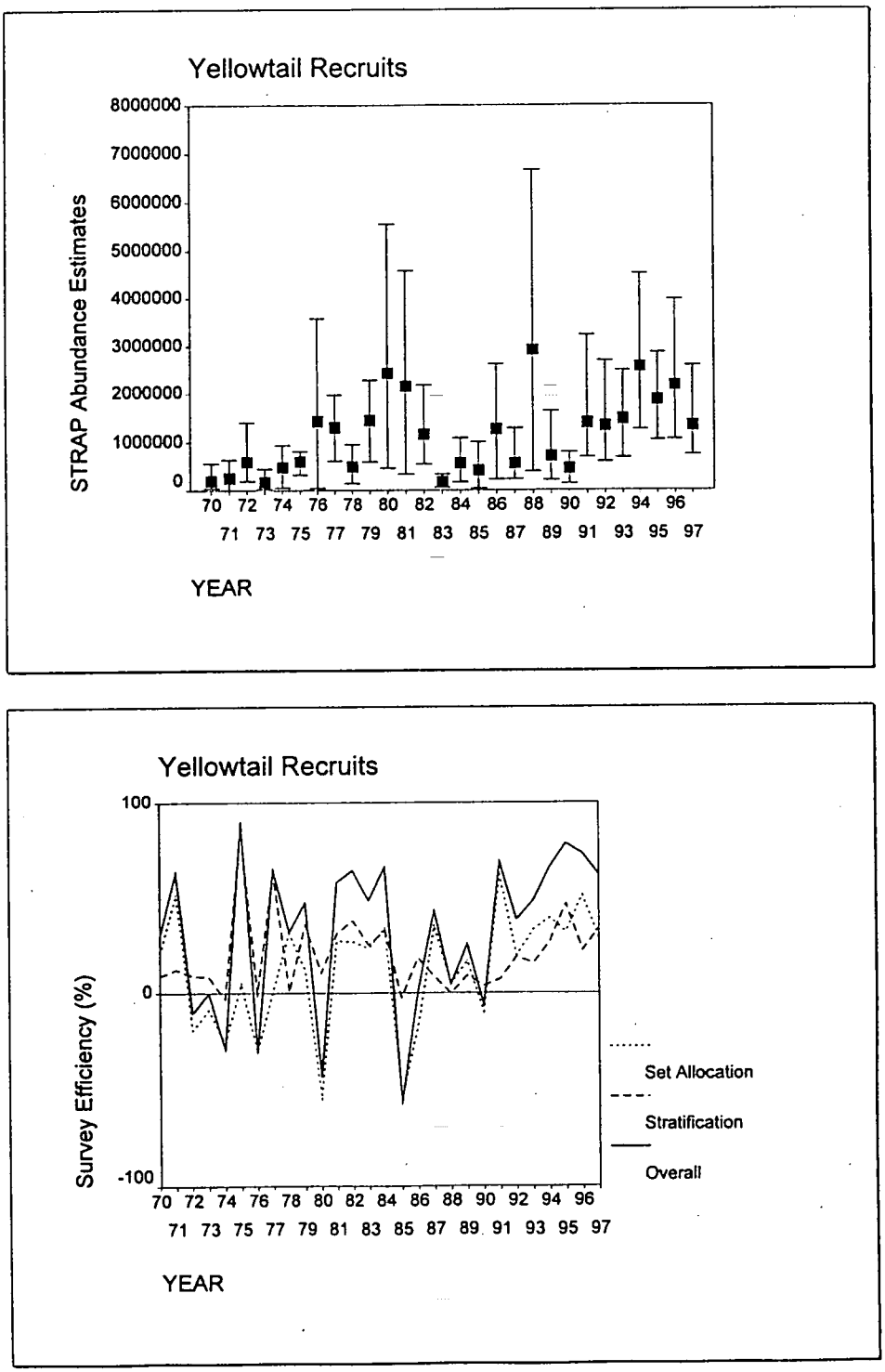


Figure 40. Research vessel abundance estimates of yellowtail flounder (>30cm) from 1970 to 1997 (upper panel). The 95% confidence intervals are also given. Estimates of survey efficiency for this species in terms of set allocation and the stratification scheme, compared to a random survey are given in the lower panel.

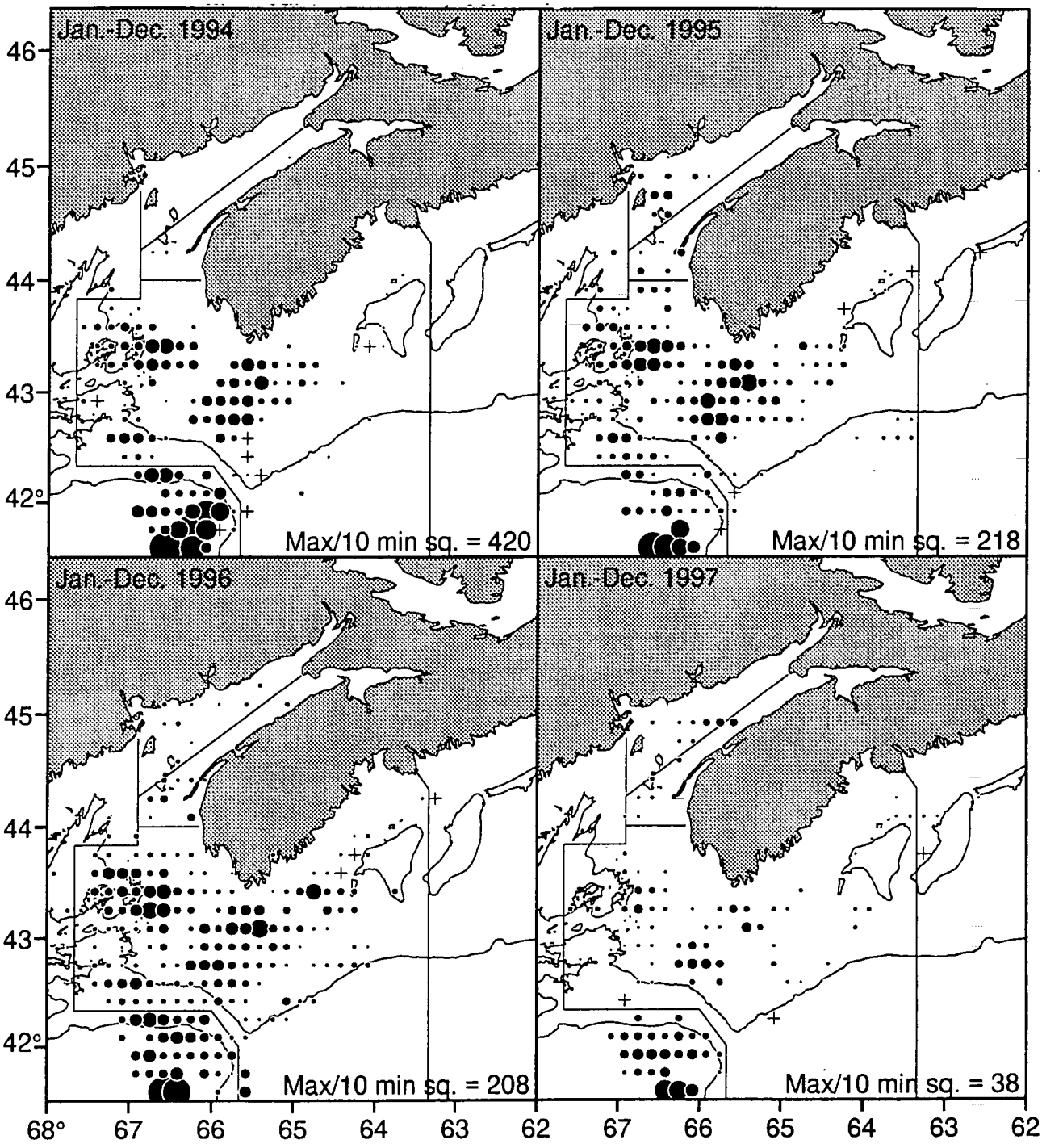


Figure 41. Distribution of the Div. 4X catch (mt) identified as yellowtail flounder in the catch-effort statistical database from 1994 to 1997. Catch information from Sub-area 5 are provided for comparative value. The 1997 data are incomplete since only 6-months of the fishery had been completed. The maximum catch in any given square for each year is given at the bottom of each panel.

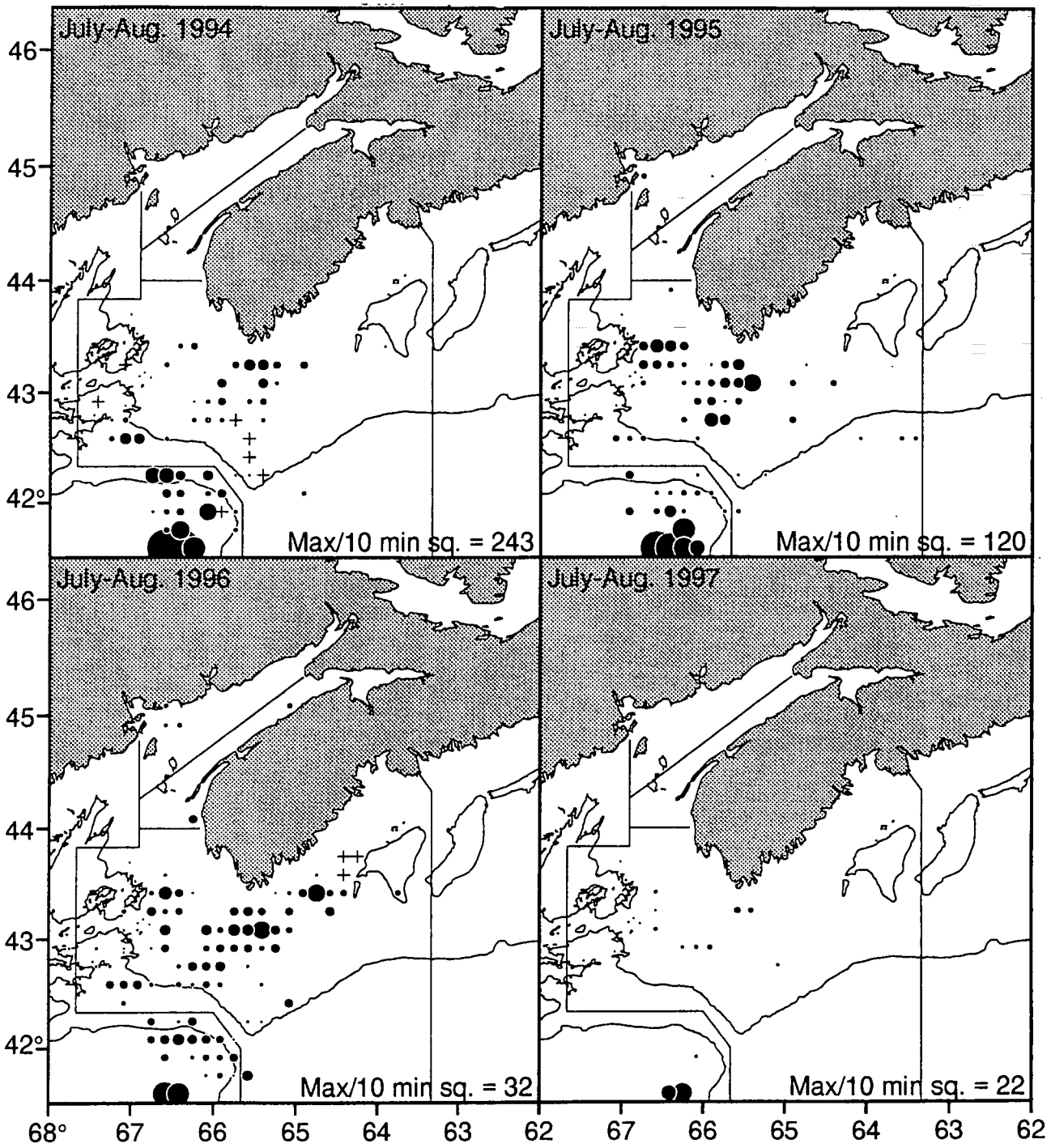


Figure 42. Distribution of the Div. 4X catch (mt) identified as yellowtail flounder in the catch-effort statistical database in July-August from 1994 to 1997. Catch information from Sub-area 5 are provided for comparative value. The 1997 data are incomplete since only 6-months of the fishery had been completed. The maximum catch in any given square for each year is given at the bottom of each panel.

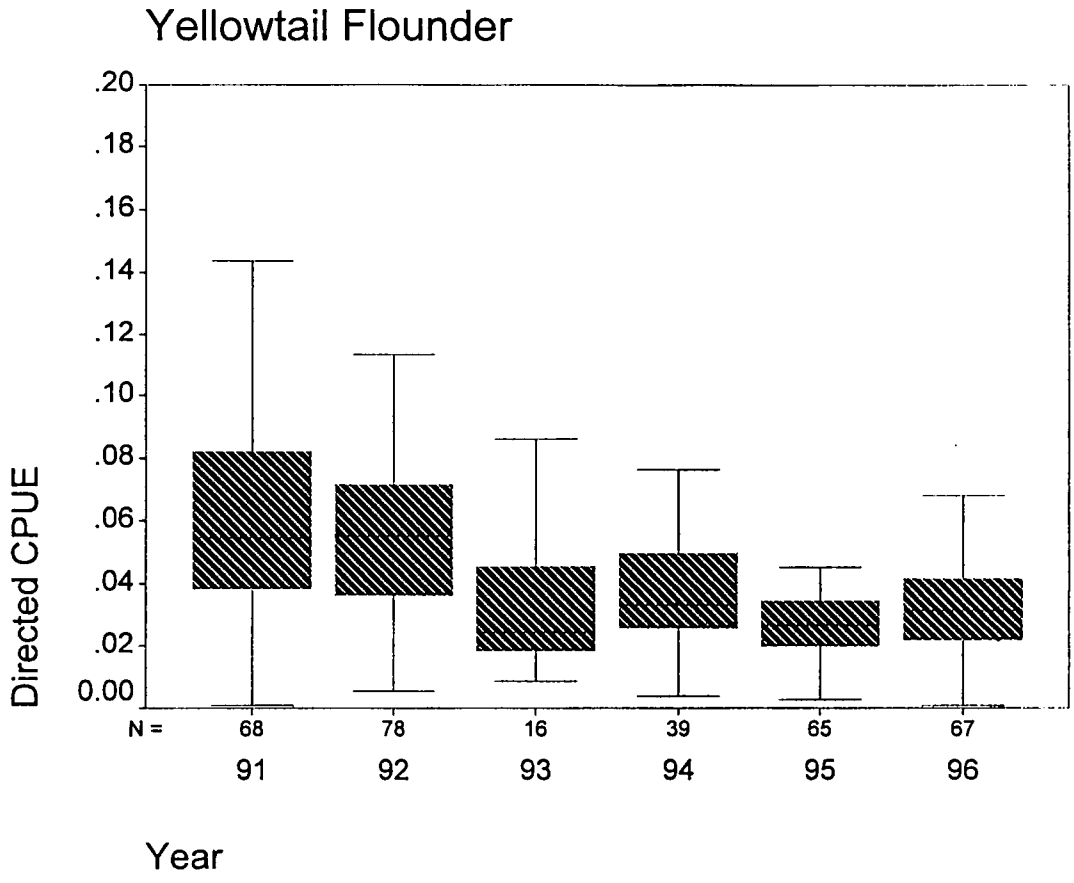


Figure 43. Commercial catch rates (t/hr) of all tonnage class 1-3 stern trawlers fishing for yellowtail flounder in Div. 4X, 1989-96, as 'Main Species'.