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The status of Redfish in Unit 2 (Laurentian Channel
Management Unit)

by

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ABSTRACT

The implementation of this new 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 successful. Catches have declined from 27,000 metric tons in 1993 to 9,000 metric tons in 1997 closely matching reductions in TACs over the same period. Summer DFO research surveys indicate that stock size remained stable between 1995 and 1997. This survey was not conducted in 1998. Industry surveys in 1997-1998 also suggest stability in the resource. Current commercial catches are composed primarily of the early 1980s year-class(es). The next anticipated pulse of recruitment (the 1988 year-class) is now becoming increasingly vulnerable to the fishery. Its contribution to the fishable stock will be less than that of the year-class(es) of the early 1980s, which have dominated the fishery for eight to nine years. It is not possible to provide an estimate of the absolute size of this stock nor to estimate fishing mortalities for the past. The ratio of catch to estimated exploitable biomass index derived from recent surveys suggests that relative exploitation has been about 6% and that a catch of 11,000 t in 1998 is not likely to be higher than the catch associated with fishing at $F_{0.1}$. A pulse of recruitment was observed in the 1997 DFO survey but will require a few years of monitoring before its relative strength can be related to other year classes comprising the commercial fishery.

RÉSUMÉ

La création de cette nouvelle unité de gestion en 1993 a donné lieu à une modification du régime de pêche par rapport à celui qui prévalait dans les anciennes unités de 3P, 4RST et 4VWX. Les fermetures saisonnières et un protocole de protection des poissons de petite taille ont aussi influé sur le régime de pêche, mais les pêcheurs jugent que les pêches des trois années antérieures ont été bonnes. Les captures ont diminué pour passer de 27 000 tonnes métriques en 1993 à 9 000 tonnes métriques en 1997 et ces valeurs traduisent étroitement les réductions des TPA imposées au cours de la même période. Les relevés de recherche d'été du MPO montrent que le stock est demeuré stable entre 1995 et 1997. Le relevé n'a pas été effectué en 1998. Les relevés de l'industrie de 1997 à 1998 indiquent aussi une ressource stable. Les captures commerciales actuelles sont surtout formées de poissons d'une ou plusieurs classes d'âge du début des années 1980. La prochaine poussée de recrutement (classe d'âge de 1988) devient de plus en plus vulnérable à la pêche. Son apport au stock exploitable sera inférieur à celui des classes d'âge du début des années 1980 qui ont dominé la pêche pendant huit ou neuf ans. Il est impossible d'estimer la taille absolue du stock ni la mortalité par pêche antérieure. Le rapport des captures à l'indice de la biomasse exploitable tiré des relevés des dernières années porte à croire que le taux d'exploitation relatif a été de 6 % environ et que des captures de 11 000 t en 1998 ne devraient pas être supérieures à celles correspondant à une pêche au niveau $F_{0.1}$. Une poussée de recrutement a été notée au moment du relevé du MPO de 1997, mais il faudra attendre encore quelques années avant d'être en mesure d'en comparer l'importance avec celle des autres classes d'âge annuelles exploitées par les pêches commerciales.

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 Laurentian Channel 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 redfish in Unit 2 in 1993 was 28,000 t. TACs declined successively to 10,000 t in 1996 as a conservation measure and was maintained at that level for 1997. There was an increase in the TAC to 11,000 t. for 1998. Seasonal/area closures for redfish were implemented in 1995 and maintained to 1998 to (i) minimize possible overlaps with Unit 1 redfish given a lack of understanding of redfish migration patterns (subdivisions 3Pn/4Vn closed November and December), and (ii) 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 in from 1995-1998 for January to April in related to 4T4Vn cod. A small fish protocol at 25cm was imposed for 1996 aimed at protecting the 1988 year class as it appears this may be the major contributor to the fishable population in the near future given the current exploitation pattern in the fishery. In 1997, the small fish protocol was reduced to the standard 22 cm for the protection of juveniles and maintained for 1998.

Nominal Catches

From 1960-1968 landings were about 20,000 t, increased to an average of 43,000 t up to 1975 mainly due to increases by foreign fleets, then subsequently declined to the lowest on record in 1984 at 8,100 t (Table 1, Fig. 1). Catches then steadily increased to 27,000 t in 1993 but declined sequentially to 9,000 t in 1996 and 1997 matching reductions in TACs. Up to the end of October 1998 about 9,800 t of the 11,000 t TAC had been taken.

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. Prior to 1980 most of the catch was taken in Div. 3Ps and Div. 4Vs. Since then a higher proportion of the catch taken by domestic fleets has been taken in subdivisions 3Pn and 4Vn. 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). 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 the former management regime. 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.

Monthly catches from 1985 to 1992 indicate prosecution of the fishery under the regulation of the previous management units occurred throughout the year in all subdivisions (Table 3). From 1991-1993, during which catches in the range of 20,000 t were about double those in the previous eight years, a higher proportion of landings were taken during the fall/winter fishery in Div. 3Pn/3Ps respectively, while the greatest activity in Div. 4Vn/4Vs occurred around the summer season. The implementation of this new management unit in 1993 caused a change in fishing pattern from that generally in place under the former 3P, 4RST and 4VWX units. There was a 10,000 t increase from the 1992 total catch of about 17,000 t and this was almost totally accounted for by landings from subdivision 3Pn during October to December. It has been suggested that catches in November and December were probably of Unit 1 redfish which moved into the Cabot Strait area earlier in 1993 (see Morin et al, 1994; Power et al, 1995). To avoid possible overlap with fish from Unit 1, fishing in Subdivs. 3Pn and 4Vn was closed from November to December in 1995 and this closure has continued to 1998.

Otter trawling is the predominant method of fishing, primarily with bottom trawls (Table 4). From 1986 to the early 1990s there had been an increase in the proportion of catch taken with midwater trawls. In recent years only in 3Ps does the midwater trawl still account for a substantial portion of the catch.

In both 1996 and 1997, about 3,500 t and 2,500 t respectively of the total catch (about 9,000 t for each year) had been taken in the first quarter from statistical area 3Psd which resides in the northwest portion of Div. 3Ps adjacent to subdivision 3Pn. In 1998, about 90% of the TAC has been taken up to Oct. 28, primarily in the first quarter and the majority taken in Div 3Ps.

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. During the time period since 1988, the commercial catch rates are greatly 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 1994-1997 fisheries by port sampling and observer programs were weighted by monthly landings by subdivision to derive a combined catch-at-length for Unit 2. Revisions to these distributions and samples from the 1998 fishery were unable to be

completed in time for the November 1998 assessment, therefore the catch-at-length plots are identical to those presented in last years assessment. The length-weight relationships used were:

$$\begin{aligned} \text{WT (males)} &= 0.01659 \text{ Forklength}^{2.9548} \\ \text{WT (females)} &= 0.013272 \text{ Forklength}^{3.0210} \end{aligned}$$

For 1997, only samples from January to April for Newfoundland (44) and one February sample from Maritimes were available for the assessment in October. The 1996 catch at length is for the Newfoundland fleet only. 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 sampling of the Nfld. fleet in 1996 suggest a unimodal distribution for each sex with the peak at 30 cm for males and 32 cm for females. A small fish protocol of 25 cm was implemented in 1996, which is reflected in the catch size distribution relative to 1994-1995. The preliminary 1997 catch at length suggests predominant modes for males and females between 32-35 cm again consistent with the 1980 year class. The 1988 year class was present in the catches in 1994, 1995 and 1997 but not so in 1996. This was likely because of the effect of the higher small fish protocol at 25 cm in 1996 compared to 22 cm in 1997. The only information available at the assessment on size distribution for 1998 was for the FPI fleet (B. Smith, Fishery Products International, pers. comm.) which indicated that about 64% of the catch occurred between 31-35 cm which is consistent with the 1997 data suggesting the exploitation pattern was similar in both years.

RESEARCH SURVEY DATA

3Ps Winter-Spring 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 1998 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 historical series of mean numbers and weights per standard tow for 3Ps show some rather dramatic fluctuations between some years (Tables 5-8, 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 1997. 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 1994-1998 (Tables 6 and 8) 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.

Geographical distribution plots (Fig. 4-5) of catches in Div. 3P(s+n) since 1988 (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 1979-1998 (Fig. 6) show the relatively strong year-class(es) of the early 1980s that were 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 very low in abundance by 1998. It is difficult to determine whether this decrease represents mortality or migration because the survey is a multispecies survey and is not designed to cover the entire area of Unit 2. The 1988 year class was next to appear in the 1991 survey in relatively large numbers at 10 cm. In the 1995 survey (the last survey with the Engel trawl), the early 1980s year-classes comprised a much greater proportion of the research catch than those of either 1985 or 1988. This suggests that it is much stronger because it has been fished for about eight years.

The Engel data have not yet been converted into Campelen equivalents and therefore are not directly comparable with the surveys from 1996-1998. The 1996 Campelen 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 predominant early 1980 year-class. The 1998 survey indicates the 1994 year class was the most abundant in the research catch, followed by the early 1980s.

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, the historical series of mean number and weight per standard tow (Tables 9-10, Fig. 7) show large annual fluctuations between years and between strata within each year. Again, 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 attempting to convert the earlier data into Western IIA equivalents. It is interesting that a change in vessel and gear for the 3Ps winter/spring series in 1982 had the opposite affect in that estimates after the change were lower.

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 1980s which were generally strong in a number of different redfish stocks. The early 1980s year classes did not appear relatively strong in the distributions 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 1980s year classes (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 all but gone 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. The 1997 and 1998 surveys were dominated by fish larger than 29cm. There has been no other sign of good recruitment since 1990.

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. In addition strata in Div. 3O adjacent to 3Ps are also covered for the purposes of mapping the distribution. Station allocation is applied 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 was no survey conducted in 1998.

Although there are some fluctuations, particularly in 4Vs, caused by the occurrence of a large set 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 11). 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. 9) 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 (Fig. 10) from the surveys generally show bi-modal distributions from 1994 to 1997 within each subdivision. 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 and only 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. 10). 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 is still a substantial proportion of the research catch comprised of the early to mid 1980s year-classes, which have been fished for about 8-9 years now. This suggests that the 1988 year class is much weaker than that of the early 1980s.

Application of selectivity curves for 88 mm and 132 mm mesh codends (Lisovsky et al, 1995) to the Unit2 survey abundance-at-length estimates, which covers the main stock area, enables estimation of a biomass index based on two scenarios of exploitation pattern in the fishery (Table 12). Assuming that averaging the 88mm and 132mm selectivity curves would approximate an exploitation pattern for the current commercial gears, survey exploitable biomass indices derived from the 1997 summer estimates were 120,000 t (with a 22 cm small fish protocol) and 110,000 t (with a size protocol at 28 cm to protect the 1988 year class).

INDUSTRY SURVEY DATA

Unit 2 GEAC Redfish Surveys

Stratified-random industry funded surveys conducted by GEAC (Groundfish Enterprise Allocation Council) in subdivisions 3Ps, 3Pn, 4Vs and 4Vn during December 1997 and August 1998 utilizing a commercial Engel 170' bottom trawl with a 90 mm mesh unlined codend. The general protocol for the surveys was consistent with the DFO Unit2 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 survey covered approximately 89% of the intended area and was conducted by the M.V. Cape Beaver. The 1998 survey covered 94% of the area and was conducted by M.V. Cape Ballard, a ship of equal design and size as the M. V. Cape Beaver. 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.

The mean weight per standard tow (Table 12) shows large fluctuations within and between strata from the 1997 and August 1998. 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 the 1997 and 1998 surveys. Given this caveat, however, the survey biomass index remained relatively stable between 1997 (240,000 t) and 1998 (222,000 t). A plot of the distribution of the standardized catches (Fig. 12) show that in both 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 shows 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 survey shows that the area of highest density occurred at the southern extent of the subdivision 3Pn/4Vn line centred on 46°30'N.

Size composition from the GEAC surveys (Fig. 13) indicates bi-modal distributions in Div. 3Ps and 4Vs and single mode distributions in subdivisions 3Pn and 4Vn. For both surveys, Div. 3Ps and 4Vs modes at about 24cm-25 cm and 32cm-34cm correspond to the 1988 and 1980 year classes respectively. In subdivisions 3Pn and 4Vn the mode at 32cm-34cm again correspond to the 1980 year class. The 1997 December survey corresponds reasonably well with the DFO August survey with the exception of the 1994 year class, which is not captured by the commercial gear.

An index of abundance at length estimated for the combined areas surveyed in Unit 2 from the 1998 August GEAC survey (Fig. 14) again reflects the difference in growth rate between males and females from a given year class. Allowing for these different growth rates, there are two major groups defined by modes between 25-27cm (the 1988 year class) and one between modes at 31-34 cm (the 1980 year class). The abundance of the 1988 year class increased from 121 million in 1997 to 204 million in 1998 in the survey index, while the 1980 year class decreased from 266 million to 209 million. The increase in the 1988 year class suggests it has become more exploitable to the commercial gear.

BIOLOGICAL CHARACTERISTICS

Size at Maturity Ogives

Maturity data for redfish were available from two sources: (1) set by set samples taken for length distribution, sex and maturity (LSM) during DFO research surveys to Unit2 in summer (1996-1997) and 3Ps in spring (1997-1998), and, (2) otolith samples taken for age (A&G) determination during DFO research surveys to Unit2 in summer (1994-1996) and 3Ps in winter/spring (1972-1995). A logistic model with a logit link function and binomial error was fit to the data to estimate the length (cm) at 50% maturity (L_{50}). Estimation of parameters was conducted using the Probit procedure of SAS (SAS, 1989). Fish were classified as mature or immature based on a visual examination of the fresh gonad at sea. Determination of maturity stage was consistent with that described by Ni and Templeman (1985). Data sources (1) and (2) were analyzed separately but within each data source, the data were combined for all years and surveys. There was no attempt to distinguish between *Sebastes fasciatus* and *S. mentella*. Sample sizes are given in the table below:

Data Source	Females	Males
A&G	13362	11677
LSM	25430	28823

The ogives derived for the LSM and A&G data were different (Fig. 15). The estimation of L_{50} plus 95% fiducial limits was higher in the A&G data by at least 1 cm for males (22.31 1 .14 cm versus

20.76 ± 1.09 cm) and females (28.08 ± 1.13 cm versus 26.86 ± 1.09 cm). The A&G data covers sampling each year back to 1972, which reflect a more historical perspective of size at maturity. A further investigation is warranted to see if there is a trend in size at maturity over time and whether there are differences between divisions where the data are sufficient. In any case, averaging between the two estimated values results in an L_{50} of 21.5 cm for males and 27.5 cm for females. Ni and Sandeman (1984) reported L_{50} values for *S. mentella* and/or *S. fasciatus* of 18.56 cm and 17.40 cm for males in Div. 3P and Div. 4V respectively, and 29.61 cm and 26.36 cm for females in Div. 4V respectively. This was based on data collected between 1957 and 1969. It appears, based on the current data, that size at maturity has changed within areas of Unit 2.

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 (in 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 (minimum size of 22 cm), the major stakeholders in the fishery cannot relate their past experiences to the current situation.

In general, industry considered that fisheries over the past three years have been successful. The 1996 and 1997 fisheries were conducted primarily in areas 3Psd and 4Vsc and a good portion of the catches there are taken in the first quarter of the year. Major allocation holders experienced a substantial increase in catch rate in 1996 compared to 1995 due to the detection of a relatively large body of fish in 3Psd during the first quarter of the year. The 1997 fishery was considered by some harvesters to be as good or better than 1996. Most of the difficulties in 1997 were related to bad weather rather than the fishery. One stakeholder related that fish sizes were generally larger in 3Psd than 4Vsc and had more parasites. The 1998 fishery saw a shift into area 3Psg. There was a substantial increase in catch rate for one fleet (2.5 t/hour) compared to 1997 (1.1 t/hour). There have been little to no difficulties encountered as a result of the small fish protocol (at 22 cm). At present, the majority of fish caught are in the 31-35cm range.

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. An exploitable biomass index, based on the 1997 DFO summer survey, suggests that a catch of 11,000 t (TAC in 1998) would generate a relative exploitation rate (ratio of TAC to survey exploitable biomass) of about 10%. The calculation was based on an averaging of 88mm and 132mm selectivity curves. As current trawl mesh regulation allows for a minimum of 90mm, recalculation of the commercially exploitable biomass from the 1997 DFO survey using only the selectivity curve for 90mm mesh and assuming a 22 cm small fish protocol results in an estimate of 175,000 t. An 11,000 t catch would represent a relative exploitation rate of about 6%. The survey results are assumed to provide minimum estimates of exploitable biomass so the actual exploitation rate is likely to be lower than 6%. Assuming the results from the 1998 GEAC industry survey represent an empirical estimate of the commercially exploitable portion of the stock (220,000 t),

the relative exploitation rate is about 5%. Therefore, a catch in 1998 of 11,000 t is not likely to be higher than the catch associated with fishing at $F_{0.1}$.

The stock biomass is expected to remain stable over the next few years. Current commercial catches are composed primarily of the early 1980s year-class(es) which have been fished for about eight to nine years. The 1988 year-class is now becoming increasingly vulnerable to the fishery although its contribution to the fishable stock will be less than that of the year-class(es) of the early 1980s.

There are some indications that the 1994 year-class may be relatively strong, but a number of years of monitoring will be required to clarify this. This year class would not contribute significantly to the commercial fishery until about 2004.

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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	239	5077	1679	1937	40	-	8972			1	10000
1998 ^a							9832 ^b				11000

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 Oct. 28, 1998 (Canadian Atlantic Quota Reports)

Table 2a: Nominal catches of Redfish by country from Subdiv. 3Pn (Jun.-Dec.) (1994-1997 are provisional).

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Canada (M)	325	143	577	39	825	0	346	213	4915	1205	74	20	1
Canada (N)	1262	815	770	445	1128	189	704	548	5537	2966	1475	688	238
Canada (Q)	-	-	1	-	-	-	-	5	488	5	-	-	-
Total	1587	958	1348	484	1953	189	1050	766	10940	4176	1549	708	239

Table 2b: Nominal catches of Redfish by country from Subdiv. 3Ps (1994-1997 are provisional).

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Canada (M)	313	606	421	836	1038	1252	377	2648	3545	4165	500	2024	1515
Canada (N)	1529	2915	1645	1441	1823	4186	4013	3981	3745	3935	2244	3861	3317
Canada (Q)	-	88	-	-	-	-	-	-	24	11	-	-	-
France (M)	-	-	67	95	-	-	-	-	-	-	-	-	-
France (SPM)	-	42	36	14	13	-	-	-	-	-	-	-	245
France	12	-	-	-	-	-	-	-	-	-	-	-	-
Total	1854	3651	2169	2386	2874	5438	4390	6629	7314	8111	2744	5885	5077

Table 2c: Nominal catches of Redfish by country from Subdiv. 4Vn (Jun.-Dec.) (1994-1997 are provisional).

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Canada (M)	1368	1237	2544	2327	3245	1874	7453	5871	6757	3669	2076	1125	1679
Canada (N)	1677	1790	3682	2345	1909	579	1076	1255	603	1971	1460	77	-
Canada (Q)	38	63	-	-	1	-	217	222	450	500	-	-	-
France (SPM)	-	-	-	-	-	-	-	-	-	-	-	-	-
Japan	60	257	197	184	81	18	-	-	-	-	-	-	-
Total	3143	3347	6423	4856	5236	2471	8746	7348	7810	6140	3536	1202	1679

Table 2d: Nominal catches of Redfish by country from Subdiv. 4Vs (1994-1997 are provisional).

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Canada (M)	2924	1081	2279	2111	3452	3997	5864	1621	1125	4914	3995	1580	1888
Canada (N)	724	465	428	335	1139	1852	1911	106	68	693	259	19	48
Canada (Q)	-	-	-	-	-	-	263	-	-	-	-	-	-
France (SPM)	-	-	-	-	-	-	-	-	-	-	-	-	1
Japan	854	1190	944	279	399	475	499	-	-	-	-	-	-
Total	4502	2736	3651	2725	4990	6324	8537	1727	1193	5607	4254	1599	1937

Table 3a: Nominal catches of Redfish in Subdiv. 3Pn by month (1994 to 1997 are provisional).

Year	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1985	131	272	527	206	135	122	194	1587
1986	69	169	94	84	188	282	72	958
1987	77	97	242	74	13	45	800	1348
1988	120	39	123	74	40	69	19	484
1989	7	44	153	878	611	131	129	1953
1990	4	36	64	55	8	4	18	189
1991	10	59	44	42	250	310	335	1050
1992	19	6	11	21	394	79	236	766
1993	332	353	131	889	3552	3022	2661	10940
1994	12	212	5	1374	1076	959	538	4176
1995	-	245	320	372	612	-	-	1549
1996	-	90	1	9	602	-	6	708
1997	-	220	16	1	2	-	-	239

Table 3b: Nominal catches of Redfish in Subdiv. 3Ps by month (1994 to 1997 are provisional).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1985	32	27	102	50	126	127	361	413	367	150	63	36	1854
1986	13	37	685	281	499	433	754	213	343	111	186	96	3651
1987	41	94	110	139	172	268	439	244	189	92	74	307	2169
1988	73	557	208	129	135	180	128	179	200	97	126	374	2386
1989	263	174	353	356	116	402	185	376	522	60	37	30	2874
1990	140	2161	1104	370	59	277	298	435	357	159	50	28	5438
1991	210	1234	378	678	79	80	365	361	393	450	51	111	4390
1992	92	763	3716	911	113	110	106	272	261	122	87	76	6629
1993	111	1504	1373	777	628	50	78	182	244	819	895	653	7314
1994	1585	270	76	510	2119	770	501	185	549	861	549	136	8111
1995	400	154	146	246	11	4	360	454	402	190	135	242	2744
1996	793	1700	1708	357	1	1	89	15	3	80	661	477	5885
1997	315	1274	1907	969	16	31	171	218	67	77	2	30	5077

Table 3c: Nominal catches of Redfish in Subdiv. 4Vn by month (1994 to 1997 are provisional).

Year	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1985	705	517	1123	244	114	197	243	3143
1986	480	1502	474	428	155	162	146	3347
1987	2041	1611	941	603	132	327	768	6423
1988	1339	1285	799	656	284	325	168	4856
1989	1700	857	881	602	250	42	904	5236
1990	696	822	353	176	56	33	335	2471
1991	4181	1627	620	555	182	737	844	8746
1992	1658	1126	909	488	453	769	1945	7348
1993	4178	1692	1367	337	180	52	4	7810
1994	2695	2403	557	403	76	6	-	6140
1995	-	2222	696	485	90	41	2	3536
1996	-	700	273	91	130	8	-	1202
1997	-	1125	405	144	1	-	4	1679

Table 3d: Nominal catches of Redfish in Subdiv. 4Vs by month (1994 to 1997 are provisional).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1985	98	510	242	207	187	469	940	615	126	410	341	357	4502
1986	34	62	209	206	233	357	409	256	356	236	319	59	2736
1987	35	27	187	477	330	806	529	616	304	115	150	75	3651
1988	9	34	94	77	580	331	425	138	617	257	103	60	2725
1989	30	31	170	35	800	2651	388	376	248	191	68	2	4990
1990	40	71	120	454	1714	2040	81	778	177	182	514	154	6325
1991	89	52	67	1315	5845	243	387	19	260	20	224	16	8537
1992	33	28	105	68	73	666	92	26	4	28	410	194	1727
1993	1	6	223	377	108	325	32	6	-	27	86	2	1193
1994	496	849	470	443	816	1513	385	14	19	128	383	91	5607
1995	737	615	760	1214	3	-	282	28	30	179	313	93	4254
1996	687	271	126	28	6	-	46	22	4	1	226	182	1599
1997	512	789	431	-	-	-	12	5	1	-	175	12	1937

Table 4a: Nominal catches (t) of Redfish in Division 3P by gear (1994-1997 are provisional).

Year	3Pn				3Ps			
	Bottom trawl	Midwater trawl	Other	Total	Bottom trawl	Midwater trawl	Other	Total
1985	1584	-	3	1587	1533	-	321	1854
1986	953	5	-	958	2920	152	579	3651
1987	1057	285	6	1348	1311	35	823	2169
1988	413	62	9	484	1389	467	530	2386
1989	1440	499	14	1953	1527	747	600	2874
1990	147	40	2	189	933	3162	1343	5438
1991	402	570	78	1050	1641	1599	1150	4390
1992	196	537	33	766	1137	4639	853	6629
1993	4740	6172	28	10940	2287	4583	444	7314
1994	2832	1311	33	4176	3169	4881	61	8111
1995	1278	251	20	1549	1572	1061	111	2744
1996	558	148	2	708	1217	4500	168	5885
1997	235	-	4	239	665	3979	433	5077

Table 4b: Nominal catches (t) of Redfish in Division 4V by gear (1994-1997 are provisional).

Year	4Vn				4Vs			
	Bottom trawl	Midwater trawl	Other	Total	Bottom trawl	Midwater trawl	Other	Total
1985	3131	-	12	3143	4502	-	-	4502
1986	3153	182	12	3347	2731	5	-	2736
1987	5338	1049	36	6423	3615	35	1	3651
1988	4506	314	36	4856	2720	5	-	2725
1989	2853	2350	33	5236	2911	2075	4	4990
1990	1923	444	104	2471	3530	2789	6	6325
1991	5060	3619	67	8746	2308	6223	6	8537
1992	4128	3030	190	7348	1112	612	3	1727
1993	3727	4072	11	7810	754	431	8	1193
1994	3151	2891	98	6140	4401	1170	36	5607
1995	2371	1040	125	3536	4247	4	3	4254
1996	1201	-	1	1202	1190	408	1	1599
1997	1677	-	2	1679	1927	10		1937

Table 5. Mean number of redbfish 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	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
			ATC 207 Mar 12-25	ATC 221 Apr 19-30	ATC 234 Jun 2-13	ATC 247-248 May 11-Jun 6	ATC 261 Apr 14-26	ATC 275 Apr 4-14	ATC 287 Feb 16-Mar 5	ATC 302 Mar 19-Apr 2	ATC 316 Mar 7-26	ATC 330 May 28-Jun 9	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 5. (Cont'd.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993
			AN 26 Apr 9-18	WT 26 Mar 7-26	WT 45 Mar 5-24	WT 55-56 Feb 12-Mar 23	WT 68 Jan 26-Feb 15	WT 81 Jan 31-Feb 17	WT 91 Jan 31-Feb 20	WT 103 Feb 2-20	WT 118 Feb 6-24	WT 133 Feb 6-23	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 (x 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 6. Mean number of Redfish caught per standard tow (number of sets indicated in brackets) during surveys to Subdiv. 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	1995	1996	1997	1998
			WT 150-151 Apr 5-27	WT 166-167 Apr 3-29	WT186-187 Apr 10-May1	WT 202-203 Apr 1 - 24	WT218-219 Apr 2- 23
307	093 - 183	395	25.00 (4)	2.22 (4)	331.34 (4)	73.33 (3)	18.96 (3)
311	093 - 183	317	5.00 (4)	1.33 (3)	2.67 (3)	13.50 (2)	14.22 (3)
317	093 - 183	193	0.00 (2)	0.00 (2)	2.00 (2)	0.00 (2)	13.00 (2)
319	093 - 183	984	0.00 (9)	16.00 (8)	180.91 (8)	10.89 (8)	4.88 (8)
306	185 - 274	419 (363)	132.50 (4)	2.33 (3)	212.04 (3)	368 (3)	206.97 (3)
309	185 - 274	296	333.67 (3)	31.33 (3)	227.00 (3)	57.94 (2)	469.33 (2)
310	185 - 274	170	492.00 (3)	8.50 (2)	74.50 (2)	161.00 (2)	158.50 (2)
313	185 - 274	165	155.50 (2)	57.00 (2)	80.44 (2)	44.00 (2)	184.89 (2)
316	185 - 274	189	22.50 (2)	18.50 (2)	313.50 (2)	205.00 (2)	134.00 (2)
318	185 - 274	129	0.00 (2)	2696.50 (2)	237.50 (2)	1050.00 (2)	647.00 (2)
705	275 - 366	195	87.67 (3)	6546.00 (2)	99.51 (2)	9.00 (2)	49.22 (2)
706	275 - 366	476	79.25 (4)	138.00 (4)	232.67 (3)	68.11 (3)	46.50 (4)
707	275 - 366	74	2615.50 (2)	1100.00 (2)	983.30 (2)	1724.44 (2)	812.00 (2)
715	275 - 366	132 (128)	328.25 (4)	852.50 (2)	76.28 (2)	154.10 (2)	441.44 (2)
716	275 - 366	539	79.40 (5)	18.40 (5)	42.30 (5)	15.47 (4)	109.53 (4)
708	367 - 549	126	5878.50 (2)	853.50 (2)	2718.50 (2)	33.72 (2)	199.70 (3)
711	367 - 549	961 (593)	52.50 (6)	183.40 (5)	84.08 (4)	71.73 (5)	22.47 (5)
712	367 - 549	973 (731)	134.86 (7)	153.14 (7)	143.67 (6)	72.00 (5)	112.46 (6)
713	367 - 549	950 (851)	148.00 (7)	187.63 (8)	139.49 (7)	176.59 (6)	68.51 (7)
714	367 - 549	1195 (1074)	121.75 (8)	203.50 (10)	141.05 (9)	138.03 (7)	122.75 (9)
709	550 - 731	158 (147)	59.30 (2)	17.00 (2)	3.00 (2)	---	5.00 (2)
710	732 - 914	176 (156)	0.00 (2)	---	---	---	---
Number per tow:							
Upper CI			500.00	2343.30	758.82	199.96	199.80
Stratified Mean			198.80	325.00	193.45	124.10	112.91
Lower CI			-102.40	-1693.20	-371.92	48.24	26.02
Total Abundance (millions)			137.50	197.80	216.00	136.40	126.40

Table 7. 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	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
			ATC 207 Mar 12-25	ATC 221 Apr 19-30	ATC 234 Jun 2-13	ATC 247-248 May 11-Jun 6	ATC 261 Apr 14-26	ATC 275 Apr 4-14	ATC 287 Feb 16-Mar 5	ATC 302 Mar 19-Apr 2	ATC 316 Mar 7-26	ATC 33 May 28-Jun 9	AN 9 Apr 22-May 8	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 7. (Cont'd.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993
			WT 26 Mar 7-26	WT 45 Mar 5-24	WT 55-56 Feb 12-Mar 23	WT 68 Jan 26-Feb 15	WT 81 Jan 31-Feb 17	WT 91 Jan 31-Feb 20	WT 103 Feb 2-20	WT 118 Feb 6-24	WT 133 Feb 6-23	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 8. Mean weight (kg.) of Redfish caught per standard tow (number of sets indicated in brackets) during surveys to Subdiv. 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	1995	1996	1997	1998
			WT 150 - 151 Apr 5-27	Wt 166 - 167 Apr 3-29	WT 186 - 187 Apr 10-May1	WT 202 - 203 Apr 1 - 24	WT218-219 Apr 2- 23
307	093 - 183	395	1.86 (4)	0.45 (4)	3.84 (4)	1.74 (3)	0.33 (3)
311	093 - 183	317	0.45 (4)	0.06 (3)	0.20 (3)	0.46 (2)	0.23 (3)
317	093 - 183	193	0.00 (2)	0.00 (2)	0.03 (2)	0.00 (2)	1.15 (2)
319	093 - 183	984	0.00 (9)	2.00 (8)	21.49 (8)	0.47 (8)	1.09 (8)
306	185 - 274	419 (363)	11.53 (4)	0.49 (3)	2.57 (3)	6.98 (3)	6.94 (3)
309	185 - 274	296	56.53 (3)	4.68 (3)	21.01 (3)	4.60 (2)	23.03 (2)
310	185 - 274	170	38.57 (3)	2.30 (2)	5.40 (2)	9.38 (2)	6.67 (2)
313	185 - 274	165	11.23 (2)	5.05 (2)	6.36 (2)	3.78 (2)	9.71 (2)
316	185 - 274	189	1.75 (2)	1.17 (2)	27.61 (2)	13.38 (2)	9.13 (2)
318	185 - 274	129	0.00 (2)	622.97 (2)	26.88 (2)	142.28 (2)	62.85 (2)
705	275 - 366	195	16.30 (3)	3356.81 (2)	14.83 (3)	1.45 (2)	11.38 (2)
706	275 - 366	476	21.48 (4)	30.44 (4)	34.63 (3)	20.82 (3)	8.36 (4)
707	275 - 366	74	777.36 (2)	151.23 (2)	240.10 (2)	226.75 (2)	128.75 (2)
715	275 - 366	132 (128)	74.05 (4)	403.97 (2)	12.01 (2)	14.15 (2)	59.35 (2)
716	275 - 366	539	10.19 (5)	9.24 (5)	9.12 (5)	2.60 (4)	8.69 (4)
708	367 - 549	126	1036.12 (2)	351.07 (2)	781.56 (2)	7.83 (2)	42.87 (3)
711	367 - 549	961 (593)	18.62 (6)	84.86 (5)	32.32 (4)	20.41 (5)	9.99 (5)
712	367 - 549	973 (731)	58.72 (7)	71.04 (7)	72.01 (6)	36.74 (5)	56.14 (6)
713	367 - 549	950 (851)	64.32 (7)	89.79 (8)	66.29 (7)	88.57 (6)	34.54 (7)
714	367 - 549	1195 (1074)	52.43 (8)	89.01 (10)	68.20 (9)	70.14 (7)	64.57 (9)
709	550 - 731	158 (147)	38.92 (2)	3.34 (2)	0.95 (2)	---	2.55 (2)
710	732 - 914	176 (156)	0.00 (2)	---	---	---	---
Weight per tow:							
Upper CI			83.9	1174.2	204.07	41.29	31.44
Stratified Mean			49.2	141.7	47.23	31.19	24.94
Lower CI			14.4	-890.9	-109.61	21.08	18.43
Total Biomass (t)			33994	86210	52853	34270	27908

4VW Summer RV Surveys

Table 9. Mean number per standard tow and survey abundance (millions) in Division 4VW from 1971-1998 Maritimes Region summer groundfish surveys.

STR	Depth (m)	Area	71	72	73	74	75	76	77	78	79	80	81	82	83	84
440	184 - 366	924	548.13	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
441	93 - 183	1000	373.63	.00	36.72	13.27	0.61	.00	6.52	.00	1.62	0.32	16.63	135.72	23.91	13.44
444	93 - 183	3925	38.28	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
445	184 - 366	1023	105.74	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
446	184 - 366	491	275.43	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
449	93 - 183	144	154.58	.00	42.05	0.78	.00	0.58	.00	.00	0.55	2.92	.00	1.94	.00	209.51
450	93 - 183	383	3.40	.00	.00	.00	.00	0.61	1.09	88.47	.00	.00	.00	.00	.00	0.97
451	184 - 366	147	933.92	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
452	184 - 366	345	275.18	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
453	184 - 366	259	496.56	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
454	93 - 183	499	5.69	1.03	.00	.00	7.55	0.78	.00	17.89	0.36	.00	.00	0.88	.00	.00
457	93 - 183	811	89.83	.00	18.04	21.62	.00	0.97	473.49	68.91	2.67	0.40	.00	4.38	1.03	9527.21
Mean per standard tow			174.24	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
Abundance (millions)			146.93	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

STR	Depth (m)	Area	85	86	87	88	89	90	91	92	93	94	95	96	97	98
440	184 - 366	924	160.26	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
441	93 - 183	1000	104.03	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
444	93 - 183	3925	124.32	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
445	184 - 366	1023	222.73	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
446	184 - 366	491	1727.22	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
449	93 - 183	144	12.15	.00	.00	0.51	.00	.00	.00	.00	0.50	.00	1.57	.00	1.93	0
450	93 - 183	383	.00	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	1410.85	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
452	184 - 366	345	135.88	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
453	184 - 366	259	.00	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
454	93 - 183	499	.00	0.69	3.75	.00	.00	.00	.00	.00	1.98	0.51	0.99	2.33	7.37	4
457	93 - 183	811	239.53	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			227.74	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
Abundance (millions)			192.05	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

4VW Summer RV Surveys

Table 10. Mean weight (kg) per standard tow and survey biomass in Division 4VW from 1971-1998 Maritimes Region summer groundfish surveys.

STR	Depth (m)	Area	71	72	73	74	75	76	77	78	79	80	81	82	83	84
440	184 - 366	924	307.50	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
441	93 - 183	1000	177.63	.00	8.58	1.07	.00	.00	0.69	5.00	0.32	.00	2.92	8.23	0.34	0.58
444	93 - 183	3925	21.33	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
445	184 - 366	1023	21.32	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
446	184 - 366	491	95.57	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
449	93 - 183	144	71.94	.00	21.05	0.39	.00	.00	.00	.00	.00	1.94	.00	1.94	.00	165.28
450	93 - 183	383	0.97	.00	.00	.00	.00	.00	0.36	54.44	.00	.00	.00	.00	.00	0.97
451	184 - 366	147	312.08	2.92	.00	2.30	2.60	.00	9.82	825.38	42.78	36.03	21.00	4.46	14.49	141.15
452	184 - 366	345	135.41	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
453	184 - 366	259	220.06	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
454	93 - 183	499	.00	.00	.00	.00	1.72	.00	.00	1.56	.00	.00	.00	.00	.00	.00
457	93 - 183	811	21.58	.00	9.40	4.80	.00	.00	129.89	21.88	0.55	.00	.00	.00	.00	506.47
Mean wgt (kg) per standard tow			79.59	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
Biomass Index (tons)			67118	27700	24106	33238	19391	39336	41583	55381	33623	17709	14865	33605	18070	60874

STR	Depth (m)	Area	85	86	87	88	89	90	91	92	93	94	95	96	97	98
440	184 - 366	924	58.43	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
441	93 - 183	1000	14.99	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
444	93 - 183	3925	79.62	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
445	184 - 366	1023	85.26	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
446	184 - 366	491	298.11	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
449	93 - 183	144	5.35	.00	.00	.00	.00	.00	.00	.00	.00	.00	0.73	.00	1.16	0
450	93 - 183	383	.00	.00	7.21	.00	229.99	.00	.00	2.27	.00	.00	.00	2.62	.11	0
451	184 - 366	147	462.92	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
452	184 - 366	345	15.44	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
453	184 - 366	259	.00	0.34	1.03	449.71	0.49	1.03	53.05	8.75	.00	.00	1.76	1.60	.18	6.1
454	93 - 183	499	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.04	0.62	.02	0.01
457	93 - 183	811	24.06	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			71.22	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
Biomass Index (tons)			60060	58843	44514	67017	126325	43035	81669	50954	47578	17817	48290	43420	42191	23833

Table 11. Mean weight (kg) of redfish caught per standard 15 minute tow in Unit2 during summer research surveys for 1994-1997. (Numbers in brackets are successful sets, "-" indicates strata not sampled)

STRATUM	Depth Range (m)	Area sq. n. mi.	1994	1995	1996	1997
3Pn						
303	185-274	554	63.34	43.47	14.65	48.45
304	093-183	151	463.55	234.44	105.18	303.36
305	185-274	733	45.61	75.95	46.00	42.97
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	14.50	15.57	23.23
309	185-274	296	146.39	191.88	120.2	75.80
310	185-274	170	136.20	12.70	40.95	185.45
313	185-274	165	18.01	124.95	100.55	116.06
316	185-274	189	136.11	162.04	336.98	89.03
318	185-274	129	270.81	303.17	350.96	836.44
705	275-366	195	229.86	45.25	86.1	58.40
706	275-366	476	296.88	88.19	94.62	81.43
707	275-366	74	1008.71	356.33	560.66	662.28
708	367-549	126	550.85	233.98	89.36	168.53
709	550-731	147	0.19	6.80	15.78	29.27
710	732-914	156	0.00	1.13	0	
711	367-549	593	173.65	138.73	91.02	82.08
712	367-549	731	99.97	56.58	165.72	55.98
713	367-549	851	38.15	161.09	213.64	64.12
714	367-549	1047	78.86	92.97	36.13	45.99
715	275-366	128	127.28	63.03	161.13	115.57
716	275-366	539	79.08	67.41	140.7	76.06
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						
415	367-532	2915	113.49	65.38	80.2	92.26
416	275-366	671	264.84	103.88	78.35	114.49
417	185-274	387	300.25	56.16	122.59	147.71
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						
397	367-549	540	77.42	104.93	57.9	49.54
398	367-549	833	169.34	137.89	112.29	62.82
399	367-549	465	66.27	227.87	217.99	79.25
400	367-549	270	56.27	105.13	485.83	546.60
446	275-366	313	102.51	606.82	53.13	71.65
451	275-366	147	212.80	109.00	-	723.85
452	275-366	345	1.08	1.98	3.9	7.82
468	367-549	148	-	467.18	-	1421.65
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 12. Calculation of a survey exploitable biomass index from the Unit 2 summer survey in 1997. Selectivity ogives were applied from 88mm and 132mm mesh selection experiments (see text) to the survey numbers at length and converted to biomass with a length-weight relationship. The indexes shown are relative to (1) fishing with the 22cm small fish protocol and (2) not fishing on the 1988 year class.

Length (cm)	Total (millions)			88mm	88mm		132mm	132mm	
	Male	Female	Unsexed	Selectivity	Exploitable Biomass	Exploitable Biomass	Selectivity	Exploitable Biomass	Exploitable Biomass
					Male	Female		Male	Female
7	0.00	0.00	0.34	0.00	-	-	0.00	-	-
8	0.08	0.00	0.69	0.00	-	-	0.00	-	-
9	0.26	0.06	3.88	0.00	-	-	0.00	-	-
10	0.13	0.16	5.39	0.00	-	-	0.00	-	-
11	0.76	0.63	14.92	0.00	-	-	0.00	-	-
12	1.50	1.09	23.93	0.00	-	-	0.00	-	-
13	2.05	1.64	20.15	0.00	-	-	0.00	-	-
14	2.39	1.11	9.94	0.00	-	-	0.00	-	-
15	2.37	2.60	6.57	0.00	-	-	0.00	-	-
16	5.14	4.42	0.00	0.01	2	1	0.00	-	-
17	5.61	4.41	0.00	0.02	9	7	0.02	6	5
18	7.26	6.38	0.00	0.04	27	23	0.01	7	6
19	11.59	7.45	0.00	0.08	91	57	0.02	21	13
20	14.96	9.25	0.00	0.13	229	138	0.02	36	22
21	24.05	17.03	0.00	0.18	586	406	0.02	77	54
22	28.83	17.65	0.00	0.26	1,138	684	0.03	115	69
23	34.12	24.63	0.00	0.35	2,116	1,504	0.03	203	144
24	28.57	21.28	0.00	0.46	2,588	1,904	0.05	267	196
25	20.12	20.04	0.00	0.60	2,710	2,673	0.07	320	316
26	17.42	14.46	0.00	0.72	3,175	2,616	0.10	430	354
27	9.21	12.53	0.00	0.86	2,237	3,027	0.11	272	368
28	10.92	12.29	0.00	0.92	3,131	3,515	0.18	623	699
29	14.06	10.95	0.00	0.94	4,606	3,588	0.23	1,123	875
30	23.58	10.27	0.00	0.95	8,566	3,741	0.26	2,354	1,028
31	29.12	13.51	0.00	0.95	11,718	5,461	0.30	3,660	1,706
32	26.32	21.30	0.05	0.97	11,804	9,615	0.34	4,122	3,358
33	19.25	22.85	0.00	0.98	9,604	11,492	0.39	3,822	4,573
34	12.22	22.75	0.00	1.00	6,760	12,715	0.45	3,085	5,801
35	8.33	15.53	0.00	1.00	5,032	9,496	0.53	2,660	5,020
36	4.52	8.22	0.00	1.00	2,966	5,470	0.60	1,788	3,297
37	4.16	5.66	0.00	1.00	2,970	4,107	0.65	1,919	2,653
38	2.49	3.21	0.00	1.00	1,920	2,525	0.69	1,332	1,752
39	1.31	3.25	0.00	1.00	1,088	2,763	0.73	799	2,028
40	0.51	1.91	0.00	1.00	454	1,757	0.81	366	1,416
41	0.31	1.03	0.00	1.00	295	1,022	0.89	263	908
42	0.19	0.90	0.00	1.00	196	954	0.88	173	839
43	0.13	0.46	0.00	1.00	142	526	0.92	130	482
44	0.02	0.17	0.00	1.00	20	206	0.95	19	196
45	0.01	0.06	0.00	1.00	12	84	1.00	12	84
46	0.00	0.02	0.00	1.00	-	26	1.00	-	26
47	0.00	0.04	0.00	1.00	-	53	1.00	-	53
48	0.00	0.02	0.00	1.00	-	30	1.00	-	30
49	0.00	0.01	0.00	1.00	-	16	1.00	-	16
50	0.00	0.00	0.00	1.00	-	-	1.00	-	-

(1) Under a 22cm small fish protocol (exclude fish 22 cm and less)

				AVERAGE
TOTAL	174,996	TOTAL	67,961	121,478
TAC	11,000	TAC	11,000	11,000
Exploitation	6%	Exploitation	16%	9%

(2) Also excluding 1988 YC (all fish less than 28 cm)

TOTAL	150,447	TOTAL	65,090	107,769
TAC	11,000	TAC	11,000	11,000
Exploitation	7%	Exploitation	17%	10%

Table 13. Mean weight (kg) of redfish caught per standard 30 minute tow and survey biomass in Unit2 during GEAC surveys in December 1997 and August 1998.

(Numbers in brackets are successful sets, "-" indicates strata not sampled)

STRATUM	Depth Range (m)	Area sq. n. mi.	1997 December	1998 August
3Pn				
304	093-183	151	187.78 (2)	651.18 (2)
303	185-274	554	194.22 (2)	49.76 (2)
305	185-274	733	27.15 (2)	76.76 (2)
Upper			828.33	982.77
Mean			108.38	126.68
Lower			-611.57	-729.41
Biomass (metric tons)			7630	8918
3Ps				
306	185-274	363	0.14 (2)	11.65 (2)
309	185-274	296	10.66 (2)	106.41 (2)
310	185-274	170	-	20.65 (2)
313	185-274	165	10.57 (2)	10.59 (2)
316	185-274	189	40.60 (2)	68.29 (2)
318	185-274	129	1697.54 (2)	-
705	275-366	195	105.77 (2)	29.12 (2)
706	275-366	476	-	97.41 (2)
707	275-366	74	707.27 (2)	931.24 (2)
708	367-549	126	1267.75 (2)	995.30 (2)
709	550-731	147	-	-
711	367-549	593	482.07 (2)	173.12 (2)
712	367-549	731	74.49 (3)	160.41 (2)
713	367-549	851	1285.46 (4)	31.06 (3)
714	367-549	1047	236.17 (3)	312.35 (3)
715	275-366	128	204.34 (2)	397.06 (2)
716	275-366	539	-	195.35 (2)
Upper			903.08	267.39
Mean			444.44	173.27
Lower			-14.19	79.15
Biomass (metric tons)			106329	50412
4Vn				
417	185-274	387	17.92 (2)	347.56 (2)
416	275-366	671	73.74 (2)	242.47 (2)
415	367-532	2915	416.65 (7)	347.56 (8)
Upper			1009.99	648.17
Mean			319.9	382.9
Lower			-370.2	117.63
Biomass (metric tons)			62219	74474
4Vs				
397	367-549	540	1403.48 (3)	279.00 (2)
398	367-549	833	51.14 (4)	558.35 (3)
399	367-549	465	56.33 (3)	132.35 (2)
400	367-549	270	36.55 (2)	78.35 (2)
446	275-366	313	32.44 (2)	3550.76 (2)
451	275-366	147	1995.65 (3)	-
452	275-366	345	-	-
468	367-549	148	1077.59 (2)	-
Upper			828.84	747.57
Mean			478.48	6604.85
Lower			128.11	-5109.71
Biomass (metric tons)			63619	88601
TOTAL GEAC SURVEY BIOMASS			239797	222405

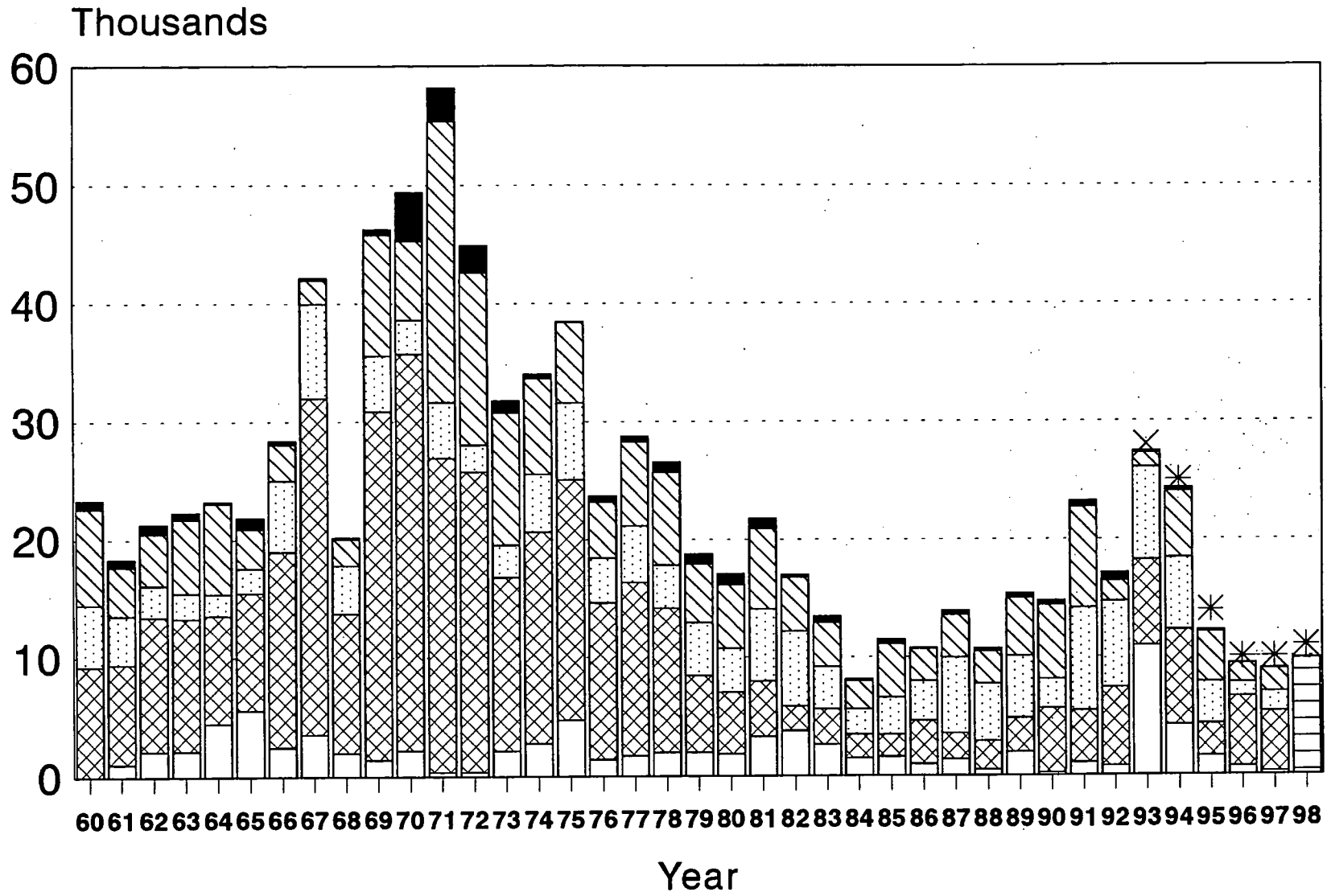


Fig. 1. Nominal catches of redfish from Unit2 (3Pn4Vn[Jan-May], 3Ps4Vs4Wfgj) management unit for 1960-1998 (1998 provisional to Oct. 28).

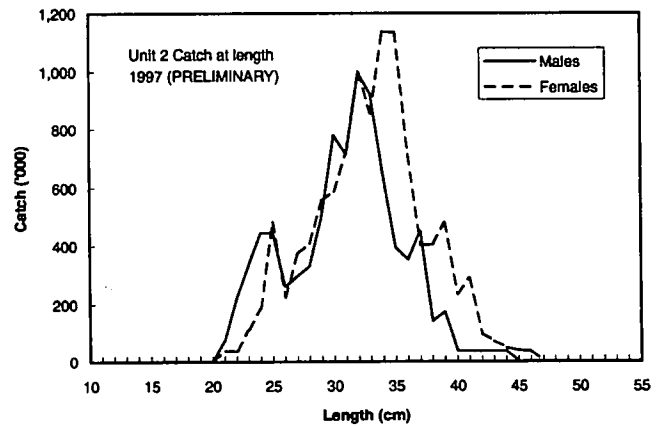
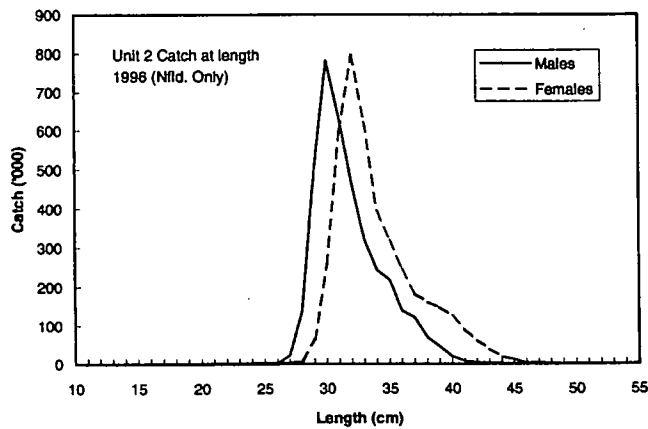
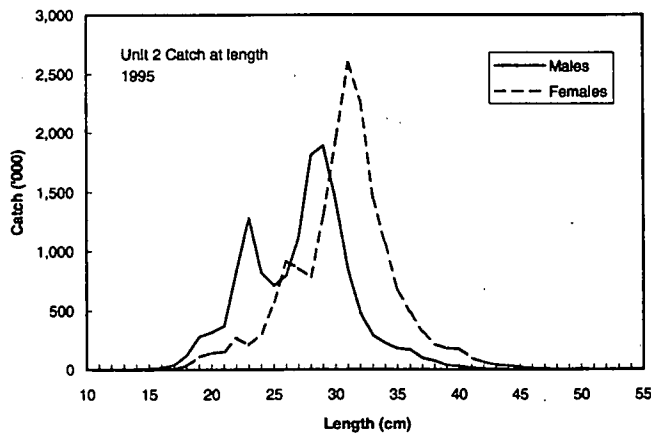
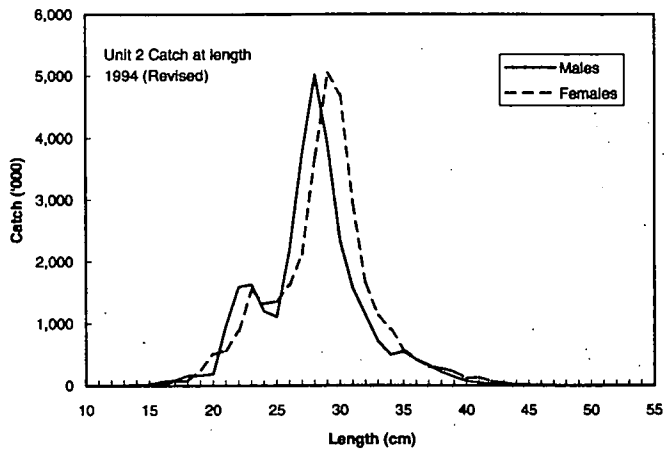


Fig. 2. Commercial catch-at-length of Unit 2 redfish estimated by available port samples adjusted to landings by fleet, gear and month.

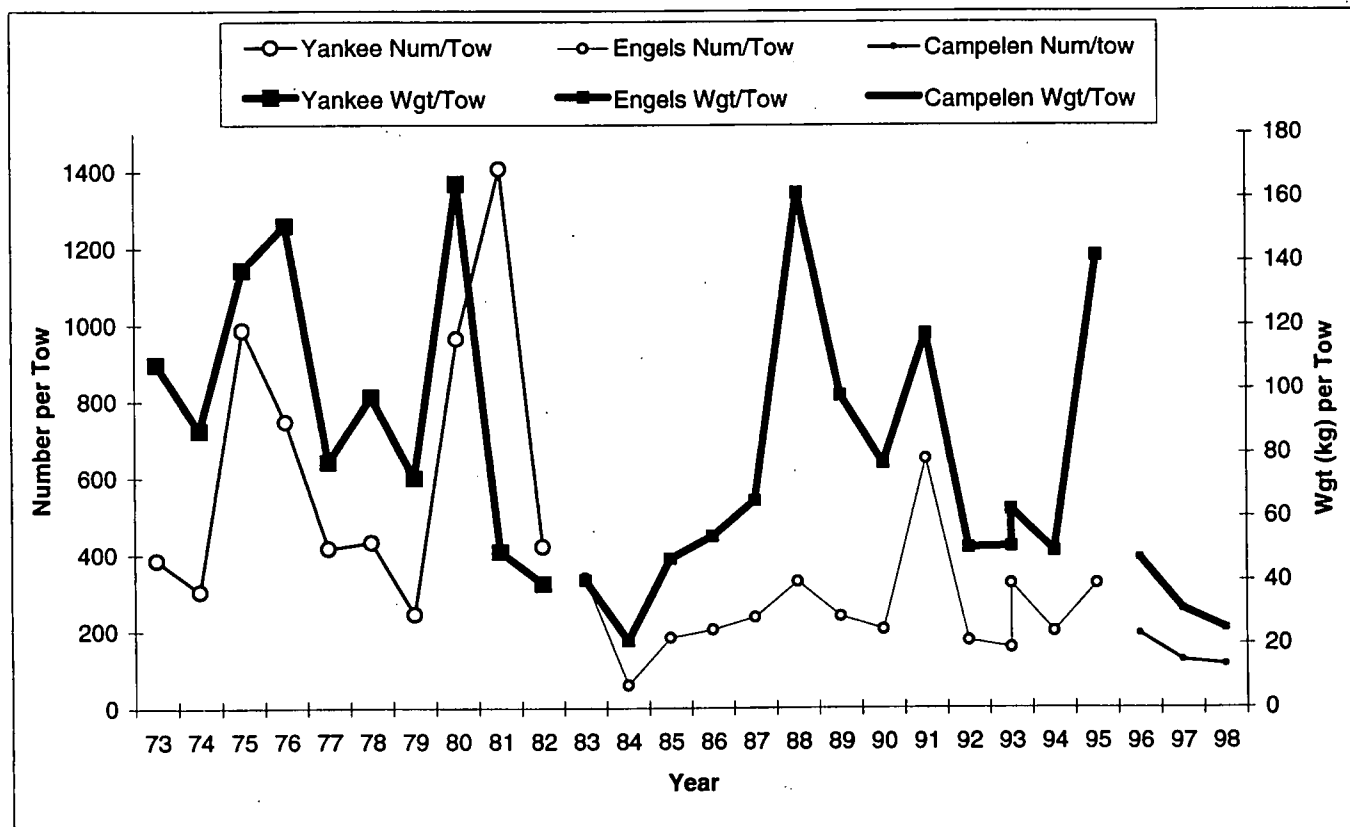


Fig. 3. RV mean numbers and weights (kg) per standard tow for 3Ps winter/spring surveys. There were various trawls and standard tows used over the years: 1978-1982 (Yankee 41-5), 1983-1995 (Engels 145), 1996-present (Campelen 1800).

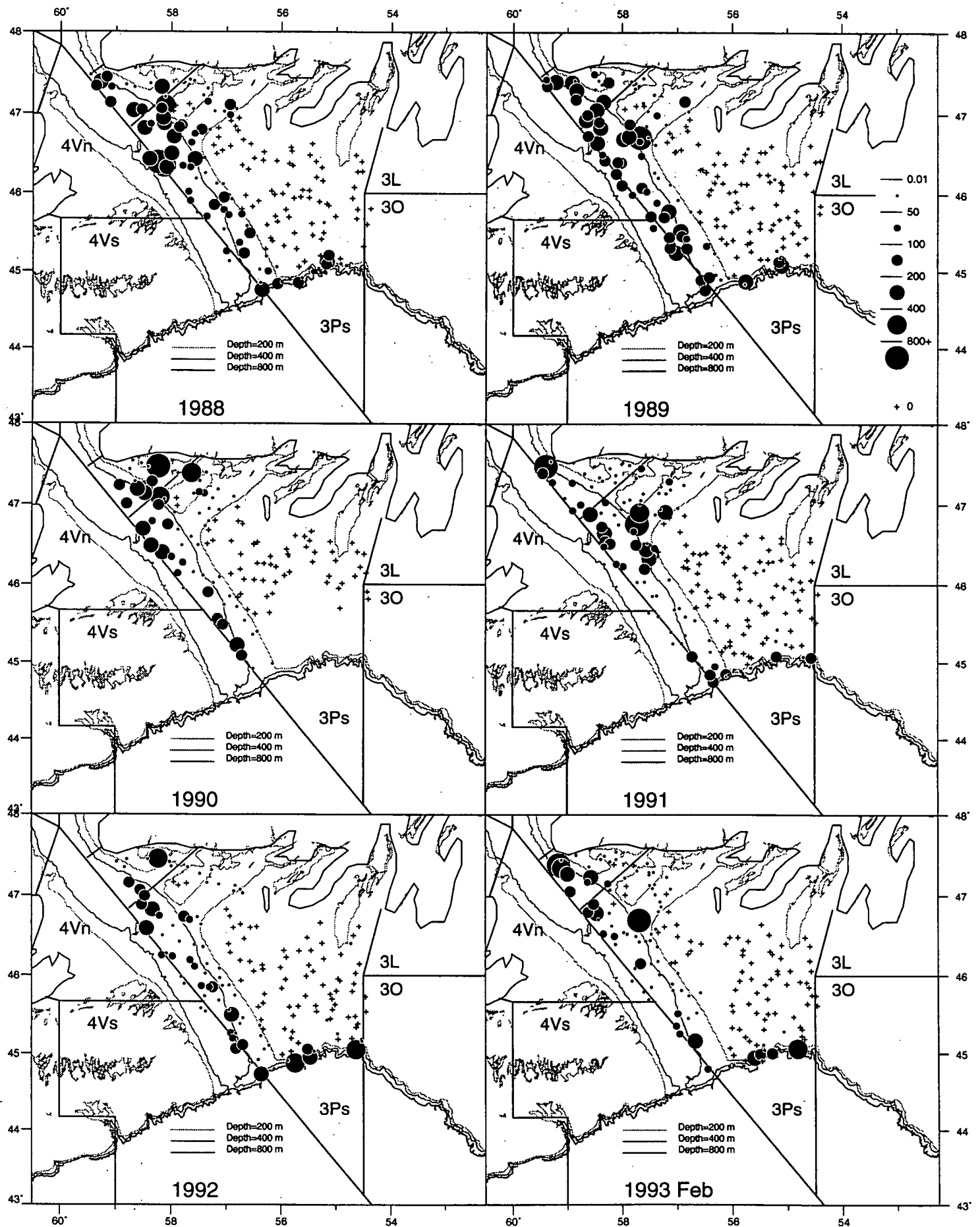


Fig. 4. Distribution of Redfish catches (Kg./ standard tow) from 1988-1993 spring surveys to Div. 3P. The surveys utilized an Engels 145 trawl (1.75 n. mi. tow).

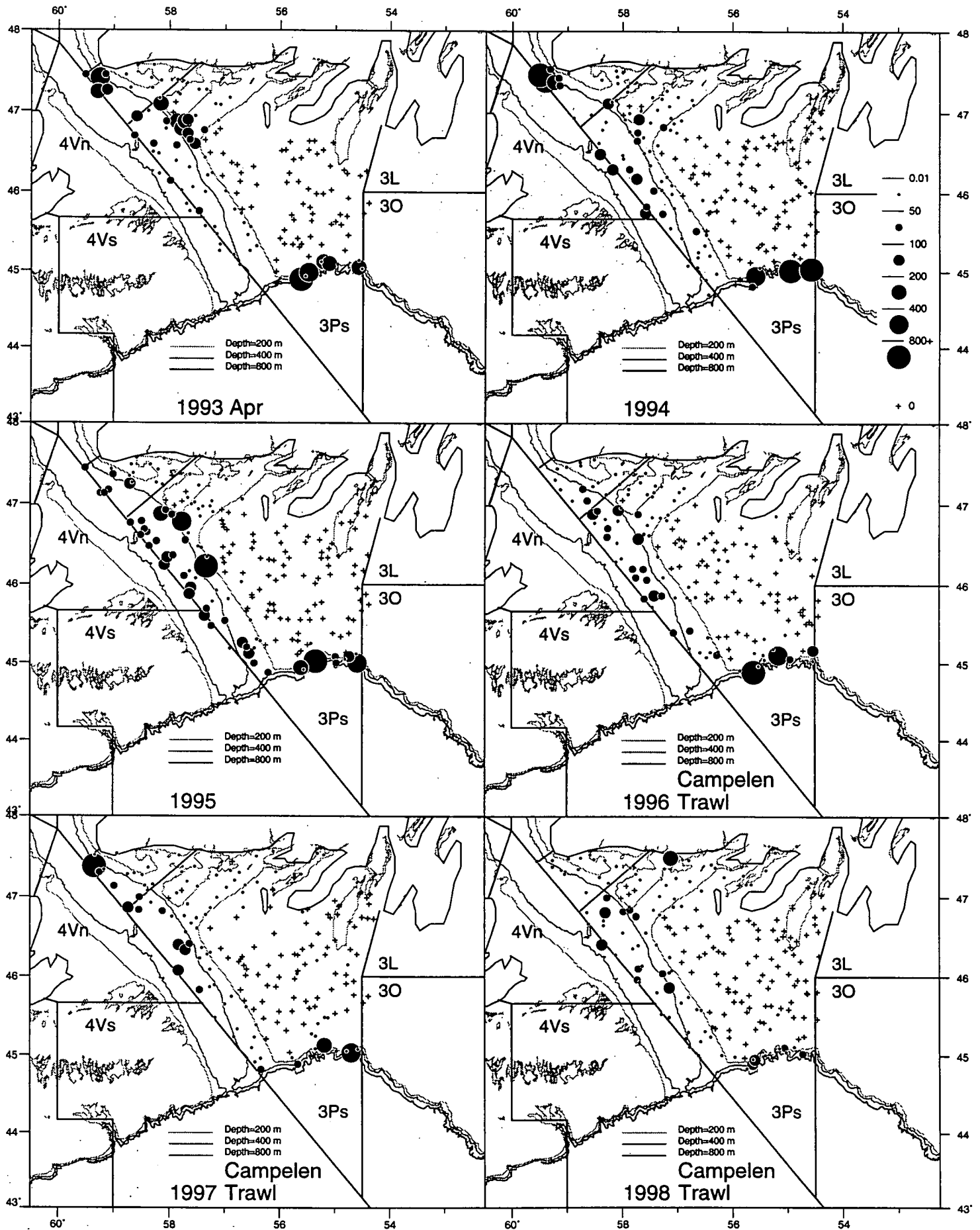


Fig. 5. Distribution of Redfish catches (Kg./ standard tow) from 1993 April-1998 spring surveys to Div. 3P. The surveys utilized an Engels 145 trawl (1.75 n. mi. tow) up to 1995 and a Campelen trawl (0.75 n. mi. tow) for 1996-1998.

3Ps RV Surveys

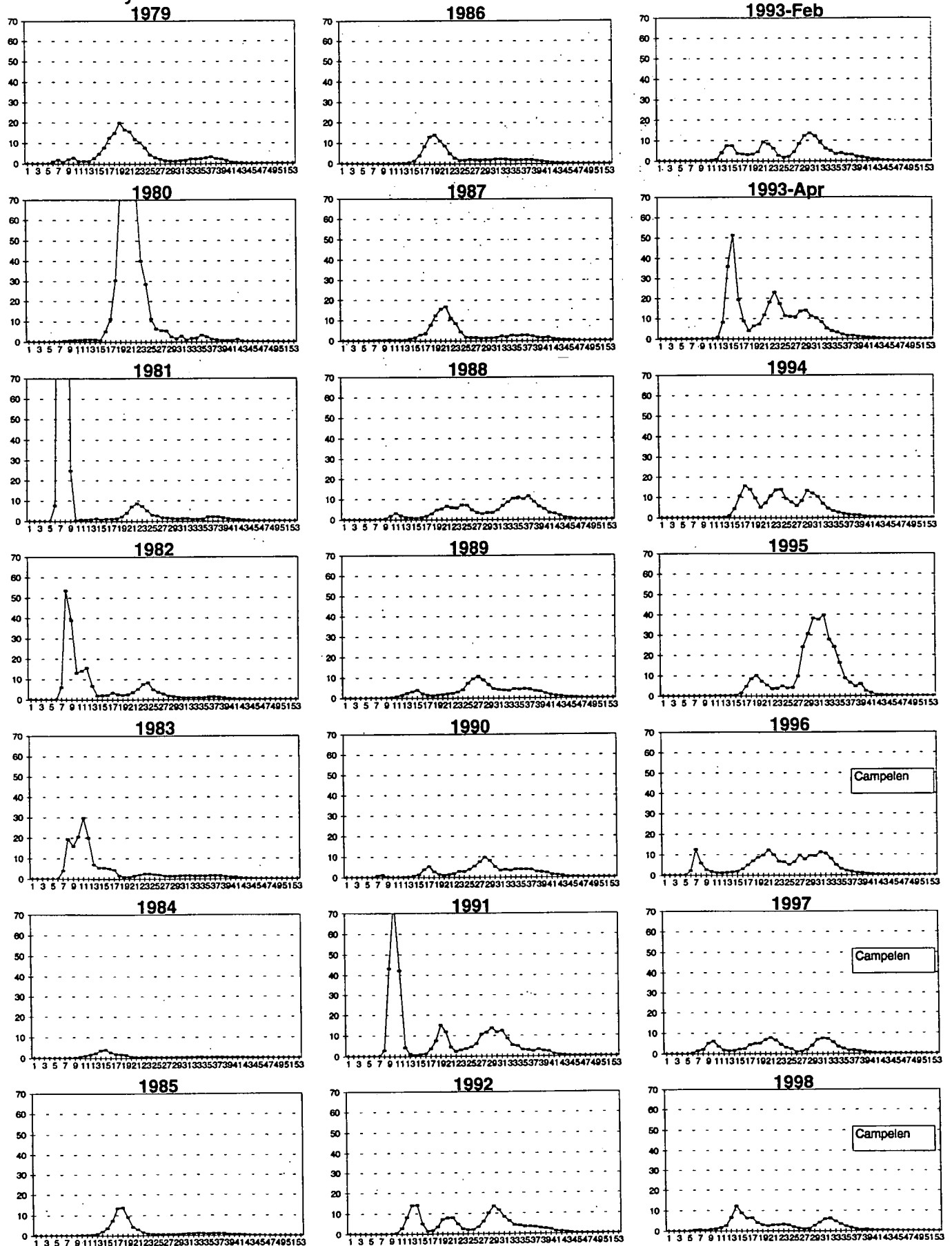


Fig. 6. Length distributions (mean per standard tow) from stratified-random research surveys to Div. 3Ps in spring/winter from 1979-1998. X-axis is forklength in centimetres. The following trawls were used over the series: Yankee 41-5 otter trawl (1979-1982), Engel 145 otter trawl (1983-1995), Campelen 1800 shrimp trawl (1996-present)

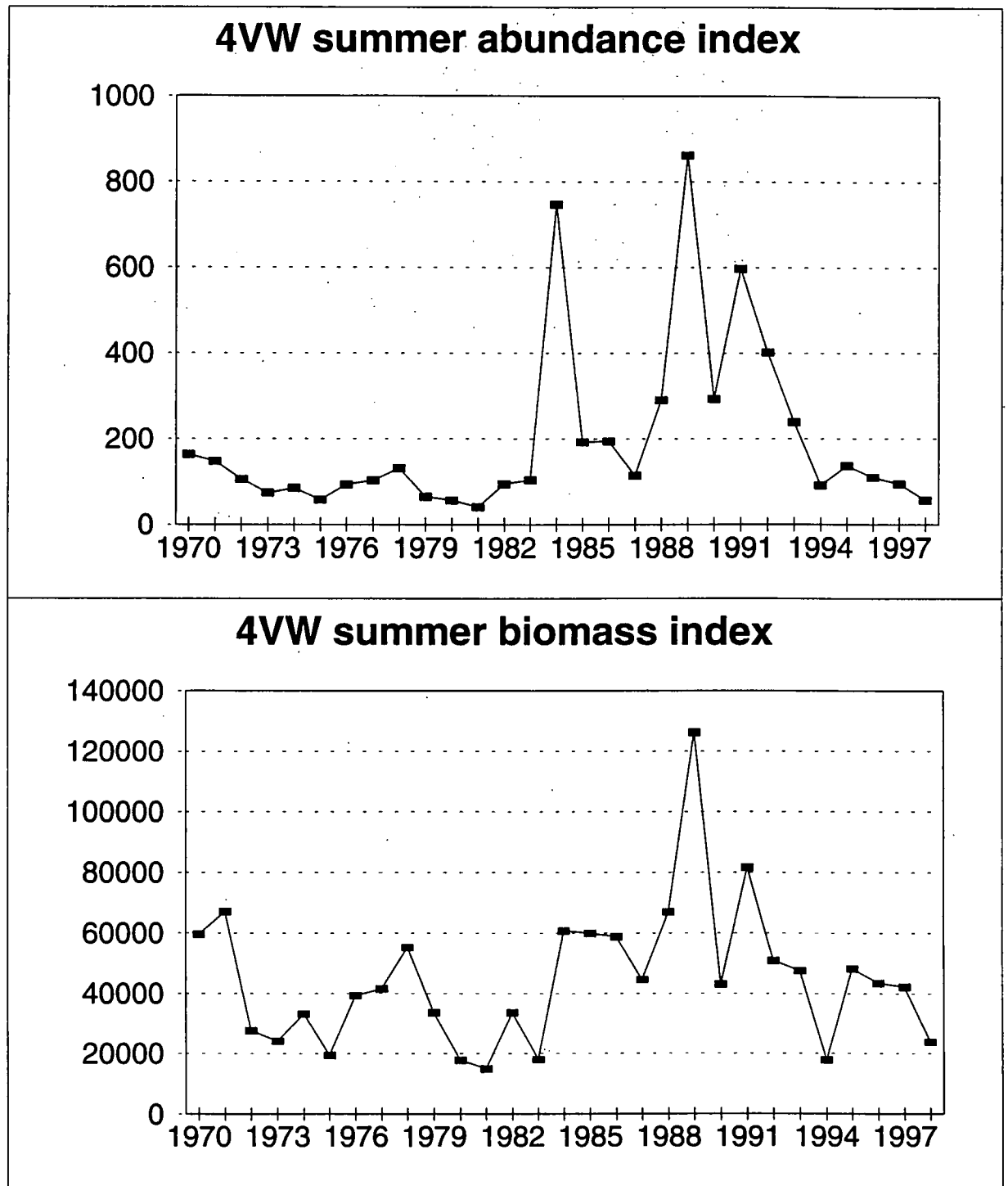


Fig. 7. Redfish abundance and biomass estimates for 1970-1998 4VW groundfish directed summer surveys conducted by the Maritimes Region. From 1970 to 1981 the A. T. Cameron conducted the surveys with a Yankee trawl. The Alfred Needler conducted surveys from 1982 to 1998 utilizing a Western Ila trawl.

4VW Summer RV Surveys

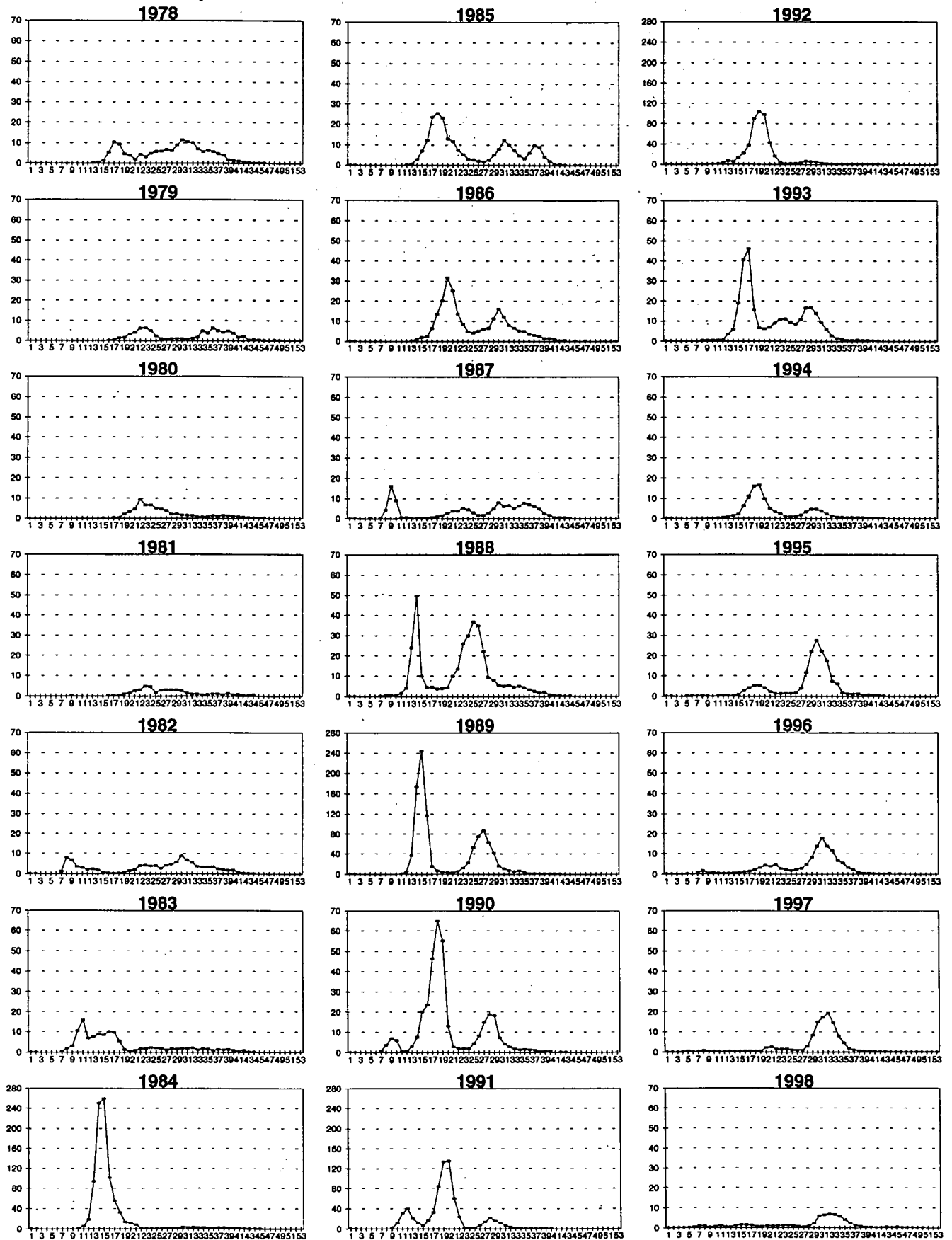


Fig. 8. Redfish length distributions from stratified-random groundfish directed research surveys conducted by the Maritimes Region in Div. 4VW in the summer from 1978-1998. Plotted above are mean number per standard tow. X-axis is forklength in centimetres.

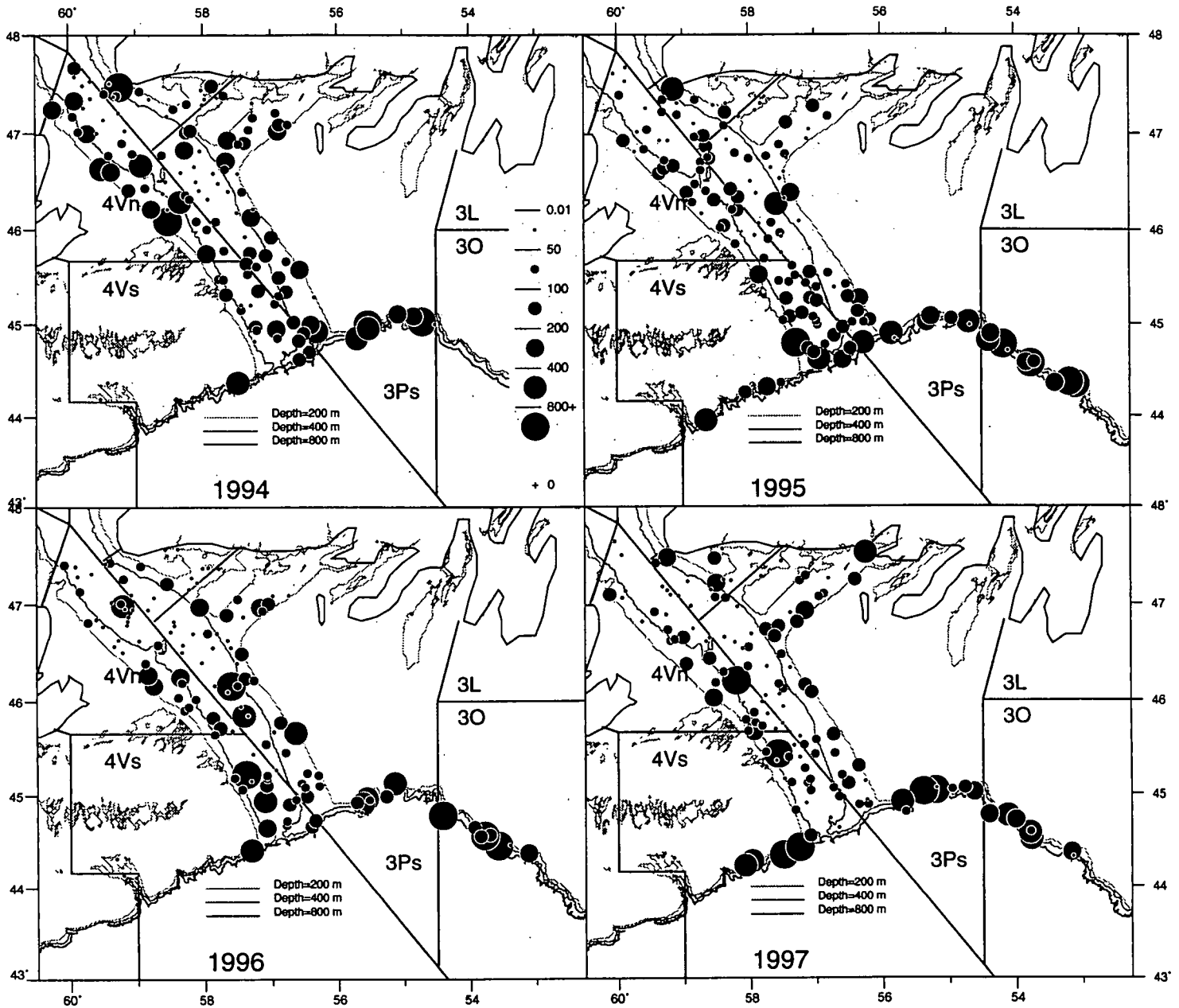


Fig. 9. Distribution of Redfish catches (Kg. per standard 0.8 nm. tow) from summer RV redfish directed surveys to Unit 2 using a Campelen 1800 survey trawl.

Unit 2 Summer RV Survey

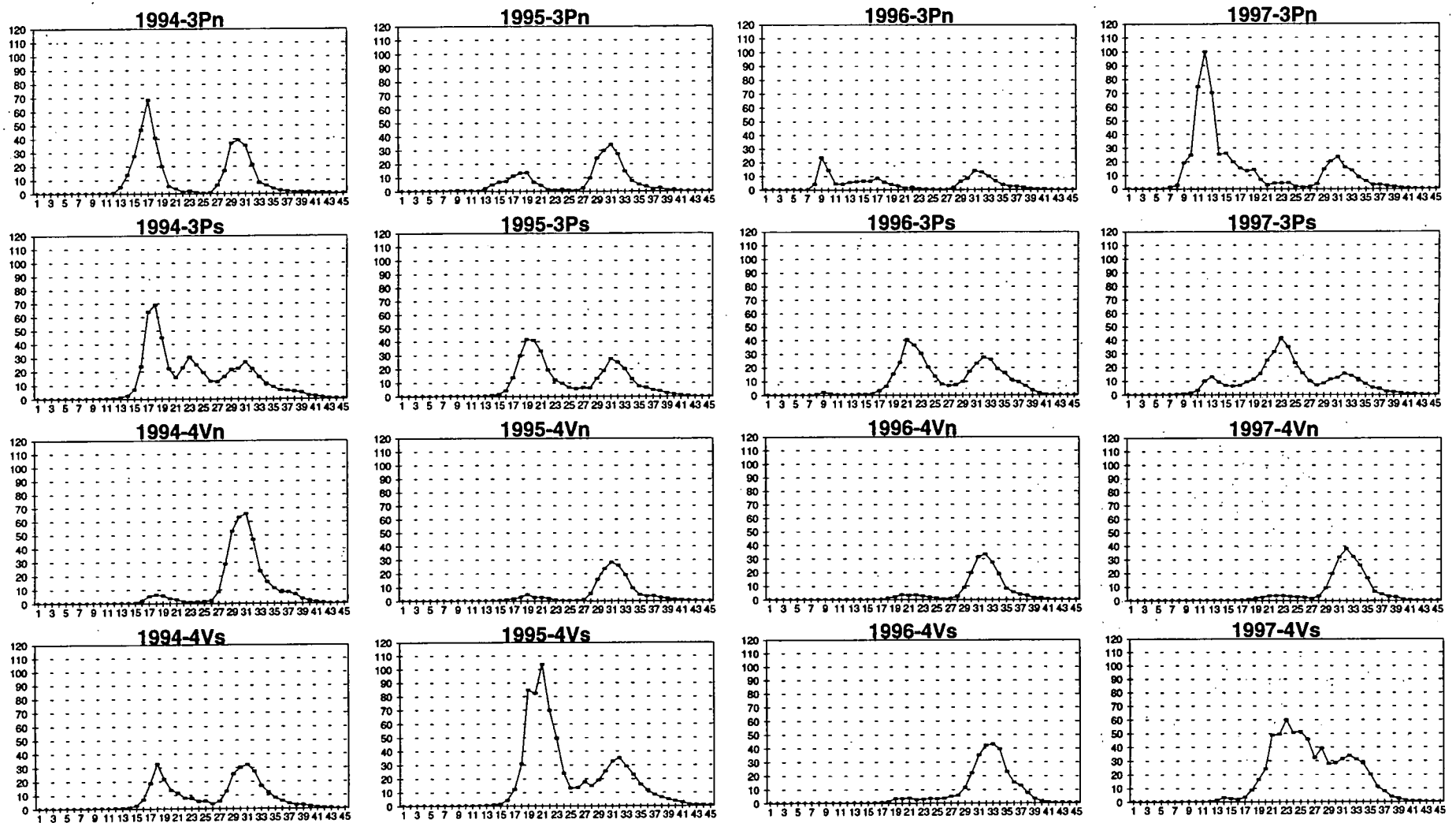


Fig. 10. Length distributions from stratified-random research surveys to UNIT2 for 1994-1997. Plotted are mean number per standard (0.75 n. mi.) tow. X-axis is centimetres. The 1994 survey was conducted by the MV Gadus Atlantica and the 1995-1997 surveys were conducted by the by the CSS Teleost . All surveys were conducted with a Campelen 1800 shrimp trawl.

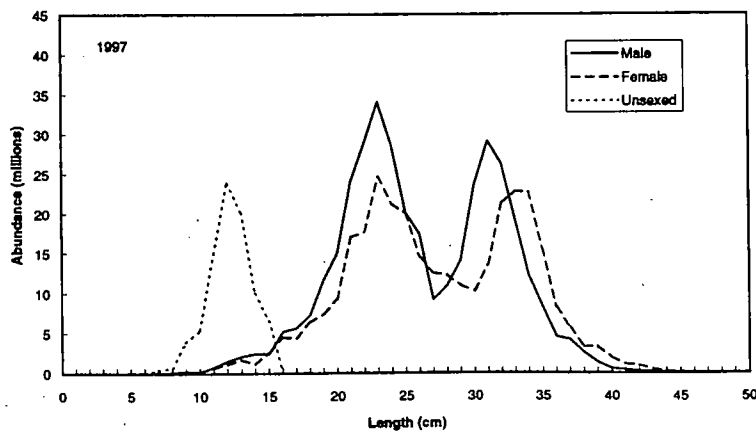
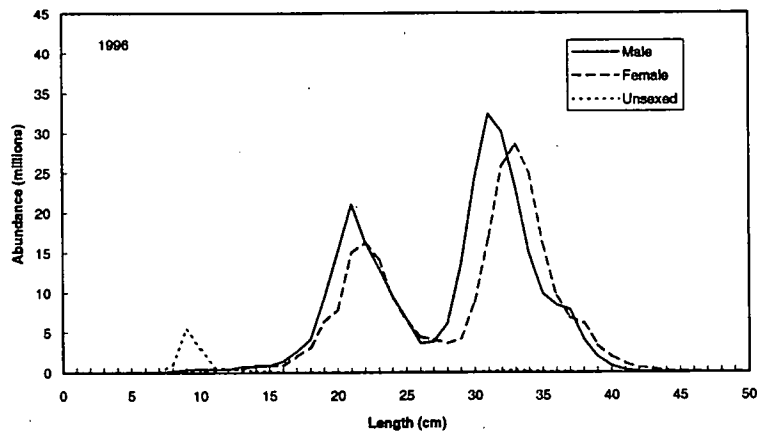
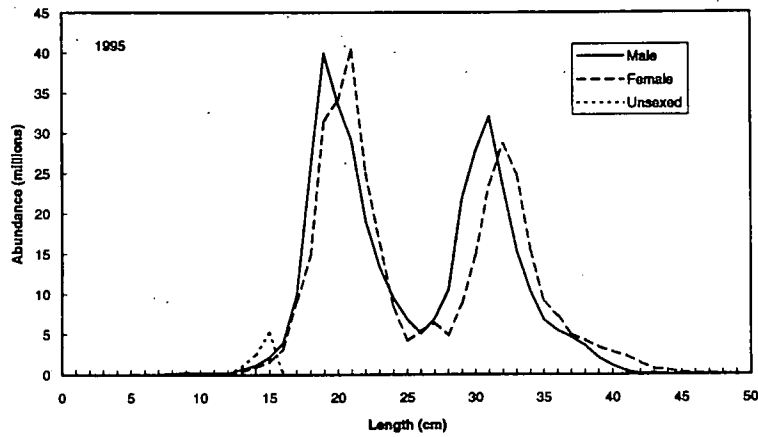
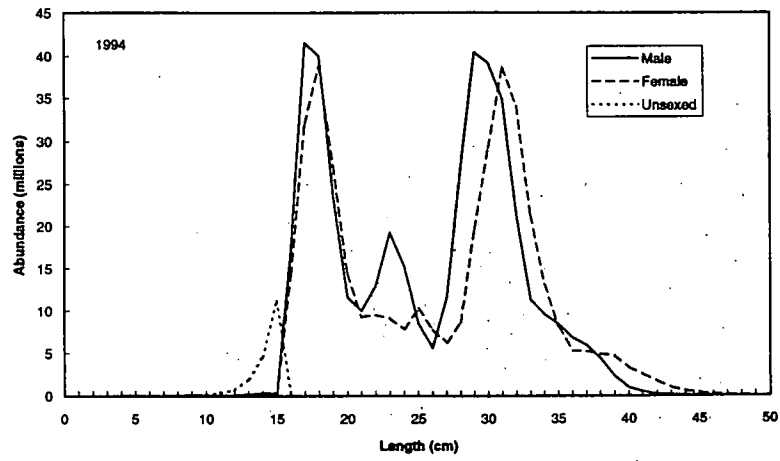


Figure 11. Survey abundance index at length from summer RV surveys of UNIT 2 redfish.

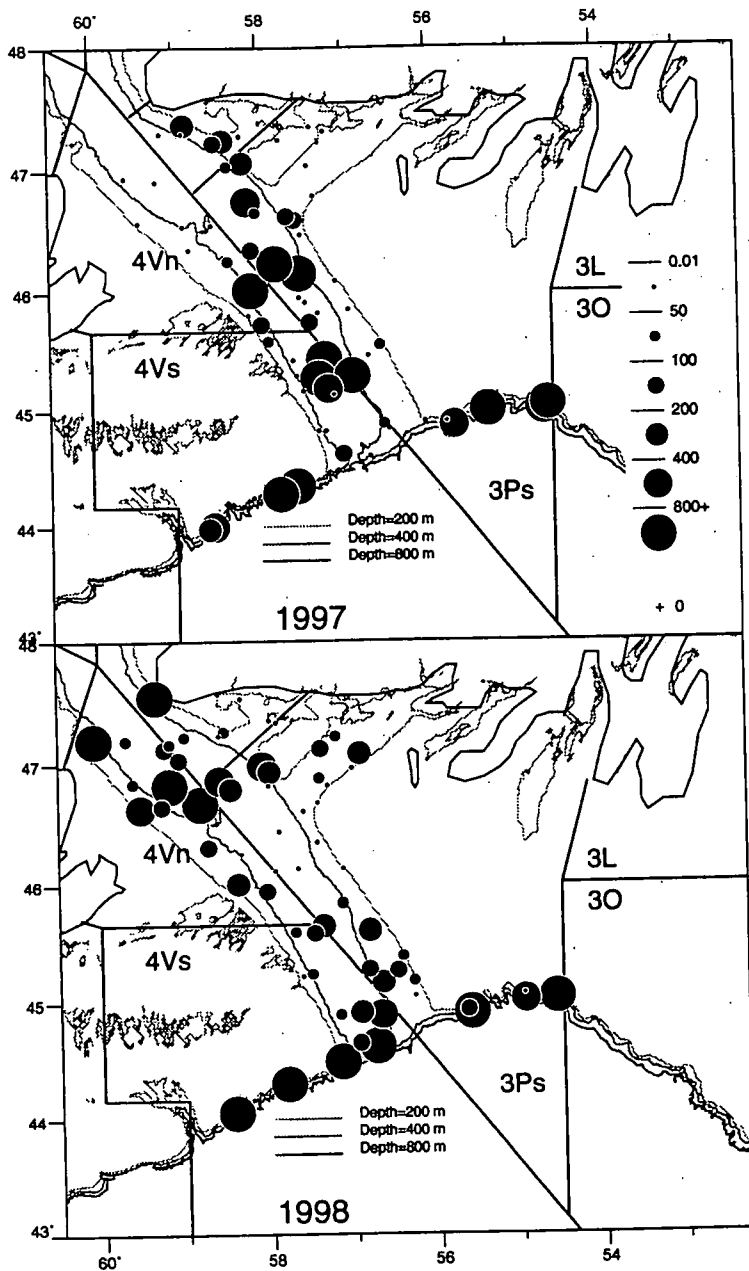


Fig. 12. Distribution of Redfish catches (Kg./standard 1.8 nm. tow) from GEAC redfish surveys to Unit 2 using an Engels 170 commercial trawl.

GEAC Industry Surveys

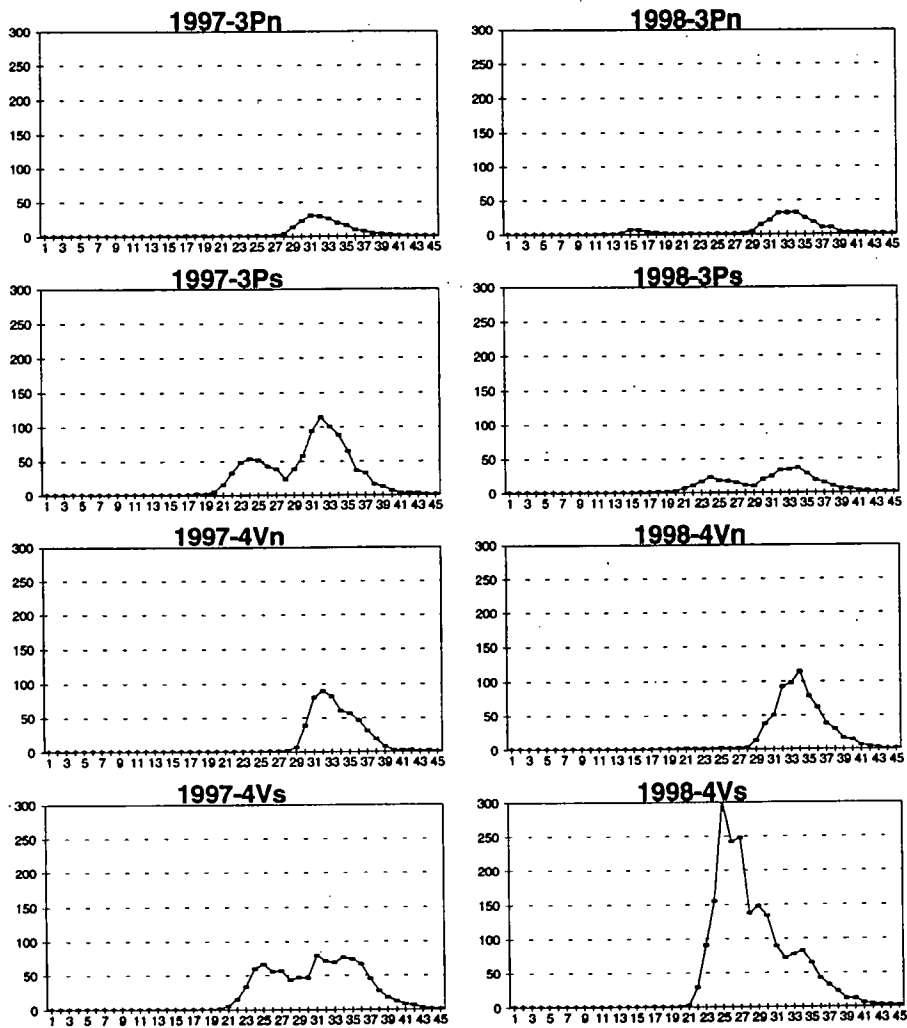


Fig. 13. Length distributions from stratified-random GEAC industry surveys to UNIT2 for December 1997 and August 1998. Plotted are mean number per standard (1.75 n. mi.) tow. X-axis is forklength in centimetres. The 1997 survey was conducted by the MV Cape Beaver and the 1998 survey was conducted by the MV Cape Ballard. Both surveys were conducted with an Engel 170 trawl with no liner.

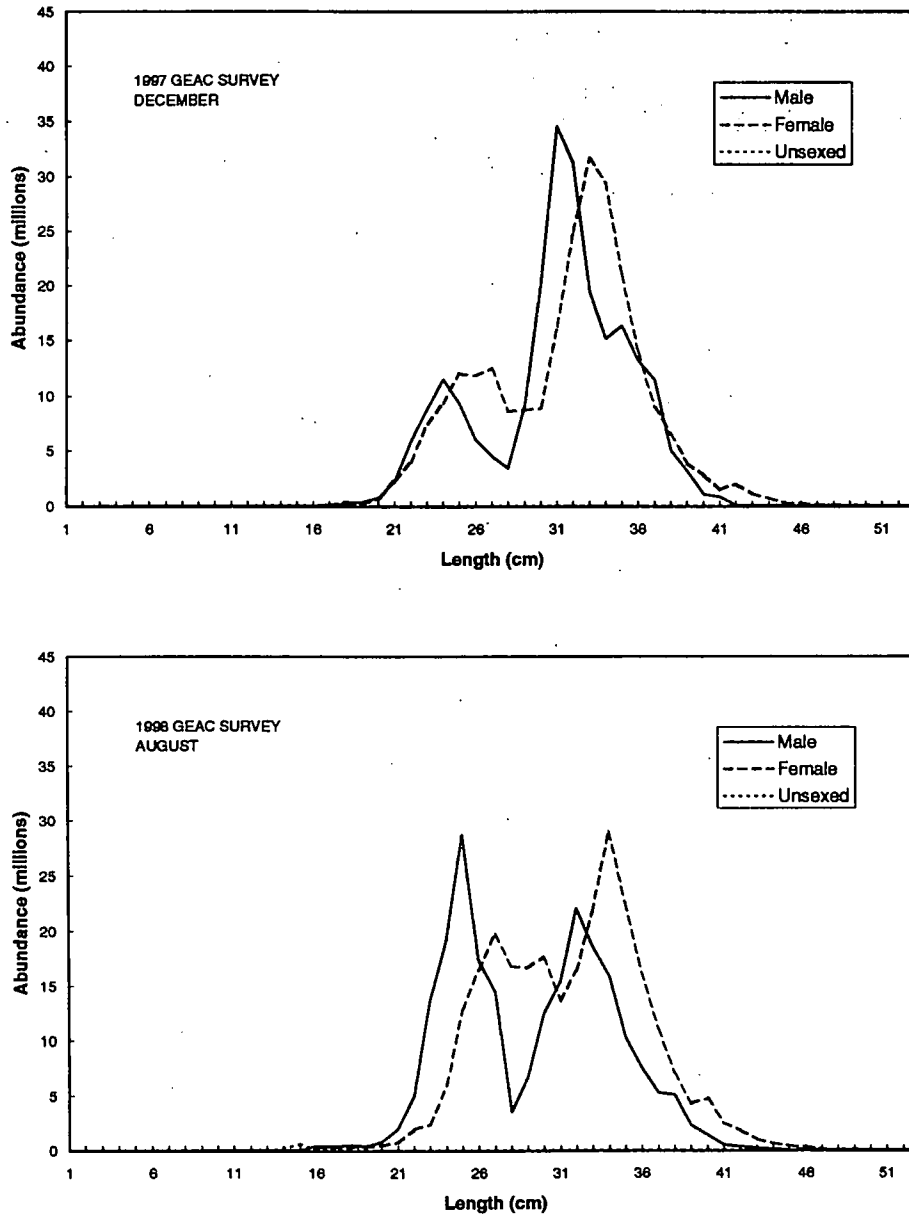
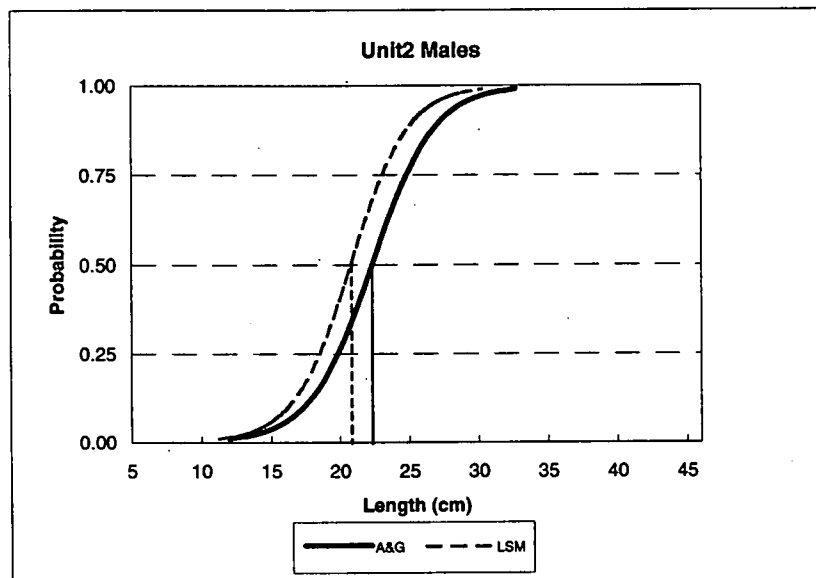
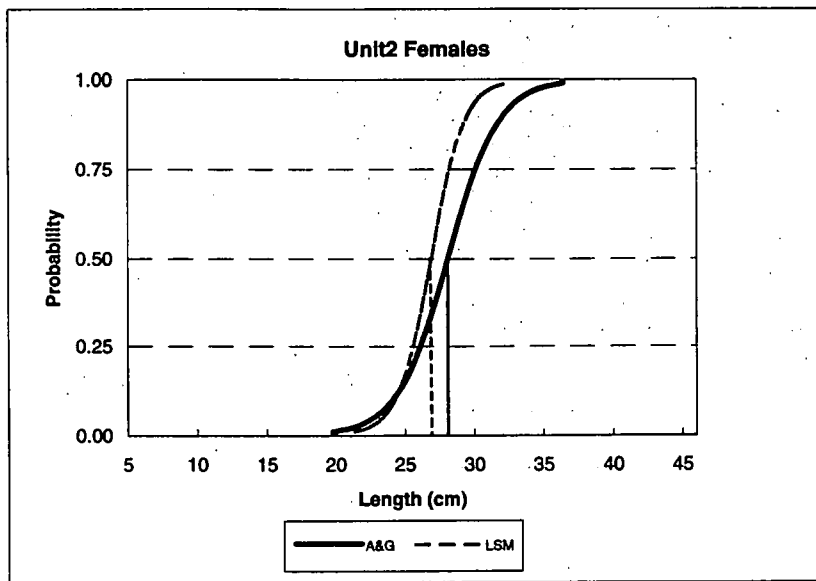


Fig. 14. Redfish survey abundance index at length from GEAC Industry surveys of UNIT 2.



	A&G Data		LSM Data		Average	
	Males	Females	Males	Females	Males	Females
L75	24.79	30.08	23.04	28.17	23.91	29.13
L50	22.31	28.08	20.76	26.86	21.54	27.47
L25	19.84	26.09	18.49	25.55	19.16	25.82

Fig. 15. Maturity ogives derived separately for otolith sampled (A&G) and LSM sampled data from surveys in Unit2.