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The status of Redfish in Unit 2

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Abstract

The implementation of this management unit in 1993 caused a change in fishing pattern from that generally in place under the former 3P, 4RST and 4VWX units. Seasonal closures and a small fish protocol have also impacted fishing pattern, however harvesters consider that fisheries over the past three years have been generally successful. Catches have declined from 27,000 metric tons in 1993 to 9, 500 metric tons in 1996. From 1997-1999, catches and TACs have been about 10,000 metric tons. Summer DFO trawl surveys indicate that stock size remained stable between 1995 and 1997. This survey has not been conducted since 1997. Industry surveys targeting the commercially exploitable population suggested stability from 1997-1998 but a substantial decline in 1999, however, it is not unusual to see such fluctuation in trawl survey results for redfish. Commercial catches are dominated by the 1980 year-class which has provided yield for the past nine years. The 1988 year-class, which is not as strong as the 1980 year-class, is now fully available to the fishery. However, market demand for larger fish will maintain the targeting of the 1980 year-class. It is not possible to provide an estimate of the absolute size of this stock nor to estimate fishing mortalities. There are indications that the 1994 year-class may be relatively strong but renewed monitoring of pre-recruit year-classes would be required to clarify this.

Résumé

La mise en place de cette unité de gestion en 1993 a modifié les patrons de pêche. Ils ne sont plus ce qu'ils étaient généralement du temps des unités 3P, 4RST et 4VWX. De plus, les fermetures saisonnières et un protocole pour la protection des juvéniles ont influencé les patrons de pêche. Néanmoins, les pêcheurs considèrent que, de façon générale, les pêches des trois dernières années ont été fructueuses. Les prises ont diminué. Elles sont passées de 27 000 tonnes métriques en 1993 à 9 500 tonnes métriques en 1996. De 1997 à 1999, les prises et les TAC ont été d'environ 10 000 tonnes métriques. D'après les résultats de relevés au chalut effectués par le MPO pendant l'été, la taille des stocks est demeurée stable de 1995 à 1997. Il n'y a pas eu de tels relevés depuis 1997. D'après les résultats de relevés de la population pouvant être pêchée commercialement qui ont été effectués par l'industrie, la taille des stocks serait restée stable de 1997 à 1998, mais elle aurait diminué de façon substantielle en 1999. Par contre, de telles variations des résultats de relevés du sébaste au chalut ne sont pas inhabituelles. Les prises commerciales sont composées principalement de la classe annuelle de 1980 qui a assuré un rendement au cours des neuf dernières années. La classe annuelle de 1988 n'est pas aussi abondante que la classe annuelle de 1980, mais on peut maintenant commencer à la pêcher. Cependant, compte tenu de la demande de plus gros poissons sur les marchés, on continuera de recruter la classe annuelle de 1980. Il est impossible de faire une estimation de la taille absolue de ce stock ou des mortalités par pêche. Certains indices permettent de croire que la classe annuelle de 1994 est relativement forte, mais, pour en être certain, il faudrait recommencer à faire des relevés des classes annuelles de prérecrues.

INTRODUCTION

Prior to 1993 redfish in Divisions 3P4RST4VWX were managed as three units: Div. 3P, Div 4RST and Div. 4VWX. In 1989 the integrity of these units as separate management areas was questioned and an examination of applicable data and pertinent published studies ensued. This resulted in the proposal of new management units believed to have a firmer biological basis than the former units (see CAFSAC (1991); Atkinson and Power (1990, 1991)). Allocations and regulatory measures under these new management units were first implemented in 1993. This caused a shift in the general fishing pattern that had existed for fleets under the former Div. 3P, Div. 4RST and Div 4VWX units. This paper presents information relevant to the provision of advice for the April 1, 2000 to March 31, 2001 fishing year for the Laurentian Channel management unit (UNIT 2) which comprises Div. 3Ps4Vs (Jan-Dec), subdivisions 4Wfgj (Jan-Dec) and subdivisions 3Pn4Vn (Jun-Dec).

DESCRIPTION OF MANAGEMENT REGULATIONS AND THE FISHERY

Management regulations

The first quota for UNIT 2 in 1993 was 28,000 t. Subsequently, TACs were reduced successively to 10,000 t for 1996 as a conservation measure and was maintained at that level to 1997. The TAC was raised to 11,000 t for 1998 and initially to 12,000 t for 1999. There was an upward adjustment of the TAC to 18,240 t made at mid-year 1999 to allow for the transition to an April 1 to March 31 based TAC. The supplementary allowance was based on fishing pattern in UNIT 2 from January-March. France is allocated 3.6% of the TAC as part of the 1994 Canada/France Proces-Verbal and can only be fished in 3Ps.

Seasonal and area closures for redfish were implemented in 1995 to (a) minimize possible overlaps with UNIT 1 redfish, given a lack of understanding of redfish migration patterns (subdivisions 3Pn/4Vn closed November and December), and (b) allow for a period when peak spawning of females is likely to occur (UNIT 2 closed in May and June). In addition, subdivisions 4Vn and 4Vsb were closed to all fishing January 1 to April 30 from 1995-1999 related to 4TVn cod.

A small fish protocol, currently at 22cm, was initially established at 25cm in 1996 aimed at protecting the 1988 year-class as it appeared this may be the major contributor to the fishable population.

Nominal Catches

From 1960 to 1968, catches averaged about 20,000 t, increased to an average of 43,000 t up to 1975 mainly due to increased catches by foreign fleets. Catches then declined to the lowest on record in 1984 at 8,100 t (Table 1, Fig. 1). Since then, catches steadily increased to 27,000 t by 1993 but declined subsequently to about 10,000 t in 1997 due to reductions in TACs. Catch increased to about 11,000 in 1998 matching a similar increase in TAC. Up to November 5, 1999, about 10,000 t had been taken. There was an upward adjustment of the TAC from 12,000 t to 18,240 t made at mid-year 1999 to allow for the transition to an April 1, 2000 to March 31, 2001 based TAC. This revision was based on fleet activity in the January to March period.

Since the declaration of the 200-mile Exclusive Economic Zone in 1977, catches have been primarily by Canadian fleets. The increase in catches from 1990-1994 relative to the 1985-1990 is a mainly due to renewed interest in redfish because of depletion of other groundfish resources. Maritime vessels generally account for the majority of landings in Div. 4Vs and subdivision 4Vn while Newfoundland vessels concentrate in Div. 3Ps and subdivision 3Pn. Otter trawling is the predominant method of fishing, primarily with bottom trawls. From the mid-1980s to the early 1990s there had been an increase in the proportion of catch taken with midwater trawls. In recent years midwater trawling only accounts for a substantial portion of the catch in 3Ps.

Prior to 1980 most of the catch was taken in Div. 3Ps and Div. 4Vs. Throughout the 1980s a higher proportion of the catch taken by domestic fleets has been taken in subdivisions 3Pn and 4Vn during a predominantly winter fishery. From 1992 to 1994, increases in total landings have been primarily due to removals from Div. 3Ps, subdivisions 3Pn and 4Vn while there was a substantial decrease in landings from Div. 4Vs for 1992-1993 (Table 2). The activity in this time period is partly related to the incorporation of previous fishing experience within the temporal and spatial definition of the UNIT 2 management unit. In recent years most of the catch has been taken in Div. 3Ps and Div. 4Vs as area and seasonal closures have further affected fleet activity in comparison to the former management regime.

Catch by quarter and subdivision (unit area) since the implementation of UNIT2 in 1993 (Table 3) indicates both the learning experience of the fleets and the introduction of additional season closures in 1995. Closures are in 3Pn/4Vn in November and December for the protection of UNIT1 fish (under moratorium) that may be mixed in the area, and all of UNIT2 in May and June to allow for peak spawning of females to occur. The closures have forced the fleets to fish further south (3Pd) than previously. In 1998 fishing in 3Psg, the most southern of the unit areas fished has accounted for about 30% of the landings. Fleets reported the same pattern for 1999. In general, the fishery is still primarily concentrated in late fall and winter when catch rates are highest.

COMMERCIAL DATA

CPUE Index of Abundance

In past assessments a standardized commercial catch rate index based on data since 1960 had been developed routinely for evaluation. However, in recent years, it has been difficult to interpret a large increase from 1988 to 1990, a historical high, followed by successive decreases to 1995, a historical low. Since 1988 the commercial catch rates are affected by factors other than stock abundance (i.e. changes in the efficiency of the fishing fleets, changes in management regime, area/seasonal closures and the introduction of a small fish protocol which have affected the fishing pattern) and thus cannot be considered a reliable index of abundance of the stock.

Catch at length

Length distributions sampled from 1994-1999 fisheries by port sampling and observer programs were weighted by monthly landings by subdivision to derive a combined catch-at-length for UNIT 2.

The length-weight relationships used were:

$$WT\ (males) = 0.01659\ Forklength^{2.9548}$$
$$WT\ (females) = 0.013272\ Forklength^{3.0210}$$

The data (Fig. 2) suggest primarily bi-modal distributions in 1994 and 1995 with predominant modes for males and females between 28-31 cm (primarily the 1980 year-class) and another between 23-26 cm (mid-1980s year-classes), with the bulk of the catch over 27 cm in both years. The 1996 catch at length represents the Newfoundland fleet only and requires revision. The sampling suggests a unimodal distribution for each sex with the peak at 30 cm for males and 32 cm for females. A small fish protocol at 25 cm was implemented in 1996, which is reflected in the catch size distribution relative to 1994-1995. The protocol was reduced to 22 cm in 1997. The 1997 sampling indicates a much broader range in the catch with a larger proportion of fish greater than 35 cm than in the previous three years. The predominant modes in 1997 for males and females occurred between 32-35 cm corresponding to the 1980 year-class. The 1988 year-class is also represented here as modes between 23-25 cm. Size distribution in the catch from 1998 and 1999 were similar in that they were unimodal for each sex at around 30-31 cm for males and 33-34 cm for females. The 1988 year-class was not as apparent in 1998 or 1999 as it was in the 1997 catch.

RESEARCH SURVEY DATA

3Ps Winter-Spring DFO Groundfish Surveys

Stratified-random groundfish surveys have been conducted since 1973 in Subdiv. 3Ps generally in the February to April period. Station allocation is applied proportionally based on stratum area. These surveys usually cover the extent of the area of Subdiv. 3Ps to a maximum of 730m. A Yankee 41-5 otter trawl was used from 1973 to 1982 (1.75 n. mi. standard tow), an Engel 145 otter trawl was used from 1983 to 1995 (1.75 n. mi. standard tow) and a Campelen 1800 shrimp trawl (0.75 n. mi. standard tow) was used for the 1996 to 1999 surveys. Although comparative fishing trials have been conducted to derive conversion factors from Engel to Campelen, the application of the conversion factors to the data has not been completed. The stratification scheme from which the stratified-random design of the surveys is based has been revised several times in recent years (see Bishop (1994), Murphy (1996)), consequently data for 1994-1999 (Tables 5 and 7) are presented separately to avoid any confusion. One revision was necessary to account primarily for an incorrect boundary line between Div. 3P and 4V in the Laurentian Channel, however the stratified analyses have not been updated to eliminate those sets whose position were actually in Div. 4Vs or subdivision 4Vn because of the error.

The historical series of mean numbers and weights per standard tow for 3Ps show some rather dramatic fluctuations between some years (Tables 4-7, Fig. 3). The changes in relative abundance throughout the series are too dynamic to reflect year to year changes in stock abundance. These surveys only cover part of the management unit and consequently may not be reflective of changes in stock size throughout the entire unit, but may reflect fish movements into and out of the survey area. Therefore, the 3Ps winter/spring survey series has limited value in determining current stock status in UNIT 2. Generally the series indicates a higher level of relative abundance prior to 1983 compared to the period from 1983 to 1999. This is coincident with the change in vessel and gear but whether this is reflective

of the dynamics of redfish in this area cannot be determined without a method to standardize or convert the data into equivalent units.

Geographical distribution plots (Fig. 4-5) of catches in Div. 3P(s+n) since 1989 (subdivision 3Pn considered to be part of management UNIT 1 at this time of year), indicate generally two clusters of relatively higher density apparent throughout the time series. One cluster is in an area encompassing the northwest corner of St. Pierre Bank, which extends into Subdiv. 3Pn. The second cluster generally occurs along the southern slopes of St. Pierre Bank in the proximity of Div. 3O.

Size composition (mean per tow at length) from the 3Ps portion of the surveys plotted from 1980-1999 (Fig. 6) show the relatively strong 1980 year-class that was first captured in the 1981 survey and could be tracked reasonably well through to the current surveys (at mode 32 cm). The next tractable pulse of recruitment was the 1985 year-class, first detected in the 1988 survey at 11 cm. This year-class increased gradually in the surveys up to 1993 but declined thereafter and was at relatively low in abundance by 1998. The 1988 year-class was next to appear in the 1991 survey in relatively large numbers at 10 cm. It appeared stronger than the 1985 year-class for most of the surveys to 1995 (the last survey with the Engel trawl). In the Campelen series starting in 1996 the size distribution indicates three peaks, one at 7 cm corresponding to the 1994 year-class, one at 21 cm corresponding to the 1988 year-class and one at 31 cm corresponding to the 1980 year-class. From 1996 to 1999, both the 1985 and 1988 year-classes appear to diminish in comparison to the 1980 year-class. Over the same time, the 1994 year-class has gained in relative strength. It is difficult to determine if these apparent decreases in the 1985 and 1988 year-classes represent mortality and/or migration because the survey is not designed to cover the entire area of UNIT 2. Nevertheless, this suggests that the 1980 year-class it is much stronger because it has been fished for at least nine years by 1999. In the 1999 survey, the 1994 year-class (mode at 16 cm) was the most abundant in the research catch followed by the 1980 year- class (mode at 32 cm). There was also a good sign of modes at 8 cm and 11 cm. These will require a few years of tracking to estimate their relative strength.

4VW Summer DFO Groundfish Surveys

Stratified-random groundfish surveys have been conducted since 1970 in Division 4VW generally in the early summer period. In the more recent period, station allocation has been weighted by the abundance of cod, haddock and pollock while previously the allocation had been proportional to stratum area. These surveys cover to a maximum of 366 m. The A. T. Cameron conducted the surveys from 1970 to 1981 with a Yankee 36 otter trawl. The Alfred Needler continued the surveys in 1982 and used a Western IIa trawl. Both used a standard tow of 1.75 n. mi. No attempt has been made to apply conversion factors to the data for the different type of trawls.

As seen with the 3Ps surveys, the historical series of mean number and weight per standard tow (Tables 8-9, Fig. 7) show large annual fluctuations between years and between strata within each year. These surveys only cover part of the management unit and do not include areas beyond 366 m within each division surveyed. Therefore, the 4VW summer survey series has limited value in determining current stock status in UNIT 2. Generally the series indicates a higher level of relative abundance since 1982 compared to the period from 1970 to 1981. This is coincident with the change in vessel and gear but whether this is reflective of the dynamics of redfish in this area cannot be determined without a method to standardize or convert the data into equivalent trawl units. It is interesting that a change in vessel and gear for the 3Ps winter/spring series in 1983 had the opposite affect. Survey estimates after

the changes were lower. For the Western IIa series since 1982, abundance appears to have increased from 1982 to 1989 followed by a decrease to 1999 which is at the 1982 level.

Size composition (mean per tow at length) from the 4VW summer surveys (Fig. 8) show the relatively strong year-class(es) of the early 1970s and 1980 which were generally strong in a number of different redfish stocks. The 1980 year-class first appeared in the research size distributions at 8 cm in 1982. This increased in relative strength until 1984 at 14-15cm, which suggests that it is not fully recruited to the Western IIa trawl at smaller sizes. The data series from 1984 on show three modes which can be tracked for a number of years and have also been identified in the 3Ps winter/spring series: the relatively strong 1980 year-class (at 14-15 cm in 1984), a pulse corresponding to the 1985 year-class (at 9 cm in 1987) and the 1988 year-class (at 9 cm in 1990). The 1985 year-class appeared relatively strong up to 1993 but was not recognizable by the 1995 survey. The 1988 year-class showed a similar pattern, appearing relatively strong up to 1993 but declined in successive surveys until it was barely detected in 1997. An interpretation of these events as to whether it is mortality or migration must also apply the same caveat as with the 3Ps surveys. The survey was not designed for redfish in UNIT 2. Nevertheless, both the 3Ps and 4VW surveys show a similar trend for the 1985 and 1988 year-classes in that they are greatly diminished after 8-10 years in the survey. The 1997 and 1998 surveys were dominated by fish larger than 29cm. In 1999, the research catch was dominated by fish less than 21 cm with a mode at 16 cm. It is likely that this is the effect of one large set in stratum 451.

4VsW Spring DFO Cod Surveys

Stratified-random surveys had been conducted during spring in subdivision 4Vs and division 4W from 1986 to 1999, with the exception of 1998, directed towards cod. The stratification scheme on which the surveys were based was a revision of the standard Scotian Shelf strata based on distribution of cod. Earlier surveys covered down to 366 m but coverage was expanded in 1993 to include the Laurentian Channel out to the boundary with Div. 3P. The Alfred Needler conducted the surveys using a Western IIa otter trawl (1.75 n. mi. standard tow).

As seen with the 3Ps survey series, the historical series of mean number and weight (Table 10-11, Fig. 9) per standard tow show large annual fluctuations both between year and between strata within each year. It should be noted that the strata beyond 366 m in the Laurentian Channel area are not included in estimates of survey abundance and biomass in Tables 10-11. The changes in relative abundance throughout the series are too dynamic to reflect year to year changes in stock abundance. These surveys only cover part of the management unit and are directed to cod which likely results in reduced number of stations along the slopes and in deeper water where redfish reside. Each survey year is dominated by one or two large sets. Therefore, the 4VsW spring survey series has limited value in determining current stock status in UNIT 2.

Size composition (mean number per tow at length) from the surveys (Fig. 10) generally indicate the majority of fish captured range from 6 cm to 21 cm. There were larger fish captured in the surveys that covered the Laurentian Channel since 1993. A few modes can be tracked in the surveys from 1987 to 1991 but these distributions are more than likely just reflective of the larger sets taken during the surveys as indicated previously. Nevertheless, they have sampled both the 1985 year-class (at 7 cm in 1987) and the 1988 year-class (at 11 cm in 1991).

UNIT 2 Summer DFO Redfish Surveys

Stratified-random research surveys were conducted in subdivisions 3Ps, 3Pn, 4Vs and 4Vn during the summers of 1994-1997 utilizing a Campelen 1800 shrimp trawl with a 12.5-mm liner covering strata from 100-400 fathoms. In addition strata in Div. 3O adjacent to 3Ps are also covered for the purposes of mapping the distribution. Station allocation is based on proportion of stratum area. These surveys are considered a better indicator of relative stock size (compared to the winter-spring survey series) because they cover most of the area comprising UNIT 2 and are conducted at a time when it is believed that there is no mixing of UNIT 1 and UNIT 2 fish. There has been no survey conducted since 1997.

Although there are some fluctuations, particularly in 4Vs, caused by the occurrence of large sets which is not uncommon for redfish, the confidence limits around the stratified mean per tow estimates derived from these surveys are relatively narrow given the nature of bottom trawl estimates for redfish (Table 12). The biomass index derived from the surveys suggest that stock size remained stable at about 200,000 t between 1995 and 1997, slightly below the 1994 level. Geographical distribution plots of the surveys (Fig. 11) illustrate that larger catches are taken along the slopes in 3Ps and 4Vs and also depict that comparably large catches are taken in Div. 3O adjacent to 3Ps in the years sampled. The plots also show that except for 1994 higher density occurs generally south of subdivision 3Pn and an equivalent area adjacent in subdivision 4Vn.

Size composition by subdivision (Fig. 12) from the surveys generally show bi-modal distributions from 1994 to 1997. For the 1997 survey, the distributions show modes at about 12-13 cm (1994 year-class), 23 cm (1988 year-class) and 32 cm (1980 year-class). The 1994 year-class was first detected in the 1996 survey at 9 cm but was only relatively abundant in subdivision 3Pn. The 1997 survey indicates they were the most abundant year-class in subdivision 3Pn and were also represented, but to a much lesser extent, in subdivision 3Ps. There was no indication of the 1994 year-class in subdivision 4Vn or 4Vs. It is clear that there are other differences in distributions between subdivisions, the most striking being the relatively poor representation of year-classes after 1980 (fish less than 27 cm) in subdivision 4Vn in all surveys. The 1988 year-class was also poorly represented in subdivision 4Vs in the 1996 survey but the reason may simply be poor sampling in the slope areas. In subdivision 3Ps there was a tri-modal distribution in 1994 with modes at 18 cm (1988 year-class), 23 cm (1985 year-class) and 31 cm (1980 year-class). In the 1995 and 1996 surveys there were bi-modal distributions corresponding to the 1988 and 1980 year-classes. The disappearance of the 1985 year-class was also seen in the 3Ps surveys and the 4VW summer surveys. These observations suggest that a finer analysis of the data is warranted to determine whether these observations are consistent over the fishing stations or are influenced by only a few fishing stations.

An index of abundance at length estimated for the combined areas surveyed in UNIT 2 from the 1997 summer survey illustrate different growth rate between males and females from a given year-class (Fig. 13). Clearly, allowing for these different growth rates, there are three major groups, one at 12 cm (the 1994 year-class), one at 23 cm (the 1988 year-class) and one at 31-34 cm (the 1980 year-class). Although the estimated abundance index of the 1988 year-class in the 1997 survey was higher than in the 1996 survey, it does not appear to be as abundant as it was in the 1994 and 1995 surveys. The 1994 year-class, first detected in the 1996 survey, was estimated to be less than half the size of the 1988 year-class. This year-class was primarily caught in subdivision 3Pn. There was a substantial proportion of the 1997 research catch comprised of the early to mid 1980s year-classes, which had been fished for about 9 years, suggesting that the 1988 year-class is much weaker than that of 1980.

INDUSTRY SURVEY DATA

UNIT 2 GEAC Redfish Surveys

Stratified-random industry funded surveys were conducted by GEAC (Groundfish Enterprise Allocation Council) in subdivisions 3Ps, 3Pn, 4Vs and 4Vn during December in 1997 and August/September in 1998-1999 utilizing a commercial Engel 170' bottom trawl with a 105-110 mm mesh unlined codend. The general protocol and area coverage was consistent with the DFO UNIT 2 summer surveys. Station allocation amongst strata was applied based on proportion of stratum area relative to the total and the target area was between 100-400 fathoms (180-730 meters) which covers an area of about 14,700 sq. mi. The 1997 (Dec1-12) and 1999 (Aug31-Sept9) surveys were conducted by the M.V. Cape Beaver. The M.V. Cape Ballard, a ship of equal design and size as the M.V. Cape Beaver, conducted the 1998 (Aug16-23) survey. The fishing protocol at each station required 30-minute tows conducted at 3.5 knots with a net monitoring system to determine touchdown and subsequent liftoff of the trawl. Each survey covered at least 90% of the intended area.

The mean weight per standard tow (Table 13) shows large fluctuations within and between strata particularly in the shallower strata along the shelf edge on both sides of the Laurentian Channel. Although bottom trawl surveys for redfish frequently demonstrate high variable between years and/or within strata, there is an additional factor of possible seasonal differences to consider in drawing inferences between 1997 (December) and the 1998-1999 (August/September) surveys. Given this caveat, however, the survey biomass index remained relatively stable between 1997 (240,000 t) and 1998 (222,000 t) but decreased to 94,000 t in 1999. A plot of the distribution of the standardized catches (Fig. 14) show that in all surveys the largest catches taken were along the slope edges in 3Ps and 4Vs consistent with DFO surveys in these areas. It is also apparent that there are differences in the areas of largest concentrations within the Laurentian Channel between the surveys. The December 1997 survey indicates two areas of relatively high density along the 3P4V line south of Hermitage Channel, one centred on 45°30'N and the second on 46°N. The August 1998 plot shows that the area of highest density occurred at the southern extent of the subdivision 3Pn/4Vn line centred on 46°30'N. Although there were a number of strata unsampled along the southern edge of Banquereau Bank on the Scotian Shelf, the 1999 survey indicates that density was generally lower throughout the remainder of area as compared to the 1998 survey. Nevertheless, it is not unusual to see such a fluctuation in a redfish survey and a single estimate should not be given much weight. The surveys indicated the presence of both the 1980 and 1988 year-classes. In all surveys, the relative proportion of the 1988 year-class in the catches was lower than the 1980 year-class.

Size composition from the GEAC surveys (Fig. 15) generally indicates bi-modal distributions in Div. 3Ps and 4Vs and single mode distributions in subdivisions 3Pn and 4Vn. Allowing for growth, the size distributions from 1998 to 1999 are similar except in 4Vs where few fish were sampled less than 29 cm in 1999 whereas they were dominant in the distribution in 1998. The 1999 survey has modes between 32cm-34cm in all subdivisions corresponding to the 1980 year-class and mode at 25cm only in 3Ps corresponding to the 1988 year-class.

An index of abundance at length estimated for the combined areas surveyed in UNIT 2 from the 1999 August GEAC survey (Fig. 16) again reflects the difference in growth rate between males and

females for any given year-class. Allowing for these different growth rates, in the 1999 survey there are two major groups defined by modes between 26-27cm (the 1988 year-class) and 32-35 cm (the 1980 year-class). The estimates of abundance of both year-classes decreased substantially from the 1998 survey but further monitoring is required to determine extent of the magnitude or whether this was an anomalous survey. Nevertheless, the relative proportion of the 1988 year-class in the catches was lower than the 1980 year-class.

INDUSTRY PERSPECTIVE

Because of the change in fishing pattern that resulted from the implementation of this management unit in 1993, regulation of seasonal closures in 1995 (May-June for all of UNIT 2 and November-December for Subdiv. 3Pn and 4Vn) and the implementation of the small fish protocol in 1996 (currently at a minimum size of 22 cm), the major stakeholders in the fishery have difficulty relating their post-1993 fisheries to past experiences.

From 1997-1999 fishing took place throughout different areas within the management unit depending on the fleet, and industry considers that the fishery was very successful in these years. There have been little to no difficulties encountered as a result of the small fish protocol. At present, the majority of the fish caught are in the 32-35 cm (13-14 inch) range. One fleets experience in the fall of 1999 has been that concentrations of fish in 3Psd have been smaller than previous years. They also related that their fishing experience in 1999 in 4Vsc was consistent in terms of catch rate and size as related to the recent years. Market demand for larger fish will likely result in continued targeting of the 1980 year-class even though the 1988 year-class is of commercial size.

SOURCES OF UNCERTAINTY

The commercial fisheries continue to target the 1980 year-class. Although the absolute size of the 1988 year-class is unknown, it is now largely exploitable and its relative strength in all surveys still suggest it is not as great as the 1980 year-class which has already contributed at least nine years of yield. Therefore, there is reduced expectation about the overall yield that the 1988 year- class may produce.

It remains uncertain whether the 1994 year-class, first seen in 3Pn during the 1997 DFO summer survey, and noted by industry in some parts of 3Ps and 4Vs in recent fisheries, is strong. The GEAC industry survey is designed to give specific information regarding the commercially exploitable portion of the biomass. Without the ability to accurately determine year-class strength, it is therefore important to be able to monitor and measure relative year-class strengths for a number of years as has been achieved in the past using departmental surveys over the whole area in order to better forecast the future for this resource. It is important to fully understand the relative strength of the 1980, 1988 and 1994 (and subsequent) year-classes if we wish to look beyond a year or two in considering the future trajectory of this resource.

The results of genetic studies presented at a November, 1999 workshop on the Multidisciplinary Program on Redfish, indicated that while redfish from UNIT 1 and UNIT 2 could be easily separated from adjacent areas, there were no differences in the genetic profile of populations in UNIT 1 and UNIT 2 for both species of redfish which occur there. In addition, there is a 'hybrid' form

found in both areas but has not been seen elsewhere. These studies imply that interbreeding among redfish in UNIT 1 and UNIT 2 occurs at a rate sufficient to enable the populations to be genetically indistinguishable, and although this rate could be low, these require careful consideration and clarification in the context of future management. There is a need to be able to put the results of current work as well as follow-on analyses and studies in the context of current management practise in order to understand the implications of, and risks associated with what we are currently doing compared to alternative approaches.

PROGNOSIS

It is currently not possible to provide an estimate of the absolute size of this stock. It is also not possible to estimate actual fishing mortality rates.

Current commercial catches, including those to date in 1999, are composed primarily of the 1980 year-class that has been fished for about nine years now. The 1988 year-class is now fully available, based on size, to the fishery, but in 1999 was not exploited to the extent predicted due to market conditions that resulted in targeting for larger fish. It is likely that market demand for larger fish will continue resulting in continued targeting of the 1980 year-class.

Current information suggests however, that since the 1988 year-class is not as strong as that of 1980, current adult biomass will decline and catch levels will not be sustainable. Therefore consideration should be given to a reduction in catches in the next fishing year (2000/2001) in response to this anticipated decline.

There are some indications that the 1994 year-class may be relatively strong, but renewed monitoring will be required to clarify this. This year-class would not contribute to the commercial fishery until about 2004, but knowledge of its strength is important in any consideration of longer-term resource status. Renewed monitoring of pre-recruit year-classes would be required to clarify this.

REFERENCES

CAFSAC. 1991. Advice on the management of groundfish stocks. CAFSAC Adv. Doc. 91/13 (Revised):29 p.

Atkinson, D.B., and D. Power. MS 1990. Some analyses of data for redfish off the south coast of Newfoundland (NAFO Div. 3P/4V). CAFSAC Res. Doc. 90/57.

Atkinson, D.B., and D. Power. MS 1991. The Redfish Stock Issue in 3P, 4RST and 4VWX. CAFSAC Res Doc. 91/38.

Table 1 : Summary of Nominal Catches (t) of Redfish in Unit 2.

Year	3Pn (Jun-Dec)	3Ps	4Vn (Jun-Dec)	4Vs	4Wfgj	4Wfgj (assigned)	Total	3P4V (Unknown)	4W (Unknown)	3Pn/4Vn (Nov-Dec)	TAC
1960	14	9211	5277	8122	-	663	23287		-	72	
1961	1058	8340	4157	4170	-	604	18329	356	8	148	
1962	2127	11306	2710	4372	-	780	21295	52	3870	989	
1963	2154	11150	2166	6270	-	550	22290		12005	591	
1964	4445	9119	1849	7629	80	70	23192		3005	2937	
1965	5570	9931	2097	3319	733	184	21834	11	1326	2712	
1966	2444	16543	6022	3067	242	74	28392		8720	5128	
1967	3531	28465	7976	1989	78	131	42170		55	3641	
1968	1974	11764	4097	2222	16	96	20169	522	210	2608	
1969	1412	29460	4726	10241	-	437	46276		1387	1657	
1970	2169	33581	2849	6694	2101	2013	49407		8744	1170	
1971	373	26534	4762	23698	1334	1499	58200		11921	1070	
1972	511	25398	2390	14580	1346	976	45201		8609	192	
1973	2133	14714	2709	11213	495	563	31827		5484	1526	
1974	2759	17894	4898	8112	357	18	34038		4018	2899	
1975	4722	20345	6548	6791	37	28	38471		3944	896	
1976	1409	13235	3832	4718	317	198	23709		315	126	
1977	1713	14678	4763	7123	245	228	28750			307	
1978	1975	12203	3661	7856	593	260	26548			1016	
1979	1975	6459	4500	4979	666	192	18771			1642	
1980	1845	5192	3713	5431	817	131	17129			1140	
1981	3283	4685	6134	6789	430	430	21751			1421	
1982	3757	2090	6350	4585	128	115	17025			2328	
1983	2607	2996	3559	3758	489	64	13473			1301	
1984	1460	2005	2129	2367	140	40	8141			664	
1985	1587	1854	3143	4502	194	214	11494			756	
1986	958	3651	3347	2736	15	58	10765			662	
1987	1348	2169	6423	3651	195	170	13956			1940	
1988	484	2386	4856	2725	156	121	10728			581	
1989	1953	2874	5236	4990	81	252	15386			1206	
1990	189	5438	2471	6325	73	293	14789			390	
1991	1050	4390	8746	8537	96	386	23205			2226	
1992	766	6629	7348	1727	474	215	17159			3029	
1993	10940	7314	7810	1193	108	63	27428			5683	28000
1994 [a]	4176	8111	6140	5607	267	23	24324			1497	25000
1995 [a]	1549	2744	3536	4254	159	-	12242			-	14000
1996 [a]	708	5885	1202	1599	12	-	9406			6	10000
1997 [a]	523	5588	1758	2021	52	-	9942			1	10000
1998 [a]	396	8178	1507	532	25	-	10638				11000
1999 [a]							9932 [b]				12000

NOTE: Portions of Catches identified only as "4W" were assigned to 4Wfgj based on :

(1) Information of other catches that could be split between the "Laurentian Channel" and "Scotia Shelf" Units

(2) USSR and "others" fishing since 1977 (see Power MS 1992)

[a] Provisional

[b] to Nov. 5,1999 (Canadian Atlantic Quota Reports)

Table 2a: Nominal catches of Redfish by country from Subdiv. 3Pn (Jun.-Dec.)(1994-1998 are provisional).

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Canada (M)	143	577	39	825	0	346	213	4915	1205	74	20	1	254
Canada (N)	815	770	445	1128	189	704	548	5537	2966	1475	688	522	142
Canada (Q)	-	1	-	-	-	-	5	488	5	-	-	-	-
Total	958	1348	484	1953	189	1050	766	10940	4176	1549	708	523	396

Table 2b: Nominal catches of Redfish by country from Subdiv. 3Ps (1994-1998 are provisional).

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Canada (M)	606	421	836	1038	1252	377	2648	3545	4165	500	2024	1515	3836
Canada (N)	2915	1645	1441	1823	4186	4013	3981	3745	3935	2244	3861	3780	3958
Canada (Q)	88	-	-	-	-	-	-	24	11	-	-	-	-
France (M)	-	67	95	-	-	-	-	-	-	-	-	-	-
France (SPM)	42	36	14	13	-	-	-	-	-	-	-	292	384
Total	3651	2169	2386	2874	5438	4390	6629	7314	8111	2744	5885	5587	8178

Table 2c: Nominal catches of Redfish by country from Subdiv. 4Vn (Jun.-Dec.)(1994-1998 are provisional).

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Canada (M)	1237	2544	2327	3245	1874	7453	5871	6757	3669	2076	1125	1626	1296
Canada (N)	1790	3682	2345	1909	579	1076	1255	603	1971	1460	77	80	-
Canada (Q)	63	-	-	1	-	217	222	450	500	-	-	-	49
Canada (G)	-	-	-	-	-	-	-	-	-	-	-	53	162
Japan	257	197	184	81	18	-	-	-	-	-	-	-	
Total	3347	6423	4856	5236	2471	8746	7348	7810	6140	3536	1202	1759	1507

Table 2d: Nominal catches of Redfish by country from Subdiv. 4Vs (1994-1998 are provisional).

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Canada (M)	1081	2279	2111	3452	3997	5864	1621	1125	4914	3995	1580	1887	532
Canada (N)	465	428	335	1139	1852	1911	106	68	693	259	19	134	-
Canada (Q)	-	-	-	-	-	263	-	-	-	-	-	-	-
France (SPM)	-	-	-	-	-	-	-	-	-	-	-	1	-
Japan	1190	944	279	399	475	499	-	-	-	-	-	-	-
Total	2736	3651	2725	4990	6324	8537	1727	1193	5607	4254	1599	2022	532

Table 3 : Nominal catches of redfish by fleet, unit area and quarter from 1993-1998. Shaded cells indicate largest catches within each fleet, light shade for quarter and dark shade for unit area. NF=Newfoundland fleet, PQ=Quebec fleet, SF=Maritimes fleets

Sum of Catch																			
		NF						NF Total	QUE		QUE Total	SF						SF Total	Grand Total
Year	Quarter	3PA	3PD	3PG	3PN	4VC	4VN		3PN	4VN		3PA	3PD	3PG	3PN	4VC	4VN		
93	1	1367	359	5		0		1731				829	108			213		1150	2881
	2	323	13	2	333	34	289	994		440	440	309	1004	6	43	502	2397	4261	6282
	3	206	27	7	711		296	1247	30		30		7		132	13	3421	3573	5646
	4	835	274		4477	5	7	5598	459	10	469	889	106		3954	90	227	5266	11595
93 Total		2731	673	14	5521	39	592	9570	489	450	939	2027	1225	6	4129	818	6045	14250	26404
94	1	380	176	0		3		559				924	511	1		1808		3244	3803
	2	1715	149	10	5	25	635	2539	5	500	505	599	284	12	6	1596	1612	4109	7170
	3	125	34	0	745	10	1328	2242	0		0	413	43		704	433	2103	3696	6126
	4	455	143	22	2222	39	17	2898				205	374	0	368	555	75	1577	4476
94 Total		2675	502	32	2972	77	1980	8238	5	500	505	2141	1212	13	1078	4392	3790	12626	21575
95	1	431	5	0		73		509				2	249	0		1823		2074	2583
	2	62	15	1	0	159		237				70	97	0		1267	0	1434	1671
	3	651	240	10	870	27	1430	3228	0		0	3	53		65	219	1969	2309	5537
	4	439	123	0	602		29	1193				4	3	0	2	616	106	731	1931
95 Total		1683	383	11	1472	259	1459	5167	0		0	79	402	0	67	3625	2075	6548	11722
96	1	628	2410			9		3047				61	1073	0		1075		2209	5256
	2	72	12		0			84				15	277			32	0	324	408
	3	92	1		100		72	265	0		0					21	963	984	1278
	4	567	44		588		5	1204				322	209		20	408	133	1092	2296
96 Total		1359	2467		688	9	77	4600	0		0	398	1559	0	20	1536	1096	4609	9238
97	1	412	1991	153		48		2604				43	456	315		1682		2496	5100
	2	102	2	132	0			236					337	322		0	0	659	895
	3	459	3	1	426		59	948				1	11			3	1621	1636	2637
	4	296	28	3	95	85	20	527	0		0	0	23	1	1	184	5	214	741
97 Total		1269	2024	289	521	133	79	4315	0		0	44	827	638	1	1869	1626	5005	9373
98	1	68	848	1001				1917				30	1199	1416		94		2739	4656
	2	119	855	212	0			1186				8	845	207		1	0	1061	2247
	3	399	4		121			524		49	49	52	3	2	150	52	1289	1548	2283
	4	102	123	3	21			249				15	54	0	104	384	6	563	812
98 Total		688	1850	1216	142			3876		49	49	105	2101	1625	254	531	1295	5911	9998
Grand Total		10305	7879	1562	11316	517	4187	35766	494	999	1493	4794	7326	2282	5549	13071	15927	48949	88310

Table 4. Mean number of redfish caught per standard tow in Division 3Ps during Canadian research surveys 1973-1993 (Numbers in brackets are number of successful sets, * indicates those strata estimated with a multiplicative model utilizing data to 1991.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1973 ATC 207 Mar 12-25	1974 ATC 221 Apr 19-30	1975 ATC 234 Jun 2-13	1976 ATC 247-248 May 11-Jun 6	1977 ATC 261 Apr 14-26	1978 ATC 275 Apr 4-14	1979 ATC 287 Feb 16-Mar 5	1980 ATC 302 Mar 19-Apr 2	1981 ATC 316 Mar 7-26	1982 ATC 330 May 28-Jun 9	1983 AN 9 Apr 22-May 8
306	185-274	419	844.56 *	573.67(6)	3198.00(6)	2284.67(6)	2159.20(6)	2177.33(6)	408.40(5)	1051.50(2)	1830.67(3)	934.67(3)	421.50(4)
307	93-183	395	288.80(5)	200.71(7)	4067.03(4)	1861.25(4)	1252.50(4)	234.25(4)	20.50(4)	83.50(2)	924.67(3)	150.00(4)	121.25(4)
309	185-274	296	3647.00(3)	1386.75(4)	8421.66(6)	5836.57(7)	1955.48(6)	1019.33(6)	2540.33(6)	24599.00(2)	7772.50(2)	522.00(2)	981.33(3)
310	185-274	170	95.00(1)	175.00(3)	2981.52(6)	5497.80(5)	110.50(6)	622.33(6)	316.00(6)	240.00(2)	252.50(2)	5677.00(3)	547.00(3)
311	93-183	317	3.78(9)	495.00(8)	7.00(4)	805.67(6)	1022.00(4)	0.00(4)	19.50(4)	0.00(2)	6.50(2)	7.67(3)	0.00(3)
313	185-274	165	1.50(2)	133.00(5)	1010.33(3)	990.50(6)	78.90(10)	130.00(2)	80.00(5)	95.50(2)	187.00(2)	4397.00(2)	829.33(3)
316	185-274	189	228.33(3)	150.00(6)	1471.00(1)	1368.25(4)	86.42(6)	119.00(6)	110.67(3)	384.00(2)	175.00(2)	457.00(1)	653.75(4)
317	93-183	193	1.57(7)	217.62(8)	558.00(4)	466.50(4)	691.37(4)	3.25(4)	16.33(3)	3.50(2)	1.00(2)	112.00(3)	7980.66(3)
318	185-274	123	999.00(1)	169.50(2)	2034.29(4)	2087.00(7)	228.00(6)	480.50(2)	292.50(2)	1403.50(2)	807.29 *	6077.00(2)	1688.33(3)
319	93-183	984	174.20(5)	411.00(2)	432.43(4)	92.25(4)	83.17(6)	1241.00(4)	156.00(2)	3.00(4)	8455.00(2)	260.57(7)	27.29(7)
705	275-366	195	476.50(2)	56.75(4)	154.94(2)	256.20(5)	79.50(4)	251.67(3)	73.50(4)	161.00(2)	162.00(2)	644.00(2)	5.67(3)
706	275-366	476	640.00(2)	226.57(7)	165.00(1)	73.75(4)	112.28(4)	71.00(2)	312.00(3)	97.00(2)	86.00(2)	118.00(4)	77.80(5)
707	275-366	93	568.73 *	590.00(2)	785.25(4)	1893.67(6)	210.01(4)	649.50(2)	740.50(2)	211.00(2)	554.88 *	221.53 *	306.33(3)
708	367-549	117	444.99 *	574.52 *	185.00(3)	520.33(3)	364.21(4)	473.00(1)	592.50(2)	89.00(2)	434.29 *	173.32 *	722.00(2)
709	550-731	96	7.07 *	9.27 *	14.03 *	102.50(2)	8.80 *	7.26 *	4.83 *	1.39 *	6.89 *	2.46 *	0.50(2)
710	550-731	36	6.73 *	8.83 *	13.37 *	10.34 *	8.38 *	6.91 *	4.59 *	1.30 *	6.56 *	2.32 *	3.75(3)
711	367-549	961	202.08 *	260.97 *	388.34 *	169.50(2)	248.46 *	207.22 *	142.21 *	25.50(2)	32.50(2)	11.50(2)	68.13(8)
712	367-549	973	182.57 *	235.78 *	350.89 *	151.50(2)	224.48 *	187.24 *	104.00(2)	71.00(2)	150.50(2)	23.00(3)	67.86(7)
713	367-549	950	132.38 *	171.01 *	39.43(3)	87.50(2)	162.81 *	135.76 *	93.11 *	15.00(2)	65.33(6)	11.50(2)	23.71(7)
714	367-549	1195	228.90 *	295.59 *	439.79 *	248.50(2)	281.43 *	127.00(2)	145.00(1)	64.00(2)	50.50(8)	39.67(6)	62.30(10)
715	275-366	132	588.00(1)	62.75(4)	318.00(2)	811.40(5)	124.00(4)	343.75(4)	717.00(3)	2417.50(2)	1015.50(2)	20.00(2)	71.33(3)
716	275-366	539	412.00(1)	108.00(3)	1367.39 *	252.00(3)	127.50(6)	473.50(4)	173.00(4)	43.00(2)	207.75(4)	122.00(2)	54.50(4)
Stratified Analysis:													
Upper			1113.7	1499.3	2576.9	1009.5	746.4	1157.1	415.8	9026.0	14082.20	698.3	843.1
Mean			563.1	357.4	1561.4	750.2	585.0	566.7	313.0	978.9	1459.9	432.1	339.7
Lower			12.5	-784.6	545.9	490.8	423.7	-23.6	210.2	-7068.2	-11162.5	165.9	-163.8
Multiplicative Analysis:													
Mean			385.3	303.9	987.3	747.2	417.0	432.6	244.8	964.6	1407.0	420.8	339.7
Total (x 10^{-6})			260.7	205.6	668.0	505.6	282.2	292.7	165.7	652.7	952.0	284.7	229.8

Table 4. (Cont'd.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1984 AN 26 Apr 9-18	1985 WT 26 Mar 7-26	1986 WT 45 Mar 5-24	1987 WT 55-56 Feb 12-Mar 23	1988 WT 68 Jan 26-Feb 15	1989 WT 81 Jan 31-Feb 17	1990 WT 91 Jan 31-Feb 20	1991 WT 103 Feb 2-20	1992 WT 118 Feb 6-24	1993 WT 133 Feb 6-23	1993 WT 135 Apr 2-20
306	185-274	419	15.50(2)	313.00(2)	623.67(3)	231.25(4)	493.50(4)	137.33(3)	819.33(3)	870.75(4)	65.50(2)	367.50(4)	357.75(4)
307	93-183	395	127.00(2)	53.33(3)	17.00(3)	36.33(3)	44.50(4)	14.33(3)	37.67(3)	6.00(3)	1.50(2)	6.50(4)	7.67(3)
309	185-274	296	50.50(2)	453.00(3)	618.50(2)	1142.50(2)	535.00(3)	398.50(2)	363.00(2)	1898.67(3)	32.50(2)	46.00(3)	2929.00(2)
310	185-274	170	70.50(2)	1225.33(3)	303.00(2)	33.50(2)	801.33(3)	326.00(2)	85.50(2)	8716.00(2)	3.50(2)	79.00(2)	910.50(2)
311	93-183	317	41.00(2)	11.00(4)	0.00(3)	0.00(3)	1.50(4)	2.67(3)	0.00(3)	0.00(3)	1.00(2)	3.67(3)	0.00(2)
313	185-274	165	35.00(2)	1033.50(2)	988.00(2)	150.50(2)	181.00(2)	507.50(2)	61.50(2)	4682.50(2)	757.00(2)	35.00(2)	452.00(2)
316	185-274	189	127.00(2)	140.00(3)	57.50(2)	313.67(3)	210.00(3)	76.40(3)	151.00(2)	731.50(2)	661.00(2)	0.01(1)	196.67(3)
317	93-183	193	882.50(2)	0.00(2)	0.00(2)	0.00(3)	2.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)
318	185-274	123	138.00(2)	216.16 *	958.00(2)	5547.50(2)	58.50(2)	658.50(2)	410.35 *	564.00(2)	216.80(2)	52.50(2)	962.50(2)
319	93-183	984	11.67(6)	0.00(2)	15.88(8)	9.11(9)	99.38(8)	11.50(8)	37.65 *	7.33(9)	2.60(10)	0.89(9)	3.83(6)
705	275-366	195	28.50(2)	78.00(2)	424.00(2)	247.50(2)	121.00(2)	30.00(2)	22.00(2)	54.00(2)	178.00(2)	20.00(2)	235.00(2)
706	275-366	476	75.00(2)	465.25(4)	308.25(4)	181.92(5)	429.75(4)	91.00(4)	38.50(4)	201.00(4)	69.20(5)	17.67(3)	44.20(5)
707	275-366	93	226.00(2)	148.46 *	265.50(2)	200.50(2)	634.00(2)	302.13(2)	281.98 *	1389.50(2)	2203.50(2)	1306.50(2)	1148.25(2)
708	367-549	117	113.00(2)	116.11 *	278.75(2)	354.50(2)	432.50(2)	549.00(2)	220.65 *	435.50(2)	881.50(2)	2179.00(2)	7044.00(2)
709	550-731	96	4.50(2)	1.48 *	0.00(1)	14.29(1)	6.83 *	12.50(2)	3.26 *	18.00(2)	1.71 *	33.04(2)	4.44(2)
710	550-731	36	1.00(2)	8.00(2)	78.00(2)	2.51 *	114.50(2)	3.74 *	3.09 *	11.00(2)	34.00(1)	18.44(2)	0.00(2)
711	367-549	961	20.40(5)	121.75(8)	280.78(9)	154.00(7)	181.43(7)	315.43(7)	312.67(3)	265.88(8)	189.20(10)	240.60(5)	41.80(5)
712	367-549	973	31.85 *	44.33(6)	120.78(9)	117.00(4)	115.71(7)	347.50(8)	180.80(5)	71.75(8)	123.10(10)	50.00(7)	58.29(7)
713	367-549	950	22.98 *	55.50(8)	66.80(5)	197.00(4)	954.43(7)	212.88(8)	113.43(7)	279.19(8)	72.10(10)	76.13(8)	96.50(6)
714	367-549	1195	40.03 *	69.00(1)	89.40(5)	66.25(4)	488.33(9)	394.90(10)	301.29(7)	236.36(11)	285.14(7)	170.33(11)	127.22(9)
715	275-366	132	43.50(2)	2448.00(1)	569.00(2)	463.00(2)	307.50(2)	1542.00(2)	1476.50(2)	9797.50(2)	624.50(2)	1976.00(2)	1219.50(4)
716	275-366	539	18.67(3)	84.60(5)	207.00(4)	226.00(3)	240.80(5)	123.25(4)	45.80(5)	25.40(5)	175.67(3)	16.75(4)	42.25(4)
Stratified Analysis:													
Upper			238.3	225.8	282.5	1299.6	531.3	358.6	374.8	1658.2	217.5	282.00	698.32
Mean			74.0	164.0	206.8	240.6	334.4	240.1	225.4	650.9	178.0	160.46	325.18
Lower			-90.2	102.3	131.0	-818.5	137.6	121.7	76.0	-356.5	138.6	38.92	-47.96
Multiplicative Analysis:													
Mean			59.6	183.1	204.5	237.2	331.1	239.2	204.7	650.9	175.6	157.1	325.2
Total ($\times 10^{-6}$)			40.3	123.9	138.4	160.5	224.0	161.8	138.5	440.4	118.8	106.3	220.0

Table 5. Mean number of Redfish caught per standard tow (number of sets indicated in brackets) during surveys to Subidv. 3Ps utilizing revised stratification schemes in 1994 and 1995 (see text for details). Stratum areas in brackets denote a major revision to the stratification for the 1995 survey. The 1994 - 1995 surveys utilized an Engels 145 (1.75 n. mi. tows), the 1996-1998 surveys utilized a Campelen 1800 (0.75 n. mi. tows).

Stratum	Depth range M	Area Sq. N. Mi.	1994 WT 150-151 Apr 5-27	1995 WT 166-167 Apr 3-29	1996 WT186-187 Apr 10-May1	1997 WT 202-203 Apr 1 - 24	1998 WT218-219 Apr 2- 23	1999 WT236-237 Apr13-May6
307	093 - 183	395	25.00 (4)	2.22 (4)	331.34 (4)	73.33 (3)	18.96 (3)	677.86 (3)
311	093 - 183	317	5.00 (4)	1.33 (3)	2.67 (3)	13.50 (2)	14.22 (3)	335.33 (3)
317	093 - 183	193	0.00 (2)	0.00 (2)	2.00 (2)	0.00 (2)	13.00 (2)	34.00 (2)
319	093 - 183	984	0.00 (9)	16.00 (8)	180.91 (8)	10.89 (8)	4.88 (8)	404.98 (8)
306	185 - 274	419 (363)	132.50 (4)	2.33 (3)	212.04 (3)	368 (3)	206.97 (3)	588.41 (3)
309	185 - 274	296	333.67 (3)	31.33 (3)	227.00 (3)	57.94 (2)	469.33 (2)	619.44 (2)
310	185 - 274	170	492.00 (3)	8.50 (2)	74.50 (2)	161.00 (2)	158.50 (2)	235.72 (2)
313	185 - 274	165	155.50 (2)	57.00 (2)	80.44 (2)	44.00 (2)	184.89 (2)	126.00 (2)
316	185 - 274	189	22.50 (2)	18.50 (2)	313.50 (2)	205.00 (2)	134.00 (2)	122.93 (2)
318	185 - 274	129	0.00 (2)	2696.50 (2)	237.50 (2)	1050.00 (2)	647.00 (2)	421.41 (2)
705	275 - 366	195	87.67 (3)	6546.00 (2)	99.51 (2)	9.00 (2)	49.22 (2)	18.17 (2)
706	275 - 366	476	79.25 (4)	138.00 (4)	232.67 (3)	68.11 (3)	46.50 (4)	71.94 (4)
707	275 - 366	74	2615.50 (2)	1100.00 (2)	983.30 (2)	1724.44 (2)	812.00 (2)	684.89 (2)
715	275 - 366	132 (128)	328.25 (4)	852.50 (2)	76.28 (2)	154.10 (2)	441.44 (2)	80.50 (2)
716	275 - 366	539	79.40 (5)	18.40 (5)	42.30 (5)	15.47 (4)	109.53 (4)	189.69 (4)
708	367 - 549	126	5878.50 (2)	853.50 (2)	2718.50 (2)	33.72 (2)	199.70 (3)	1135.87 (2)
711	367 - 549	961 (593)	52.50 (6)	183.40 (5)	84.08 (4)	71.73 (5)	22.47 (5)	27.60 (5)
712	367 - 549	973 (731)	134.86 (7)	153.14 (7)	143.67 (6)	72.00 (5)	112.46 (6)	48.24 (6)
713	367 - 549	950 (851)	148.00 (7)	187.63 (8)	139.49 (7)	176.59 (6)	68.51 (7)	320.98 (7)
714	367 - 549	1195 (1074)	121.75 (8)	203.50 (10)	141.05 (9)	138.03 (7)	122.75 (9)	89.09 (9)
709	550 - 731	158 (147)	59.30 (2)	17.00 (2)	3.00 (2)	---	5.00 (2)	0.00 (2)
710	732 - 914	176 (156)	0.00 (2)	---	---	---	---	10.79 (2)
Number per tow:								
Upper CI			500.00	2343.30	758.82	199.96	199.80	355.85
Stratified Mean			198.80	325.00	193.45	124.10	112.91	250.97
Lower CI			-102.40	-1693.20	-371.92	48.24	26.02	146.09
Total Abundance (millions)			137.50	197.80	216.00	136.40	126.40	286.23

Table 6. Mean weight (kg) of redfish caught per standard tow in Division 3Ps during Canadian research surveys, 1973-1993. (Numbers in brackets indicate number of sets; * indicates strata estimated using a multiplicative model utilizing data to 1991.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1973 ATC 207 Mar 12-25	1974 ATC 221 Apr 19-30	1975 ATC 234 Jun 2-13	1976 ATC 247-248 May 11-Jun 6	1977 ATC 261 Apr 14-26	1978 ATC 275 Apr 4-14	1979 ATC 287 Feb 16-Mar 5	1980 ATC 302 Mar 19-Apr 2	1981 ATC 316 Mar 7-26	1982 ATC 33 May 28-Jun 9	1983 AN 9 Apr 22-May 8	1984 AN 26 Apr 9-18
306	185-274	419	83.09 *	56.09(6)	175.99(6)	188.85(6)	137.59(6)	298.47(6)	48.90(5)	165.71(2)	44.93(3)	54.93(3)	81.13(4)	3.51(2)
307	93-183	395	12.25(5)	8.55(7)	34.34(4)	58.91(4)	47.29(4)	17.69(4)	3.06(4)	12.38(2)	21.17(3)	4.05(4)	49.00(4)	69.25(2)
309	185-274	296	541.59(3)	135.85(4)	666.33(6)	939.79(7)	224.35(6)	108.48(6)	337.55(6)	3908.91(2)	264.50(2)	42.50(2)	101.92(3)	12.25(2)
310	185-274	170	2.27(1)	34.62(3)	256.09(6)	416.67(5)	29.22(6)	96.61(6)	59.35(6)	35.64(2)	17.50(2)	529.11(3)	34.67(3)	4.75(2)
311	93-183	317	0.30(9)	30.53(8)	0.11(4)	17.69(6)	61.12(4)	0.00(4)	3.69(4)	0.00(2)	1.50(2)	0.17(3)	0.00(3)	4.00(2)
313	185-274	165	0.90(2)	16.51(5)	153.62(3)	168.74(6)	12.60(10)	24.94(2)	11.25(5)	15.55(2)	29.00(2)	158.50(2)	44.33(3)	3.50(2)
316	185-274	189	25.71(3)	20.26(6)	48.99(1)	290.30(4)	13.61(6)	14.17(6)	10.89(3)	51.30(2)	21.00(2)	36.50(1)	55.88(4)	9.75(2)
317	93-183	193	0.52(7)	16.22(8)	49.05(4)	8.16(4)	41.94(4)	0.21(4)	1.74(3)	3.40(2)	0.25(2)	1.07(3)	110.70(3)	31.25(2)
318	185-274	123	97.07(1)	23.13(2)	373.83(4)	324.71(7)	32.51(6)	56.70(2)	22.46(2)	94.89(2)	48.53 *	148.50(2)	88.50(3)	21.25(2)
319	93-183	984	12.91(5)	64.41(2)	70.35(4)	8.96(4)	5.62(6)	86.64(4)	6.58(2)	0.79(4)	46.00(2)	3.86(7)	4.79(7)	2.90(6)
705	275-366	195	241.31(2)	19.28(4)	90.15(2)	123.38(5)	22.34(4)	115.21(3)	44.03(4)	62.65(2)	49.50(2)	317.00(2)	4.33(3)	13.50(2)
706	275-366	476	91.18(2)	53.27(7)	37.19(1)	33.90(4)	31.91(4)	28.12(2)	60.18(3)	26.33(2)	17.00(2)	42.25(4)	11.50(5)	8.50(2)
707	275-366	93	136.99 *	93.89(2)	237.12(4)	469.55(6)	58.59(4)	100.24(2)	126.60(2)	38.82(2)	77.86 *	37.05 *	80.83(3)	96.75(2)
708	367-549	117	157.57 *	189.83 *	82.25(3)	210.02(3)	124.44(4)	192.00(1)	201.03(2)	15.43(2)	89.61 *	42.68 *	358.75(2)	40.50(2)
709	550-731	96	4.52 *	5.54 *	7.42 *	96.39(2)	4.40 *	5.41 *	3.24 *	1.31 *	2.36 *	0.87 *	0.10(2)	1.75(2)
710	550-731	36	7.67 *	9.34 *	12.40 *	12.67 *	7.48 *	9.12 *	5.58 *	2.45 *	4.16 *	1.73 *	2.27(3)	0.50(2)
711	367-549	961	90.88 *	109.52 *	143.78 *	128.37(2)	88.78 *	107.05 *	67.50 *	15.66(2)	13.50(2)	5.40(2)	28.21(8)	16.10(5)
712	367-549	973	112.77 *	135.88 *	178.34 *	121.11(2)	110.17 *	132.82 *	83.91(2)	40.18(2)	112.00(2)	15.00(3)	49.50(7)	30.09 *
713	367-549	950	87.61 *	105.59 *	30.50(3)	68.04(2)	85.59 *	103.21 *	65.07 *	10.44(2)	41.33(6)	8.25(2)	16.86(7)	23.29 *
714	367-549	1195	144.85 *	174.50 *	228.98 *	206.62(2)	141.52 *	89.36(2)	110.67(1)	41.09(2)	32.69(8)	30.08(6)	49.85(10)	38.75 *
715	275-366	132	201.40(1)	26.99(4)	99.79(2)	339.65(5)	39.12(4)	70.31(4)	383.81(3)	472.84(2)	183.84(2)	11.40(2)	12.50(3)	22.00(2)
716	275-366	539	258.55(1)	25.93(3)	101.59 *	106.90(3)	32.66(6)	155.13(4)	73.26(4)	22.02(2)	22.25(4)	25.25(2)	15.50(4)	10.07(3)
Stratified Analysis:														
Upper			168.2	218.7	198.1	182.2	65.0	145.4	87.0	1285.3	185.7	72.6	54.1	75.3
Mean		85.2	45.7	125.2	151.8	52.4	89.2	67.6	166.7	48.8	39.6	40.1	15.8	
Lower			2.2	-127.3	52.4	121.4	39.8	33.0	48.3	-951.9	-88.1	6.7	26.0	-43.8
Multiplicative Analysis:														
Mean		107.8	86.9	137.3	151.3	77.1	97.4	72.1	164.3	49.0	39.0	40.1	21.1	
Biomass (t)			72952	58800	92910	102343	52193	65903	48801	111141	33130	26401	27099	14304

Table 6. (Cont'd.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1985 WT 26 Mar 7-26	1986 WT 45 Mar 5-24	1987 WT 55-56 Feb 12-Mar 23	1988 WT 68 Jan 26-Feb 15	1989 WT 81 Jan 31-Feb 17	1990 WT 91 Jan 31-Feb 20	1991 WT 103 Feb2-20	1992 WT 118 Feb 6-24	1993 WT 133 Feb 6-23	1993 WT 135 Apr 2-20
306	185-274	419	37.00(2)	39.67(3)	24.63(4)	190.77(4)	10.33(3)	212.48(3)	32.64(4)	1.70(2)	17.53(4)	107.15(4)
307	93-183	395	3.70(3)	2.00(3)	5.67(3)	3.95(4)	3.00(3)	25.63(3)	0.44(3)	0.04(2)	0.69(4)	0.64(3)
309	185-274	296	85.33(3)	69.25(2)	127.00(2)	86.17(3)	69.00(2)	44.80(2)	235.25(3)	2.15(2)	2.77(3)	191.30(2)
310	185-274	170	95.83(3)	43.00(2)	4.00(2)	46.17(3)	16.25(2)	2.75(2)	132.77(2)	0.85(2)	3.10(2)	50.08(2)
311	93-183	317	1.97(4)	0.00(3)	0.00(3)	0.05(4)	0.13(3)	0.00(3)	0.00(3)	0.02(2)	0.17(3)	0.00(2)
313	185-274	165	89.50(2)	93.75(2)	20.25(2)	31.00(2)	25.00(2)	1.92(2)	42.26(2)	21.14(2)	1.47(2)	25.43(2)
316	185-274	189	12.83(3)	10.50(2)	40.50(3)	24.33(3)	4.87(3)	2.65(2)	7.97(2)	25.23(2)	0.01(1)	11.27(3)
317	93-183	193	0.00(2)	0.00(2)	0.00(3)	0.20(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)
318	185-274	123	27.04 *	149.75(2)	671.00(2)	13.00(2)	105.75(2)	48.70 *	14.23(2)	7.36(2)	7.05(2)	169.25(2)
319	93-183	984	0.00(2)	1.45(8)	1.19(9)	13.82(8)	1.00(8)	4.44 *	0.28(9)	0.05(10)	0.03(9)	0.22(6)
705	275-366	195	29.50(2)	90.50(2)	102.25(2)	65.00(2)	11.00(2)	5.50(2)	4.58(2)	34.33(2)	6.78(2)	91.30(2)
706	275-366	476	60.13(4)	45.88(4)	35.10(5)	114.35(4)	23.88(4)	10.78(4)	24.70(4)	10.84(5)	7.57(3)	7.70(5)
707	275-366	93	43.51 *	61.50(2)	69.50(2)	153.25(2)	108.28(2)	78.12 *	93.25(2)	321.02(2)	185.63(2)	271.79(2)
708	367-549	117	50.11 *	73.25(2)	101.75(2)	156.00(2)	228.00(2)	89.91 *	70.72(2)	338.30(2)	322.58(2)	1666.10(2)
709	550-731	96	1.11 *	0.00(1)	5.70(1)	5.43 *	6.25(2)	2.37 *	4.65(2)	0.79 *	19.71(2)	2.21(2)
710	550-731	36	5.25(2)	53.50(2)	3.74 *	68.63(2)	4.55 *	4.18 *	4.70(2)	16.70(1)	10.93(2)	0.00(2)
711	367-549	961	31.27(8)	119.11(9)	52.71(7)	84.71(7)	149.36(7)	165.15(3)	73.04(8)	75.35(10)	115.53(5)	16.94(5)
712	367-549	973	27.97(6)	70.78(9)	77.63(4)	68.00(7)	163.06(8)	83.46(5)	29.91(8)	64.88(10)	20.28(7)	25.86(7)
713	367-549	950	41.19(8)	45.10(5)	110.13(4)	651.84(7)	119.06(8)	57.26(7)	127.50(8)	38.22(10)	36.74(8)	42.03(6)
714	367-549	1195	31.00(1)	58.60(5)	48.38(4)	312.92(9)	204.10(10)	160.49(7)	104.55(11)	138.29(7)	78.12(11)	57.58(9)
715	275-366	132	1137.00(1)	97.25(2)	127.50(2)	133.00(2)	735.43(2)	353.00(2)	4253.50(2)	105.01(2)	935.83(2)	184.81(4)
716	275-366	539	27.50(5)	71.63(4)	147.50(3)	100.06(5)	52.88(4)	17.10(5)	8.30(5)	17.37(3)	3.53(4)	14.48(4)
Stratified Analysis:												
Upper			38.7	72.1	116.6	301.0	245.8	133.4	915.7	65.40	256.4	223.8
Mean		30.6	54.5	65.9	163.1	98.4	87.5	117.4	50.9	51.8	62.3	
Lower			22.5	36.8	15.2	25.1	-49.0	41.6	-681.0	36.46	-152.9	-99.1
Multiplicative Analysis:												
Mean		46.9	53.9	65.0	161.4	98.0	76.6	117.4	50.3	50.7	62.3	
Biomass (t)			31721	36472	44002	109193	66325	51820	79423	34006	34290	42180

Table 7. Mean weight (kg.) of Redfish caught per standard tow (number of sets indicated in brackets) during surveys to Subidv. 3Ps utilizing revised stratification schemes in 1994 and 1995 (see text for details). Stratum areas in brackets denote a major revision to the stratification for the 1995 survey. The 1994 - 1995 surveys utilized an Engels 145 (1.75 n. mi. tows), the 1996-1998 surveys utilized a Campelen 1800 (0.75 n. mi. tows).

Stratum	Depth range M	Area Sq. N. Mi.	1994 VT 150 - 151 Apr 5-27	1995 Wt 166 - 167 Apr 3-29	1996 VT 186 - 187 Apr 10-May1	1997 VT 202 - 203 Apr 1 - 24	1998 WT218-219 Apr 2- 23	1999 WT236-237 Apr13-May6
307	093 - 183	395	1.86 (4)	0.45 (4)	3.84 (4)	1.74 (3)	0.33 (3)	33.47 (3)
311	093 - 183	317	0.45 (4)	0.06 (3)	0.20 (3)	0.46 (2)	0.23 (3)	8.97 (3)
317	093 - 183	193	0.00 (2)	0.00 (2)	0.03 (2)	0.00 (2)	1.15 (2)	0.48 (2)
319	093 - 183	984	0.00 (9)	2.00 (8)	21.49 (8)	0.47 (8)	1.09 (8)	46.76 (8)
306	185 - 274	419 (363)	11.53 (4)	0.49 (3)	2.57 (3)	6.98 (3)	6.94 (3)	45.09 (3)
309	185 - 274	296	56.53 (3)	4.68 (3)	21.01 (3)	4.60 (2)	23.03 (2)	85.59 (2)
310	185 - 274	170	38.57 (3)	2.30 (2)	5.40 (2)	9.38 (2)	6.67 (2)	11.25 (2)
313	185 - 274	165	11.23 (2)	5.05 (2)	6.36 (2)	3.78 (2)	9.71 (2)	28.00 (2)
316	185 - 274	189	1.75 (2)	1.17 (2)	27.61 (2)	13.38 (2)	9.13 (2)	12.37 (2)
318	185 - 274	129	0.00 (2)	622.97 (2)	26.88 (2)	142.28 (2)	62.85 (2)	90.41 (2)
705	275 - 366	195	16.30 (3)	3356.81 (2)	14.83 (3)	1.45 (2)	11.38 (2)	5.66 (2)
706	275 - 366	476	21.48 (4)	30.44 (4)	34.63 (3)	20.82 (3)	8.36 (4)	18.59 (4)
707	275 - 366	74	777.36 (2)	151.23 (2)	240.10 (2)	226.75 (2)	128.75 (2)	126.27 (2)
715	275 - 366	132 (128)	74.05 (4)	403.97 (2)	12.01 (2)	14.15 (2)	59.35 (2)	19.85 (2)
716	275 - 366	539	10.19 (5)	9.24 (5)	9.12 (5)	2.60 (4)	8.69 (4)	93.09 (4)
708	367 - 549	126	1036.12 (2)	351.07 (2)	781.56 (2)	7.83 (2)	42.87 (3)	371.36 (2)
711	367 - 549	961 (593)	18.62 (6)	84.86 (5)	32.32 (4)	20.41 (5)	9.99 (5)	12.97 (5)
712	367 - 549	973 (731)	58.72 (7)	71.04 (7)	72.01 (6)	36.74 (5)	56.14 (6)	25.71 (6)
713	367 - 549	950 (851)	64.32 (7)	89.79 (8)	66.29 (7)	88.57 (6)	34.54 (7)	173.89 (7)
714	367 - 549	1195 (1074)	52.43 (8)	89.01 (10)	68.20 (9)	70.14 (7)	64.57 (9)	50.67 (9)
709	550 - 731	158 (147)	38.92 (2)	3.34 (2)	0.95 (2)	---	2.55 (2)	0.00 (2)
710	732 - 914	176 (156)	0.00 (2)	---	---	---		2.38 (2)
Weight per tow:								
Upper CI			83.9	1174.2	204.07	41.29	31.44	94.91
Stratified Mean			49.2	141.7	47.23	31.19	24.94	56.99
Lower CI			14.4	-890.9	-109.61	21.08	18.43	19.05
Total Biomass (t)			33994	86210	52853	34270	27908	64992

Table 8. Mean number per standard tow and survey abundance (millions) in Division 4VW from 1971-1998 Maritimes Region summer groundfish surveys.

Stratum	Depth (m)	Area	72	73	74	75	76	77	78	79	80	81	82	83	84	85
440	184 - 366	924	884.82	108.42	375.90	101.69	120.92	44.40	139.48	557.14	127.42	154.76	378.00	198.07	222.52	160.26
441	93 - 183	1000	.00	36.72	13.27	0.61	.00	6.52	.00	1.62	0.32	16.63	135.72	23.91	13.44	104.03
444	93 - 183	3925	3.27	53.60	50.78	20.27	97.22	8.09	160.18	0.67	3.56	2.70	24.85	24.89	3.45	124.32
445	184 - 366	1023	62.37	181.74	61.33	175.30	103.97	74.09	17.06	25.06	42.25	172.86	174.74	57.65	192.74	222.73
446	184 - 366	491	223.09	443.01	674.44	554.61	992.50	166.39	802.63	389.84	971.86	243.83	608.61	1002.96	920.56	1727.22
449	93 - 183	144	.00	42.05	0.78	.00	0.58	.00	.00	0.55	2.92	.00	1.94	.00	209.51	12.15
450	93 - 183	383	.00	.00	.00	.00	0.61	1.09	88.47	.00	.00	.00	.00	.00	0.97	.00
451	184 - 366	147	25.47	.00	9.67	19.43	1.09	37.82	1826.03	149.72	114.17	61.25	124.24	55.03	724.18	1410.85
452	184 - 366	345	441.46	112.03	8.89	17.22	14.00	1691.18	14.10	4.63	1.93	3.09	95.64	49.38	100.50	135.88
453	184 - 366	259	328.12	232.56	120.23	164.10	3.40	3.43	15.88	15.40	22.49	6.39	17.77	1354.91	128.72	.00
454	93 - 183	499	1.03	.00	.00	7.55	0.78	.00	17.89	0.36	.00	.00	0.88	.00	.00	.00
457	93 - 183	811	.00	18.04	21.62	.00	0.97	473.49	68.91	2.67	0.40	.00	4.38	1.03	9527.21	239.53
Mean per standard tow			125.15	87.46	101.2	68.42	109.98	121.71	155.28	76.99	67.98	48.09	112.58	123.9	885.67	227.74
Abundance (millions)			105.53	73.75	85.34	57.70	92.74	102.63	130.94	64.92	57.33	40.55	94.93	104.48	746.85	192.05

Stratum	Depth (m)	Area	86	87	88	89	90	91	92	93	94	95	96	97	98	99
440	184 - 366	924	313.40	218.48	1075.04	1972.10	1018.35	925.70	176.21	312.67	259.54	1055.27	842.50	615.23	333.32	242.67
441	93 - 183	1000	84.21	72.75	50.13	10.55	55.73	31.09	53.86	63.50	45.66	24.26	13.84	9.65	24.28	16.39
444	93 - 183	3925	92.85	9.72	0.49	11.49	7.85	6.43	4.47	132.59	24.73	1.13	5.88	10.08	11.92	0.24
445	184 - 366	1023	98.22	510.28	128.75	88.19	33.17	38.14	8.99	372.65	13.70	69.82	7.61	0	87.66	7.37
446	184 - 366	491	1886.03	362.63	1378.00	3598.70	2787.84	7891.81	5979.80	456.00	1338.34	354.17	847.57	942.64	199.02	395.69
449	93 - 183	144	.00	.00	0.51	.00	.00	.00	.00	0.50	.00	1.57	.00	1.93	0	242.35
450	93 - 183	383	0.34	32.94	.00	3786.43	0.67	.00	19.44	1.67	.00	0.34	9.55	4.10	0	
451	184 - 366	147	27.73	52.79	2661.25	3946.25	91.84	334.56	45.75	4709.36	6.46	1126.44	46.67	3.55	457.19	10996.9
452	184 - 366	345	926.05	407.99	2756.06	12750.81	2789.10	3209.51	4412.52	1832.82	47.96	522.70	45.60	18.53	30	147.71
453	184 - 366	259	9.95	27.77	752.76	9.78	17.16	1130.39	127.85	8.55	1.48	15.59	22.06	21.99	97.5	100.94
454	93 - 183	499	0.69	3.75	.00	.00	.00	.00	.00	1.98	0.51	0.99	2.33	7.37	4	
457	93 - 183	811	243.25	199.88	31.72	.00	58.29	954.78	0.49	18.29	1.92	6.77	15.56	7.25	3.9	
Mean per standard tow			229.99	135.18	343.33	1021.7	347.5	708.39	477.29	283.52	107.87	161.33	129.14	125.71	67.77	218.26
Abundance (millions)			193.94	113.99	289.52	861.56	293.03	597.35	402.48	239.08	90.96	136.04	108.90	93.58	57.15	184.05

Table 9. Mean weight (kg) per standard tow and survey biomass in Division 4VW from 1972-1999 Maritimes Region summer groundfish surveys.

Stratum	Depth (m)	Area	72	73	74	75	76	77	78	79	80	81	82	83	84	85
440	184 - 366	924	198.64	40.63	162.82	73.99	85.40	29.50	116.67	329.37	59.29	73.54	127.62	67.58	107.86	58.43
441	93 - 183	1000	.00	8.58	1.07	.00	.00	0.69	5.00	0.32	.00	2.92	8.23	0.34	0.58	14.99
444	93 - 183	3925	0.96	14.71	29.74	8.70	48.06	2.04	71.83	.00	1.76	1.38	9.86	9.08	1.96	79.62
445	184 - 366	1023	19.21	50.59	15.57	46.64	33.97	16.39	6.91	2.56	14.35	52.50	93.57	17.50	102.57	85.26
446	184 - 366	491	83.35	170.76	185.28	118.58	326.00	73.85	180.62	167.42	253.79	85.03	264.12	162.94	83.29	298.11
449	93 - 183	144	.00	21.05	0.39	.00	.00	.00	.00	.00	1.94	.00	1.94	.00	165.28	5.35
450	93 - 183	383	.00	.00	.00	.00	.00	0.36	54.44	.00	.00	.00	.00	.00	0.97	.00
451	184 - 366	147	2.92	.00	2.30	2.60	.00	9.82	825.38	42.78	36.03	21.00	4.46	14.49	141.15	462.92
452	184 - 366	345	86.27	38.96	1.88	3.25	5.25	854.22	5.35	0.51	.00	1.54	15.05	6.99	17.63	15.44
453	184 - 366	259	188.34	80.85	46.90	69.61	.00	0.34	1.98	1.46	9.26	0.31	0.65	47.67	10.99	.00
454	93 - 183	499	.00	.00	.00	1.72	.00	.00	1.56	.00	.00	.00	.00	.00	.00	.00
457	93 - 183	811	.00	9.40	4.80	.00	.00	129.89	21.88	0.55	.00	.00	.00	.00	506.47	24.06
Mean wgt (kg) per standard tow			32.85	28.59	39.42	22.99	46.65	49.31	65.67	39.87	21	17.63	39.85	21.43	72.19	71.22
Biomass Index (tons)			27700	24106	33238	19391	39336	41583	55381	33623	17709	14865	33605	18070	60874	60060

Stratum	Depth (m)	Area	86	87	88	89	90	91	92	93	94	95	96	97	98	99
440	184 - 366	924	146.06	116.68	299.60	628.71	319.12	326.84	67.28	139.45	75.42	394.01	362.83	307.04	161.47	132.88
441	93 - 183	1000	11.53	20.53	4.05	0.49	5.12	2.47	14.97	16.04	8.14	2.27	0.96	.35	6.71	3.94
444	93 - 183	3925	37.34	1.86	.00	5.49	1.55	0.26	0.30	10.71	2.84	0.28	0.31	3.35	0.2	0.01
445	184 - 366	1023	57.68	313.50	56.84	13.64	8.81	7.75	0.97	95.52	1.15	20.79	1.77	0	59.28	1.53
446	184 - 366	491	362.82	113.77	371.92	921.95	257.43	1024.95	686.79	188.50	242.29	160.98	344.08	407.67	100.72	159.25
449	93 - 183	144	.00	.00	.00	.00	.00	.00	.00	.00	.00	0.73	.00	1.16	0	61.27
450	93 - 183	383	.00	7.21	.00	229.99	.00	.00	2.27	.00	.00	.00	2.62	.11	0	
451	184 - 366	147	12.48	2.09	753.40	904.38	1.61	138.46	3.60	969.27	0.49	117.27	3.08	.48	81.32	1496.01
452	184 - 366	345	230.36	18.53	119.09	579.56	185.10	268.23	524.89	119.88	3.10	244.08	2.76	.71	2.56	8.18
453	184 - 366	259	0.34	1.03	449.71	0.49	1.03	53.05	8.75	.00	.00	1.76	1.60	.18	6.1	8.13
454	93 - 183	499	.00	.00	.00	.00	.00	.00	.00	.00	.00	.04	0.62	.02	0.01	
457	93 - 183	811	102.08	4.10	1.09	.00	2.44	25.22	.00	0.49	.00	.09	1.29	.10	0.05	
Mean wgt (kg) per standard tow			69.78	52.79	79.47	149.8	51.03	96.85	60.43	56.42	21.13	57.27	51.49	56.58	28.26	44.23
Biomass Index (tons)			58843	44514	67017	126325	43035	81669	50954	47578	17817	48290	43420	42191	23833	37300

Table 10. Mean number of redfish caught per standard tow and survey abundance in Division 4VW from 1986-1997 Maritime Region cod directed spring surveys .

Stratum	Depth (m)	Area sq. n. mi.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
396	368 - 503		-	-	-	-	-	-	-	-	-	21.6	-	481.9		
397	368 - 458		-	-	-	-	-	-	-	80.4	90.7	15.7	171.0	250.94	N	351.01
398	368 - 458		-	-	-	-	-	-	-	833.6	235.1	114.4	17.4	157.96	O	197.12
399	368 - 458		-	-	-	-	-	-	-	109.2	-	183.4	1008.1	66.01		229
400	368 - 458		-	-	-	-	-	-	-	250.1	-	50.5	258.4	.94	S	65.83
401	0 - 274	2782	0.1	3.2	.0	-	3.1	4.8	2.9	0.2	0.3	1.4	1.0	21.43	U	0.31
402	0 - 366	3394	6.6	339.8	14.0	23.1	0.9	4.3	55.7	13.4	161.7	37.0	40.8	.98	R	5.58
403	0 - 274	3401	0.9	.0	119.2	18.5	.0	3.1	54.2	3.4	.0	.0	.0	318.56	V	6.9
404	183 - 366	150	812.2	11.7	.0	37.1	9075.3	349.7	.0	151.4	17.2	1632.3	4779.1	12.28	E	1268.57
405	0 - 366	454	11.0	314.1	30.9	3677.7	132.6	27.4	17.1	3.8	12.7	11.7	382.9	.63	Y	10.9
406	0 - 274	4650	4.6	497.2	2.5	18.9	11.7	5.7	7.9	1.4	6.7	0.1	0.2	.12		0.11
407	0 - 274	1763	3.6	39.0	2.3	6.8	4.1	27.8	3.7	0.7	1.1	0.1	.0	2.12		0.31
408	0 - 183	3184	14.2	.0	.0	1.1	1.9	607.5	18.1	.0	0.2	0.2	184.2	.00		1.22
409	0 - 92	1500	.0	.0	.0	.0	0.1	.0	.0	.0	.0	.0	.0	.00		
410	0 - 183	2936	.0	0.1	.0	0.1	0.3	3.6	4.7	.0	0.4	5.3	2.8	.94		3.93
411	185 - 366	379	.0	2.1	13.9	20.2	65.4	0.9	.0	7.8	.0	9.8	-	-		31.91
440	185 - 366	924	-	-	-	-	-	-	-	-	-	1.0	-	-		
441	93 - 183	1000	-	-	-	-	-	-	-	-	-	19.1	-	-		
444	93 - 183	3925	-	-	-	-	-	-	-	-	-	2.7	-	-		
445	185 - 366	1023	-	-	-	-	-	-	-	-	-	6.0	-	-		
446	185 - 366	491	-	-	-	-	-	-	-	-	-	5.5	-	-		
Mean per tow			9.19	149.99	19.82	88.41	62.08	86.38	20.47	3.76	24.11	13.76	67.25	5.79		10.86
Abundance (millions)			19.142	312.580	41.313	163.414	129.369	180.015	42.662	7.838	50.254	37.270	137.969	12.057		22.631

Note: Strata 396-400 not included in estimate of abundance index

Table 11. Mean weight (kg) of redfish caught per standard tow and survey biomass in Division 4VW from 1986-19967 Maritime Region cod directed spring surveys.

Stratum	Depth (m)	Area sq. n. mi.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
396	368 - 503		-	-	-	-	-	-	-	-	-	8.4	-	242.3		
397	368 - 458		-	-	-	-	-	-	-	35.4	38.5	5.4	83.4	124.23	N	226.48
398	368 - 458		-	-	-	-	-	-	-	294.3	82.2	44.8	5.8	78.47	O	113.26
399	368 - 458		-	-	-	-	-	-	-	37.4	-	40.4	523.0	34.51		124.67
400	368 - 458		-	-	-	-	-	-	-	119.3	-	19.5	124.5	.06	S	37.28
401	0 - 274	2782	.0	0.3	.0	-	.0	.0	0.1	.0	.0	.0	.0	2.91	U	0.05
402	0 - 366	3394	3.2	189.3	4.4	4.6	0.3	0.8	7.2	0.8	15.7	5.3	9.3	.08	R	0.52
403	0 - 274	3401	0.1	.0	2.3	0.9	.0	.0	2.1	0.4	.0	.0	.0	59.67	V	0.07
404	183 - 366	150	403.5	1.9	.0	1.5	613.5	142.0	.0	19.0	2.4	431.5	1174.9	1.09	E	430.56
405	0 - 366	454	1.0	143.2	2.6	226.1	8.1	3.9	0.4	0.2	0.7	0.6	87.2	.04	Y	0.87
406	0 - 274	4650	1.1	3.2	0.7	2.2	0.4	0.9	2.0	0.3	0.5	.0	0.1	.00		
407	0 - 274	1763	0.9	2.3	0.3	0.7	0.3	0.5	0.1	.0	.0	.0	.0	.08		0.01
408	0 - 183	3184	2.0	.0	.0	0.8	0.2	29.0	13.5	.0	.0	.0	15.4	.00		0.03
409	0 - 92	1500	.0	.0	.0	.0	0.1	.0	.0	.0	.0	.0	.0	.00		
410	0 - 183	2936	.0	.0	.0	.0	.0	0.6	.0	.0	.0	.0	0.4	.23		0.07
411	185 - 366	379	.0	.0	1.0	0.5	3.6	.0	.0	1.0	.0	0.8	-	-		1.49
440	185 - 366	924	-	-	-	-	-	-	-	-	-	.0	-	-		
441	93 - 183	1000	-	-	-	-	-	-	-	-	-	1.0	-	-		
444	93 - 183	3925	-	-	-	-	-	-	-	-	-	.0	-	-		
445	185 - 366	1023	-	-	-	-	-	-	-	-	-	.0	-	-		
446	185 - 366	491	-	-	-	-	-	-	-	-	-	0.5	-	-		
Mean per tow			3.47	29.59	1.16	6.24	4.11	5.09	3.43	0.36	2.3	2.65	12.31	0.83		2.77
Biomass (t)			7232	61671	2410	11530	8562	10600	7156	748	4789	7170	25255	1721		5762

Note: Strata 396-400 not included in estimate of biomass index

Table 12. Mean weight (kg) of redfish caught per standard 15 minute tow in Unit2 during DFO research surveys for 1994-1997. (Numbers in brackets are successful sets, "-" indicates unsampled strata).

STRATUM	Depth Range (m)	Area sq. n. mi.	1994	1995	1996	1997
3Pn						
303	185-274	554	63.34 (5)	43.47 (5)	14.65 (4)	48.45 (4)
304	275-366	151	463.55 (2)	234.44 (2)	105.18 (2)	303.36 (2)
305	367+	733	45.61 (5)	75.95 (6)	46.00 (6)	42.97 (6)
Upper			694.89	171.34	64.72	99.07
Mean			96.33	80.08	40.14	72.42
Lower			-502.23	-11.18	15.55	45.77
Biomass (metric tons)			17546	14568	7311	13192
3Ps						
306	185-274	363	45.37 (3)	14.50 (3)	15.57 (3)	23.23 (2)
309	185-274	296	146.39 (3)	191.88 (2)	120.2 (2)	75.80 (2)
310	185-274	170	136.20 (2)	12.70 (2)	40.95 (2)	185.45 (2)
313	185-274	165	18.01 (2)	124.95 (2)	100.55 (2)	116.06 (2)
316	185-274	189	136.11 (2)	162.04 (2)	336.98 (2)	89.03 (2)
318	185-274	129	270.81 (2)	303.17 (2)	350.96 (2)	836.44 (2)
705	275-366	195	229.86 (2)	45.25 (2)	86.1 (2)	58.40 (2)
706	275-366	476	296.88 (3)	88.19 (4)	94.62 (3)	81.43 (3)
707	275-366	74	1008.71 (2)	356.33 (2)	560.66 (2)	662.28 (2)
715	275-366	128	127.28 (2)	63.03 (2)	161.13 (2)	115.57 (2)
716	275-366	539	79.08 (5)	67.41 (4)	140.7 (4)	76.06 (4)
708	367-549	126	550.85 (2)	233.98 (2)	89.36 (3)	168.53 (2)
711	367-549	593	173.65 (4)	138.73 (5)	91.02 (4)	82.08 (4)
712	367-549	731	99.97 (6)	56.58 (6)	165.72 (5)	55.98 (5)
713	367-549	851	38.15 (6)	161.09 (7)	213.64 (6)	64.12 (6)
714	367-549	1047	78.86 (9)	92.97 (9)	36.13 (8)	45.99 (7)
709	550-731	147	0.19 (2)	6.80 (2)	15.78 (2)	29.27 (2)
710	732-914	156	0.00 (2)	1.13 (2)	0 (2)	-
Upper			173.06	140.77	190.20	131.51
Mean			129.70	104.29	122.64	93.11
Lower			86.34	67.81	55.09	54.71
Biomass (metric tons)			104733	84217	99037	73350
4Vn						
417	185-274	387	300.25 (3)	56.16 (4)	122.59 (3)	147.71 (3)
416	275-366	671	264.84 (6)	103.88 (6)	78.35 (6)	114.49 (6)
415	367+	2915	113.49 (26)	65.38 (24)	80.2 (24)	92.26 (25)
Upper			225.44	85.64	125.44	164.16
Mean			157.24	70.98	84.02	101.42
Lower			89.04	56.32	42.6	38.38
Biomass (metric tons)			79133	35722	42283	51040
4Vs						
446	275-366	313	102.51 (2)	606.82 (3)	53.13 (2)	71.65 (2)
451	275-366	147	212.80 (2)	109.00 (2)	-	723.85 (2)
452	275-366	345	1.08 (2)	1.98 (3)	3.9 (3)	7.82 (3)
397	367-549	540	77.42 (4)	104.93 (5)	57.9 (4)	49.54 (4)
398	367-549	833	169.34 (6)	137.89 (8)	112.29 (7)	62.82 (7)
399	367-549	465	66.27 (4)	227.87 (4)	217.99 (4)	79.25 (4)
400	367-549	270	56.27 (2)	105.13 (2)	485.83 (2)	546.60 (2)
468	367-549	148	-	467.18 (2)	-	1421.65 (2)
Upper			145.83	403.22	675.96	449.93
Mean			100.45	190.02	135.69	197.79
Lower			55.07	-23.18	-404.58	-54.34
Biomass (metric tons)			37065	73679	47542	76693
TOTAL SURVEY BIOMASS			238477	208186	196173	214275

Table 13 . Mean weight (kg) of redfish caught per standard 30 minute tow and survey biomass in UNIT2 during GEAC surveys from 1997-1999. (Numbers in brackets are successful sets, "-" indicates strata not sampled).

STRATUM	Depth Range (m)	Area sq. n. mi.	1997 Dec 1-10	1998 Aug16-23	1999 Aug31-Sep9
3Pn					
303	185-274	151	187.78 (2)	651.18 (2)	271.41 (3)
304	275-366	554	194.22 (2)	49.76 (2)	36.27 (2)
305	367+	733	27.15 (2)	76.76 (2)	96.74 (4)
Upper			828.33	982.77	443.18
Mean			108.38	126.68	157.68
Lower			-611.57	-729.41	-127.82
Biomass (metric tons)			7630	8918	11100
3Ps					
306	185-274	363	0.14 (2)	11.65 (2)	9.24 (2)
309	185-274	296	10.66 (2)	106.41 (2)	411.00 (2)
310	185-274	170	-	20.65 (2)	8.38 (2)
313	185-274	165	10.57 (2)	10.59 (2)	5.00 (2)
316	185-274	189	40.60 (2)	68.29 (2)	19.06 (2)
318	185-274	129	1697.54 (2)	-	173.65 (2)
705	275-366	195	105.77 (2)	29.12 (2)	32.50 (2)
706	275-366	476	-	97.41 (2)	58.33 (3)
707	275-366	74	707.27 (2)	931.24 (2)	202.03 (2)
715	275-366	128	204.34 (2)	397.06 (2)	249.51 (2)
716	275-366	539	-	195.35 (2)	88.08 (3)
708	367-549	126	1267.75 (2)	995.30 (2)	1906.49 (2)
711	367-549	593	482.07 (2)	173.12 (2)	75.00 (3)
712	367-549	731	74.49 (3)	160.41 (2)	64.95 (4)
713	367-549	851	1285.46 (4)	31.06 (3)	123.15 (5)
714	367-549	1047	236.17 (3)	312.35 (3)	99.28 (6)
709	550-731	147	-	-	-
Upper			903.08	267.39	552.21
Mean			444.44	173.27	135.48
Lower			-14.19	79.15	-281.24
Biomass (metric tons)			106329	50412	40273
4Vn					
417	185-274	387	17.92 (2)	347.56 (2)	332.11 (2)
416	275-366	671	73.74 (2)	242.47 (2)	118.60 (4)
415	367-532	2915	416.65 (7)	347.56 (8)	92.52 (16)
Upper			1009.99	648.17	145.12
Mean			319.9	382.9	120.26
Lower			-370.2	117.63	95.41
Biomass (metric tons)			62219	74474	23391
4Vs					
446	275-366	313	32.44 (2)	3550.76 (2)	- (2)
451	275-366	147	1995.65 (3)	-	-
452	275-366	345	-	-	-
397	367-549	540	1403.48 (3)	279.00 (2)	106.17 (2)
398	367-549	833	51.14 (4)	558.35 (3)	320.60 (3)
399	367-549	465	56.33 (3)	132.35 (2)	97.25 (2)
400	367-549	270	36.55 (2)	78.35 (2)	93.40 (2)
468	367-549	148	1077.59 (2)	-	-
Upper			828.84	6604.85	357.54
Mean			478.48	747.57	187.30
Lower			128.11	-5109.71	17.06
Biomass (metric tons)			63619	88601	19329
TOTAL GEAC SURVEY BIOMASS			239797	222405	94093

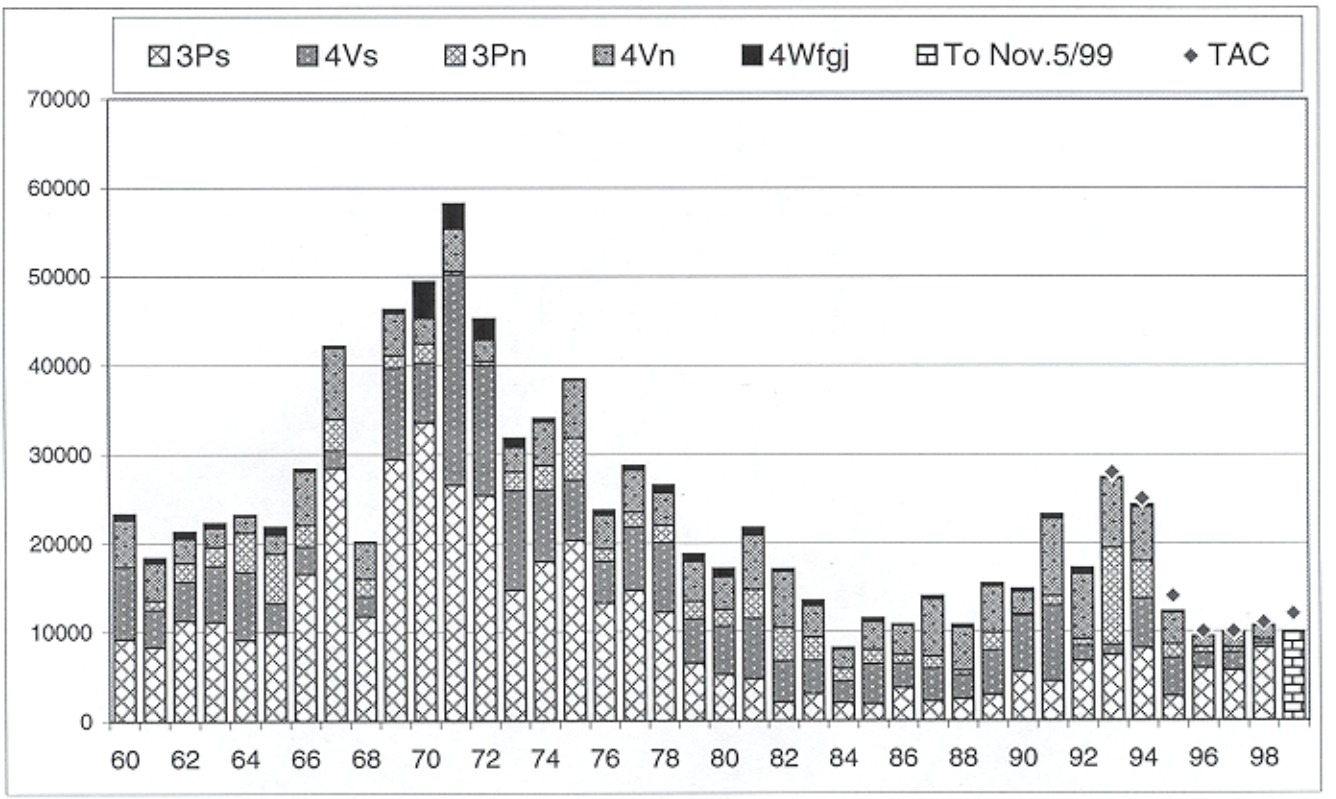


Fig. 1. Nominal catch of redfish from UNIT2 management unit (3Pn4Vn[Jan-May], 3Ps4Vs4Wfgj) from 1960-1999 (1999 provisional to Nov. 5)

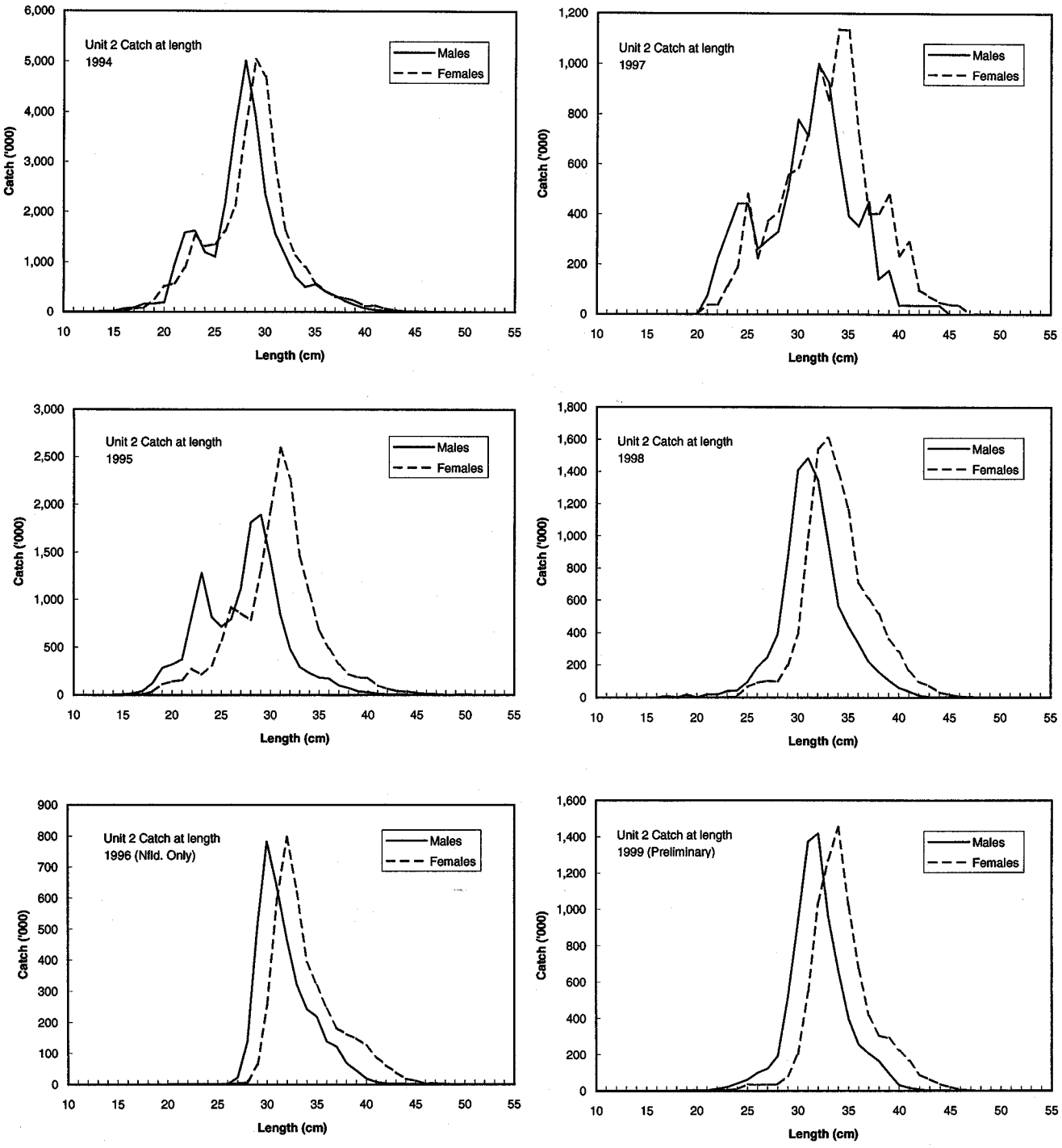


Fig. 2. Commercial catch-at-length of Unit 2 redfish estimated by available port samples adjusted to landings by fleet, gear and month.

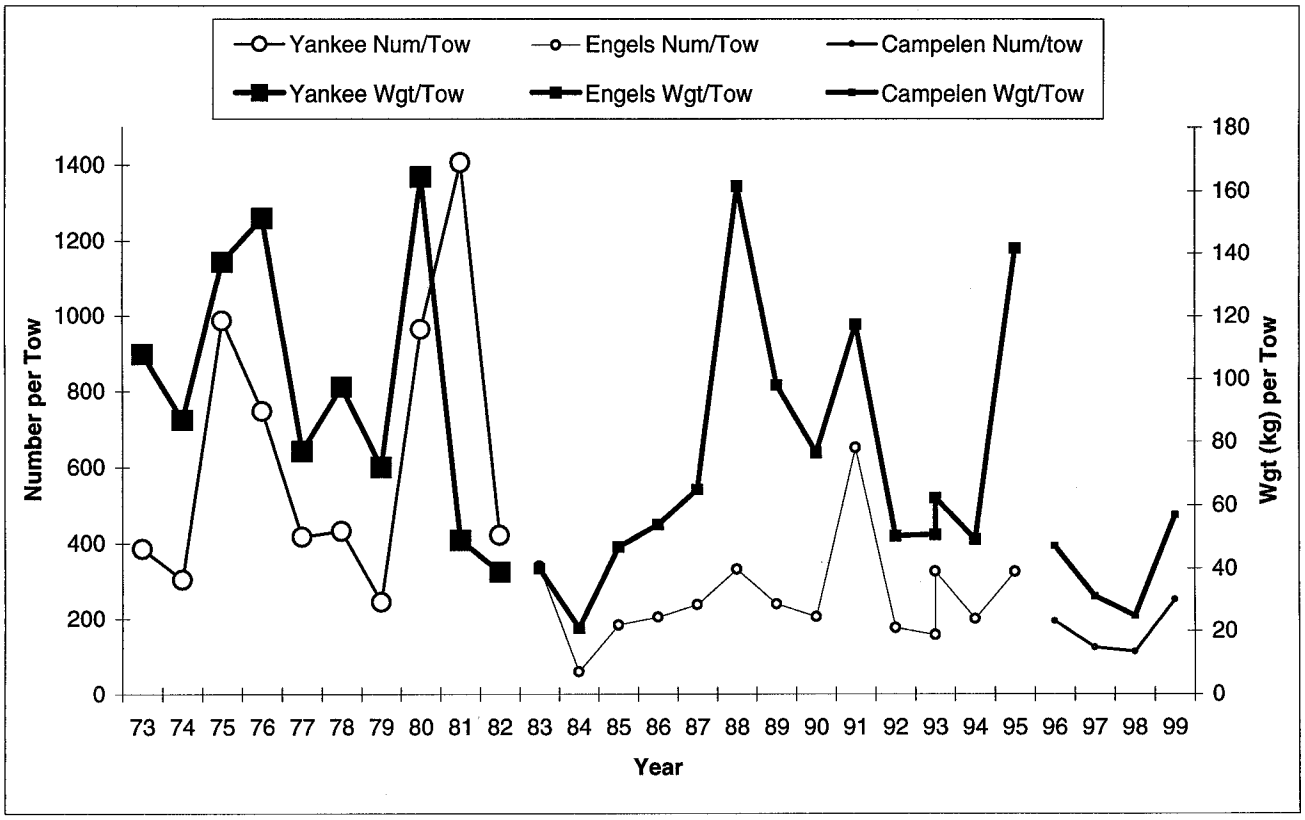


Fig. 3. RV mean number and weight (kg) per standard tow for 3Ps winter/spring surveys. There were various trawls and standard tows used over the years:
1978-1982 (Yankee 41-5), 1983-1995 (Engels 145), 1996-present (Campelen 1800).

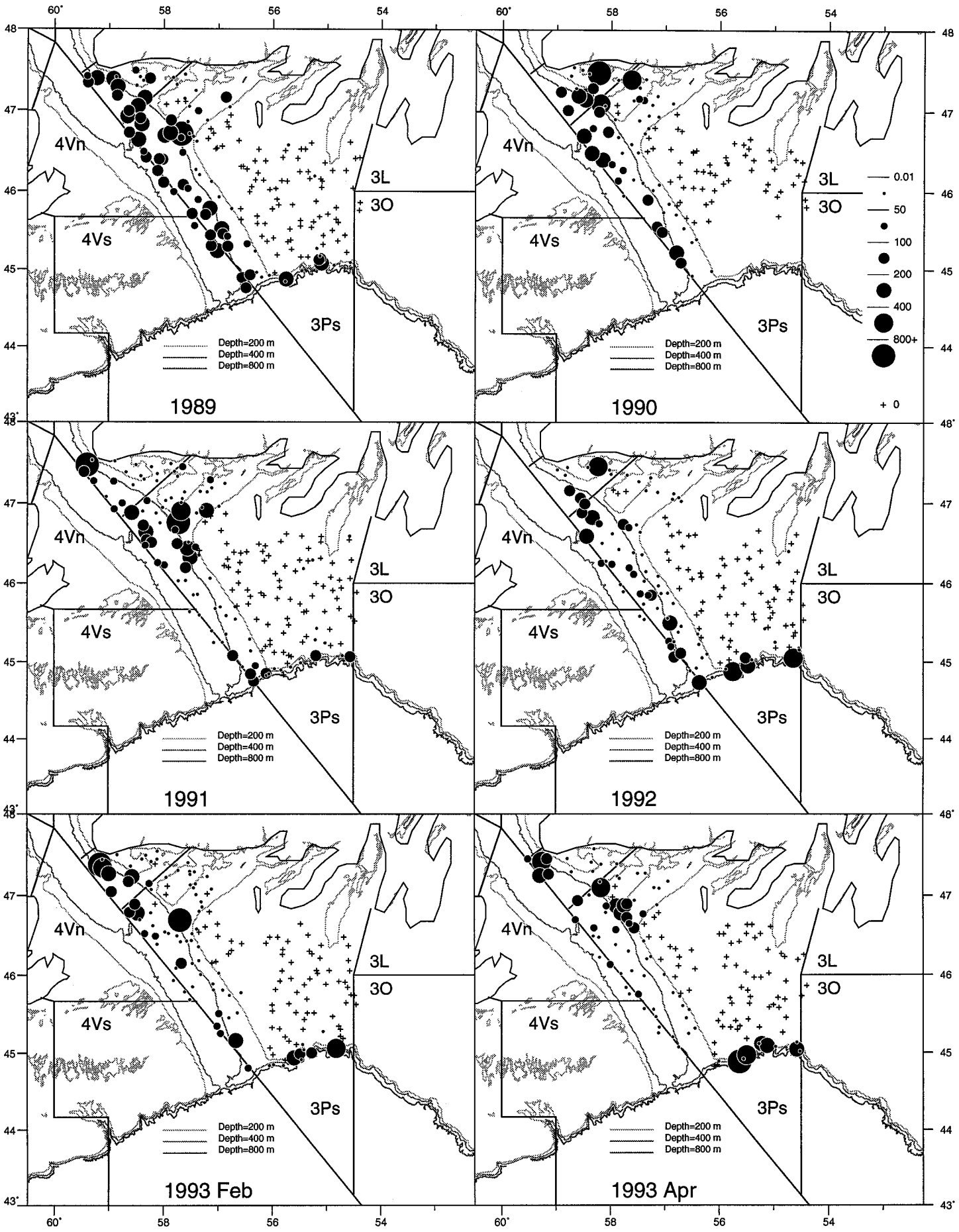


Fig. 4. Distribution of Redfish catches (Kg./ standard tow) from 1989-1993 spring surveys to Div. 3P. The surveys utilized an Engels 145 trawl (1.75 n. mi. tow).

red8993a.cmd

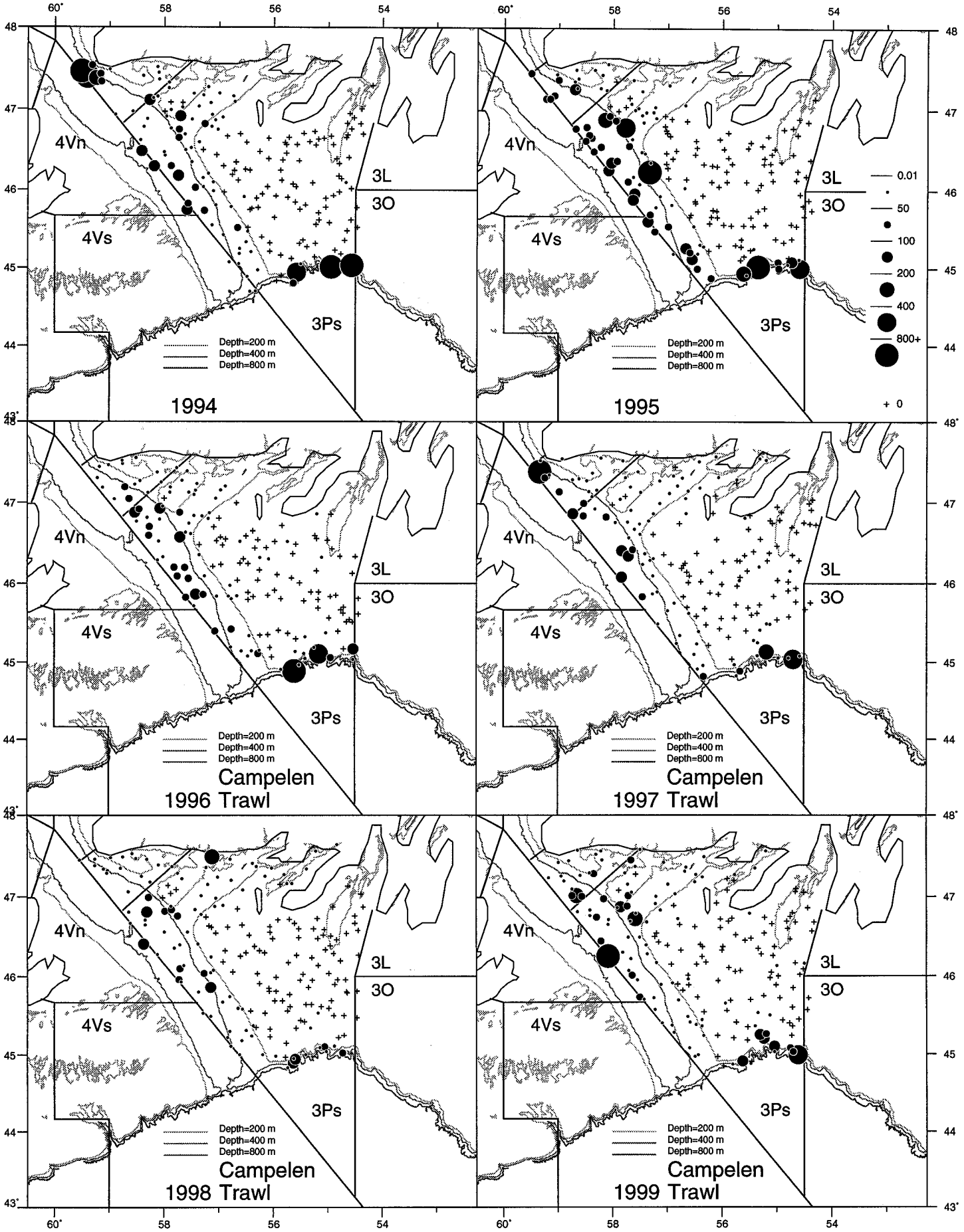


Fig. 5. Distribution of Redfish catches (Kg./ standard tow) from 1994-1999 spring surveys to Div. 3P. The surveys utilized an Engels 145 trawl (1.75 n. mi. tow) up to 1995 and a Campelen trawl (0.75 n. mi. tow) for 1996-1999.

red9499.cmd

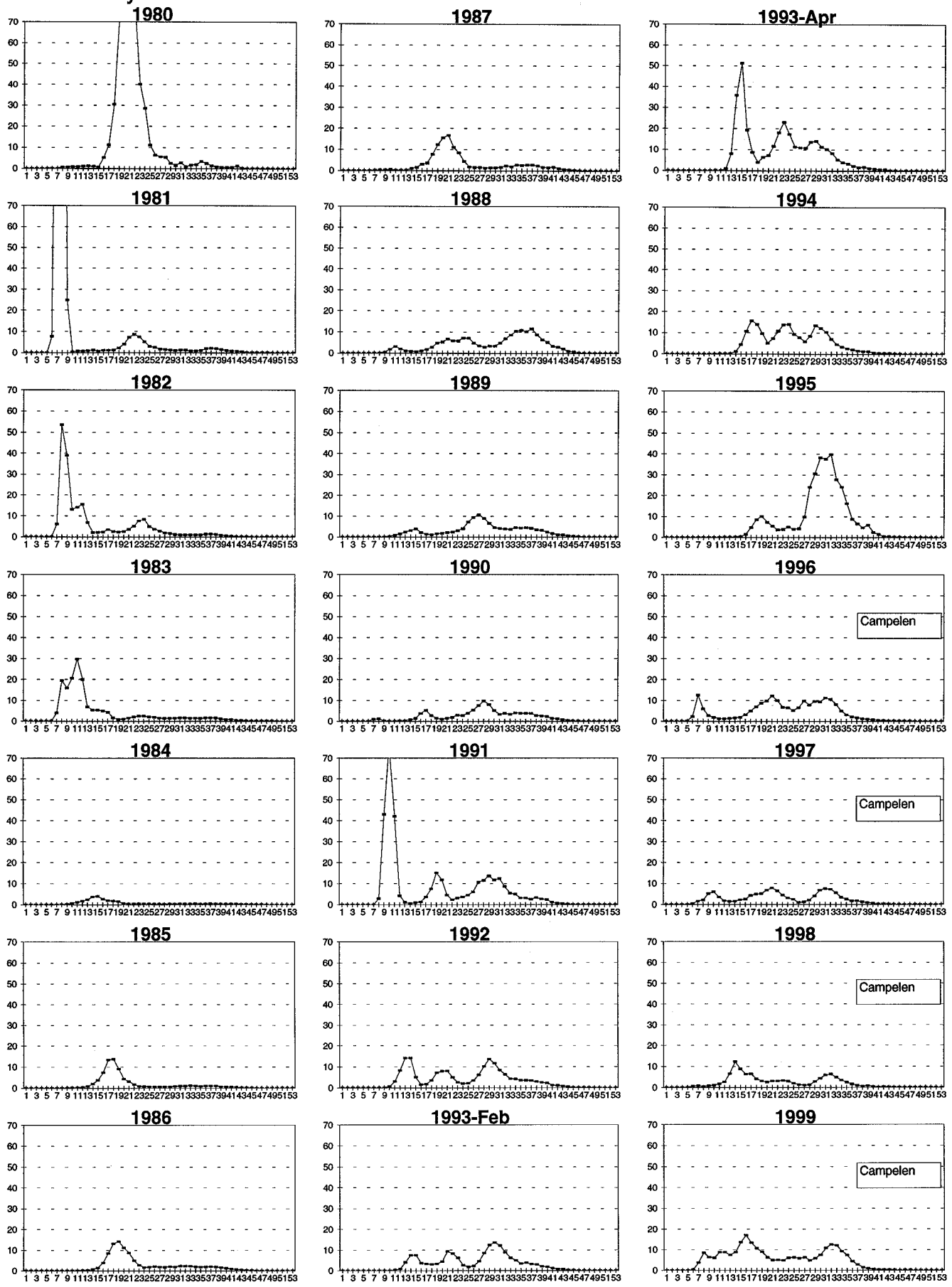


Fig. 6. Length distributions (mean per standard tow) from stratified-random research surveys to Div. 3Ps in spring/winter from 1980-1999. X-axis is forklength in centimetres. The following trawls were used over the series: Yankee 41-5 otter trawl (1979-1982), Engel 145 otter trawl (1983-1995), Campelen 1800 shrimp trawl (1996-present)

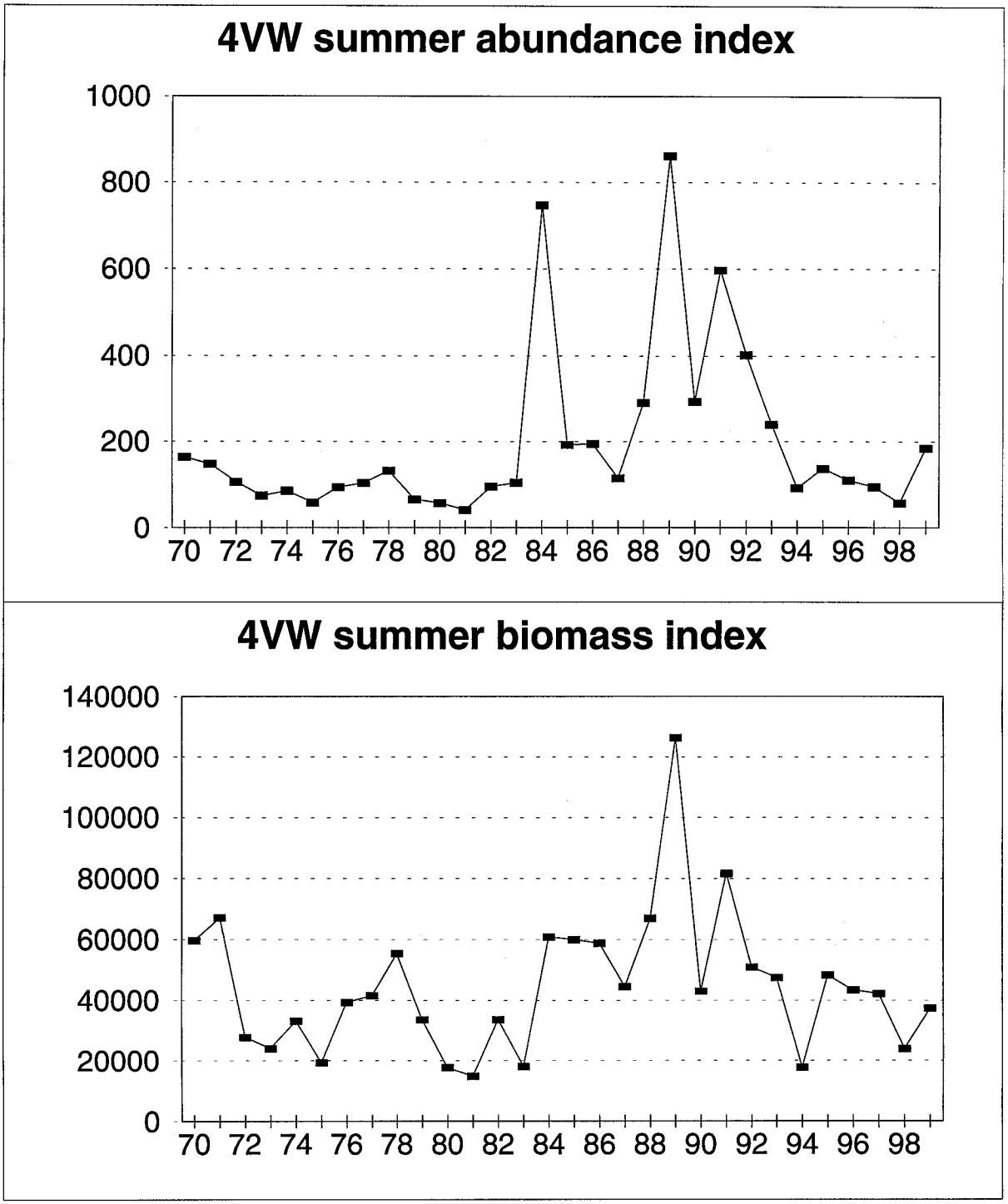


Fig. 7. Redfish abundance and biomass estimates for 1970-1999 4VW groundfish directed summer surveys conducted by the Maritimes Region. From 1970 to 1981 the A. T. Cameron conducted the surveys with a Yankee trawl. The Alfred Needler conducted surveys from 1982 to 1999 utilizing a Western IIa trawl.

4VW Summer RV Survey

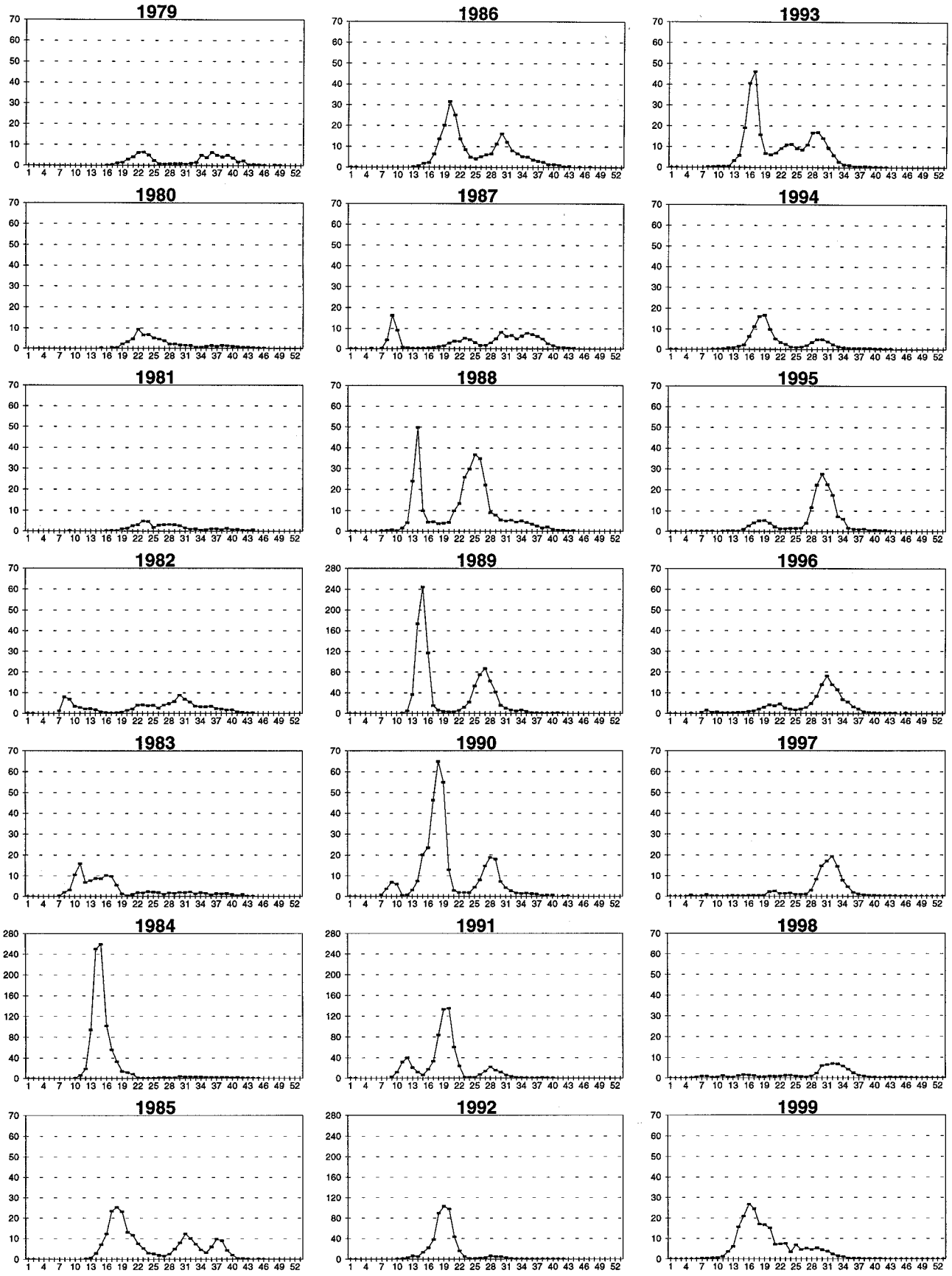


Fig. 8. Redfish length distributions from stratified-random groundfish directed research surveys conducted by the Maritimes Region in Div. 4VW in the summer from 1979-1999. Plotted above are mean number per standard tow. X-axis is forklength in centimetres.

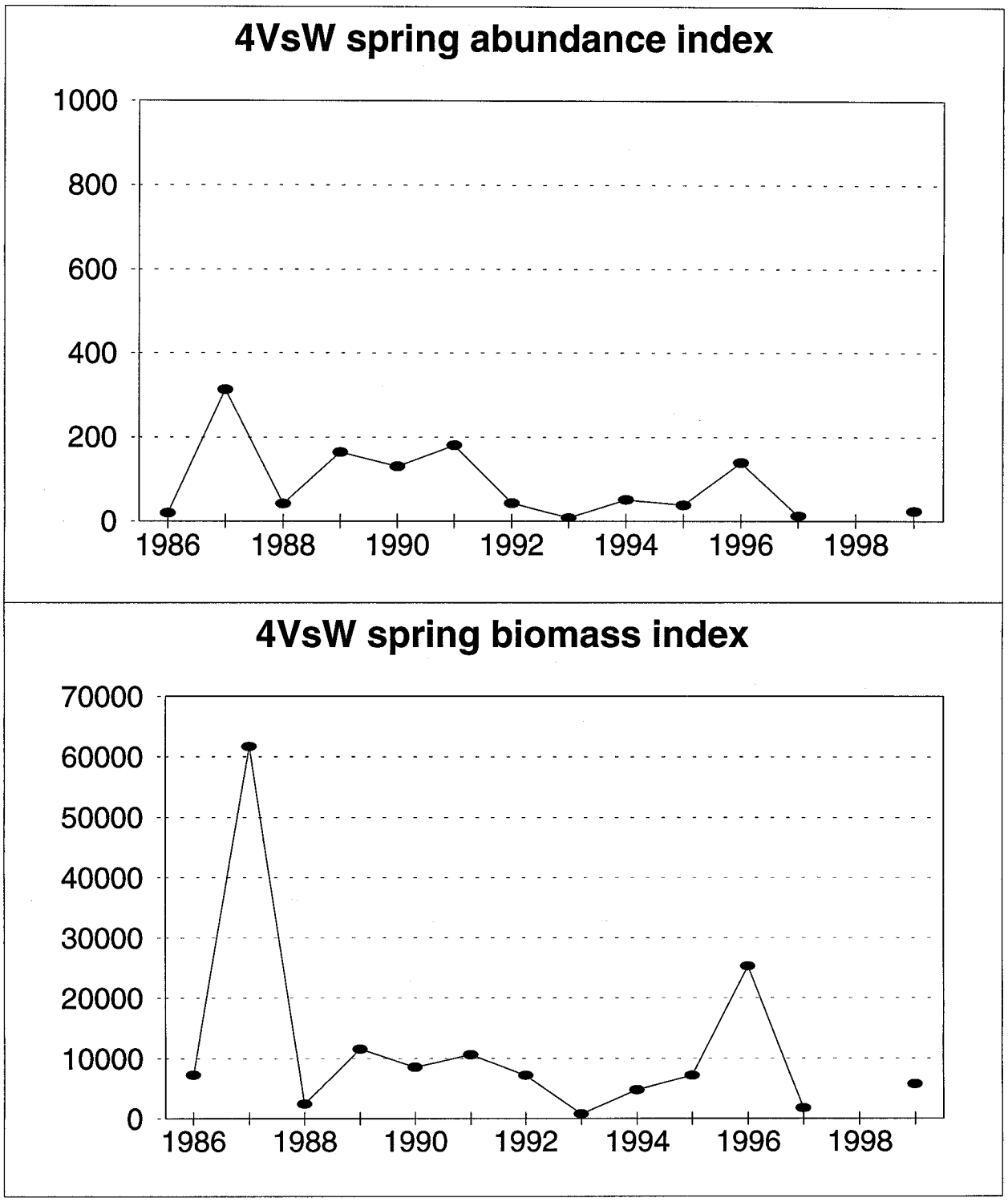


Fig. 9. Redfish abundance and biomass estimates from 1986-1999 4VW Cod directed groundfish surveys conducted by the Maritimes Region.

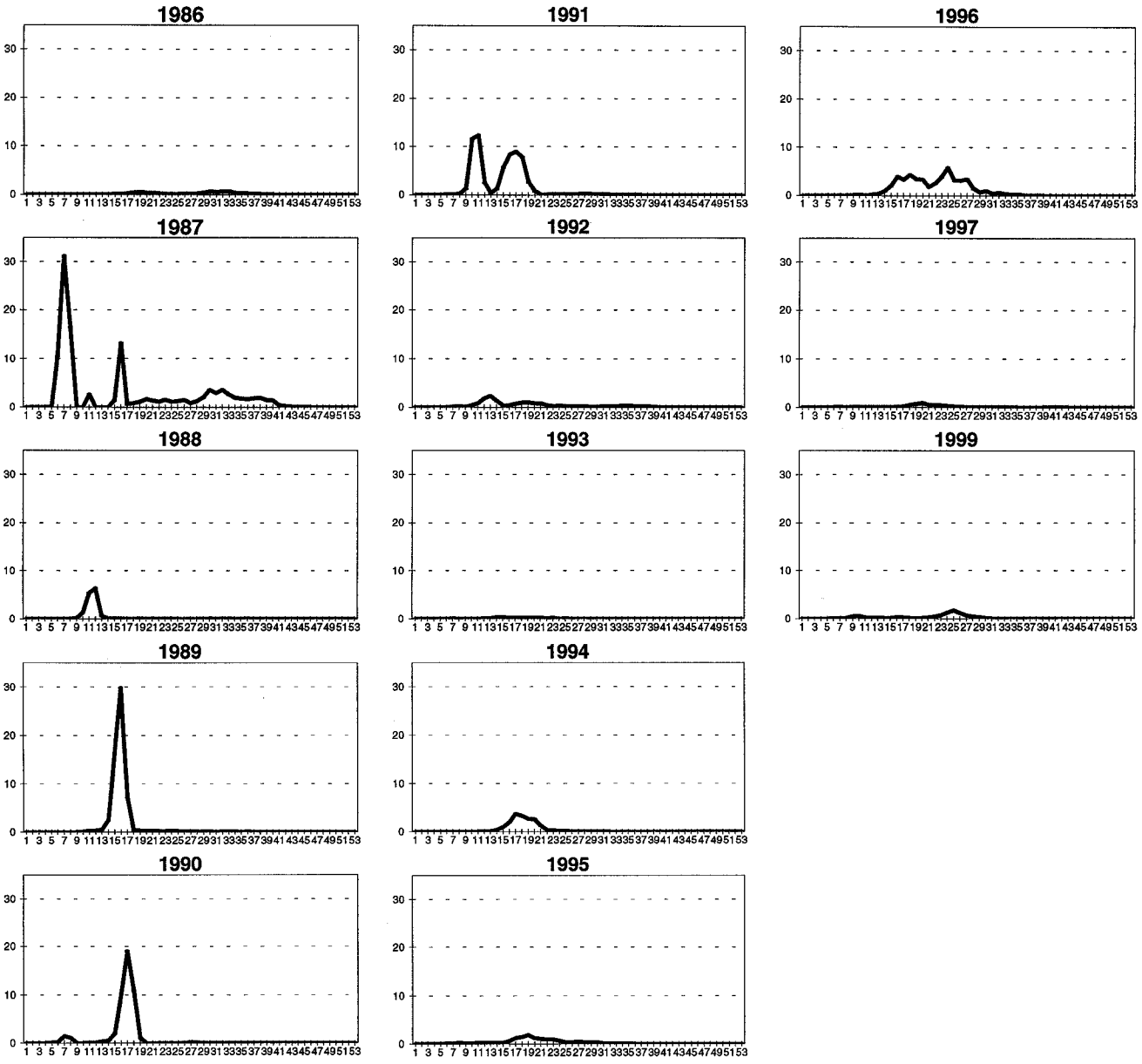


Fig. 10. Redfish length distributions from stratified-random Cod directed research surveys conducted by Maritime Region in Div. 4VsW in the spring from 1986-1997, 1999. Plotted above are mean number per standard tow. X-axis is forklength in centimetres.

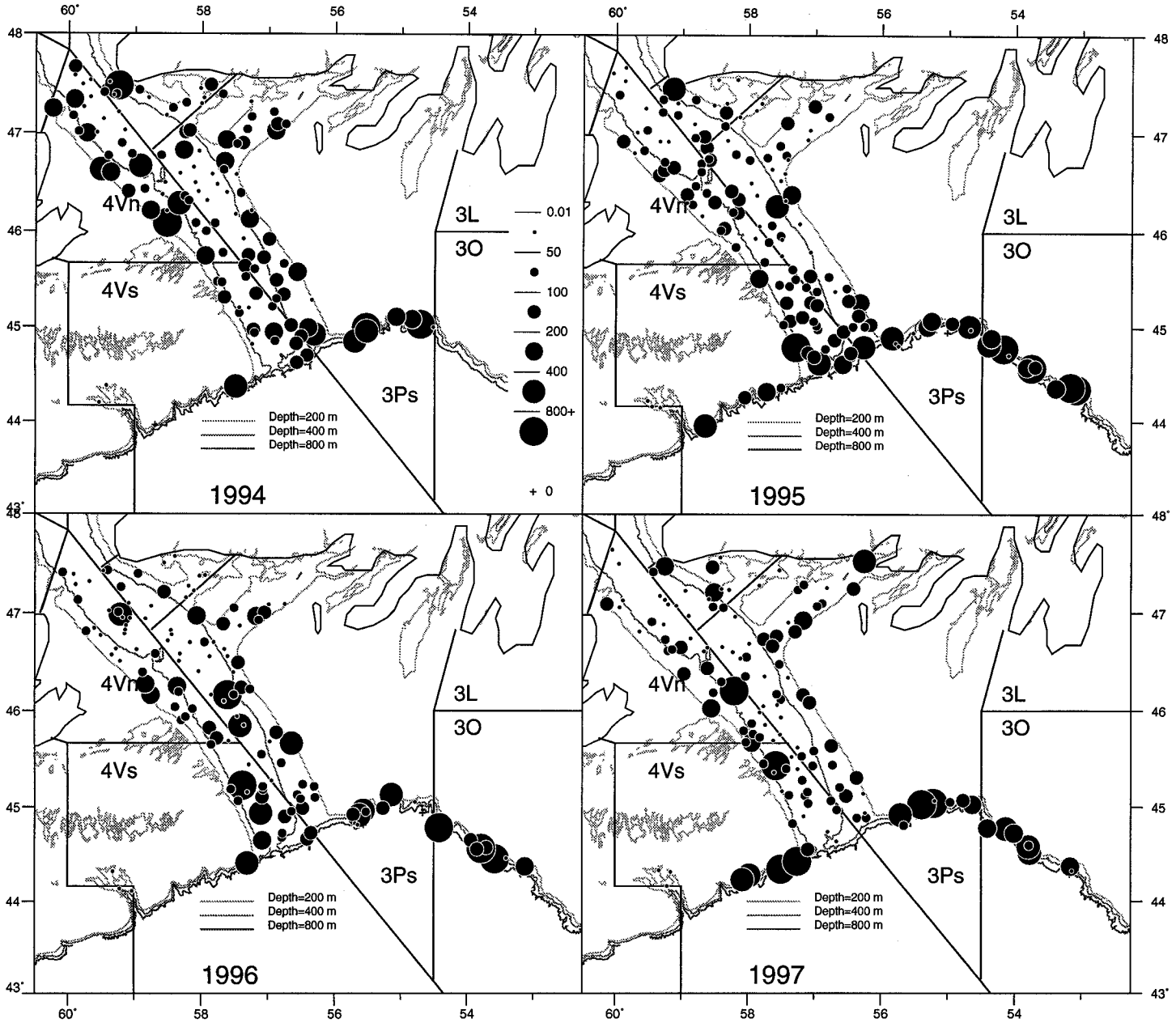


Fig. 11. Distribution of Redfish catches (Kg. per standard 0.8 nm. tow) from summer DFO redfish directed surveys to Unit 2 using a Campelen 1800 survey trawl with a 12.5 mm liner.

3p4v9497.cm4

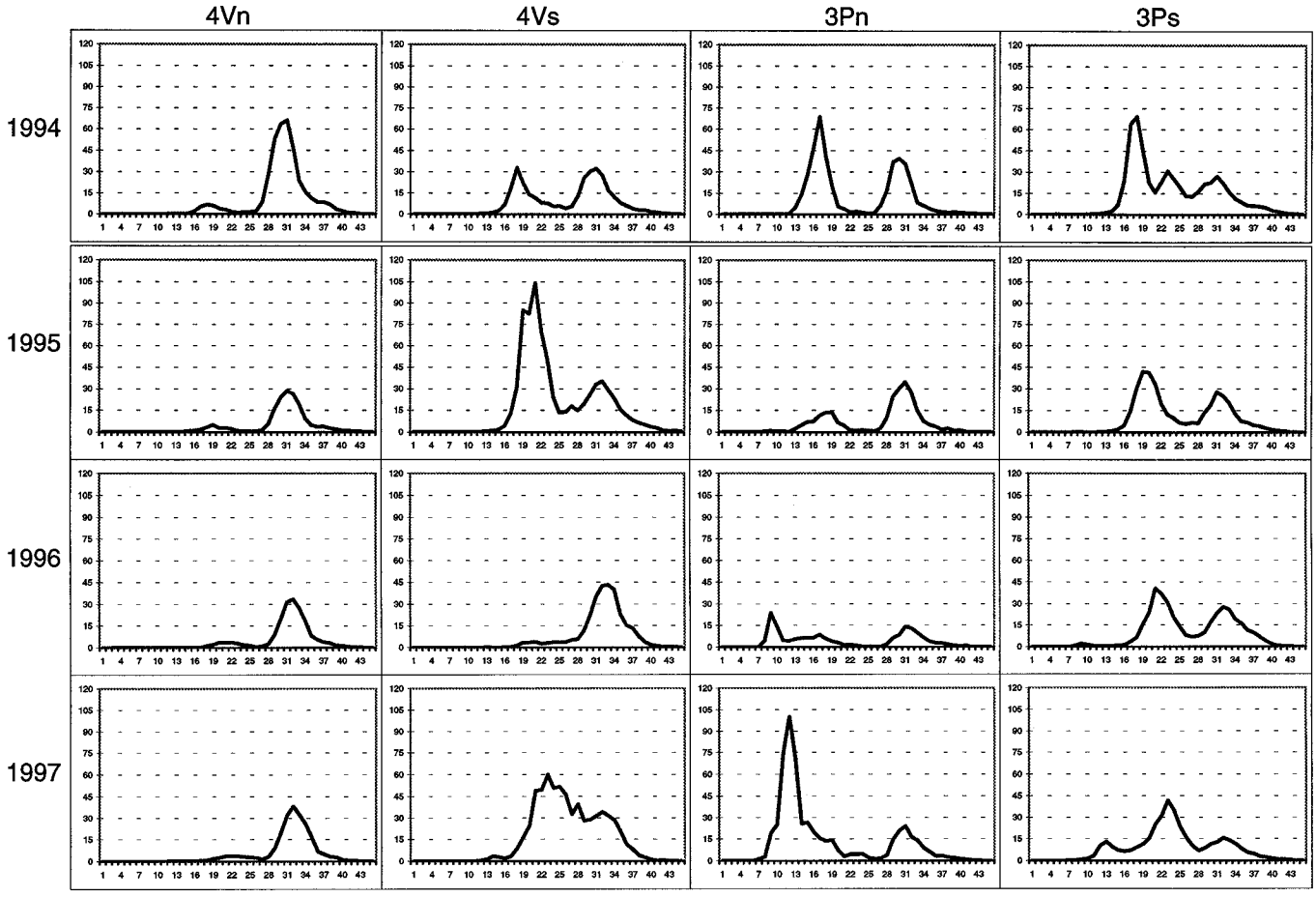
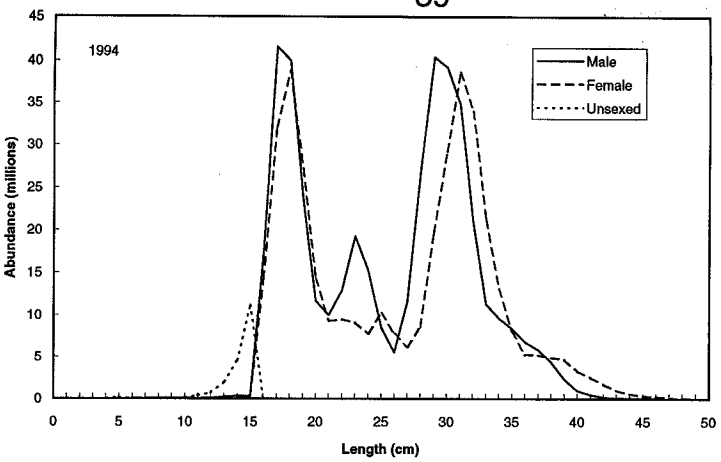
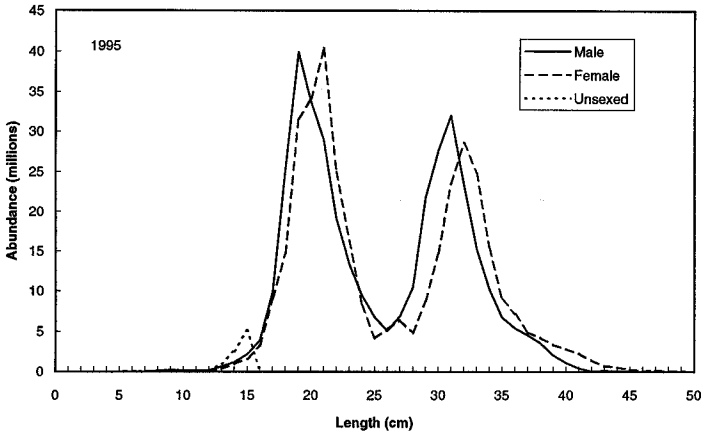
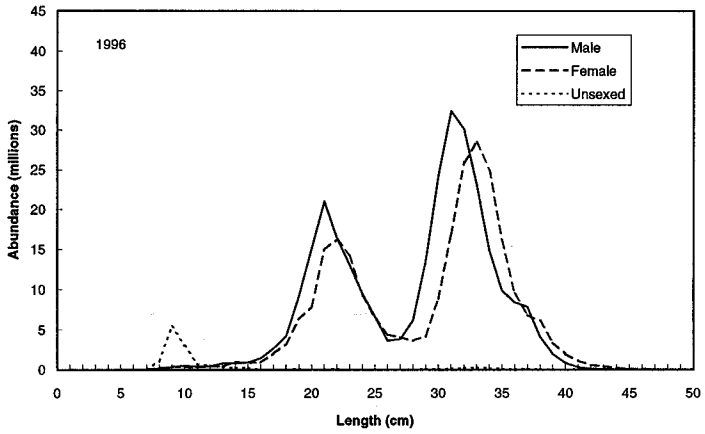


Fig. 12. Length distributions from stratified-random DFO surveys to UNIT2 for 1994-1997. Plotted are mean number per standard (0.75 n. mi.) tow. X-axis is centimetres. The 1994 survey was conducted by the MV Gadus Atlantica and the 1995 to 1997 surveys were conducted by the by the CSS Teleost . All surveys were conducted with a Campelen 1800 shrimp trawl.







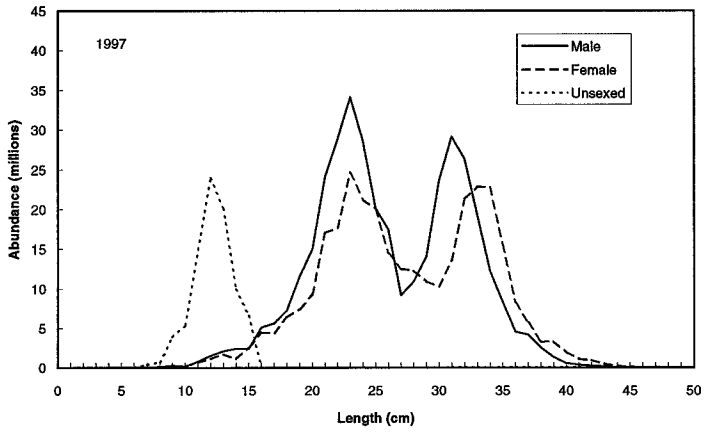


Fig. 13. UNIT2 redfish abundance index at length from summer DFO surveys from 1994-1997.

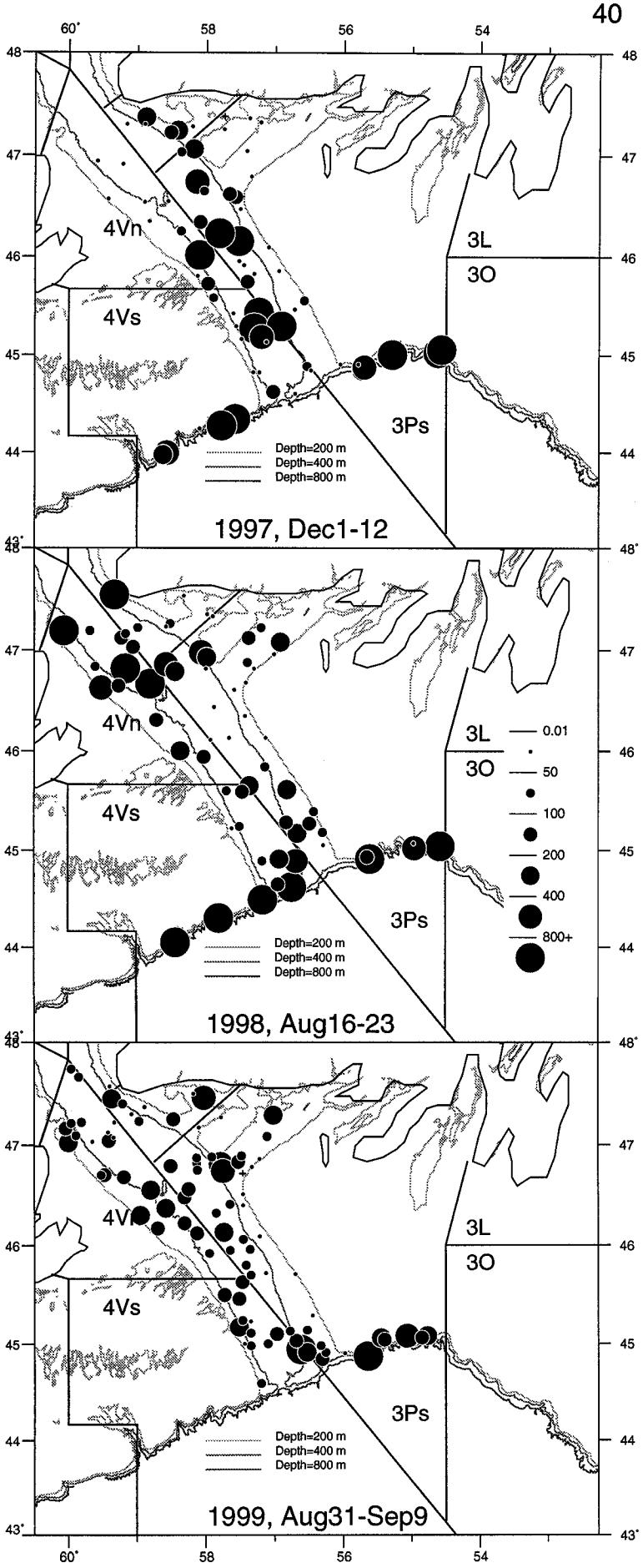


Fig. 14. Distribution of Redfish catches (Kg./standard 1.8 nm. tow) from GEAC redfish surveys in Unit 2 from 1997-1999 using an Engels 170 commercial trawl.

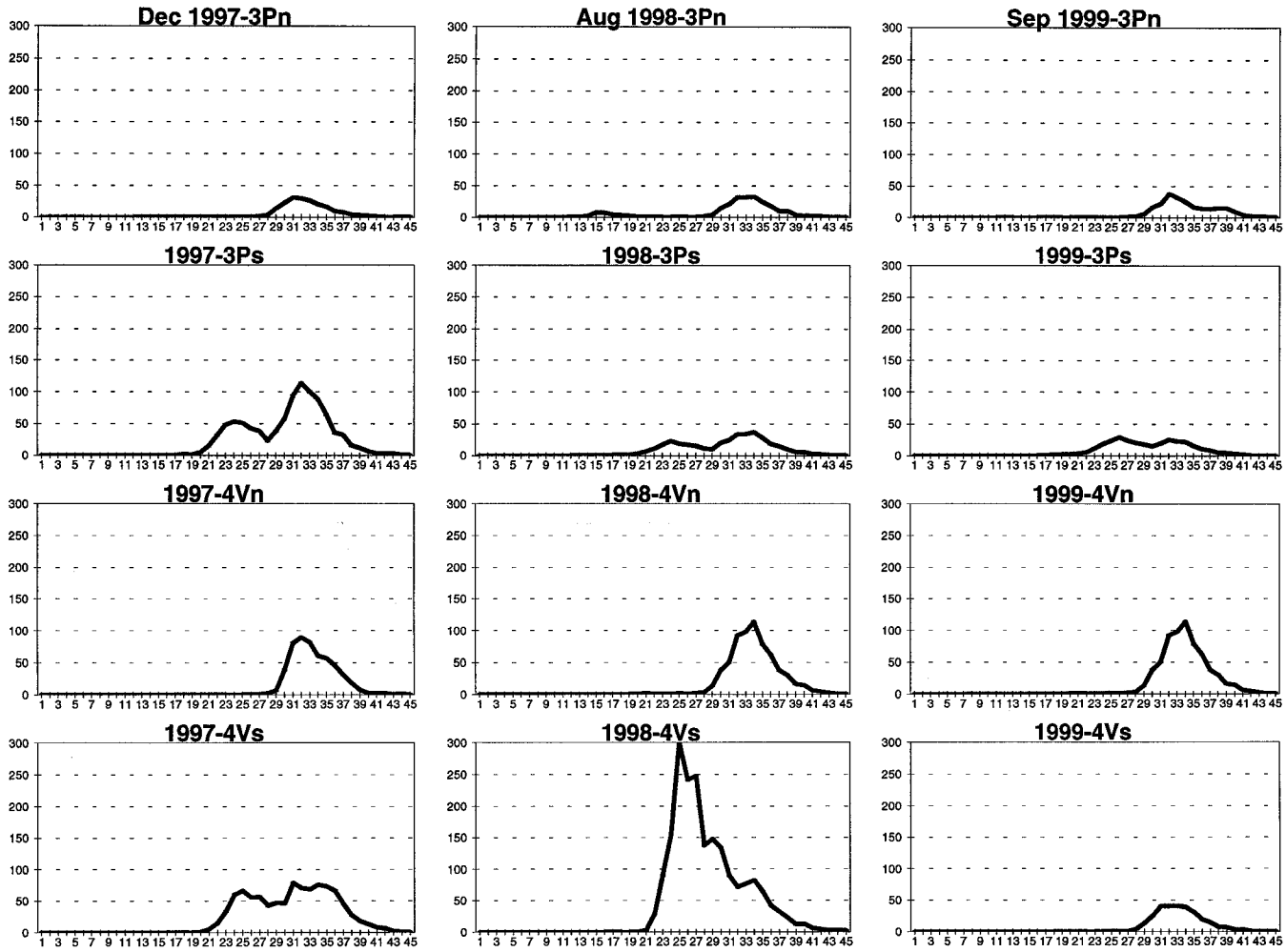
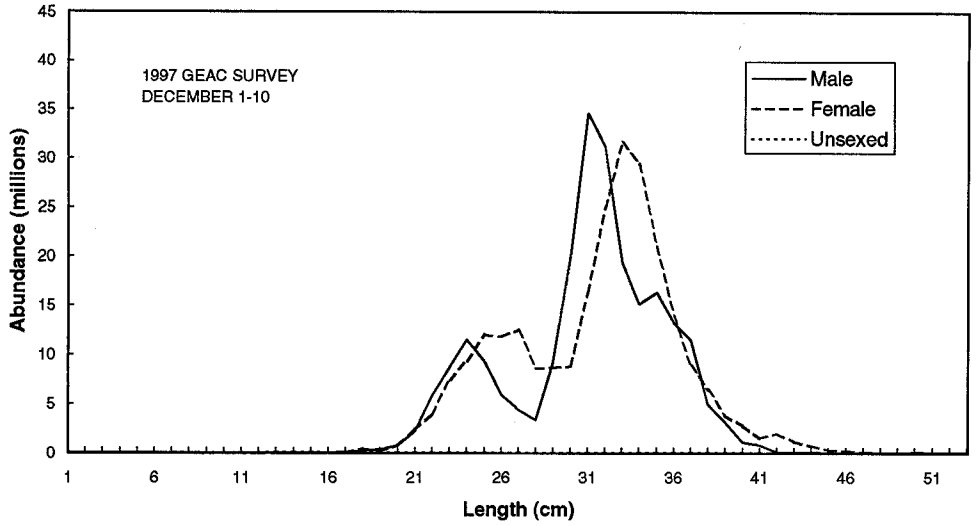
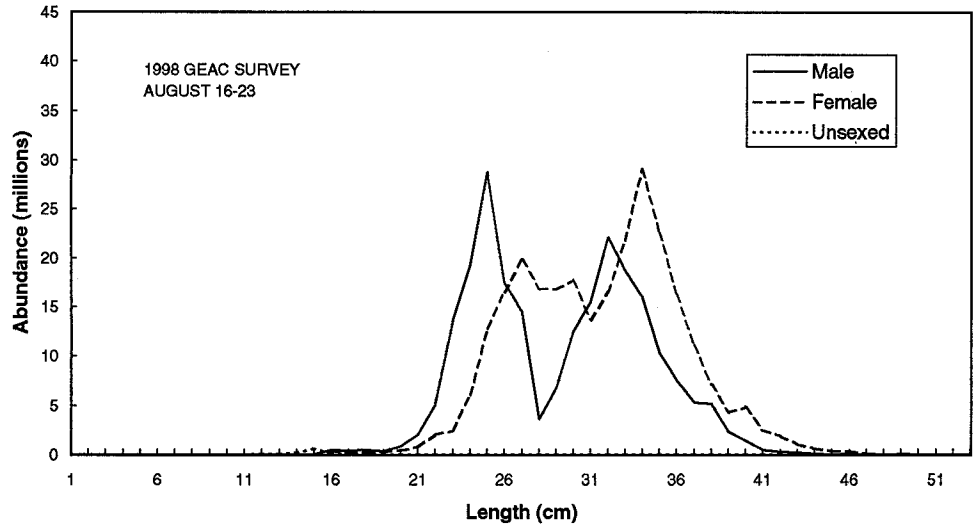


Fig. 15. Length distributions from stratified-random GEAC industry surveys to UNIT2 for 1997 to 1999. Plotted are mean number per standard (1.75 n. mi.) tow. X-axis is forklength in centimetres. The 1997 and 1999 surveys were conducted by the MV Cape Beaver and the 1998 survey by the MV Cape Ballard. Both surveys utilized an Engel 170 trawl with no liner.





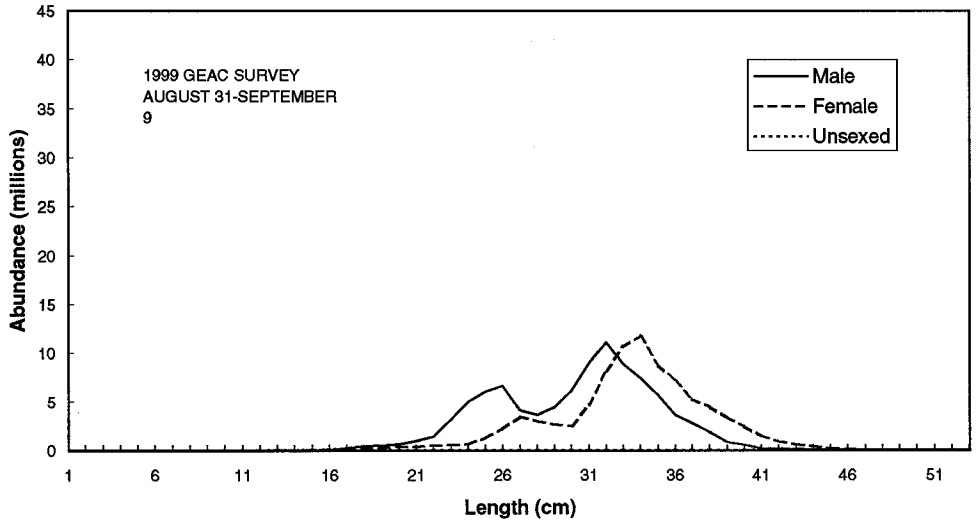


Fig. 16. Redfish survey abundance index at length from GEAC Industry surveys of UNIT 2 from 1997-1999.