Fisheries and Oceans Science
Pêches et Océans Sciences

C S A S

Canadian Stock Assessment Secretariat

S C É S

Secrétariat canadien pour l'évaluation des stocks

Research Document 2000/136

Document de recherche 2000/136

Not to be cited without permission of the authors [1]

Ne pas citer sans autorisation des auteurs [1]

The status of Redfish in UNIT 2

D. Power and F. Mowbray

Department of Fisheries and Oceans
Science, Oceans and Environment Branch
P.O. Box 5667
St. John's NF A1C 5X1

ISSN 1480-4883
Ottawa, 2000

Canada

Abstract

Three species of redfish are present in the Northwest Atlantic (*Sebastes mentella, S. fasciatus* and *S. marinus* [=*S. norvegicus]*). These three species are similar and are nearly impossible to distinguish by their appearance. They are not separated in the fishery, and they are managed together. The most abundant of these are *Sebastes mentella* and *S. fasciatus*. The range of both species overlaps significantly in the Gulf of St. Lawrence (Unit 1) and Laurentian Channel area (Unit 2). *S. mentella* is generally distributed deeper than *S. fasciatus*. The implementation of management Unit 2 in 1993 caused a change in fishing pattern from that generally in place under three former units (3P, 4RST and 4VWX). In UNIT 2, seasonal closures and a small fish protocol have also impacted fishing pattern, however harvesters are making adjustments and consider that fisheries in the recent past have generally been successful. Catches have declined from 27,000 metric tons in 1993 to 9, 500 metric tons in 1996. From 1997-2000, catches and TACs have been about 10,000 metric tons. DFO surveys between 1994-1997 and 2000 suggest stability. Industry based surveys support this between 1997-1998 but indicate some decline thereafter. Commercial catches are dominated by the 1980 year-class, which has provided most of the yield for the past 10 years. The 1988 year-class, which is not as strong as the 1980 year-class, is now fully available to the fishery. However, because the current fishery is targeting almost exclusively the remnants of the 1980 year-class (*S. mentella*), a decline in SSB is expected in the next 1 to 2 years. The prospects for both the stock and fishery in the next few years depend heavily on the degree to which the 1988 year-class (*S. fasciatus*) contributes to both reproductive potential and yield. The 2000 DFO survey indicates recruitment to the stock from the predominantly 1994 and 1998 year classes (*S. fasciatus*) accounted for 35% of the survey abundance index but it will be several years before these year-classes contribute to the fishery or spawning biomass. Questions remain concerning stock structure and mixing in Unit 1 and Unit 2.

Résumé

Trois espèces de sébastes sont présentes dans l'Atlantique nord-ouest : Sebastes mentella, S. fasciatus et S. marinus (=S. norvegicus). Comme ces trois espèces, qui se ressemblent beaucoup, sont presque impossibles à distinguer en apparence, elles ne sont pas différenciées dans la pêche et sont gérées ensemble. Sebastes mentella et S. fasciatus, les plus abondantes des trois espèces, présentent des aires de répartition qui se chevauchent considérablement dans le golfe du Saint-Laurent (unité 1) et le chenal Laurentien (unité 2). S. mentella se trouve généralement à de plus grandes profondeurs que S. fasciatus. La création de l'unité de gestion 2 en 1993 a entraîné une modification du régime de pêche par rapport à celui qui avait généralement cours dans les trois unités antérieures (3P, 4RST et 4VWX). Dans l'unité 2, des périodes d'interdiction saisonnière et un protocole pour la protection des juvéniles ont aussi eu un effet sur le régime de pêche, mais les pêcheurs s'adaptent, et ils considèrent que la pêche a généralement été bonne ces derniers temps. Les prises ont baissé de 27 000 tonnes métriques en 1993 à 9 500 tonnes métriques en 1996. De 1997 à 2000, les TAC et les prises se chiffraient à environ 10 000 tonnes métriques. Selon des relevés effectués par le MPO entre 1994 et 1997 et en 2000, l'effectif du stock serait stable. Des relevés fondés sur les prises faites par l'industrie ont donné des chiffres semblables pour 1997-1998 mais ont indiqué une certaine baisse par la suite. Les prises commerciales sont dominés par la classe d'âge de 1980, qui représente la plus grande partie de la production depuis dix ans. La classe d'âge de 1988, qui n'est pas aussi abondante que celle de 1980, est maintenant entièrement exploitable. Mais comme la pêche à l'heure actuelle cible presque exclusivement ce qui reste de la classe d'âge de 1980 (S. mentella), on s'attend à un déclin de la biomasse du stock reproducteur d'ici un an ou deux. Les perspectives du stock et de la pêche pour les prochaines années dépendent beaucoup de la contribution de la classe d'âge de 1988 (S. fasciatus) au potentiel de reproduction et à la production halieutique. Selon le relevé effectué par le MPO en 2000, le recrutement des classes d'âge de 1994 et de 1998 (S. fasciatus) représentait 35 % de l'indice d'abondance, mais ces classes d'âge ne contribueront pas à la pêche ou à la biomasse du stock reproducteur avant plusieurs années. On se pose encore des questions sur la structure et le mélange des stocks dans les unités 1 et 2.

INTRODUCTION

Three species of redfish are present in the Northwest Atlantic (*Sebastes mentella, S. fasciatus* and *S. marinus* [=*S. norvegicus]*). These three species are similar and are nearly impossible to distinguish by their appearance. They are not separated in the fishery, and they are managed together. The most abundant of these are *Sebastes mentella* and *S. fasciatus*. The range of both species overlaps significantly only in the Laurentian Channel area (Unit 1 and Unit 2). *S. mentella* is generally distributed deeper than *S. fasciatus*.

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 assessment of stock status to November 2000 and provision of advice for the April 1, 2001 to March 31, 2002 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 historical fishing pattern in UNIT 2 from January-March. The 2000-2001 TAC was set at 10,000 t. 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 and 2000 to (a) minimize possible mixed harvests with Gulf of St. Lawrence management unit (UNIT 1) redfish, given a lack of understanding of redfish migration patterns (subdivisions 3Pn/4Vn closed November and December since 1995 and October of 2000), and (b) allow for a period when peak spawning of females is likely to occur (UNIT 2 closed in May and June since 1995). In addition, subdivisions 4Vn and 4Vsb were closed to all fishing January 1 to April 30 from 1995-2000 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 and 1999 matching a similar increase in TAC. There was an upward adjustment of the 1999 TAC from 12,000 t to 18,240 t and an extension of the "fishing year" to March 2000 to allow for the transition to an April 1 to March 31 based TAC. Up to early November 2000, about 4,400 t had been taken from the 2000-2001 TAC.

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 (Table 2). 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 accounts for a substantial portion of the catch only 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 3P4V catch taken by domestic fleets was taken in subdivisions 3Pn and 4Vn during a predominantly winter fishery (January-April), but under the revised management units this is considered to be UNIT 1. 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 in 3Pn and 4Vn is likely related to capitalizing on the fishing experience of the outward Gulf of St. Lawrence migration within the temporal and spatial boundaries of UNIT 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 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 and 1999, fishing in 3Psg, the most southern of the unit areas in the Laurentian Channel, has accounted for about 30% of the landings. Fleets with the largest allocations reported that for the first four months of 2000, which corresponds to the adjusted 1999 season, the percentage of catch from 3Psg was closer to 60%. 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 1994-2000 fisheries by port and sea sampling (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 1998-2000 were similar in that they continue to be dominated by the 1980 year class progressing in modes from 30cm to 33cm for males and 32-34 cm for females. The 1988 year-class was not apparent in the 1998-2000 catches 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 2000 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 over the past decade (see Bishop (1994), Murphy (1996)), consequently data for 1994-2000 (Table 6) 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 current stratification chart (Fig. 3) incorporates these revisions and is the basis for current 3Ps spring survey and the UNIT 2 summer surveys by DFO and the Groundfish Enterprise Allocation Council (GEAC).

The historical series of mean numbers and weights per standard tow for 3Ps show some rather dramatic fluctuations between some years (Tables 4-6, Fig. 4). 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 2000. 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. The Campelen series, which uses the same net and protocol as the summer survey of UNIT 2, suggests a decrese from 1996 to 1998 followed by an increase to 2000.

Geographical distribution plots (Fig. 5-6) of catches in Div. 3P(s+n) since 1990 (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. This is consistent throughout the time series of varying gears, fishing protocols and research vessels.

Size composition (mean per tow at length) from the 3Ps portion of the surveys plotted from 1981-2000 (Fig. 7) 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 2000, 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 2000 survey, there were four distinct groups that correspond to the 1997 or 1998 year-class (mode at 9 cm), the 1994 year class (mode at 19cm), the 1985 and 1988 year classes (a group between 24cm-28cm) and the 1980 year class (mode at 33cm). The 1997/1998 year class was the most abundant in the research catch followed by the 1994 year class.

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 7-8, Fig. 8) 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 in that 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 2000, which is the lowest in the series since 1982.

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 early 1970s year-classes are represented by 22cm-27cm fish in the 1980 survey. 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), 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 4VW 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. The 2000 survey indicated three modal groups of fish, one at 13cm (perhaps the 1996 year class), one at 18cm perhaps the 1994 year class) and the dominant 1980 year class at a mode of 33cm.

4VsW Spring DFO Cod Surveys

Stratified-random surveys had been conducted during spring in subdivision 4Vs and division 4W from 1986 to 2000, with the exception of 1998. The stratification scheme on which the surveys were based was a revision of the standard Scotian Shelf strata based on the 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 spring and 4VW summer survey series, the historical series of mean number and weight (Table 9, Fig. 10) per standard tow show large annual fluctuations both between year and between strata within each year. The strata less than 366m include very large areas up on the bank area where redfish are infrequent and only occasionally will a random set be chosen in areas which overlaps with redfish habitat. Consequently, the estimates will be highly influenced in those years by single sets rather than reflect year to year changes in stock abundance. In addition, these surveys only cover a small part of the management unit, which makes it of limited value in determining current stock status in UNIT 2. Nevertheless, the series since 1993 suggests an increase in the biomass index but stability in the abundance index in the strata deeper than 366 m in the Laurentian Channel area of 4Vs, which suggests that only fish growth has occurred over the time period.

Size composition (mean number per tow at length) from the surveys (Fig. 11) generally indicate the majority of fish captured range from 6 cm to 21 cm in the surveys prior to 1993 which only covered down to 366m. 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). In surveys since 1993 the 1980 year-class is also a consistent occurrence, first detected in 1993 at a range of 29cm-31cm.

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 and 2000 utilizing a Campelen 1800 shrimp trawl with a 12.5-mm liner covering strata from 183m – 732m (Fig. 3). 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.

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 10). The biomass index derived from the surveys suggest that stock size remained relatively stable between 1994 and 2000. The annual estimates of the survey biomass index were revised upwards by about 8.5% from last year's assessment (Power, 1999) because an analysis of gear performance parameters gave an empirical estimate of the wing spread of the trawl rather than a theoretical that had been used previously in the swept area estimates. In addition, there were 5 additional strata covered in the 2000 survey that extended into the nearshore areas of Hermitage Bay in 3Ps. These strata represented about 4% (10,000 t) of the survey biomass estimate (258,000 t), which is not considered a dramatic affect with regard to the comparability of the survey series.

Geographical distribution plots of the surveys (Fig. 12) 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. 13) from the surveys generally show bi-modal distributions from 1994 to 1997 with a new mode in 2000 at 10cm (the 1998 year-class) evident in 3Pn but to a lesser extent in 3Ps. The 1994 year-class was first detected in the 1996 survey at 9 cm but was only relatively abundant in subdivision 3Pn. The 2000 survey indicates that at 18cm-19cm they were the most abundant year-class in subdivision 3Pn and were also represented, but to a much lesser extent, in subdivision 3Ps and 4Vs. There was no indication of the 1994 year-class in subdivision 4Vn. 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 28cm) in subdivision 4Vn in all surveys. The 1988 year-class was also poorly represented at 22cm-23cm 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 subsequent 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 spring surveys and the 4VW summer surveys. These observations suggest that a finer analysis of the data be conducted to determine whether these observations are consistent over the fishing stations or are influenced by only a few fishing stations.

Detailed biological sampling also conducted on these surveys on meristic and morphologic characters for species determination. Although the data have not been fully analysed on a set by set basis, a cursory examination reveals that the 1980 year-class is primarily *S. mentella*, and all other above average year-classes since 1980 (the 1985, 1988, 1994 and 1998 year-classes) have been *S. fasciatus*.

An combined index of abundance at length estimated for UNIT 2 survey area illustrate different growth rates between males and females from a given year-class (Fig. 13). Clearly, allowing for these different growth rates, there are four modal groups in the 2000 survey, the peaks of which were 10cm (the 1998 year-class), 18cm-19cm (the 1994 year-class), 25cm-27 cm (the 1988 year-class) and 33-35 cm (the 1980 year-class). It is evident that the abundance index of the both the 1988 year-class (at 17cm-18cm in the 1994 survey) and the 1980 year-class (at 29cm-32cm in the 1994) has decreased at a similar rate in the series from 1994 to 2000. The reduction in the 1980 year-class was expected, as this has comprised the bulk of the commercial catches in the 1990s. However, although the 1988 year-class has progressively become more vulnerable to the fishery since 1994, and has been somewhat protected in 1995 and particularly in 1996 by a minimim size regulation, the reason for it's corresponding reduction is unclear as it has not been harvested to the extent that the 1980 year-class has since 1994.

The 1994 and 1998 year-classes represented about 35% of the 2000 survey abundance. The 1980 year-class accounted for 30% of the survey abundance but 60% of the survey biomass.

Acoustic Component of the UNIT 2 Survey in 2000

A pilot project using acoustic sampling in conjunction with the standard summer Unit 2 bottom trawl survey was conducted for the first time in the year 2000. There were two reasons for adding the acoustic component: (1) The acoustic data may eventually be used to derive an additional abundance index and (2) supplementary acoustic information could be used to help describe availability to the bottom trawl and patchiness in spatial distribution which could be used to improve confidence in the bottom trawl estimate. On the horizontal plane acoustic sampling can map dynamics in fish distribution and densities at a much finer scale than trawl surveying alone as it can collect data between stations as well as during fishing. Vertically, acoustics can add important information on abundance above the opening of the trawl (approximately 5m for the Campelen trawl) while the trawl samples include fish in the acoustic deadzone. The acoustic deadzone in this case is a layer about 0.75 m thick consecutive to bottom where ground shadowing prevents separation of fish from bottom (Figure 15).

Due to a current lack of statistical technique for deriving an estimate of abundance from the acoustic data collected during a stratified-random trawl survey design, no attempt to derive a separate acoustic abundance index was made at this time. However, supplementary information from acoustic surveillance is used qualitatively and quantitatively to investigate the availability of redfish to the bottom trawl as a result of horizontal and vertical structuring of aggregations.

Acoustic data were collected during the 2000 UNIT 2 summer redfish survey on the research vessel CCGS Teleost while travelling at a maximum speed of 10 knots between stations and during fishing tows (speed of 3.0 knots). The acoustic equipment used consisted of a calibrated, hull-mounted split beam 38 kHz transducer and a Simrad EK500 echosounder system. This system produced high resolution (10cm vertical bins, ping interval 1-3 secs) backscatter volume (Sv) measurements which were recorded using the Canadian DAT software CH1. Echogram files were subsequently edited and integrated with the DAT program CH2 using an Sv threshold of -70 dB. Editing procedures included removing noise from SCANMAR net monitoring system, whales or other ambient sources; examining and redefining bottom placement to remove bottom echo protrusions and slope shadowing and classifying fish marks. Echogram mark characteristics such as shape and density were used in combination with target strength distribution information and species composition of trawl catches to identify those marks characteristic of fish. Marks were then classified as redfish (> 80% redfish by weight) or redfish mix. Backscatter area (Sa) estimates in m^2/m^2 were obtained for each classification type (MacLennan and Simmonds 1992) by integrating Sv values over the whole water column, by 10 m surface referenced layers and for a 5m bottom referenced layer. Integrations were performed twice, once for 100m horizontal bins and again in 1852 m horizontal bins. These values were then scaled to numbers of individuals per square meter by dividing Sa for redfish by $\sigma_{(bs)}$. Back-scatter coefficient ($\sigma_{(bs}$) was derived using the following target strength relationship and the mean length of redfish in the stratum.

$$TS = 20 \log L - 67.1$$ where L is length in cm (Foote et al. 1986)

Estimates of redfish densities presented from this point on are those for echogram marks which were recognized unambiguously as redfish plus the redfish portion of those classed as 'mixed' scatterers. Backscatter contribution of redfish in the 'mixed' classification were calculated as the percent by weight of redfish in the trawl catch. This method was chosen because length frequencies were not always available for the other scatterers in the catch (principally cod, haddock and hake).

The cruise track giving redfish densities for the whole water column is shown in Figure 16. Redfish were detected at low densities (<0.001 fish/m^2) over nearly all the survey area with several small high-density zones, which contained densities up to 1.3 fish/m^2. High-density areas seldom spanned track segments over 1000m and frequently covered 200 m or less. Highest redfish densities were observed in the Gully and northeastern portion of survey area. Redfish demonstrated little vertical migration throughout most of the survey area. Redfish marks and behaviour was most consistent in waters of the Laurentian channel greater than 350m in depth. Phenomena commonly referred to by commercial fisherman as ‘redfish balls’ were noted in a number of locations. These redfish balls are spherical or columnar patches of high signal intensity, usually within 50 m off, or extending to, bottom, but did not necessarily coincide with areas of high acoustic densities or trawl catches. Redfish balls are commonly used by commercial fisherman as an indicator of a high-density area, though the composition of the balls themselves is not certain (Capt. Rene Langdon, Fishery Products International, pers. comm.).

Point kriging with Surfer software (Golden Software Inc.,1999) was used to produce a density surface profile from the acoustic survey. Bottom trawl set locations superimposed on this density surface show no discernible bias in sampling of high and low density areas. Areas of high acoustic redfish densities frequently coincided with those of high trawl catch rates (Figure 17). However, in several instances redfish were hard on bottom resulting in high bottom trawl catch and low acoustic abundance, as well as occasions when redfish were predominately off bottom resulting in acoustic density estimates higher than indicated by bottom trawl catches.

A comparison of the acoustic estimates of the trawl zone content (resolvable bottom 5m) with bottom trawl catches indicated that in most cases redfish were hard on bottom and not available to the acoustics (Fig. 18). Consequently trawl catches exceeded acoustic estimates of abundance (for whole water column) in 109 of 120 sets (Fig 19). Mean availability to the bottom trawl was estimated for each set as the number of redfish caught in the trawl divided by the sum of the trawl catch and the acoustic estimate of the number of redfish in the water column above trawl zone (assuming an effective fishing height of 5m) (Fig. 20). Overall 81% of redfish were estimated to be available to bottom trawl.

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 2000 survey was conducted with a liner in the cod-end. The general design, fishing protocol and area coverage was consistent with the DFO UNIT 2 summer surveys. A detailed account and results of these surveys is given in McClintock (2000) but the summary points as extracted from the document are as follows:

- The Unit 2 biomass estimate of 169 ktonnes is up from the 1997 to 1999 values of 240, 222, and 94 ktonnes respectively more in keeping with the first two years, although still down from those years but also suggesting that perhaps 1999’s low values were an anomaly. A small caution with this estimate is that since a liner was used in 2000, some selectivity should be applied for comparison with the earlier years. At the same time, the additional redfish seen at the smaller lengths of 20 cm amount to 6% of the 2000 abundance estimate of 318 million. By comparison, very small amounts of about 1% or less of the fish caught in 1997 to 1999 are less than 20 cm, consistent with the absence of a liner. Overall, some level of stability can be inferred for the past four years. Continued annual surveys are required to monitor the stock status.

- The 1980 year-class is still “prevalent” and increased in numbers for 4Vn and 4Vs, with comparable numbers to 1999 in 3Ps and a slight reduction from 1999 in 3Pn.

- The 1988 year-class remains absent from 3Pn and 4Vn, is down slightly in 3Ps and up slightly from 1999 in 4Vs although still at levels slightly below those seen in 1997 and greatly reduced from those seen in 1998. The 1988 year class does appear to be gradually replacing the 1980 year class in the adult population as evidenced in 3Ps and 4Vs, although the 1988 year class is still not as strong is the 1980 year class.

- The 1994 year-class first seen in 3Pn in 1998 is now evident in 3Pn and also in 3Ps and 4Vn. As noted above, the 2000 survey used a liner whereas the previous three years did not so that with this element of selectivity the surveys are not comparable in this one regard. GEAC indicate they will do comparison fishing in 2001 to determine differences with and without a liner to make earlier surveys more comparable.

- Within the Laurentian Channel and slopes, where a great portion of the fish were caught in 2000 – the other area being on the southern reaches of the continental shelf – there continues to be a prevalence of fish towards the western reaches with a possible slight increase on the western 4Vs side compared to that to the east and 3Ps. Depth and oceanographic conditions may be factors associated with these aggregations.

INDUSTRY PERSPECTIVE

Because of changes in fishing patterns brought about by redefinition of management units in 1993, seasonal closures introduced in 1995, and small fish protocols (minimum size of 22 cm), industry has difficulty relating current fishing to past experiences.

In 2000, the majority of the large vessel fishery was concentrated in 3Psg and 4Vsc. The catch from 3Psd was less than in the previous three years. Catch rates declined in early winter because of extreme weather at sea. The large vessel fishery for Unit 2 is concentrated from November to early April. Smaller vessels can begin fishing in April but concentrate most of their effort in July through to September in 3Pn and 4Vn. Inshore fishermen reported good catch rates during August and September inside 12 miles close to Port aux Basques. The majority of landings continue to consist of large 30cm plus fish. However, there were reported catches of smaller fish in 3Pn and 4Vsc. Industry also found some concentrations of very large redfish (45cm-50cm) in 3Psa which had characteristics of *S. marinus* rather than very old *S. mentella* but are of less commercial value.

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.

ENVIRONMENTAL CONSIDERATIONS

Oceanographic conditions in NAFO Subdivisions 3Pn and 3Ps

The most recent cold period lasted from 1984-1995 with bottom temperatures up to 1°C below average and surface temperatures up to 2°C colder than the late 1970s and early 1980s (E. Colbourne, DFO Science, Oceans and Environment Branch, pers. comm). A preliminary analysis of temperatures in the deeper water off the banks show a high degree of variability but no significant trends. Since 1991, temperatures have moderated in some areas from lows experienced from the mid-1980s and early 1990s but negative temperature anomolies continued over large areas of the bank into the spring of 1995. Temperatures have shown a variable increasing trend from 1996-98 being above normal in 1999 and 2000. In 2000, only Hermitage Channel and the deeper portions of the southeastern slope of St. Pierre Bank shower below normal bottom temperatures.

The areal extent of the subzero °C bottom water covering the banks in water depths less than 100m, while increasing during the 1980s, and subsequently beginning to decrease after 1994 has disappeared in 1999 and 2000. As a result, the areal extent of bottom water above 1°C has increased from 50% in 1998 to 85%in 2000. Salinity data showed a clear change in water mass characteristics during 1998 and 1999 shifting to a warm saltier condition compared to cold fresh conditions that prevailed during the early 1990s. The spring 2000 water mass was found to be fresher and warmer than normal and this fresher water may have been advected from the eastern Newfoundland shelf.

SOURCES OF UNCERTAINTY

The commercial fisheries continue to target the 1980 year-class. Although the absolute size of the 1988 year-class is uncertain, it is now largely exploitable. Its relative strength in all surveys still suggest it is not as large as the 1980 year-class which has already contributed 10 years of yield. Therefore, there is reduced expectation about the overall yield that the 1988 year- class may produce. The causes of the apparent reduction of the strength of the 1988 year-class as estimated from two independent surveys, despite low exploitation, also are unknown.

The results of genetic studies presented at the 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 that has not been seen elsewhere.

These studies imply that interbreeding among redfish in Unit 1 and Unit 2 occurs at a rate sufficient to render the populations to be genetically indistinguishable, and although this rate could be low, these require careful consideration and clarification in at least two aspects of management. Because of the winter mixing and lack of characteristics for separation of redfish from the two Units, it is not possible to allocate the relative impact of late fall and winter fisheries in 3Pn and Cabot Strait, to Unit 1 and Unit 2 stocks. Therefore conservation of both Units requires continuation of measures to prevent significant exploitation of redfish during the period of mixing. More fundamentally, the lack of genetic differentiation of redfish from the two Units, and similarity of past production of strong year-classes raises questions about the degree to which they should be managed as separate units of production. This is a particularly important consideration, because the only known large spawning biomass of *S. mentella* is the remnants of the 1980 year-class in the two Units. The long-term impact of the Unit 2 redfish fishery, which presently targets primarily the 1980 year-class of *S. mentella*, on future recruitment to both Units is not known.

The 2000 DFO survey confirmed the presence of the 1994 year-class and also detected the 1998 year class. Biological characteristics suggest both these year-classes and the 1988 year-class are predominantly *S. fasciatus*, a shallower water species. The strength of year-classes of *S. mentella* since

1980 is apparently very weak. Monitoring of these year-classes based on the DFO summer surveys will not take place until 2002.

RESEARCH RECOMMENDATIONS ADDRESSED

The Fisheries Resource Conservation Council, based on concerns that redfish were migrating out the Gulf of St. Lawrence earlier than previously thought, made a recommendation to investigate this in it's 2000 Conservation Requirements for Groundfish Stocks on the Scotian Shelf and in the Bay of Fundy (4VWX), in Sub-Areas), 2 + 3 and Redfish Stocks (FRCC 2000). The Council requested that DFO Science conduct a targeted investigation of this migration drawing if possible upon available industry cooperation to design and implement a project, with the objective of concluding what additional management measures (if any) should be made to minimize fishing that may contain redfish from both Units 1 and 2. There was no new project developed, but in an effort to address the concerns related to a possible recent shift in the timing and extent of the migration, logbook data from commercial fisheries from 1990-2000 were plotted by month (Fig. 21-31) to give perspective on a period prior to, and after, the establishment and refinement of these units in 1993 based on the analyses of the day (Atkinson and Power, 1990 and 1991).

The results prior to 1993 (Figs. 21-22) demonstrate the general pattern and extent of the migration, where Gulf fish migrate into the Cabot Strait area by January and presumably disperse back into the Gulf by May. It is also clear that the migration could have started as early as October in some years (Fig. 22-24). Therefore, at the same time the moratorium on Unit 1 came into effect in 1995, Unit 2 was also closed to November and December fishing in 3Pn and 4Vn to protect harvesting mixtures of Unit 1 fish in the Unit 2 fishery. This seasonal closure in 3Pn and 4Vn extended to October starting in 2000. There is nothing definitive in the logbook information to suggest that the seasonal closures be extended further. The data also illustrate (Fig. 27-28, Table 3) that from 1996-1997 catches came primarily from the deeper water seaward of Burgeo Bank (3Psd) and at the mouth of the Laurentian Channel (4Vsc), and to a lesser degree, in the south of 4Vn. It is also clear, beginning in 1997 (Fig.27), that catches increased in 3Psg (south of 3Psd) at about the middle of the Laurentian Channel. It can be considered that the bulk of the Unit 2 fishery since 1997 (Fig. 27-31) has been taking place south of the Hermitage Channel, well distanced from the Cabot Strait area where the Gulf migration mostly occurred. Although there is nothing in these data that can definitively say about refining the position of the current boundaries, there appears to be no cause for concern if the pattern of the fishery continues south of the Hermitage Channel.

PROGNOSIS

Current commercial catches, including those to date in 2000, are composed primarily of the 1980 year-class that has been fished for about 10 years. The 1988 year-class is now fully available, based on size, to the fishery, but has not been 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.

The current exploitation rate of Unit 2 redfish is considered to remain fairly low. However, because the current fishery is targeting almost exclusively the remnants of the 1980 year-class of *S. mentella*, a decline in SSB is expected in the next 1 to 2 years. The prospects for both the stock and fishery in the next few years depend heavily on the degree to which the 1988 year-class comes to contribute to reproductive potential and yield, respectively.

The 2000 DFO survey indicates recruitment to the stock from the predominantly 1994 and 1998 year classes accounted for 35% of the survey abundance index but it will be several years before these year-classes contribute to the fishery or spawning biomass.

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.

Foote, K.G., Aglen, A., and D. Nakken. 1986. Measurement of fish target strength with a split-beam echo sounder. J. Acoust. Soc. Am. 80: 612-621.

FRCC. 2000. 2000 Conservation Requirements for Groundfish Stocks on the Scotian Shelf and in the Bay of Fundy (4VWX), in Sub-areas 0, 2 + 3 and Redfish Stocks. Fisheries Resource Conservation Council. *(FRCC.2000.R.1*, January 2000*) (website:* www.ncr.dfo.ca/frcc *)*. Minister of Public Works and Govt. Services Canada Cat. No. Fs1-61/8-2000E.

MacLennan, D.N. and E. J. Simmonds. 1992. Fisheries Acoustics, Chapman and Hall, New York.

Power, D. MS 1999. The status of Redfish in Unit 2. DFO CSAS Res. Doc. 99/155. 42 pp.

Golden Software Inc.1999. Surfer 7 User's Guide. Golden Software Inc. Golden, Colorado, U.S.A..

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	4176	8111	6140	5607	267	23	24324			1497	25000
1995	1549	2744	3536	4254	159	-	12242			-	14000
1996	708	5885	1202	1599	12	-	9406			6	10000
1997	523	5588	1758	2021	52	-	9942			1	10000
1998	396	8178	1507	532	25	-	10638				11000
1999-2000 [a]	708	6536	1674	2398	2	-	11318 [b]			27	18240 [b]
2000-2001 [a]							4368 [c]				10000 [d]

NOTE: For information on catch partitioning see Power MS (1992)

[a] Provisional

[b] Catches are for 1999. TAC adjusted from 12,000 tons and extended to March 31, 2000 (see text)

[c] Provisional to Nov. 2, 2000 (Canadian Atlantic Quota Reports)

[d] TAC runs from April 1, 2000 to March 31, 2001

Table 2a: Nominal catches of Redfish by country from Subdiv. 3Pn (Jun.-Dec.)(1999 are provisional).

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada (M)	577	39	825	0	346	213	4915	1205	74	20	1	254	111
Canada (N)	770	445	1128	189	704	548	5537	2966	1475	688	522	142	597
Canada (Q)	1	-	-	-	-	5	488	5	-	-	-	-	-
TOTAL	1348	484	1953	189	1050	766	10940	4176	1549	708	523	396	708

Table 2b: Nominal catches of Redfish by country from Subdiv. 3Ps (1999 are provisional).

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada (M)	421	836	1038	1252	377	2648	3545	4165	500	2024	1515	3836	2460
Canada (N)	1645	1441	1823	4186	4013	3981	3745	3935	2244	3861	3780	3958	4076
Canada (Q)	-	-	-	-	-	-	24	11	-	-	-	-	-
France (M)	67	95	-	-	-	-	-	-	-	-	-	-	-
France (SPM)	36	14	13	-	-	-	-	-	-	-	292	384	393
TOTAL	2169	2386	2874	5438	4390	6629	7314	8111	2744	5885	5587	8178	6929

Table 2c: Nominal catches of Redfish by country from Subdiv. 4Vn (Jun.-Dec.)(1999 are provisional).

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada (M)	2544	2327	3245	1874	7453	5871	6757	3669	2076	1125	1626	1296	1674
Canada (N)	3682	2345	1909	579	1076	1255	603	1971	1460	77	80	-	-
Canada (Q)	-	-	1	-	217	222	450	500	-	-	-	49	-
Canada (G)	-	-	-	-	-	-	-	-	-	-	53	162	-
Japan	197	184	81	18	-	-	-	-	-	-	-	-	-
TOTAL	6423	4856	5236	2471	8746	7348	7810	6140	3536	1202	1759	1507	1674

Table 2d: Nominal catches of Redfish by country from Subdiv. 4Vs (1999 are provisional).

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada (M)	2279	2111	3452	3997	5864	1621	1125	4914	3995	1580	1887	532	1874
Canada (N)	428	335	1139	1852	1911	106	68	693	259	19	134	-	551
Canada (Q)	-	-	-	-	263	-	-	-	-	-	-	-	-
France (SPM)	-	-	-	-	-	-	-	-	-	-	1	-	-
Japan	944	279	399	475	499	-	-	-	-	-	-	-	-
TOTAL	3651	2725	4990	6324	8537	1727	1193	5607	4254	1599	2022	532	2425

Table 3 : Nominal catches of redfish by fleet, unit area and quarter from 1993-1999. Shaded cells indicate largest catches within each fleet, light shade for quarter and dark shade for unit area. G=Gulf fleet, NF=Newfoundland fleet, PQ=Quebec fleet, SF=Maritimes fleet.

Sum of Catch		Cntr / Unit G		G	NF						NF	PQ		PQ	SF						SF	Grand
Yea	Qua	3PN	4VN	Total	3PA	3PD	3PG	3PN	4VC	4VN	Total	3PN	4VN	Total	3PA	3PD	3PG	3PN	4VC	4VN	Total	Total
93	1				1367	359	5		0		1731				829	108			213		1150	2881
	2		587	587	323	13	2	333	34	289	994		440	440	309	1004	6	43	502	2397	4261	6282
	3	379	417	796	206	27	7	711		296	1247	30		30		7		132	13	3421	3573	5646
	4	262		262	835	274		4477	5	7	5598	459	10	469	889	106		3954	90	227	5266	11595
93 Total		641	1004	1645	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		17	17	1715	149	10	5	25	635	2539	5	500	505	599	284	12	6	1596	1612	4109	7170
	3	130	58	188	125	34	0	745	10	1328	2242	0		0	413	43		704	433	2103	3696	6126
	4	1		1	455	143	22	2222	39	17	2898				205	374	0	368	555	75	1577	4476
94 Total		131	75	206	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		0	0	651	240	10	870	27	1430	3228	0		0	3	53		65	219	1969	2309	5537
	4	7		7	439	123	0	602		29	1193				4	3	0	2	616	106	731	1931
95 Total		7	0	7	1583	383	11	1472	259	1459	5167	0		0	79	402	0	67	3925	2075	6548	11722
96	1				628	2410			9		3047				61	1073	0		1075		2209	5256
	2		0	0	72	12		0			84				15	277			32	0	324	408
	3		29	29	92	1		100		72	265	0		0					21	963	984	1278
	4		0	0	567	44		588		5	1204				322	209		20	408	133	1092	2296
96 Total			29	29	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		0	0	102	2	132	0			236					337	322		0	0	659	895
	3		53	53	459	3	1	426		59	948				1	11			3	1621	1636	2637
	4		0	0	296	28	3	95	85	20	527	0		0	0	23	1	1	184	5	214	741
97 Total			53	53	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		0	0	119	855	212	0			1186				8	845	207		1	0	1061	2247
	3		162	162	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			162	162	688	1830	1216	142			3876		49	49	105	2101	1625	254	531	1295	5911	9998
99	1				27	683	1841		514		3065					433	1237		566		2236	5301
	2				206	502	4	1			713				1	261	3		186	0	451	1164
	3				398	2	1	558			959				8	38	1	71	88	1670	1876	2835
	4				156	19	21	38	37		271				37	300	94	40	996	4	1471	1742
99 Total					787	1206	1867	597	551	0	5008				46	1032	1335	111	1836	1674	6034	11042
Grand To		779	1323	2102	11092	9085	3429	11913	1068	4187	40774	494	999	1493	4840	8358	3617	5660	14907	17601	54983	99352

Table 4. Mean number (upper panel) and weight (kg, lower panel) of redfish caught per standard tow in Division 3Ps during Canadian research surveys 1973-1983 (Numbers in brackets are number of successful sets, 'E' 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	ATC 221	ATC 234	ATC 247-248	ATC 261	ATC 275	ATC 287	ATC 302	ATC 316	ATC 330	AN 9
			Mar 12-25	Apr 19-30	Jun 2-13	May 11-Jun 6	Apr 14-26	Apr 4-14	Feb 16-Mar 5	Mar 19-Apr 2	Mar 7-26	May 28-Jun 9	Apr 22-May 8
307	93-183	395	288.8 (5)	200.7 (7)	4067.0 (4)	1861.3 (4)	1252.5 (4)	234.3 (4)	20.5 (4)	83.5 (2)	924.7 (3)	150.0 (4)	121.3 (4)
311	93-183	317	3.8 (9)	495.0 (8)	7.0 (4)	805.7 (6)	1022.0 (4)	0.0 (4)	19.5 (4)	0.0 (2)	6.5 (2)	7.7 (3)	0.0 (3)
317	93-183	193	1.6 (7)	217.6 (8)	558.0 (4)	466.5 (4)	691.4 (4)	3.3 (4)	16.3 (3)	3.5 (2)	1.0 (2)	112.0 (3)	7980.7 (3)
319	93-183	984	174.2 (5)	411.0 (2)	432.4 (4)	92.3 (4)	83.2 (6)	1241.0 (4)	156.0 (2)	3.0 (4)	8455.0 (2)	260.6 (7)	27.3 (7)
306	185-274	419	844.6 E	573.7 (6)	3198.0 (6)	2284.7 (6)	2159.2 (6)	2177.3 (6)	408.4 (5)	1051.5 (2)	1830.7 (3)	934.7 (3)	421.5 (4)
309	185-274	296	3647.0 (3)	1386.8 (4)	8421.7 (6)	5836.6 (7)	1955.5 (6)	1019.3 (6)	2540.3 (6)	24599.0 (2)	7772.5 (2)	522.0 (2)	981.3 (3)
310	185-274	170	95.0 (1)	175.0 (3)	2981.5 (6)	5497.8 (5)	110.5 (6)	622.3 (6)	316.0 (6)	240.0 (2)	252.5 (2)	5677.0 (3)	547.0 (3)
313	185-274	165	1.5 (2)	133.0 (5)	1010.3 (3)	990.5 (6)	78.9 (10)	130.0 (2)	80.0 (5)	95.5 (2)	187.0 (2)	4397.0 (2)	829.3 (3)
316	185-274	189	228.3 (3)	150.0 (6)	1471.0 (1)	1368.3 (4)	86.4 (6)	119.0 (6)	110.7 (3)	384.0 (2)	175.0 (2)	457.0 (1)	653.8 (4)
318	185-274	123	999.0 (1)	169.5 (2)	2034.3 (4)	2087.0 (7)	228.0 (6)	480.5 (2)	292.5 (2)	1403.5 (2)	807.3 E	6077.0 (2)	1688.3 (3)
705	275-366	195	476.5 (2)	56.8 (4)	154.9 (2)	256.2 (5)	79.5 (4)	251.7 (3)	73.5 (4)	161.0 (2)	162.0 (2)	644.0 (2)	5.7 (3)
706	275-366	476	640.0 (2)	226.6 (7)	165.0 (1)	73.8 (4)	112.3 (4)	71.0 (2)	312.0 (3)	97.0 (2)	86.0 (2)	118.0 (4)	77.8 (5)
707	275-366	93	568.7 E	590.0 (2)	785.3 (4)	1893.7 (6)	210.0 (4)	649.5 (2)	740.5 (2)	211.0 (2)	554.9 E	221.5 E	306.3 (3)
715	275-366	132	588.0 (1)	62.8 (4)	318.0 E	811.4 (5)	124.0 (4)	343.8 (4)	717.0 (3)	2417.5 (2)	1015.5 (2)	20.0 (2)	71.3 (3)
716	275-366	539	412.0 (1)	108.0 (3)	1367.4 E	252.0 (3)	127.5 (6)	473.5 (4)	173.0 (4)	43.0 (2)	207.8 (4)	122.0 (2)	54.5 (4)
708	367-549	117	445.0 E	574.5 E	185.0 (3)	520.3 (3)	364.2 (4)	473.0 (1)	592.5 (2)	89.0 (2)	434.3 E	173.3 E	722.0 (2)
711	367-549	961	202.1 E	261.0 E	388.3 E	169.5 (2)	248.5 E	207.2 E	142.2 E	25.5 (2)	32.5 (2)	11.5 (2)	68.1 (8)
712	367-549	973	182.6 E	235.8 E	350.9 E	151.5 (2)	224.5 E	187.2 E	104.0 (2)	71.0 (2)	150.5 (2)	23.0 (3)	67.9 (7)
713	367-549	950	132.4 E	171.0 E	39.4 (3)	87.5 (2)	162.8 E	135.8 E	93.1 E	15.0 (2)	65.3 (6)	11.5 (2)	23.7 (7)
714	367-549	1195	228.9 E	295.6 E	439.8 E	248.5 (2)	281.4 E	127.0 (2)	145.0 (1)	64.0 (2)	50.5 (8)	39.7 (6)	62.3 (10)
709	550-731	96	7.1 E	9.3 E	14.0 E	102.5 (2)	8.8 E	7.3 E	4.8 E	1.4 E	6.9 E	2.5 E	0.5 (2)
710	550-731	36	6.7 E	8.8 E	13.4 E	10.3 E	8.4 E	6.9 E	4.6 E	1.3 E	6.6 E	2.3 E	3.8 (3)
Stratified Analysis:		Upper	1113.7	1499.3	2576.9	1009.5	746.4	1157.1	415.8	9026.0	14082.2	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 Abundance (millions)			260.7	205.6	668.0	505.6	282.2	292.7	166.7	652.7	952.0	284.7	229.8

Stratum	Depth range (m)	Area (sq.n.mi.)	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
			ATC 207	ATC 221	ATC 234	ATC 247-248	ATC 261	ATC 275	ATC 287	ATC 302	ATC 316	ATC 330	AN 9
			Mar 12-25	Apr 19-30	Jun 2-13	May 11-Jun 6	Apr 14-26	Apr 4-14	Feb 16-Mar 5	Mar 19-Apr 2	Mar 7-26	May 28-Jun 9	Apr 22-May 8
307	93-183	395	12.3 (5)	8.6 (7)	34.3 (4)	58.9 (4)	47.3 (4)	17.7 (4)	3.1 (4)	12.4 (2)	21.2 (3)	4.1 (4)	49.0 (4)
311	93-183	317	0.3 (9)	30.5 (8)	0.1 (4)	17.7 (6)	61.1 (4)	0.0 (4)	3.7 (4)	0.0 (2)	1.5 (2)	0.2 (3)	0.0 (3)
317	93-183	193	0.5 (7)	16.2 (8)	49.1 (4)	8.2 (4)	41.9 (4)	0.2 (4)	1.7 (3)	3.4 (2)	0.3 (2)	1.1 (3)	110.7 (3)
319	93-183	984	12.9 (5)	64.4 (2)	70.4 (4)	9.0 (4)	5.6 (6)	86.6 (4)	6.6 (2)	0.8 (4)	46.0 (2)	3.9 (7)	4.8 (7)
306	185-274	419	83.1 E	56.1 (6)	176.0 (6)	188.9 (6)	137.6 (6)	298.5 (6)	48.9 (5)	165.7 (2)	44.9 (3)	54.9 (3)	81.1 (4)
309	185-274	296	541.6 (3)	135.9 (4)	666.3 (6)	939.8 (7)	224.4 (6)	108.5 (6)	337.6 (6)	3908.9 (2)	264.5 (2)	42.5 (2)	101.9 (3)
310	185-274	170	2.3 (1)	34.6 (3)	256.1 (6)	416.7 (5)	29.2 (6)	96.6 (6)	59.4 (6)	35.6 (2)	17.5 (2)	529.1 (3)	34.7 (3)
313	185-274	165	0.9 (2)	16.5 (5)	153.6 (3)	168.7 (6)	12.6 (10)	24.9 (2)	11.3 (5)	15.6 (2)	29.0 (2)	158.5 (2)	44.3 (3)
316	185-274	189	25.7 (3)	20.3 (6)	49.0 (1)	290.3 (4)	13.6 (6)	14.2 (6)	10.9 (3)	51.3 (2)	21.0 (2)	36.5 (1)	55.9 (4)
318	185-274	123	97.1 (1)	23.1 (2)	373.8 (4)	324.7 (7)	32.5 (6)	56.7 (2)	22.5 (2)	94.9 (2)	48.5 E	148.5 (2)	88.5 (3)
705	275-366	195	241.3 (2)	19.3 (4)	90.2 (2)	123.4 (5)	22.3 (4)	115.2 (3)	44.0 (4)	62.7 (2)	49.5 (2)	317.0 (2)	4.3 (3)
706	275-366	476	91.2 (2)	53.3 (7)	37.2 (1)	33.9 (4)	31.9 (4)	28.1 (2)	60.2 (3)	26.3 (2)	17.0 (2)	42.3 (4)	11.5 (5)
707	275-366	93	137.0 E	93.9 (2)	237.1 (4)	469.6 (6)	58.6 (4)	100.2 (2)	126.6 (2)	38.8 (2)	77.9 E	37.1 E	80.8 (3)
715	275-366	132	201.4 (1)	27.0 (4)	99.8 E	339.7 (5)	39.1 (4)	70.3 (4)	383.8 (3)	472.8 (2)	183.8 (2)	11.4 (2)	12.5 (3)
716	275-366	539	258.6 (1)	25.9 (3)	101.6 E	106.9 (3)	32.7 (6)	155.1 (4)	73.3 (4)	22.0 (2)	22.3 (4)	25.3 (2)	15.5 (4)
708	367-549	117	157.6 E	189.8 E	82.3 (3)	210.0 (3)	124.4 (4)	192.0 (1)	201.0 (2)	15.4 (2)	89.6 E	42.7 E	358.8 (2)
711	367-549	961	90.9 E	109.5 E	143.8 E	128.4 (2)	88.8 E	107.1 E	67.5 E	15.7 (2)	13.5 (2)	5.4 (2)	28.2 (8)
712	367-549	973	112.8 E	135.9 E	178.3 E	121.1 (2)	110.2 E	132.8 E	83.9 (2)	40.2 (2)	112.0 (2)	15.0 (3)	49.5 (7)
713	367-549	950	87.6 E	105.6 E	30.5 (3)	68.0 (2)	85.6 E	103.2 E	65.1 E	10.4 (2)	41.3 (6)	8.3 (2)	16.9 (7)
714	367-549	1195	144.9 E	174.5 E	229.0 E	206.6 (2)	141.5 E	89.4 (2)	110.7 (1)	41.1 (2)	32.7 (8)	30.1 (6)	49.9 (10)
709	550-731	96	4.5 E	5.5 E	7.4 E	96.4 (2)	4.4 E	5.4 E	3.2 E	1.3 E	2.4 E	0.9 E	0.1 (2)
710	550-731	36	7.7 E	9.3 E	12.4 E	12.7 E	7.5 E	9.1 E	5.6 E	2.5 E	4.2 E	1.7 E	2.3 (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
		Mean	85.2	45.7	125.2	151.8	52.4	89.2	67.6	166.7	48.8	39.6	40.1
		Lower	2.2	-127.3	52.4	121.4	39.8	33.0	48.3	-951.9	-88.1	6.7	26.0
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
Biomass (tons)			72952	58800	92910	102343	52193	65903	48801	111141	33130	26401	27099

3Ps Spring 1973-1983

Table 5. Mean number (upper panel) and weight (kg, lower panel) of redfish caught per standard tow in Division 3Ps during Canadian research surveys 1984-1993 (Numbers in brackets are number of successful sets, 'E' indicates those strata estimated with a multiplicative model utilizing data to 1991.)

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
307	93-183	395	127.0 (2)	53.3 (3)	17.0 (3)	36.3 (3)	44.5 (4)	14.3 (3)	37.7 (3)	6.0 (3)	1.5 (2)	6.5 (4)	7.7 (3)
311	93-183	317	41.0 (2)	11.0 (4)	0.0 (3)	0.0 (3)	1.5 (4)	2.7 (3)	0.0 (3)	0.0 (3)	1.0 (2)	3.7 (3)	0.0 (2)
317	93-183	193	882.5 (2)	0.0 (2)	0.0 (2)	0.0 (3)	2.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)
319	93-183	984	11.7 (6)	0.0 (2)	15.9 (8)	9.1 (9)	99.4 (8)	11.5 (8)	37.7 E	7.3 (9)	2.6 (10)	0.9 (9)	3.8 (6)
306	185-274	419	15.5 (2)	313.0 (2)	623.7 (3)	231.3 (4)	493.5 (4)	137.3 (3)	819.3 (3)	870.8 (4)	65.5 (2)	367.5 (4)	357.8 (4)
309	185-274	296	50.5 (2)	453.0 (3)	618.5 (2)	1142.5 (2)	535.0 (3)	398.5 (2)	363.0 (2)	1898.7 (3)	32.5 (2)	46.0 (3)	2929.0 (2)
310	185-274	170	70.5 (2)	1225.3 (3)	303.0 (2)	33.5 (2)	801.3 (3)	326.0 (2)	85.5 (2)	8716.0 (2)	3.5 (2)	79.0 (2)	910.5 (2)
313	185-274	165	35.0 (2)	1033.5 (2)	988.0 (2)	150.5 (2)	181.0 (2)	507.5 (2)	61.5 (2)	4682.5 (2)	757.0 (2)	35.0 (2)	452.0 (2)
316	185-274	189	127.0 (2)	140.0 (3)	57.5 (2)	313.7 (3)	210.0 (3)	76.4 (3)	151.0 (2)	731.5 (2)	661.0 (2)	0.0 (1)	196.7 (3)
318	185-274	123	138.0 (2)	216.2 E	958.0 (2)	5547.5 (2)	58.5 (2)	658.5 (2)	410.4 E	564.0 (2)	216.8 (2)	52.5 (2)	962.5 (2)
705	275-366	195	28.5 (2)	78.0 (2)	424.0 (2)	247.5 (2)	121.0 (2)	30.0 (2)	22.0 (2)	54.0 (2)	178.0 (2)	20.0 (2)	235.0 (2)
706	275-366	476	75.0 (2)	465.3 (4)	308.3 (4)	181.9 (5)	429.8 (4)	91.0 (4)	38.5 (4)	201.0 (4)	69.2 (5)	17.7 (3)	44.2 (5)
707	275-366	93	226.0 (2)	148.5 E	265.5 (2)	200.5 (2)	634.0 (2)	302.1 (2)	282.0 E	1389.5 (2)	2203.5 (2)	1306.5 (2)	1148.3 (2)
715	275-366	132	43.5 (2)	2448.0 (1)	569.0 (2)	463.0 (2)	307.5 (2)	1542.0 (2)	1476.5 (2)	9797.5 (2)	624.5 (2)	1976.0 (2)	1219.5 (4)
716	275-366	539	18.7 (3)	84.6 (5)	207.0 (4)	226.0 (3)	240.8 (5)	123.3 (4)	45.8 (5)	25.4 (5)	175.7 (3)	16.8 (4)	42.3 (4)
708	367-549	117	113.0 (2)	116.1 E	278.8 (2)	354.5 (2)	432.5 (2)	549.0 (2)	220.7 E	435.5 (2)	881.5 (2)	2179.0 (2)	7044.0 (2)
711	367-549	961	20.4 (5)	121.8 (8)	280.8 (9)	154.0 (7)	181.4 (7)	315.4 (7)	312.7 (3)	265.9 (8)	189.2 (10)	240.6 (5)	41.8 (5)
712	367-549	973	31.9 E	44.3 (6)	120.8 (9)	117.0 (4)	115.7 (7)	347.5 (8)	180.8 (5)	71.8 (8)	123.1 (10)	50.0 (7)	58.3 (7)
713	367-549	950	23.0 E	55.5 (8)	66.8 (5)	197.0 (4)	954.4 (7)	212.9 (8)	113.4 (7)	279.2 (8)	72.1 (10)	76.1 (8)	96.5 (6)
714	367-549	1195	40.0 E	69.0 (1)	89.4 (5)	66.3 (4)	488.3 (9)	394.9 (10)	301.3 (7)	236.4 (11)	285.1 (7)	170.3 (11)	127.2 (9)
709	550-731	96	4.5 (2)	1.5 E	0.0 (1)	14.3 (1)	6.8 E	12.5 (2)	3.3 E	18.0 (2)	1.7 E	33.0 (2)	4.4 (2)
710	550-731	36	1.0 (2)	8.0 (2)	78.0 (2)	2.5 E	114.5 (2)	3.7 E	3.1 E	11.0 (2)	34.0 (1)	18.4 (2)	0.0 (2)
Stratified Analysis:		Upper	238.3	225.8	282.5	1299.6	531.3	358.6	374.8	1658.2	217.5	282.0	698.3
		Mean	74.0	164.0	206.8	240.6	334.4	240.1	225.4	650.9	178.0	160.5	325.2
		Lower	-90.2	102.3	131.0	-818.5	137.6	121.7	76.0	-356.5	138.6	38.9	-48.0
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 Abundance (millions)		40.3	123.9	138.4	160.5	224.0	161.8	138.5	440.4	118.8	106.3	220.0

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
307	93-183	395	69.3 (2)	3.7 (3)	2.0 (3)	5.7 (3)	4.0 (4)	3.0 (3)	25.6 (3)	0.4 (3)	0.0 (2)	0.7 (4)	0.6 (3)
311	93-183	317	4.0 (2)	2.0 (4)	0.0 (3)	0.0 (3)	0.1 (4)	0.1 (3)	0.0 (3)	0.0 (3)	0.0 (2)	0.2 (3)	0.0 (2)
317	93-183	193	31.3 (2)	0.0 (2)	0.0 (2)	0.0 (3)	0.2 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)
319	93-183	984	2.9 (6)	0.0 (2)	1.5 (8)	1.2 (9)	13.8 (8)	1.0 (8)	4.4 E	0.3 (9)	0.1 (10)	0.0 (9)	0.2 (6)
306	185-274	419	3.5 (2)	37.0 (2)	39.7 (3)	24.6 (4)	190.8 (4)	10.3 (3)	212.5 (3)	32.6 (4)	1.7 (2)	17.5 (4)	107.2 (4)
309	185-274	296	12.3 (2)	85.3 (3)	69.3 (2)	127.0 (2)	86.2 (3)	69.0 (2)	44.8 (2)	235.3 (3)	2.2 (2)	2.8 (3)	191.3 (2)
310	185-274	170	4.8 (2)	95.8 (3)	43.0 (2)	4.0 (2)	46.2 (3)	16.3 (2)	2.8 (2)	132.8 (2)	0.9 (2)	3.1 (2)	50.1 (2)
313	185-274	165	3.5 (2)	89.5 (2)	93.8 (2)	20.3 (2)	31.0 (2)	25.0 (2)	1.9 (2)	42.3 (2)	21.1 (2)	1.5 (2)	25.4 (2)
316	185-274	189	9.8 (2)	12.8 (3)	10.5 (2)	40.5 (3)	24.3 (3)	4.9 (3)	2.7 (2)	8.0 (2)	25.2 (2)	0.0 (1)	11.3 (3)
318	185-274	123	21.3 (2)	27.0 E	149.8 (2)	671.0 (2)	13.0 (2)	105.8 (2)	48.7 E	14.2 (2)	7.4 (2)	7.1 (2)	169.3 (2)
705	275-366	195	13.5 (2)	29.5 (2)	90.5 (2)	102.3 (2)	65.0 (2)	11.0 (2)	5.5 (2)	4.6 (2)	34.3 (2)	6.8 (2)	91.3 (2)
706	275-366	476	8.5 (2)	60.1 (4)	45.9 (4)	35.1 (5)	114.4 (4)	23.9 (4)	10.8 (4)	24.7 (4)	10.8 (5)	7.6 (3)	7.7 (5)
707	275-366	93	96.8 (2)	43.5 E	61.5 (2)	69.5 (2)	153.3 (2)	108.3 (2)	78.1 E	93.3 (2)	321.0 (2)	185.6 (2)	271.8 (2)
715	275-366	132	22.0 (2)	1137.0 (1)	97.3 (2)	127.5 (2)	133.0 (2)	735.4 (2)	353.0 (2)	4253.5 (2)	105.0 (2)	935.8 (2)	184.8 (4)
716	275-366	539	10.1 (3)	27.5 (5)	71.6 (4)	147.5 (3)	100.1 (5)	52.9 (4)	17.1 (5)	8.3 (5)	17.4 (3)	3.5 (4)	14.5 (4)
708	367-549	117	40.5 (2)	50.1 E	73.3 (2)	101.8 (2)	156.0 (2)	228.0 (2)	89.9 E	70.7 (2)	338.3 (2)	322.6 (2)	1666.1 (2)
711	367-549	961	16.1 (5)	31.3 (8)	119.1 (9)	52.7 (7)	84.7 (7)	149.4 (7)	165.2 (3)	73.0 (8)	75.4 (10)	115.5 (5)	16.9 (5)
712	367-549	973	30.1 E	28.0 (6)	70.8 (9)	77.6 (4)	68.0 (7)	163.1 (8)	83.5 (5)	29.9 (8)	64.9 (10)	20.3 (7)	25.9 (7)
713	367-549	950	23.3 E	41.2 (8)	45.1 (5)	110.1 (4)	651.8 (7)	119.1 (8)	57.3 (7)	127.5 (8)	38.2 (10)	36.7 (8)	42.0 (6)
714	367-549	1195	38.8 E	31.0 (1)	58.6 (5)	48.4 (4)	312.9 (9)	204.1 (10)	160.5 (7)	104.6 (11)	138.3 (7)	78.1 (11)	57.6 (9)
709	550-731	96	1.8 (2)	1.1 E	0.0 (1)	5.7 (1)	5.4 E	6.3 (2)	2.4 E	4.7 (2)	0.8 E	19.7 (2)	2.2 (2)
710	550-731	36	0.5 (2)	5.3 (2)	53.5 (2)	3.7 E	68.6 (2)	4.6 E	4.2 E	4.7 (2)	16.7 (1)	10.9 (2)	0.0 (2)
Stratified Analysis:		Upper	75.3	38.7	72.1	116.6	301.0	245.8	133.4	915.7	65.4	256.4	223.8
		Mean	15.8	30.6	54.5	65.9	163.1	98.4	87.5	117.4	50.9	51.8	62.3
		Lower	-43.8	22.5	36.8	15.2	25.1	-49.0	41.6	-681.0	36.5	-152.9	-99.1
Multiplicative Analysis:		Mean	21.1	46.9	53.9	65.0	161.4	98.0	76.6	117.4	50.3	50.7	62.3
	Biomass (tons)		14304	31721	36472	44002	109193	66325	51820	79423	34006	34290	42180

3Ps Spring 1984-1993

Table 6. 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 1996-2000 surveys utilized a Campelen 1800 (0.75 n. mi. tows).

				Engel	Campelen				
			1994	1995	1996	1997	1998	1999	2000
Stratum	Depth range	Area	WT150-151	WT166-167	WT186-187	WT202-203	WT218-219	WT236-237	WT313-315
	M	(sq.n.mi.)	Apr 5-27	Apr 3-29	Apr10-May1	Apr 1 - 24	Apr 2- 23	Apr13-May6	Apr13-May6
297	093 - 183	152	---	---	---	6.5 (2)	9.0 (2)	48.3 (2)	241.5 (2)
307	093 - 183	395	25.0 (4)	2.2 (4)	331.3 (4)	73.3 (3)	19.0 (3)	677.9 (3)	191.3 (3)
311	093 - 183	317	5.0 (4)	1.3 (3)	2.7 (3)	13.5 (2)	14.2 (3)	335.3 (3)	48.0 (3)
317	093 - 183	193	0.0 (2)	0.0 (2)	2.0 (2)	0.0 (2)	13.0 (2)	34.0 (2)	251.5 (2)
319	093 - 183	984	0.0 (9)	16.0 (8)	180.9 (8)	10.9 (8)	4.9 (8)	405.0 (8)	688.0 (8)
295	185 - 274	209	---	---	---	2.5 (2)	6.8 (2)	0.0 (2)	0.0 (2)
298	185 - 274	171	---	---	---	140.3 (2)	93.8 (2)	30.2 (2)	575.2 (2)
300	185 - 274	217	---	---	---	23.6 (2)	292.5 (2)	73.5 (2)	329.4 (2)
306	185 - 274	419 (363)	132.5 (4)	2.3 (3)	212.0 (3)	368.0 (3)	207.0 (3)	588.4 (3)	749.8 (3)
309	185 - 274	296	333.7 (3)	31.3 (3)	227.0 (3)	57.9 (2)	469.3 (2)	619.4 (2)	444.1 (2)
310	185 - 274	170	492.0 (3)	8.5 (2)	74.5 (2)	161.0 (2)	158.5 (2)	235.7 (2)	471.4 (2)
313	185 - 274	165	155.5 (2)	57.0 (2)	80.4 (2)	44.0 (2)	184.9 (2)	126.0 (2)	142.0 (2)
316	185 - 274	189	22.5 (2)	18.5 (2)	313.5 (2)	205.0 (2)	134.0 (2)	122.9 (2)	623.5 (2)
318	185 - 274	129	0.0 (2)	2696.5 (2)	237.5 (2)	1050.0 (2)	647.0 (2)	421.4 (2)	238.1 (2)
296	275 - 366	71	---	---	---	8.0 (2)	2.7 (2)	0.9 (2)	0.0 (2)
299	275 - 366	212	---	---	---	205.8 (2)	21.2 (2)	21.5 (2)	64.9 (2)
705	275 - 366	195	87.7 (3)	6546.0 (2)	99.5 (2)	9.0 (2)	49.2 (2)	18.2 (2)	38.0 (2)
706	275 - 366	476	79.3 (4)	138.0 (4)	232.7 (3)	68.1 (3)	46.5 (4)	71.9 (4)	130.7 (4)
707	275 - 366	74	2615.5 (2)	1100.0 (2)	983.3 (2)	1724.4 (2)	812.0 (2)	684.9 (2)	2634.0 (2)
715	275 - 366	132 (128)	328.3 (4)	852.5 (2)	76.3 (2)	154.1 (2)	441.4 (2)	80.5 (2)	118.2 (2)
716	275 - 366	539	79.4 (5)	18.4 (5)	42.3 (5)	15.5 (4)	109.5 (4)	189.7 (4)	328.5 (4)
708	367 - 549	126	5878.5 (2)	853.5 (2)	2718.5 (2)	33.7 (2)	199.7 (3)	1135.9 (2)	361.8 (2)
711	367 - 549	961 (593)	52.5 (6)	183.4 (5)	84.1 (4)	71.7 (5)	22.5 (5)	27.6 (5)	110.9 (5)
712	367 - 549	973 (731)	134.9 (7)	153.1 (7)	143.7 (6)	72.0 (5)	112.5 (6)	48.2 (6)	50.3 (5)
713	367 - 549	950 (851)	148.0 (7)	187.6 (8)	139.5 (7)	176.6 (6)	68.5 (7)	321.0 (7)	136.8 (6)
714	367 - 549	1195 (1074)	121.8 (8)	203.5 (10)	141.1 (9)	138.0 (7)	122.8 (9)	89.1 (9)	84.1 (9)
709	550 - 731	158 (147)	59.3 (2)	17.0 (2)	3.0 (2)	---	5.0 (2)	0.0 (2)	18.0 (2)
710	732 - 914	176 (156)	0.0 (2)	---	---	---	---	10.8 (2)	---
Stratified Analysis:		Upper	500.0	2343.3	758.8	177.6	190.9	320.0	405.1
		Mean	198.8	325.0	193.5	118.2	109.7	226.7	273.4
		Lower	-102.4	-1693.2	-371.9	58.7	28.4	133.5	141.7
Total Abundance (millions)			137.5	197.8	216.0	146.7	138.3	290.8	344.8

			1994	1995	1996	1997	1998	1999	2000
Stratum	Depth range	Area	WT150-151	WT166-167	WT186-187	WT202-203	WT218-219	WT236-237	WT313-315
	M	(sq.n.mi.)	Apr 5-27	Apr 3-29	Apr10-May1	Apr 1 - 24	Apr 2- 23	Apr13-May6	Apr13-May6
297	093 - 183	152	---	---	---	0.7 (2)	0.3 (2)	1.4 (2)	2.4 (2)
307	093 - 183	395	1.9 (4)	0.5 (4)	3.8 (4)	1.7 (3)	0.3 (3)	33.5 (3)	5.6 (3)
311	093 - 183	317	0.5 (4)	0.1 (3)	0.2 (3)	0.5 (2)	0.2 (3)	9.0 (3)	0.5 (3)
317	093 - 183	193	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	1.2 (2)	0.5 (2)	2.0 (2)
319	093 - 183	984	0.0 (9)	2.0 (8)	21.5 (8)	0.5 (8)	1.1 (8)	46.8 (8)	22.7 (8)
295	185 - 274	209	---	---	---	0.9 (2)	2.5 (2)	0.0 (2)	0.0 (2)
298	185 - 274	171	---	---	---	22.7 (2)	10.6 (2)	4.9 (2)	84.5 (2)
300	185 - 274	217	---	---	---	2.1 (2)	158.0 (2)	16.4 (2)	24.7 (2)
306	185 - 274	419 (363)	11.5 (4)	0.5 (3)	2.6 (3)	7.0 (3)	6.9 (3)	45.1 (3)	26.7 (3)
309	185 - 274	296	56.5 (3)	4.7 (3)	21.0 (3)	4.6 (2)	23.0 (2)	85.6 (2)	31.4 (2)
310	185 - 274	170	38.6 (3)	2.3 (2)	5.4 (2)	9.4 (2)	6.7 (2)	11.2 (2)	20.4 (2)
313	185 - 274	165	11.2 (2)	5.1 (2)	6.4 (2)	3.8 (2)	9.7 (2)	28.0 (2)	8.7 (2)
316	185 - 274	189	1.8 (2)	1.2 (2)	27.6 (2)	13.4 (2)	9.1 (2)	12.4 (2)	41.4 (2)
318	185 - 274	129	0.0 (2)	623.0 (2)	26.9 (2)	142.3 (2)	62.9 (2)	90.4 (2)	29.2 (2)
296	275 - 366	71	---	---	---	1.8 (2)	1.2 (2)	0.4 (2)	0.0 (2)
299	275 - 366	212	---	---	---	21.4 (2)	10.8 (2)	10.9 (2)	29.8 (2)
705	275 - 366	195	16.3 (3)	3356.8 (2)	14.8 (2)	1.5 (2)	11.4 (2)	5.7 (2)	10.7 (2)
706	275 - 366	476	21.5 (4)	30.4 (4)	34.6 (3)	20.8 (3)	8.4 (4)	18.6 (4)	25.9 (4)
707	275 - 366	74	777.4 (2)	151.2 (2)	240.1 (2)	226.7 (2)	128.8 (2)	126.3 (2)	595.7 (2)
715	275 - 366	132 (128)	74.1 (4)	404.0 (2)	12.0 (2)	14.1 (2)	59.3 (2)	19.9 (2)	19.0 (2)
716	275 - 366	539	10.2 (5)	9.2 (5)	9.1 (5)	2.6 (4)	8.7 (4)	93.1 (4)	69.6 (4)
708	367 - 549	126	1036.1 (2)	351.1 (2)	781.6 (2)	7.8 (2)	42.9 (3)	371.4 (2)	145.6 (2)
711	367 - 549	961 (593)	18.6 (6)	84.9 (5)	32.3 (4)	20.4 (5)	10.0 (5)	13.0 (5)	51.1 (5)
712	367 - 549	973 (731)	58.7 (7)	71.0 (7)	72.0 (6)	36.7 (5)	56.1 (6)	25.7 (6)	27.0 (5)
713	367 - 549	950 (851)	64.3 (7)	89.8 (8)	66.3 (7)	88.6 (6)	34.5 (7)	173.9 (7)	74.5 (6)
714	367 - 549	1195 (1074)	52.4 (8)	89.0 (10)	68.2 (9)	70.1 (7)	64.6 (9)	50.7 (9)	47.4 (9)
709	550 - 731	158 (147)	38.9 (2)	3.3 (2)	1.0 (2)	---	2.6 (2)	0.0 (2)	8.5 (2)
710	732 - 914	176 (156)	0.0 (2)	---	---	---	---	2.4 (2)	---
Stratified Analysis:		Upper	83.9	1174.2	204.1	37.7	46.2	85.2	57.4
		Mean	49.2	141.7	47.2	28.6	26.4	51.4	40.3
		Lower	14.4	-890.9	-109.6	19.6	6.6	17.7	23.3
Biomass (tons)			33994	86210	52853	35547	33280	65948	50827

3Ps Spring 1994-2000

Table 7. Mean number (upper Panel) and weight (kg, lower panel) of redfish caught per standard tow in Division 4VW from 1973-1986 DFO summer surveys conducted by Maritimes Region. Estimates of survey abundance and biomass include strata with only one set (shaded cells).

Stratum	Depth (m)	Area	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
440	184 - 366	924	108.4	375.9	101.7	120.9	44.4	139.5	557.1	127.4	154.8	378.0	198.1	222.5	160.3	313.4
445	184 - 366	1023	181.7	61.3	175.3	104.0	74.1	17.1	25.1	42.3	172.9	174.7	57.7	192.7	222.7	98.2
446	184 - 366	491	443.0	674.4	554.6	992.5	166.4	802.6	389.8	971.9	243.8	608.6	1003.0	920.6	1727.2	1886.0
451	184 - 366	147	0.0	9.7	19.4	1.1	37.8	1826.0	149.7	114.2	61.3	124.2	55.0	724.2	1410.9	27.7
452	184 - 366	345	112.0	8.9	17.2	14.0	1691.2	14.1	4.6	1.9	3.1	95.6	49.4	100.5	135.9	926.1
453	184 - 366	259	232.6	120.2	164.1	3.4	3.4	15.9	15.4	22.5	6.4	17.8	1354.9	128.7	0.0	10.0
441	93 - 183	1000	36.7	13.3	0.6	0.0	6.5	0.0	1.6	0.3	16.6	135.7	23.9	13.4	104.0	84.2
444	93 - 183	3925	53.6	50.8	20.3	97.2	8.1	160.2	0.7	3.6	2.7	24.9	24.9	3.5	124.3	92.9
449	93 - 183	144	42.1	0.8	0.0	0.6	0.0	0.0	0.6	2.9	0.0	1.9	0.0	209.5	12.2	0.0
450	93 - 183	383	0.0	0.0	0.0	0.6	1.1	88.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.3
454	93 - 183	499	0.0	0.0	7.6	0.8	0.0	17.9	0.4	0.0	0.0	0.9	0.0	0.0	0.0	0.7
457	93 - 183	811	18.0	21.6	0.0	1.0	473.5	68.9	2.7	0.4	0.0	4.4	1.0	9527.2	239.5	243.3
Stratified Analysis:		+ 2 SE	137.0	160.5	104.3	253.1	241.7	306.5	108.5	116.2	85.1	165.9	206.1	1238.5	349.8	411.7
		Mean	87.5	101.2	68.4	124.6	121.7	157.6	77.0	68.0	48.1	114.2	123.9	885.7	227.7	230.0
		- 2 SE	38.0	41.9	32.6	-3.8	1.7	8.6	45.5	19.8	11.1	62.5	41.7	532.8	105.7	48.3
Survey ABUNDANCE (millions):			73.7	85.3	57.7	92.7	102.6	130.9	64.9	57.3	40.5	94.9	104.5	746.9	192.0	193.9

Stratum	Depth (m)	Area	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
440	184 - 366	924	40.6	162.8	74.0	85.4	29.5	116.7	329.4	59.3	73.5	127.6	67.6	107.9	58.4	146.1
445	184 - 366	1023	50.6	15.6	46.6	34.0	16.4	6.9	2.6	14.4	52.5	93.6	17.5	102.6	85.3	57.7
446	184 - 366	491	170.8	185.3	118.6	326.0	73.9	180.6	167.4	253.8	85.0	264.1	162.9	83.3	298.1	362.8
451	184 - 366	147	0.0	2.3	2.6	0.0	9.8	825.4	42.8	36.0	21.0	4.5	14.5	141.2	462.9	12.5
452	184 - 366	345	39.0	1.9	3.3	5.3	854.2	5.4	0.5	0.0	1.5	15.1	7.0	17.6	15.4	230.4
453	184 - 366	259	80.9	46.9	69.6	0.0	0.3	2.0	1.5	9.3	0.3	0.7	47.7	11.0	0.0	0.3
441	93 - 183	1000	8.6	1.1	0.0	0.0	0.7	5.0	0.3	0.0	2.9	8.2	0.3	0.6	15.0	11.5
444	93 - 183	3925	14.7	29.7	8.7	48.1	2.0	71.8	0.0	1.8	1.4	9.9	9.1	2.0	79.6	37.3
449	93 - 183	144	21.1	0.4	0.0	0.0	0.0	0.0	0.0	1.9	0.0	1.9	0.0	165.3	5.4	0.0
450	93 - 183	383	0.0	0.0	0.0	0.0	0.4	54.4	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
454	93 - 183	499	0.0	0.0	1.7	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
457	93 - 183	811	9.4	4.8	0.0	0.0	129.9	21.9	0.6	0.0	0.0	0.0	0.0	506.5	24.1	102.1
Stratified Analysis:		+ 2 SE	42.5	65.5	31.2	106.7	110.4	130.7	56.0	33.2	30.5	65.8	29.8	102.6	126.4	114.2
		Mean	28.6	39.4	23.0	54.2	49.3	66.6	39.9	21.0	17.6	40.4	21.4	72.2	71.2	69.8
		- 2 SE	14.7	13.4	14.8	1.7	-11.8	2.6	23.8	8.8	4.7	15.0	13.1	41.8	16.0	25.3
Survey BIOMASS (tons):			24106	33238	19391	39336	41583	55381	33623	17709	14865	33605	18070	60874	60060	58843

4VW Summer Survey 1973-1986

Table 8. Mean number (upper Panel) and weight (kg, lower panel) of redfish caught per standard tow in Division 4VW from 1987-2000 DFO summer surveys conducted by Maritimes Region. Estimates of survey abundance and biomass include strata with only one set (shaded cells).

Stratum	Depth (m)	Area	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
440	184 - 366	924	218.5	1075.0	1972.1	1018.4	925.7	176.2	312.7	259.5	1055.3	842.5	6.2	333.3	242.7	186.8
445	184 - 366	1023	510.3	128.8	88.2	33.2	38.1	9.0	372.7	13.7	69.8	7.6	0.0	87.7	7.4	4.2
446	184 - 366	491	362.6	1378.0	3598.7	2787.8	7891.8	5979.8	456.0	1338.3	354.2	847.6	942.6	199.0	395.7	396.6
451	184 - 366	147	52.8	2661.3	3946.3	91.8	334.6	45.8	4709.4	6.5	1126.4	46.7	3.6	457.2	10996.9	10.0
452	184 - 366	345	408.0	2756.1	12750.8	2789.1	3209.5	4412.5	1832.8	48.0	522.7	45.6	18.5	30.0	147.7	12.0
453	184 - 366	259	27.8	752.8	9.8	17.2	1130.4	127.9	8.6	1.5	15.6	22.1	22.0	97.5	100.9	171.3
441	93 - 183	1000	72.8	50.1	10.6	55.7	31.1	53.9	63.5	45.7	24.3	13.8	9.7	24.3	16.4	48.4
444	93 - 183	3925	9.7	0.5	11.5	7.9	6.4	4.5	132.6	24.7	1.1	5.9	10.1	11.9	0.2	23.4
449	93 - 183	144	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	1.6	0.0	1.9	0.0	242.4	0.0
450	93 - 183	383	32.9	0.0	3786.4	0.7	0.0	19.4	1.7	0.0	0.3	9.6	4.1	0.0	0.0	2.3
454	93 - 183	499	3.8	0.0	0.0	0.0	0.0	0.0	2.0	0.5	1.0	2.3	7.4	4.0	0.0	1.0
457	93 - 183	811	199.9	31.7	0.0	58.3	954.8	0.5	18.3	1.9	6.8	15.6	7.3	3.9	0.0	0.0
Stratified Analysis:		+ 2 SE	240.2	566.2	1927.9	543.2	1250.8	1115.4	462.4	198.6	276.4	191.8	185.2	90.3	590.9	76.2
		Mean	135.2	343.3	1021.7	347.5	708.4	477.3	283.5	107.9	161.3	129.1	125.7	67.8	237.6	56.6
		- 2 SE	30.2	120.4	115.5	151.8	166.0	-160.8	104.6	17.2	46.3	66.5	66.3	45.2	-115.6	37.0
Survey ABUNDANCE (millions):			114.0	289.5	861.6	293.0	597.4	402.5	239.1	91.0	136.0	108.9	93.6	57.2	184.1	47.7

Stratum	Depth (m)	Area	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
440	184 - 366	924	116.7	299.6	628.7	319.1	326.8	67.3	139.5	75.4	394.0	362.8	307.0	161.5	132.9	99.28
445	184 - 366	1023	313.5	56.8	13.6	8.8	7.8	1.0	95.5	1.2	20.8	1.8	0.0	59.3	1.5	0.78
446	184 - 366	491	113.8	371.9	922.0	257.4	1025.0	686.8	188.5	242.3	161.0	344.1	407.7	100.7	159.3	149.25
451	184 - 366	147	2.1	753.4	904.4	1.6	138.5	3.6	969.3	0.5	117.3	3.1	0.5	81.3	1496.0	0.68
452	184 - 366	345	18.5	119.1	579.6	185.1	268.2	524.9	119.9	3.1	244.1	2.8	0.7	2.6	8.2	1.2
453	184 - 366	259	1.0	449.7	0.5	1.0	53.1	8.8	0.0	0.0	1.8	1.6	0.2	6.1	8.1	12.57
441	93 - 183	1000	20.5	4.1	0.5	5.1	2.5	15.0	16.0	8.1	2.3	1.0	0.4	6.7	3.9	6.22
444	93 - 183	3925	1.9	0.0	5.5	1.6	0.3	0.3	10.7	2.8	0.3	0.3	3.4	0.2	0.0	1.11
449	93 - 183	144	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	1.2	0.0	61.3	0
450	93 - 183	383	7.2	0.0	230.0	0.0	0.0	2.3	0.0	0.0	0.0	2.6	0.1	0.0	0.0	0.22
454	93 - 183	499	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0
457	93 - 183	811	4.1	1.1	0.0	2.4	25.2	0.0	0.5	0.0	0.1	1.3	0.1	0.1	0.0	0
Stratified Analysis:		+ 2 SE	116.7	120.6	218.2	77.1	169.5	129.7	84.4	31.3	96.5	81.3	84.0	40.6	97.5	25.09
		Mean	52.8	79.5	149.8	51.0	96.9	60.4	56.4	21.1	57.3	51.5	56.7	28.3	48.2	18.11
		- 2 SE	-11.1	38.4	81.4	24.9	24.2	-8.8	28.4	10.9	18.0	21.7	29.3	15.9	-1.2	11.13
Survey BIOMASS (tons):			44514	67017	126325	43035	81669	50954	47578	17817	48290	43420	42205	23833	37300	15274

4VW Summer Survey 1987-2000

Table 9. Mean number (upper Panel) and weight (kg, lower panel) of redfish caught per standard tow in Division 4VW from 1986-2000 DFO cod directed spring surveys Estimates of survey abundance and biomass include strata with only one set (shaded cells).

Stratum	Depth (m)	Area sq. n. mi.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
409	0 - 092	1500	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Y		0.0
408	0 - 183	3184	14.2	0.0	0.0	1.1	1.9	607.5	18.1	0.0	0.2	0.2	184.2	2.1	N	1.2	0.0
410	0 - 183	2936	0.0	0.1	0.0	0.1	0.3	3.6	4.7	0.0	0.4	5.3	2.8	0.0	O	3.9	0.8
401	0 - 274	2782	0.1	3.2	0.0	-	3.1	4.8	2.9	0.2	0.3	1.4	1.0	0.9		0.3	2.6
403	0 - 274	3401	0.9	.0	119.2	18.5	0.0	3.1	54.2	3.4	0.0	0.0	0.0	1.0	S	6.9	0.0
406	0 - 274	4650	4.6	497.2	2.5	18.9	11.7	5.7	7.9	1.4	6.7	0.1	0.3	0.6	U	0.1	7.6
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	0.1	R	0.3	2.2
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	21.4	V	5.6	7.6
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	12.3	E	10.9	10.2
404	183 - 366	150	812.2	11.7	0.0	37.1	9075.3	349.7	0.0	151.4	17.2	2878.6	4779.1	318.6		1268.6	731.4
411	185 - 366	379	0.0	2.1	13.9	20.2	65.4	0.9	0.0	7.8	0.0	9.8	-	0.9		31.9	180.1
397	368 - 458	540	-	-	-	-	-	-	-	80.4	90.7	15.7	171.0	481.9		351.0	358.1
398	368 - 458	833	-	-	-	-	-	-	-	833.6	235.1	114.4	17.4	250.9		197.1	343.7
399	368 - 458	465	-	-	-	-	-	-	-	109.2	-	183.4	1008.1	158.0		229.0	322.6
400	368 - 458	270	-	-	-	-	-	-	-	250.1	-	50.5	258.4	66.0		65.8	119.0
Stratified Analysis:		+ 2 SE	8.0	296.4	58.6	241.0	10.9	240.5	40.8	55.6	74.2	56.5	151.3	35.7		41.6	46.9
		Mean	4.3	150.8	22.5	88.4	6.8	86.4	20.9	35.5	32.3	29.6	86.4	26.3		28.0	34.4
		- 2 SE	0.7	5.3	-13.6	-64.2	2.6	-67.8	1.0	16.3	-9.7	2.6	21.5	17.0		14.5	22.0
Survey ABUNDANCE (millions):			19.1	312.6	41.3	163.4	129.4	180.0	42.7	80.4	71.0	66.9	192.7	59.6		63.4	77.9

Stratum	Depth (m)	Area sq. n. mi.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
409	0 - 092	1500	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Y		0.0
408	0 - 183	3184	2.0	0.0	0.0	0.8	0.2	29.0	13.5	0.0	0.0	0.0	15.4	0.1	N	0.0	0.0
410	0 - 183	2936	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.4	0.0	O	0.1	0.0
401	0 - 274	2782	0.0	0.3	0.0	-	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1		0.1	0.1
403	0 - 274	3401	0.1	0.0	2.3	0.9	0.0	0.0	2.1	0.4	.0	.0	0.0	0.1	S	0.1	0.0
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	0.0	U	0.0	0.2
407	0 - 274	1763	0.9	2.3	0.3	0.7	0.3	0.5	0.1	0.0	0.0	0.0	0.0	0.0	R	0.0	0.1
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	2.9	V	0.5	1.0
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	1.1	E	0.9	0.5
404	183 - 366	150	403.5	1.9	0.0	1.5	613.5	142.0	0.0	19.0	2.4	431.5	1174.9	59.7		430.6	155.7
411	185 - 366	379	0.0	0.0	1.0	0.5	3.6	0.0	0.0	1.0	0.0	0.8		0.2		1.5	14.7
397	368 - 458	540	-	-	-	-	-	-	-	35.4	38.5	5.4	83.4	242.3		226.5	204.6
398	368 - 458	833	-	-	-	-	-	-	-	294.3	82.2	44.8	5.8	124.2		113.3	187.8
399	368 - 458	465	-	-	-	-	-	-	-	37.4	-	40.4	523.0	78.5		124.7	186.5
400	368 - 458	270	-	-	-	-	-	-	-	119.3	-	19.5	124.5	34.5		37.3	69.7
Stratified Analysis:		+ 2 SE	2.0	70.0	2.5	15.7	0.5	12.5	7.5	18.5	11.0	9.2	43.8	15.5		19.1	20.7
		Mean	1.0	29.8	1.3	6.2	0.4	5.1	3.5	12.3	5.6	5.5	23.7	11.3		13.2	15.2
		- 2 SE	0.1	-10.5	0.2	-3.2	0.2	-2.3	-0.5	6.0	0.2	1.9	3.7	7.0		7.3	9.7
Survey BIOMASS:			7232	61671	2410	11530	8562	10600	7156	27349	12357	12511	52946	25459		29901	34430

4VWCOD Spring Survey

Table 10. Mean weight (kg) of redfish caught per standard tow (0.75 n. mi.) from DFO research surveys to UNIT2 from 1994-1997 and 2000. (Numbers in brackets are successful sets, "-" indicates unsampled strata).

STRATUM	Depth Range (m)	Area sq. n. mi.	1994	1995	1996	1997	2000
3Pn							
303	185-274	554	63.34 (5)	43.47 (5)	14.65 (4)	48.45 (4)	83.075 (4)
304	275-366	151	463.55 (2)	234.44 (2)	105.18 (2)	303.36 (2)	284.922 (2)
305	367+	733	45.61 (5)	75.95 (6)	46 (6)	42.97 (6)	37.238 (4)
Stratified Analysis:		Upper	694.89	171.34	64.72	99.07	365.16
		Mean	96.33	80.08	40.14	72.42	80.91
		Lower	-502.23	-11.18	15.55	45.77	-203.35
Survey Biomass (metric tons):			19055	15841	7939	14326	16004
Biomass (metric tons) with large set in 2000 survey							580735
3Ps							
295	185-274	209	-	-	-		0.725 (2)
298	185-274	171	-	-	-		97.4 (2)
300	185-274	217	-	-	-		132.175 (2)
306	185-274	363	45.37 (3)	14.5 (3)	15.57 (3)	23.23 (2)	50.725 (2)
309	185-274	296	146.39 (3)	191.88 (2)	120.2 (2)	75.80 (2)	98.308 (2)
310	185-274	170	136.2 (2)	12.7 (2)	40.95 (2)	185.45 (2)	43.95 (2)
313	185-274	165	18.01 (2)	124.95 (2)	100.55 (2)	116.06 (2)	16.275 (2)
316	185-274	189	136.11 (2)	162.04 (2)	336.98 (2)	89.03 (2)	82.125 (2)
318	185-274	129	270.81 (2)	303.17 (2)	350.96 (2)	836.44 (2)	81.875 (2)
299	275-366	212	-	-	-	-	133.1 (2)
705	275-366	195	229.86 (2)	45.25 (2)	86.1 (2)	58.40 (2)	40.847 (2)
706	275-366	476	296.88 (3)	88.19 (4)	94.62 (3)	81.43 (3)	249.772 (3)
707	275-366	74	1008.71 (2)	356.33 (2)	560.66 (2)	662.28 (2)	542.932 (2)
715	275-366	128	127.28 (2)	63.03 (2)	161.13 (2)	115.57 (2)	49.1 (2)
716	275-366	539	79.08 (5)	67.41 (4)	140.7 (4)	76.06 (4)	84.293 (4)
708	367-549	126	550.85 (2)	233.98 (2)	89.36 (3)	168.53 (2)	1205.29 (2)
711	367-549	593	173.65 (4)	138.73 (5)	91.02 (4)	82.08 (4)	78.235 (4)
712	367-549	731	99.97 (6)	56.58 (6)	165.72 (5)	55.98 (5)	191.906 (5)
713	367-549	851	38.15 (6)	161.09 (7)	213.64 (6)	64.12 (6)	45.838 (6)
714	367-549	1047	78.86 (9)	92.97 (9)	36.13 (8)	45.99 (7)	61.557 (7)
709	550-731	147	0.19 (2)	6.8 (2)	15.78 (2)	29.27 (2)	5.267 (2)
710	732-914	156	0 (2)	1.13 (2)	0 (2)	-	-
Stratified Analysis:		Upper	173.06	140.77	190.2	131.51	189.4
		Mean	129.7	104.29	122.64	93.11	116.53
		Lower	86.34	67.81	55.09	54.71	43.66
Survey Biomass (metric tons):			113737	91457	107551	79656	112661
Biomass of strata 295-300							10139
4Vn							
417	185-274	387	300.25 (3)	56.16 (4)	122.59 (3)	147.71 (3)	105.4 (3)
416	275-366	671	264.84 (6)	103.88 (6)	78.35 (6)	114.49 (6)	85.885 (4)
415	367+	2915	113.49 (26)	65.38 (24)	80.2 (24)	92.26 (25)	64.229 (19)
Stratified Analysis:		Upper	225.44	85.64	125.44	164.16	84.9
		Mean	157.24	70.98	84.02	101.42	71.9
		Lower	89.04	56.32	42.6	38.38	58.89
Survey Biomass (metric tons):			85937	38793	45919	55428	39294
4Vs							
446	275-366	313	102.51 (2)	606.82 (3)	53.13 (2)	71.65 (2)	9.975 (2)
451	275-366	147	212.8 (2)	109 (2)	-	723.85 (2)	1501.68 (2)
452	275-366	345	1.08 (2)	1.98 (3)	3.9 (3)	7.82 (3)	18.4 (2)
397	367-549	540	77.42 (4)	104.93 (5)	57.9 (4)	49.54 (4)	98.978 (4)
398	367-549	833	169.34 (6)	137.89 (8)	112.29 (7)	62.82 (7)	146.527 (5)
399	367-549	465	66.27 (4)	227.87 (4)	217.99 (4)	79.25 (4)	74.85 (3)
400	367-549	270	56.27 (2)	105.13 (2)	485.83 (2)	546.60 (2)	189.367 (2)
468	367-549	148	-	467.18 (2)	-	1421.65 (2)	1117.396 (2)
Stratified Analysis:		Upper	145.83	403.22	675.96	449.93	1162.77
		Mean	100.45	190.02	135.69	197.79	214.65
		Lower	55.07	-23.18	-404.58	-54.34	-733.48
Survey Biomass (metric tons):			40252	79531	51630	83286	90382
TOTAL SURVEY BIOMASS:			258981	225622	213039	232696	258341

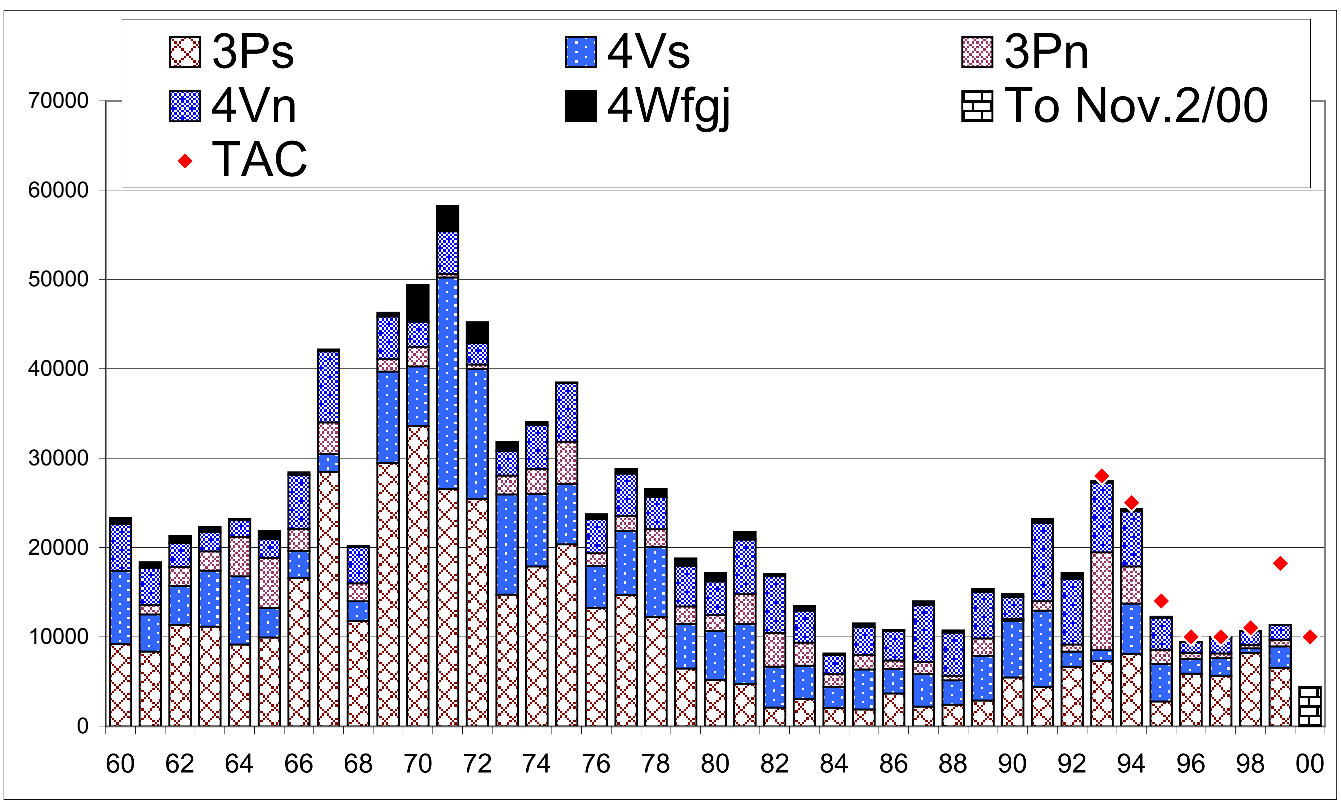


Fig. 1. Nominal catch of redfish from UNIT2 management unit (3Pn4Vn[Jan-May], 3Ps4Vs4Wfgj) from 1960-2000 (provisional to Nov. 2)

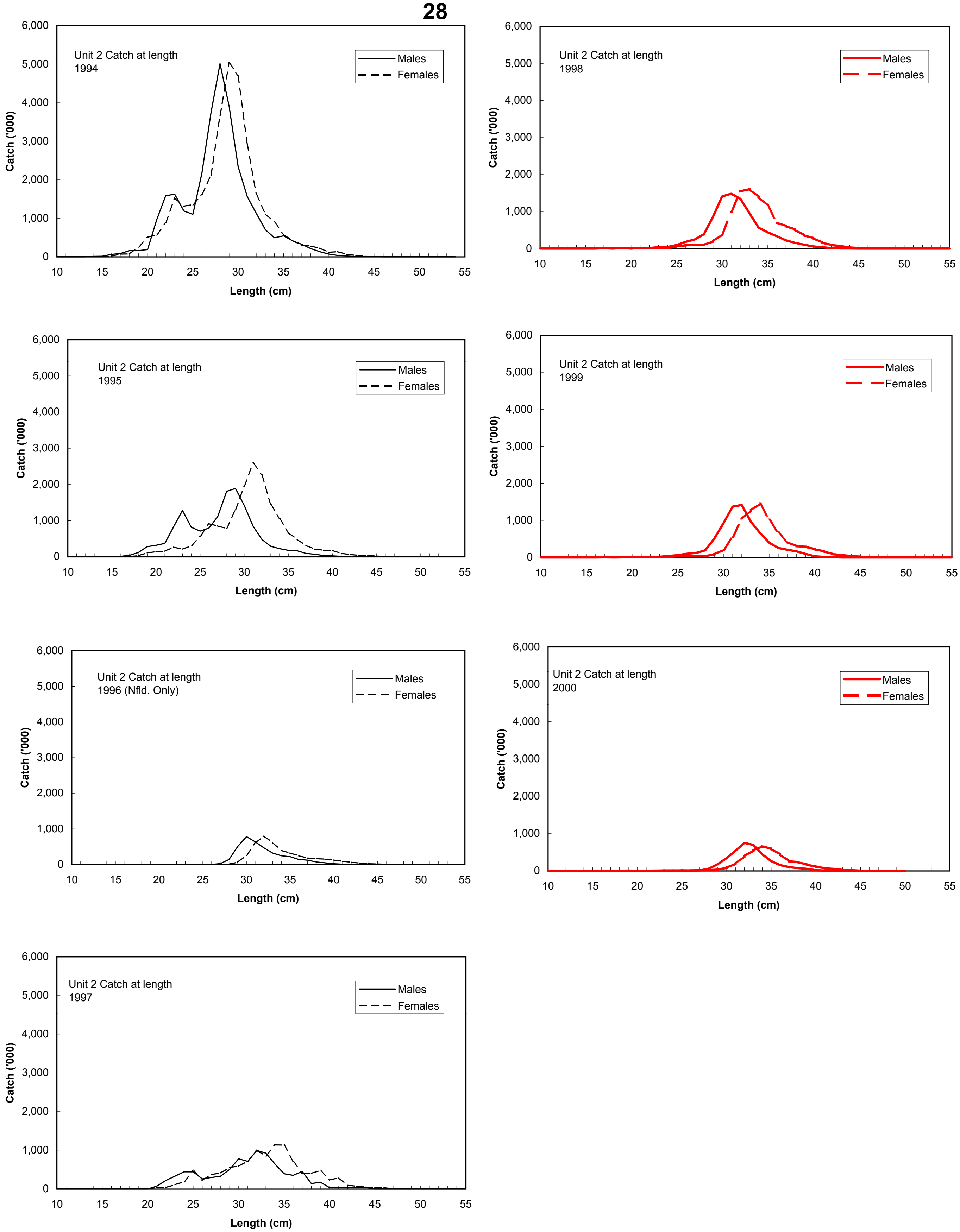


Fig. 2. Commercial catch-at-length of Unit 2 redfish estimated by available port samples adjusted to landings by fleet, gear and month.

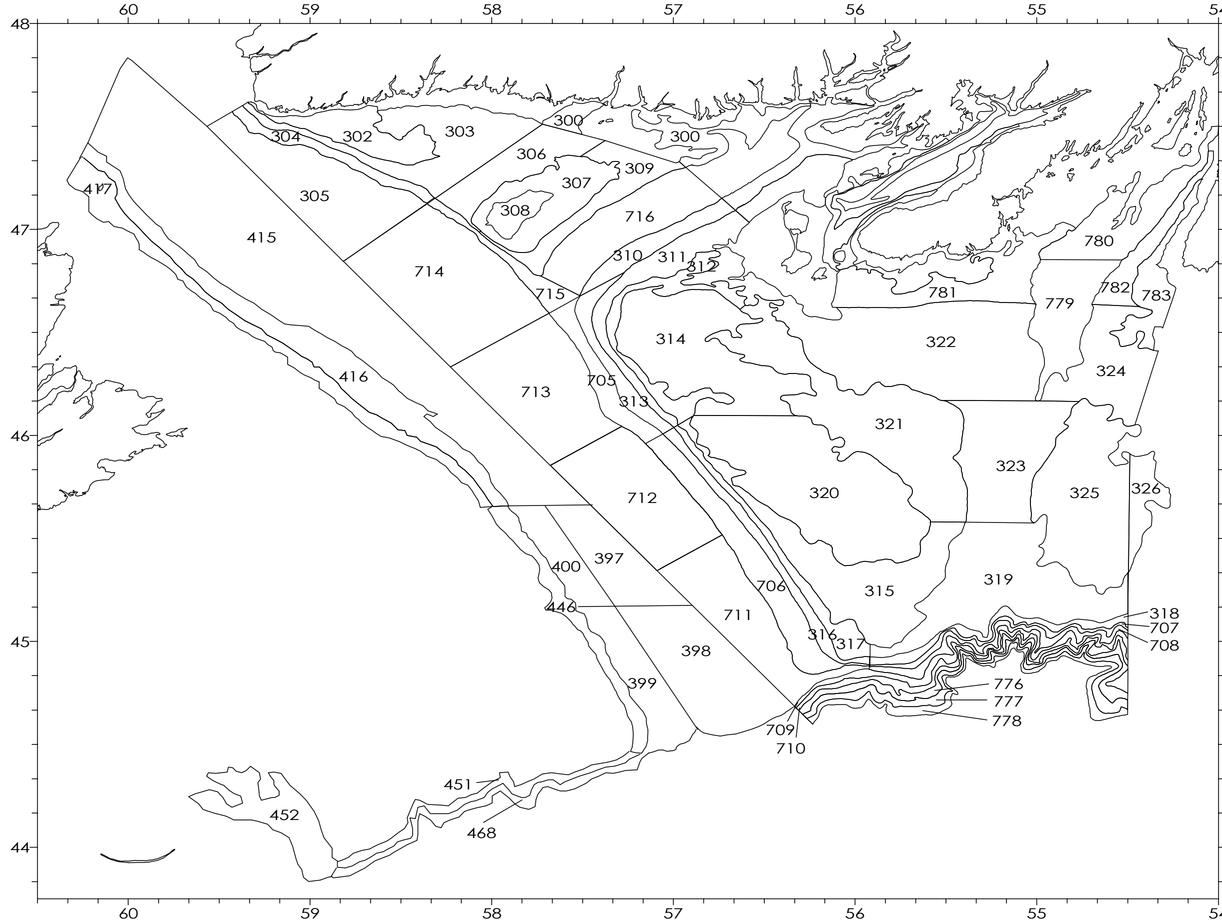


Fig. 3. Stratification chart for RV surveys conducted in Unit 2.

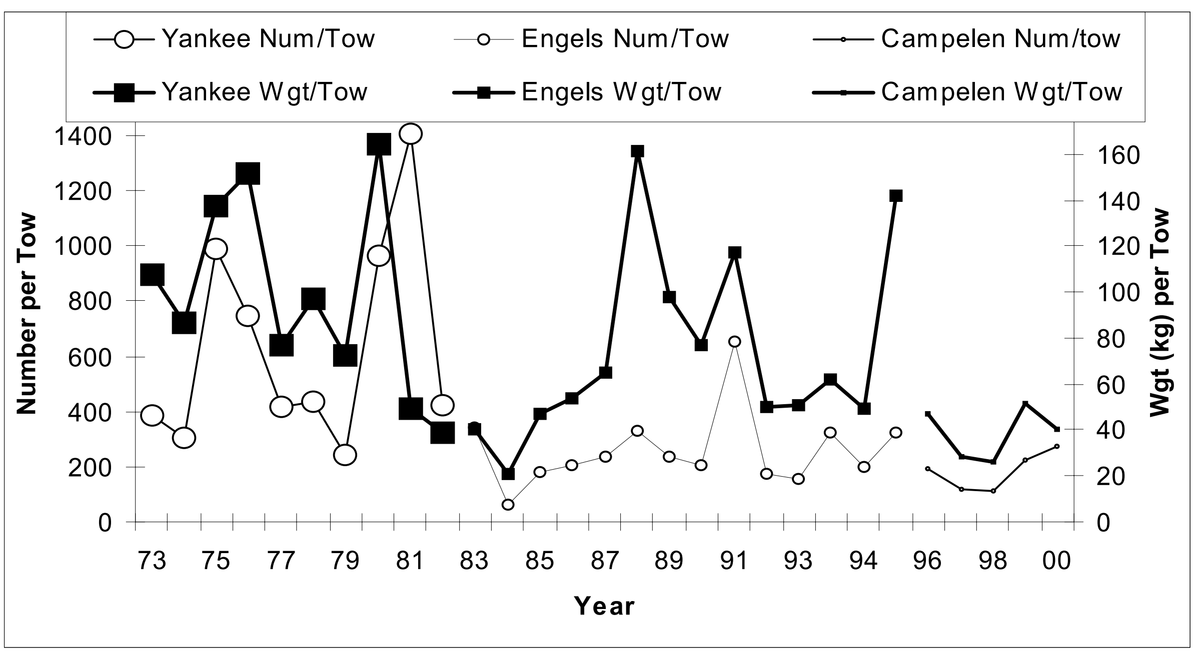


Fig. 4. RV mean number and weight (kg) per standard tow for 3Ps winter/spring surveys. There were various trawls and standard tows used over the years: 1978-1982 (Yankee 41-5), 1983-1995 (Engels 145), 1996-present (Campelen 1800).

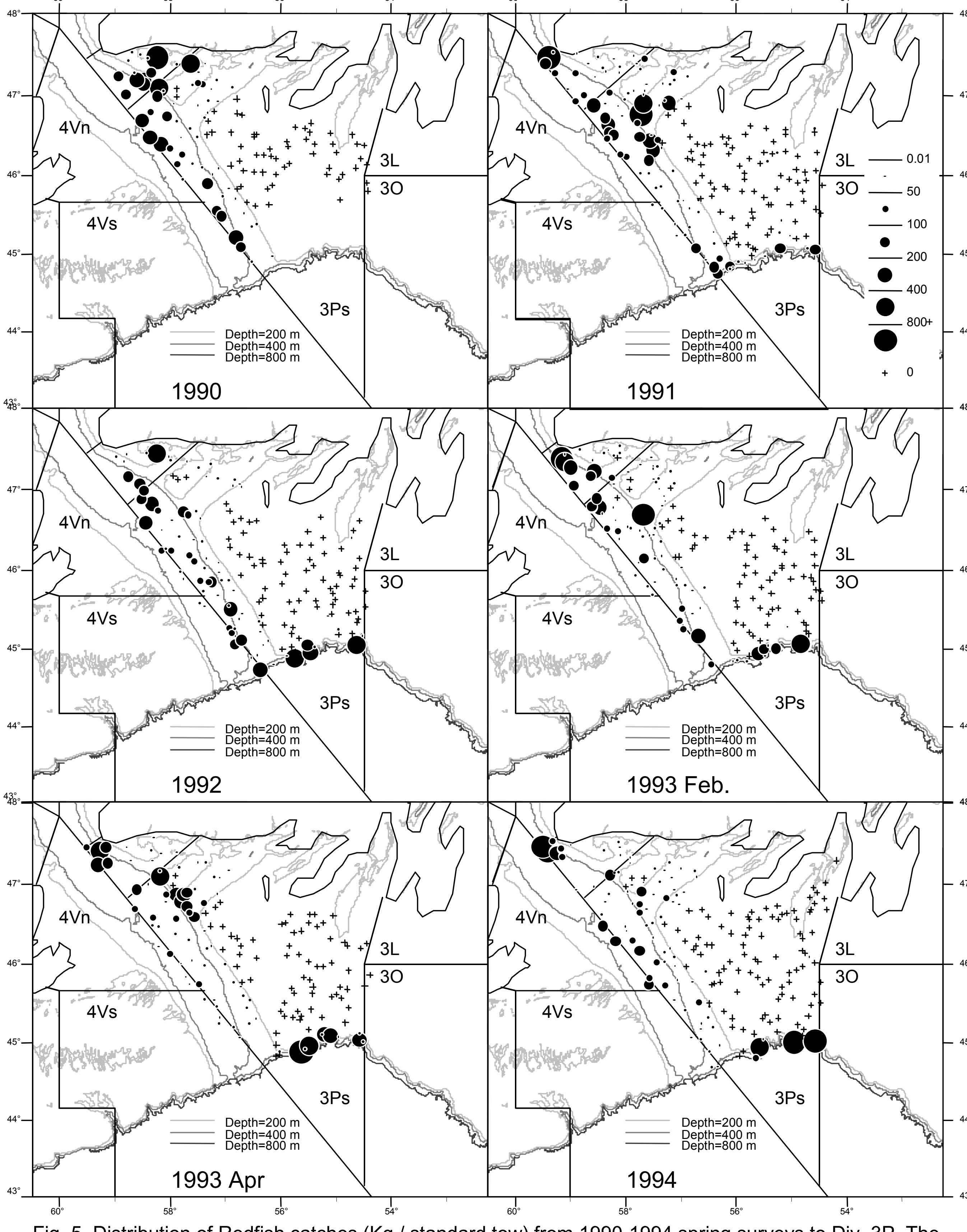


Fig. 5. Distribution of Redfish catches (Kg./ standard tow) from 1990-1994 spring surveys to Div. 3P. The utilized an Engels 145 trawl (1.75 n. mi.

red9094.acn

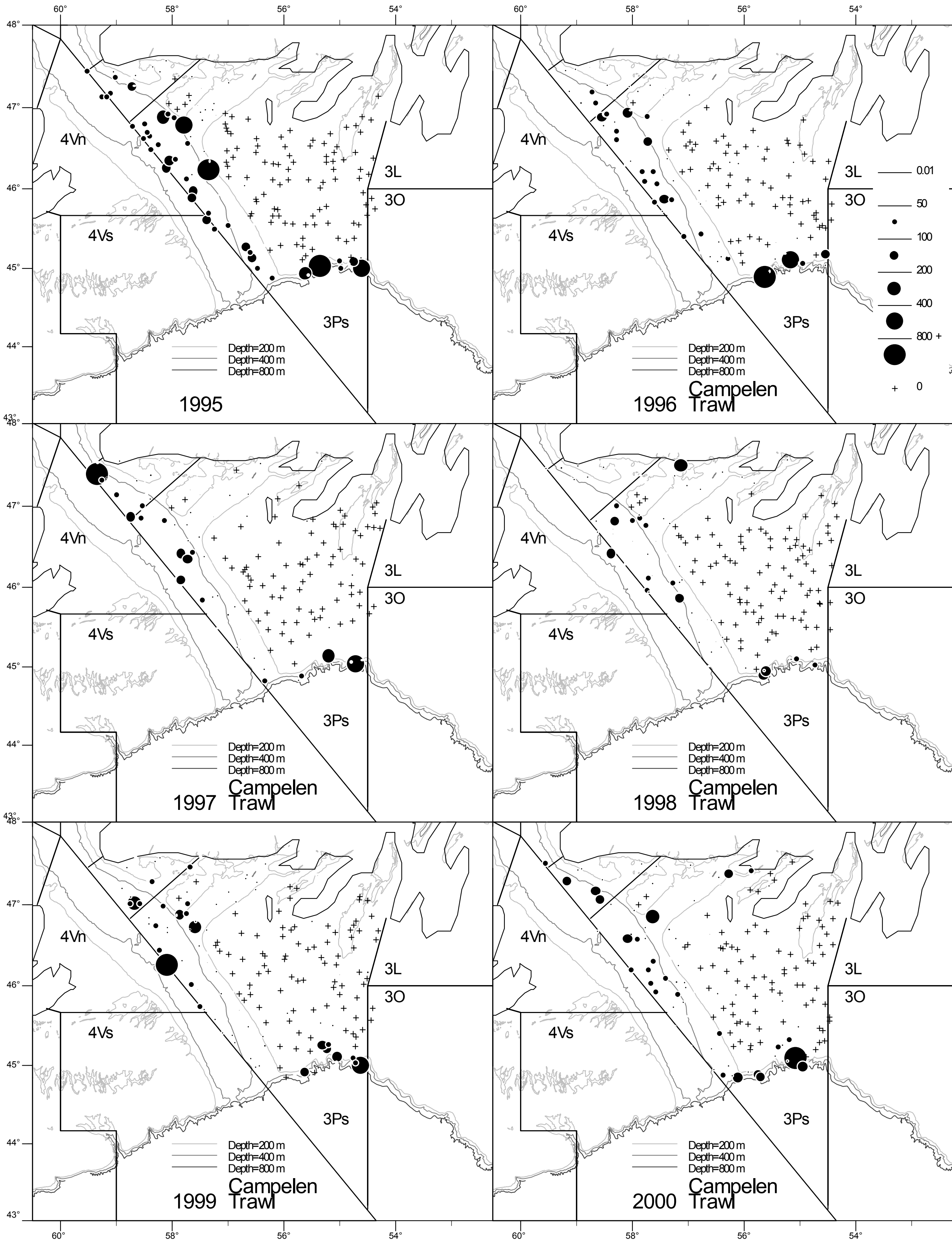


Fig. 6. Distribution of Redfish catches (Kg./ standard tow) from 1995-2000 spring surveys to Div. 3P. The surveys utilized an Engels 145 trawl (1.75 n. mi. tow) in 1995 and a Campelen trawl (0.75 n. mi. tow) for 1996-2000.

red9500.acn

3Ps RV Surveys

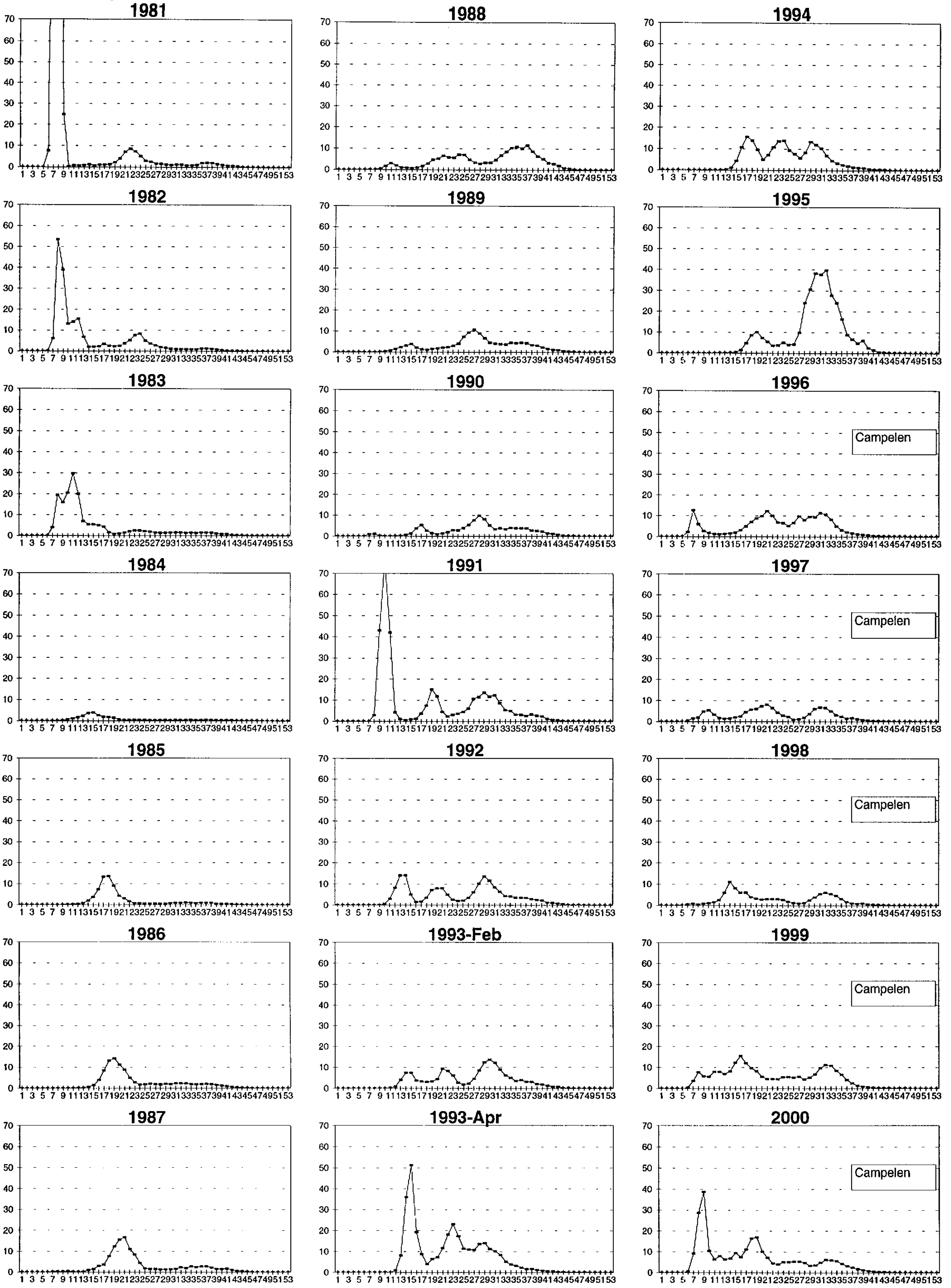


Fig. 7. Length distributions (mean per standard tow) from stratified-random research surveys to Div. 3Ps in spring/winter from 1981-2000. X-axis is forklength in centimetres. The following trawls were used over the series: Yankee 41-5 otter trawl (to 1982), Engel 145 otter trawl (1983-1995), Campelen 1800 shrimp trawl (1996-present)

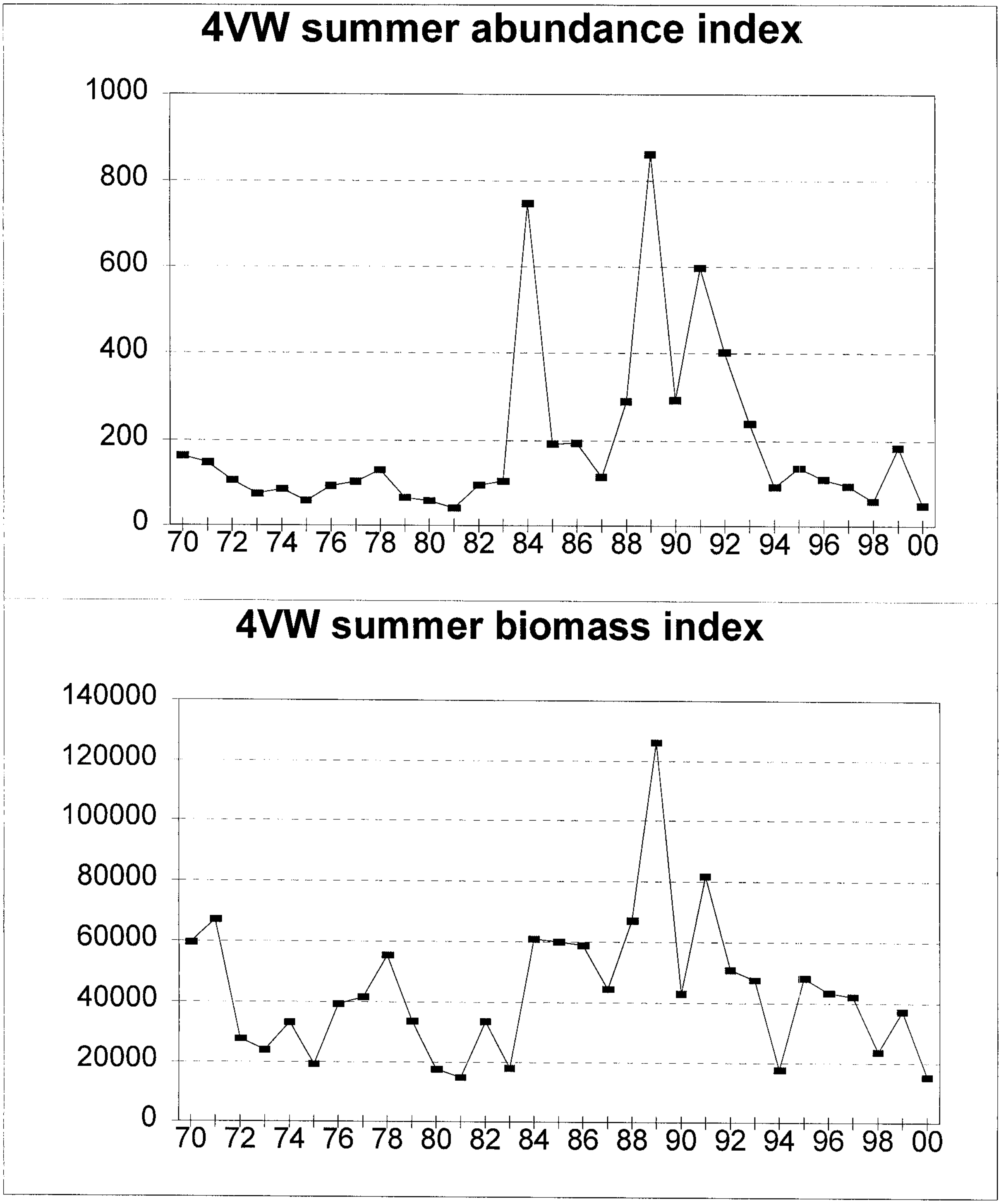


Fig. 8. Redfish abundance and biomass estimates for 1970-2000 4VW groundfish directed summer surveys conducted by the Maritimes Region. From 1970 to 1981 the A. T. Cameron conducted the surveys with a Yankee trawl. The Alfred Needler conducted surveys from 1982 to 2000 utilizing a Western IIa trawl.

4VW Summer RV Survey

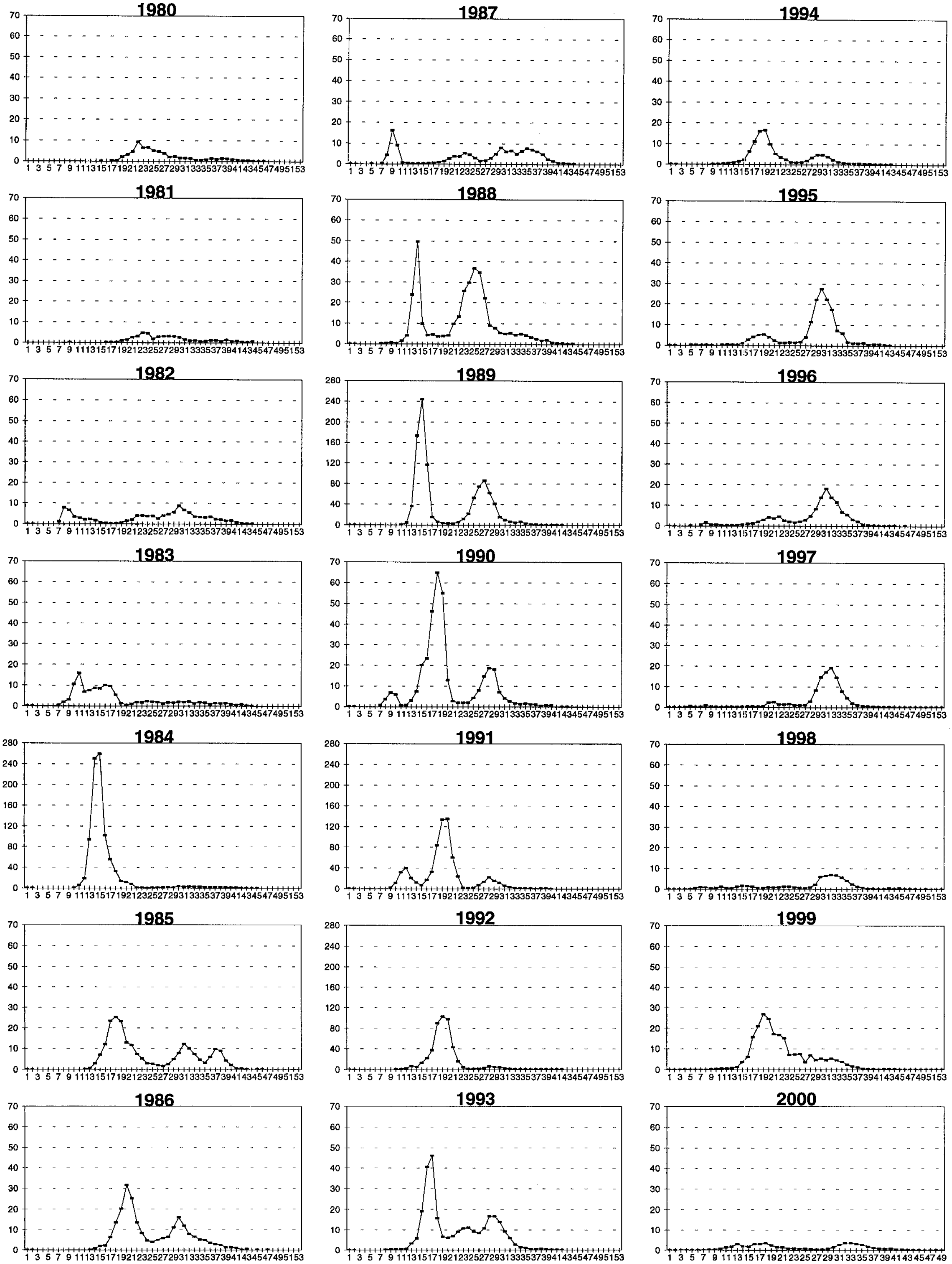
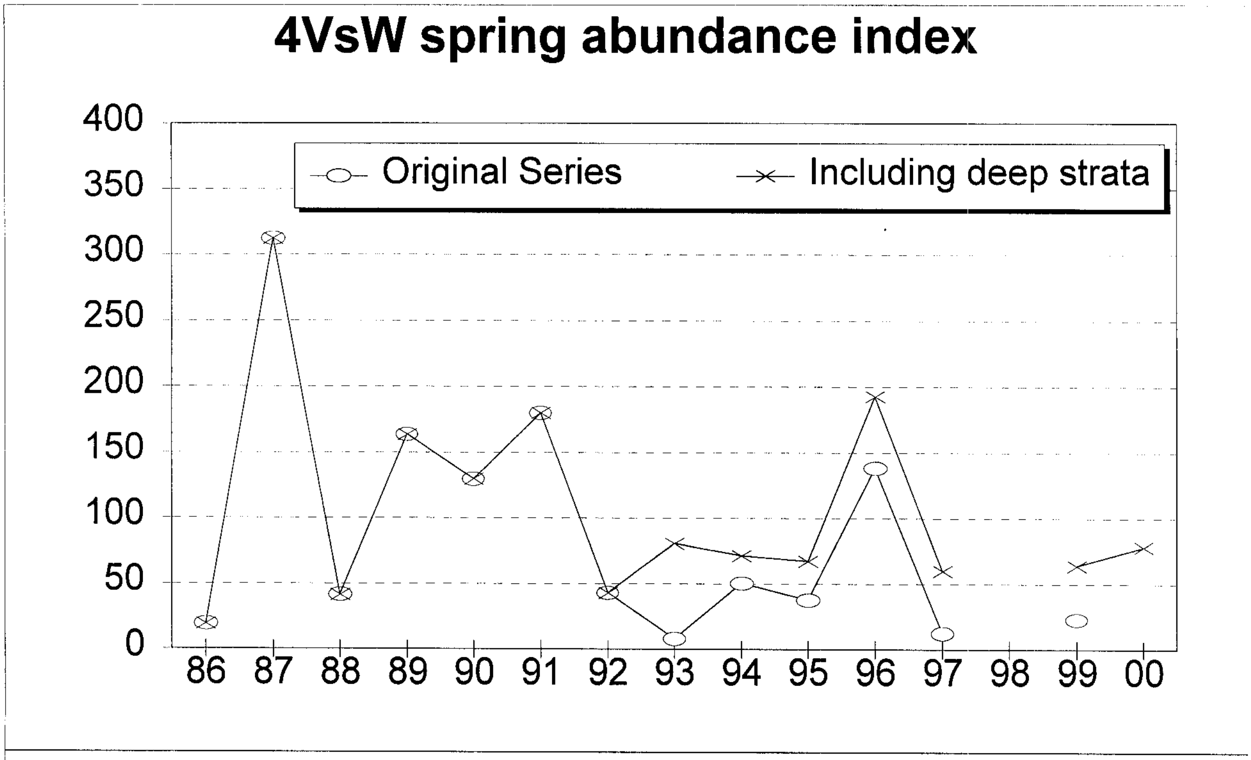


Fig. 9. Redfish length distributions from stratified-random groundfish directed research surveys conducted by the Maritimes Region in Div. 4VW in the summer from 1980-2000. Plotted above are mean number per standard tow.



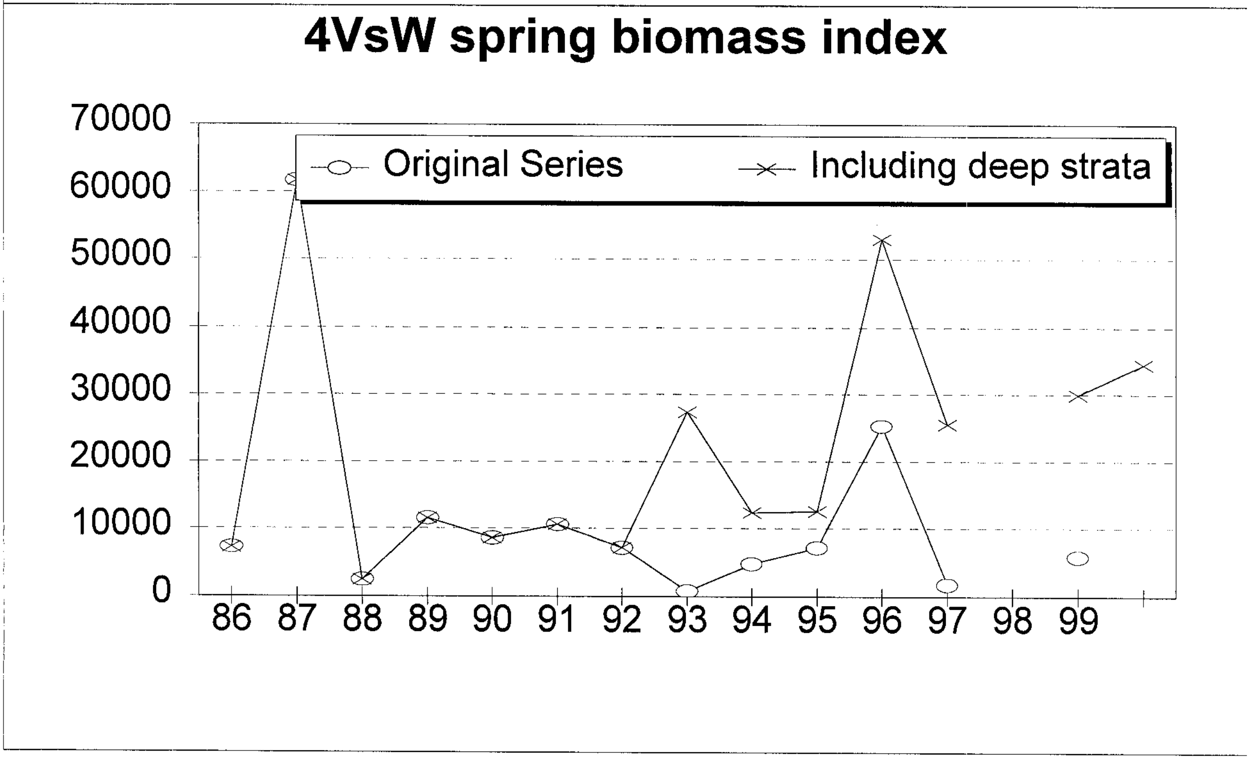


Fig. 10. Redfish abundance and biomass estimates from 1986-2000 4VW Cod directed groundfish surveys conducted by the Maritimes Region. The revised series include estimates of strata 397-400 which cover depths over 200 fathoms in 4Vs.

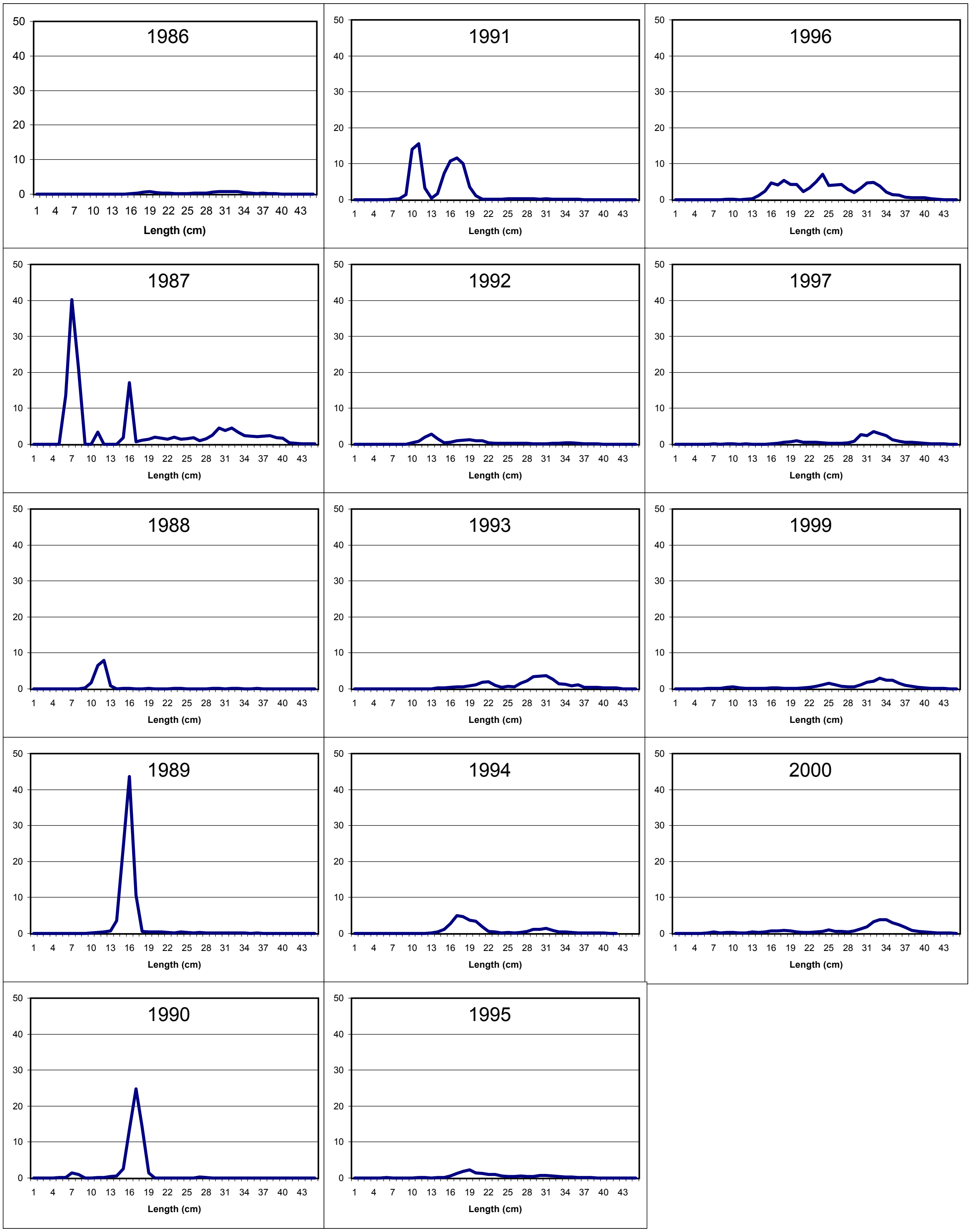


Fig. 11. Redfish length distributions from stratified-random Cod directed research surveys conducted by Maritime Region in Div. 4VsW in the spring from 1986-1997, 1999. Plotted above are mean number per standard tow. X-axis is forklength in centimetres. No survey in 1998.

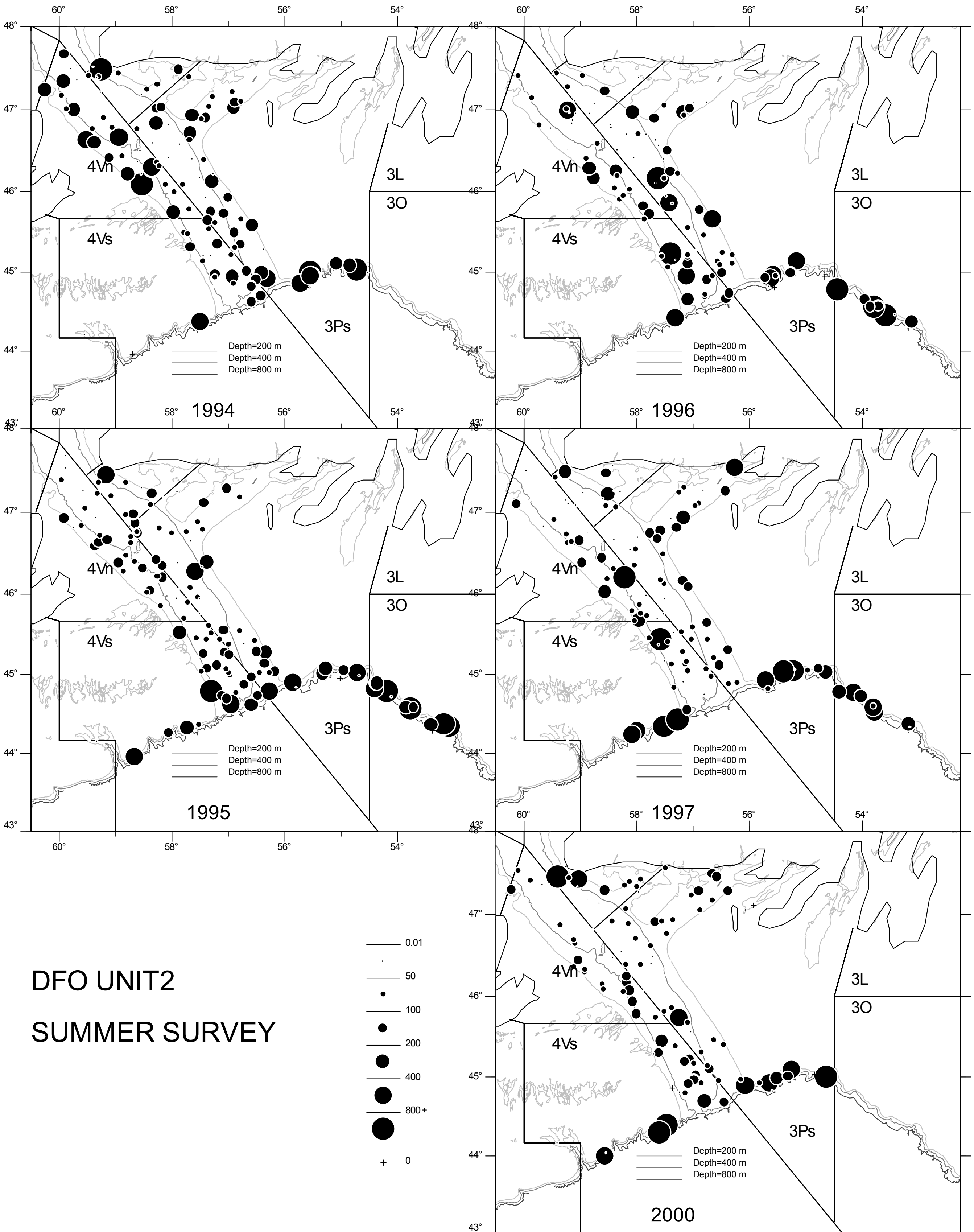


Fig. 12. Distribution of Redfish catches (Kg. per standard 0.8 nm. tow) from summer DFO redfish directed surveys to Unit 2 using a Campelen 1800 survey trawl with a 12.5 mm liner.

DFO9400_5PANEL.ACN

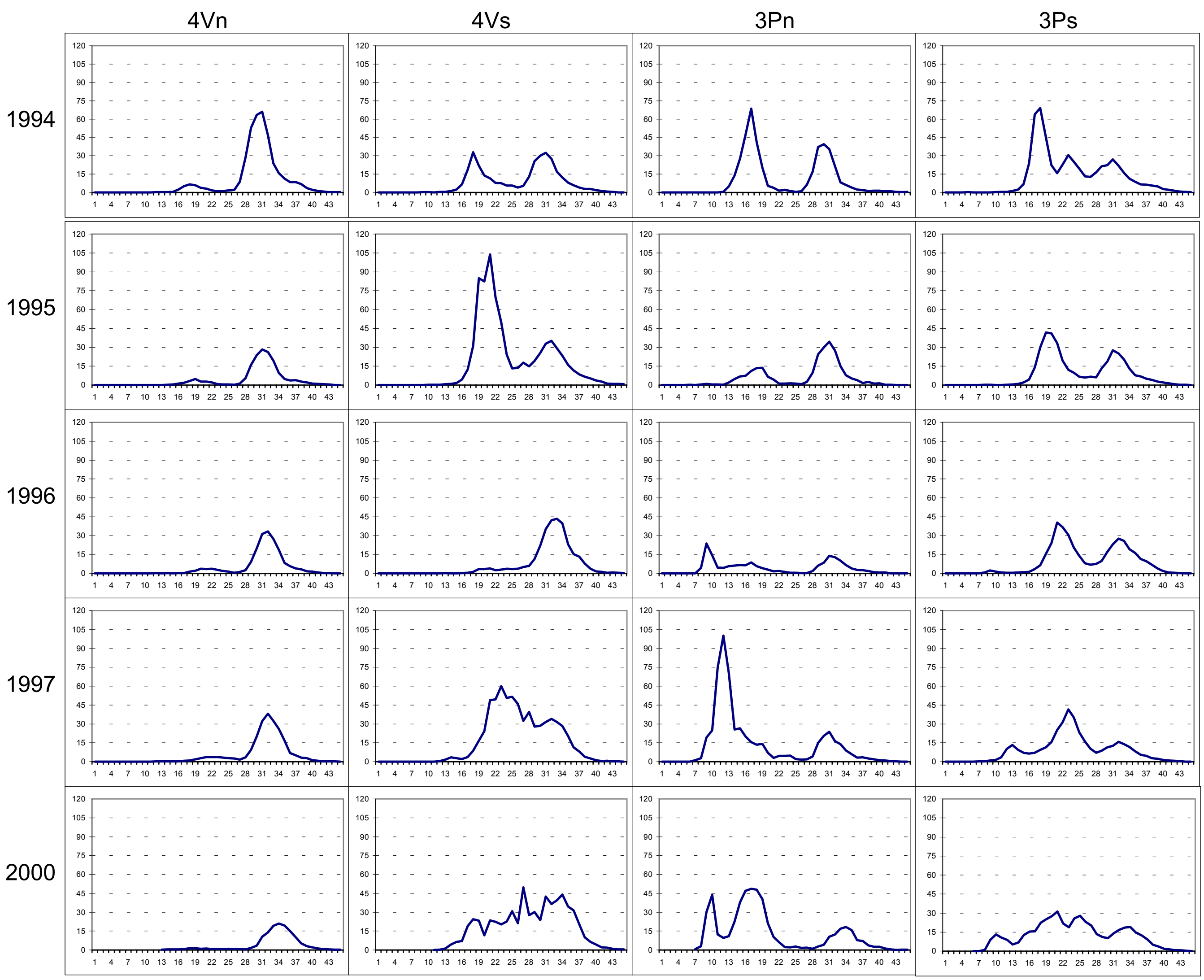


Fig. 13. Length distributions from stratified-random DFO surveys to UNIT2 for 1994-1997. Plotted are mean number per standard (0.75 n. mi.) tow. X-axis is centimetres. The 1994 survey was conducted by the MV Gadus Atlantica and the 1995 to 2000 surveys were conducted by the by the CSS Teleost . All surveys were conducted with a Campelen 1800 shrimp trawl.

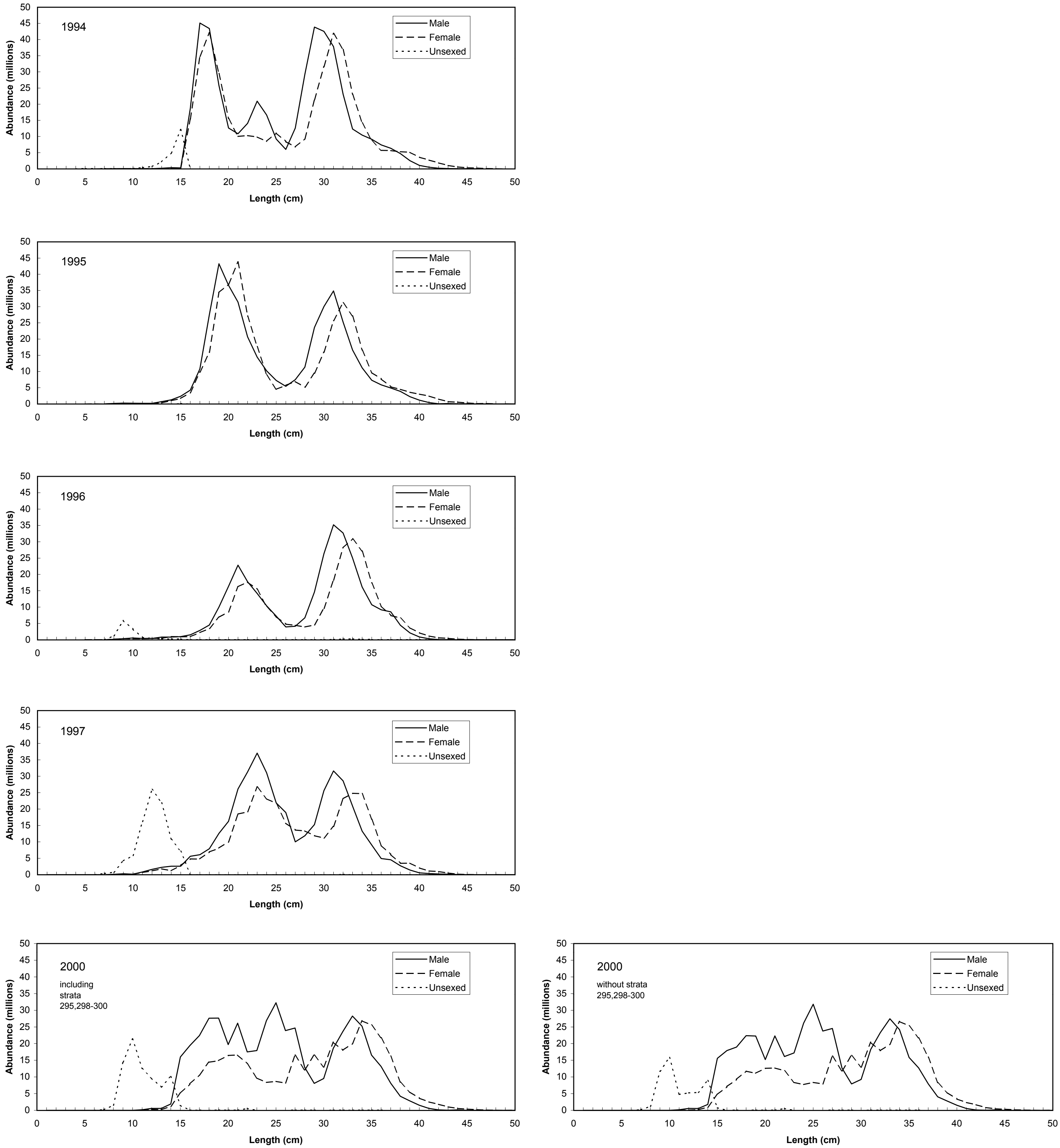


Fig. 14. UNIT2 redfish abundance index at length from summer DFO surveys from 1994-1997 and 2000.

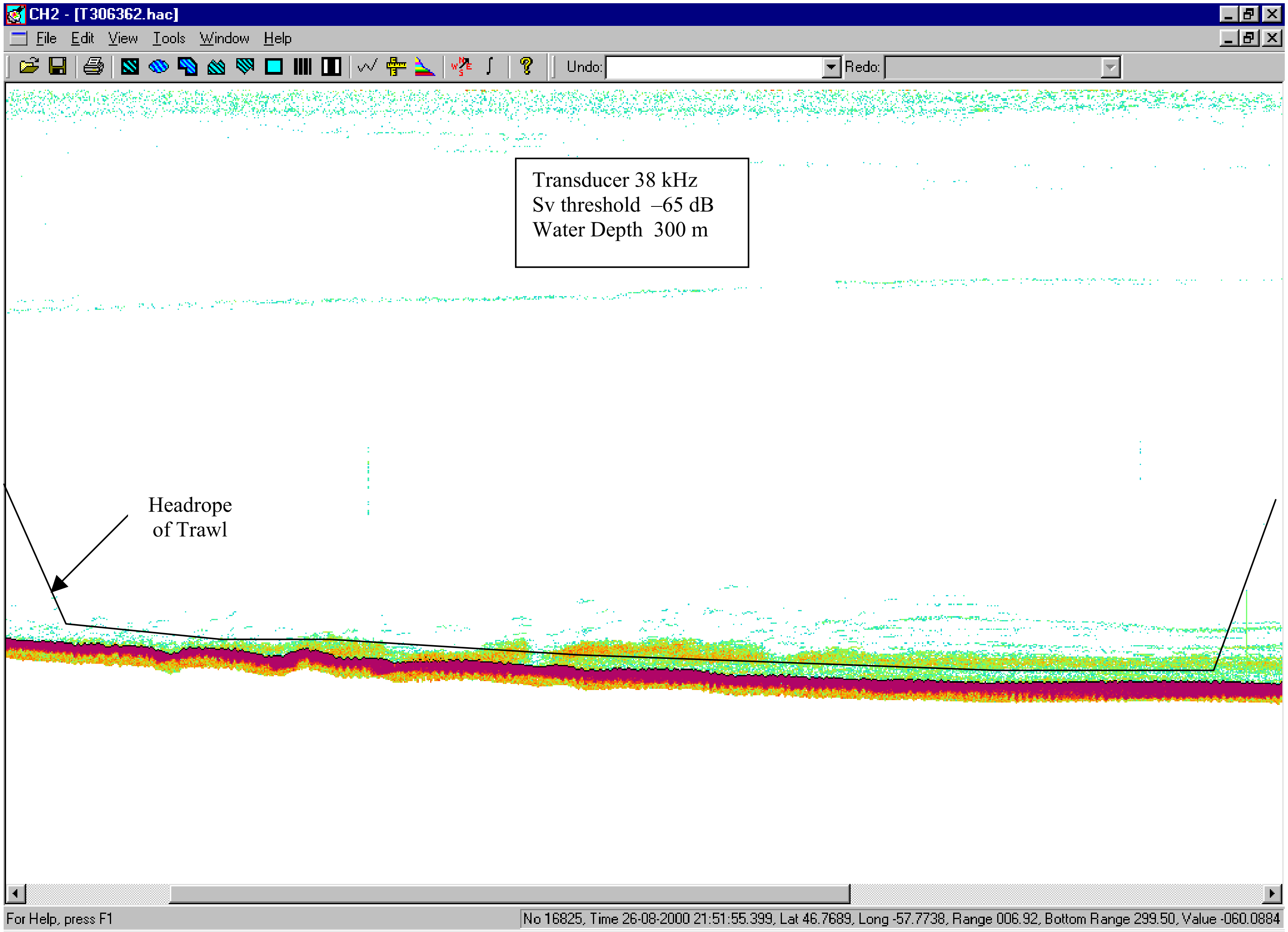


Fig 15. Echogram of redfish aggregation fished in 3Ps, fall 2000. Position of trawl headrope is indicated by solid black line.

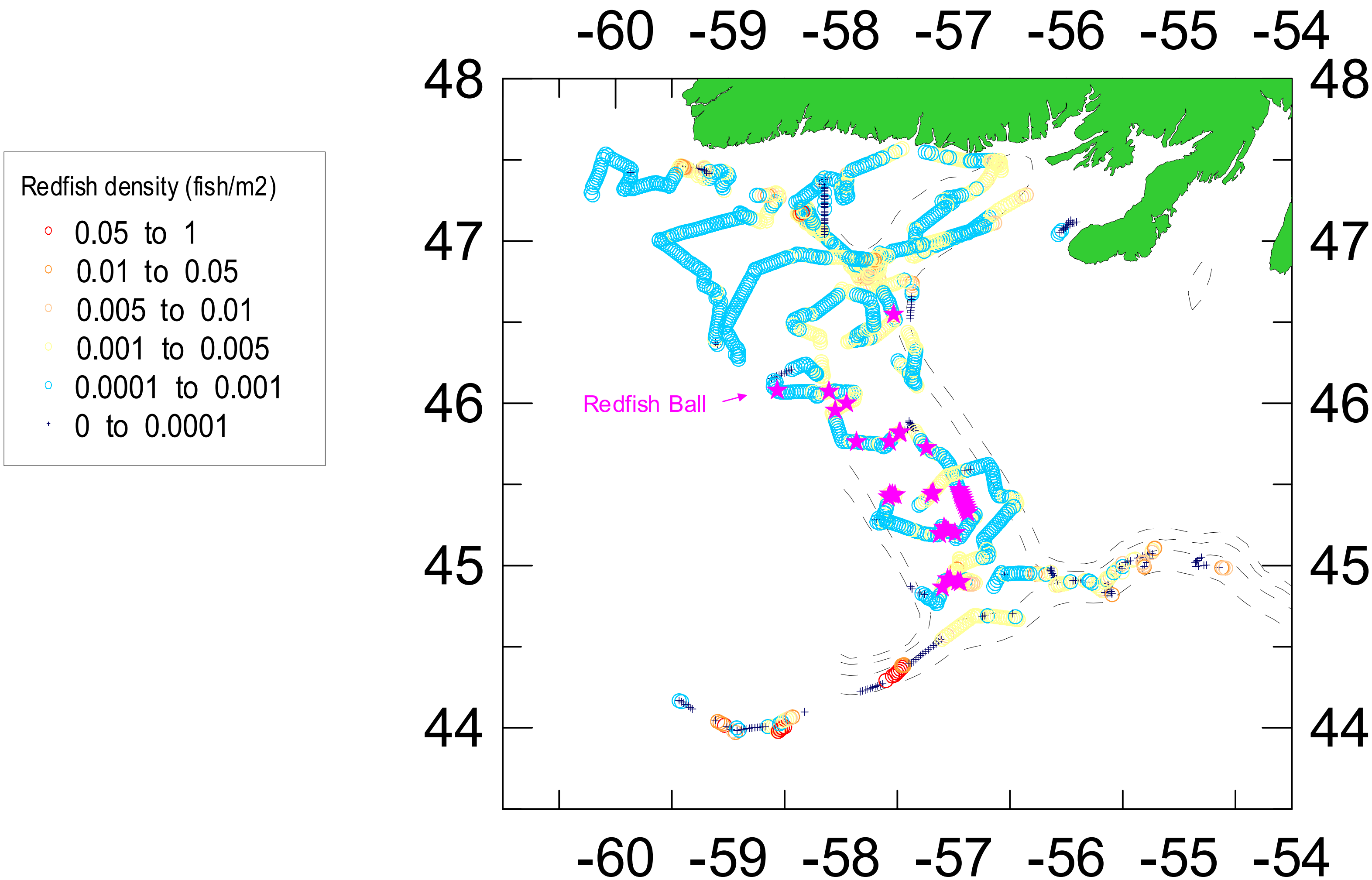


Figure 16. Map of survey area showing redfish density (fish/m2) integrated over 1 nautical mile lengths of track for the whole water column. Pink stars indicate locations of 'redfish balls' on or near bottom.

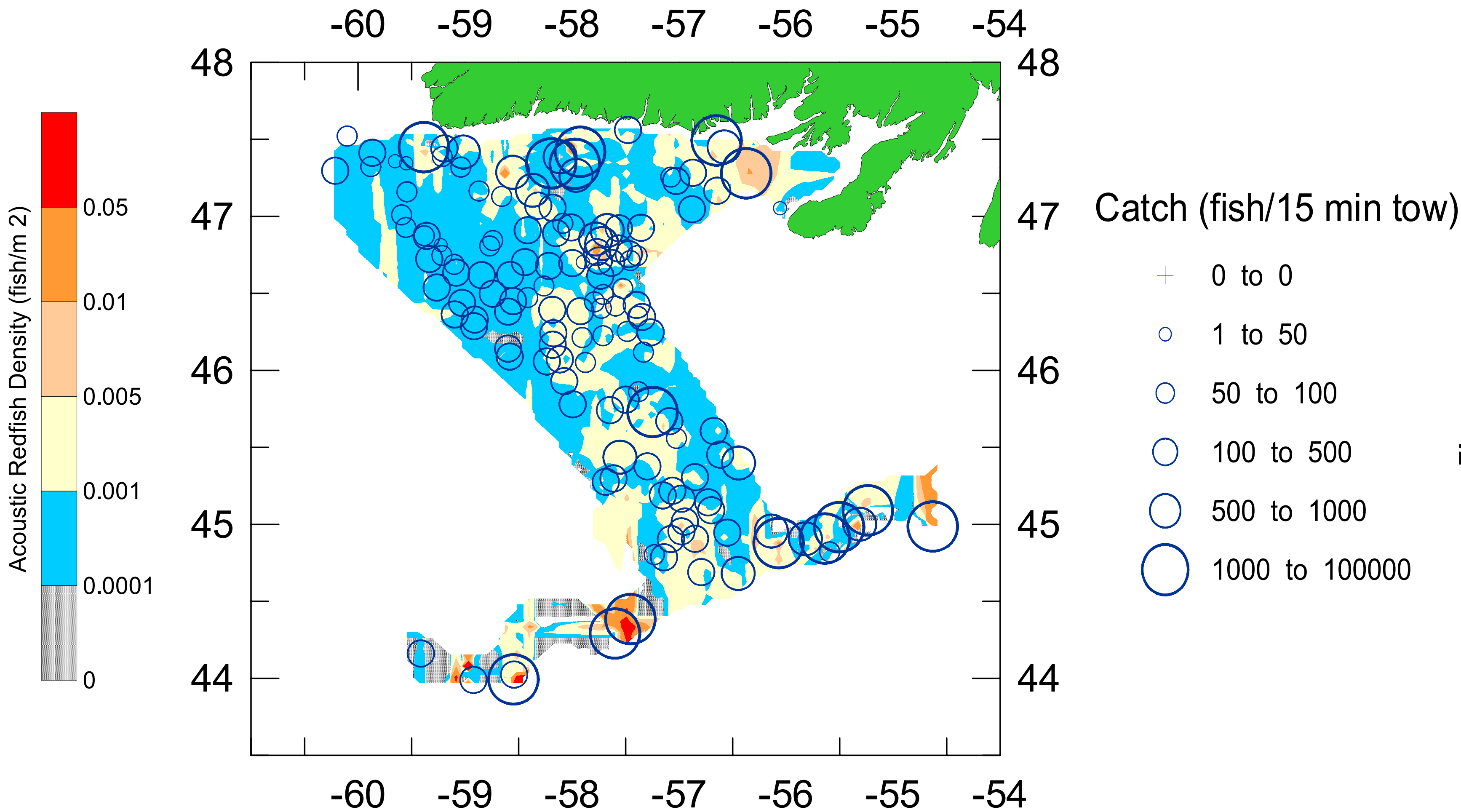
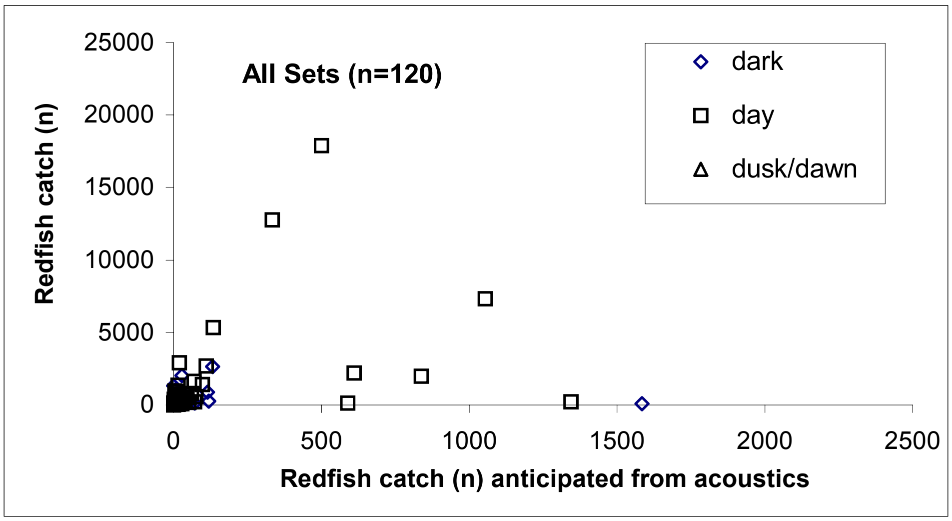


Figure 17. Redfish density in whole water column from acoustics (filled contours) and bottom trawl catches of redfish (expanding circles) recorded during a survey of SA 2 redfish area in fall 2000.



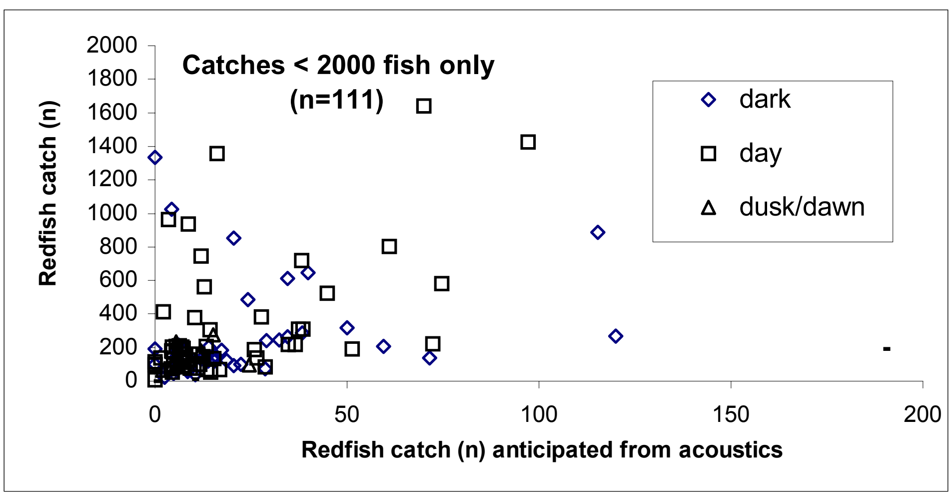


Figure 18. Numbers of redfish caught by Campelen trawl compared with number of redfish available in bottom 5 m as calculated from acoustic measurements. The lower panel is an expansion of the upper showing only sets where the redfish catch was less than 2000 fish. Trendline is drawn at 1:1 in both graphics.

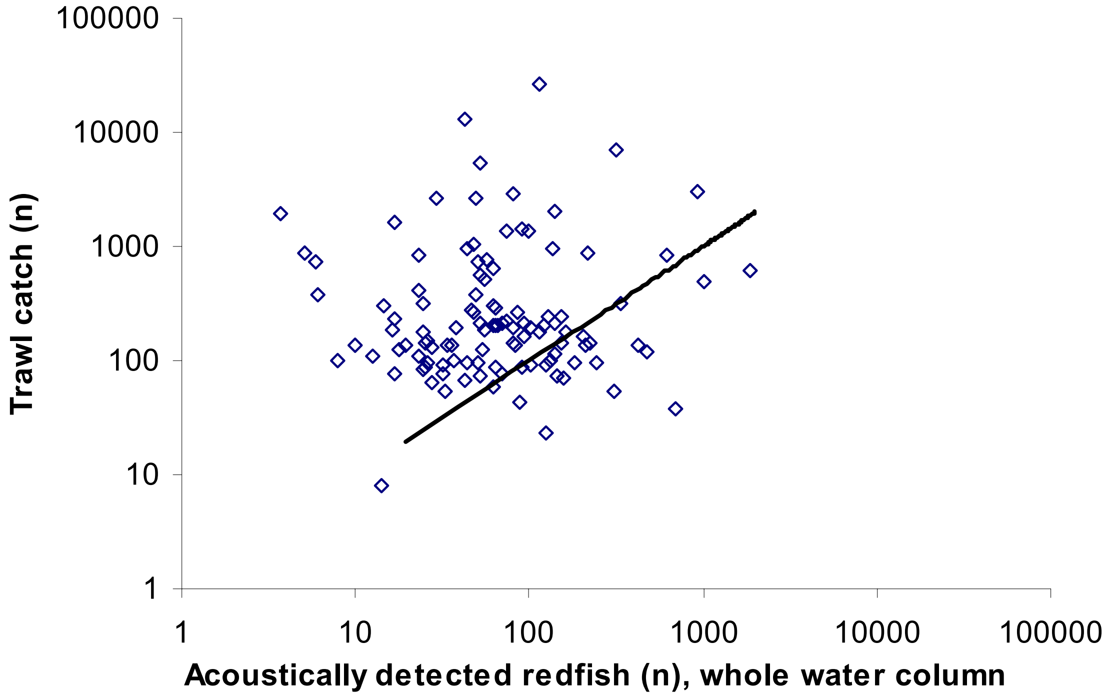


Figure 19. Trawl catch of redfish (n) and acoustically detected redfish (n) in the whole water column over the trawl swept area.

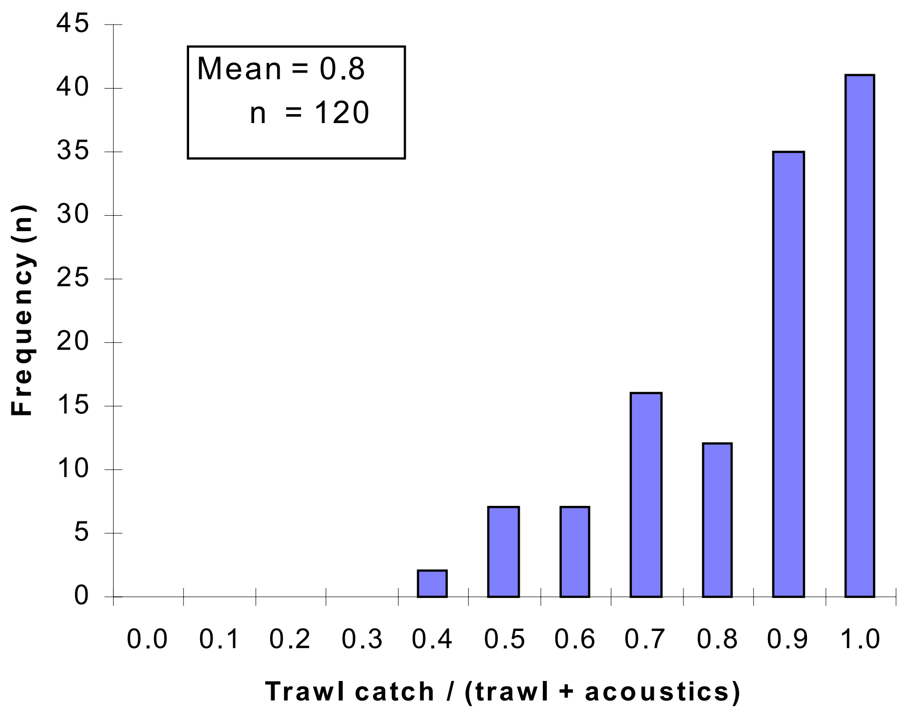


Figure 20. Trawl catch of redfish as a proportion of the whole water column redfish content. Whole water column content was estimated as the sum of the bottom trawl catch (considered representative of the bottom 5 m) and the acoustically detected redfish above the trawl (5 m above bottom to surface).

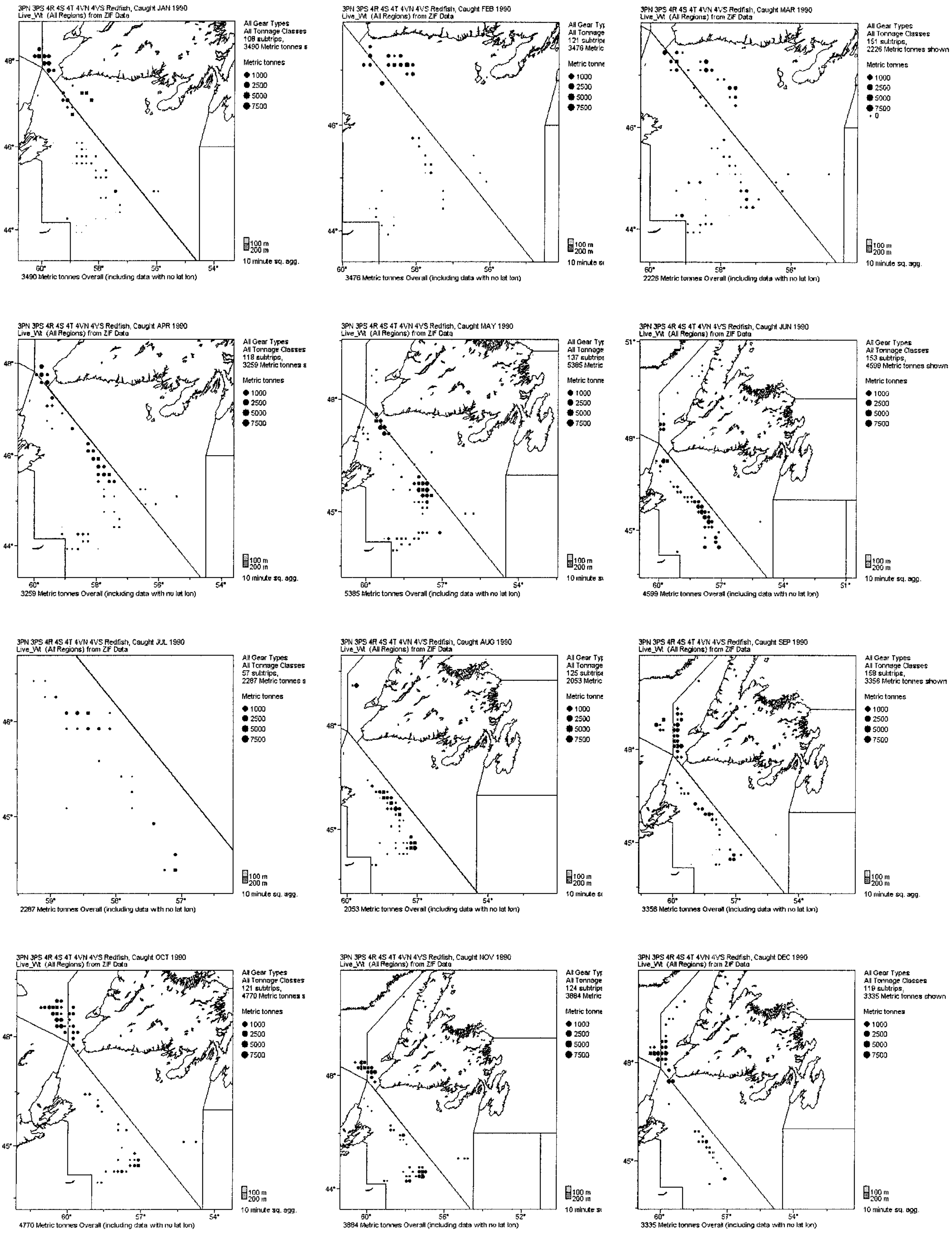


Fig. 21. Monthly plots of 1990 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

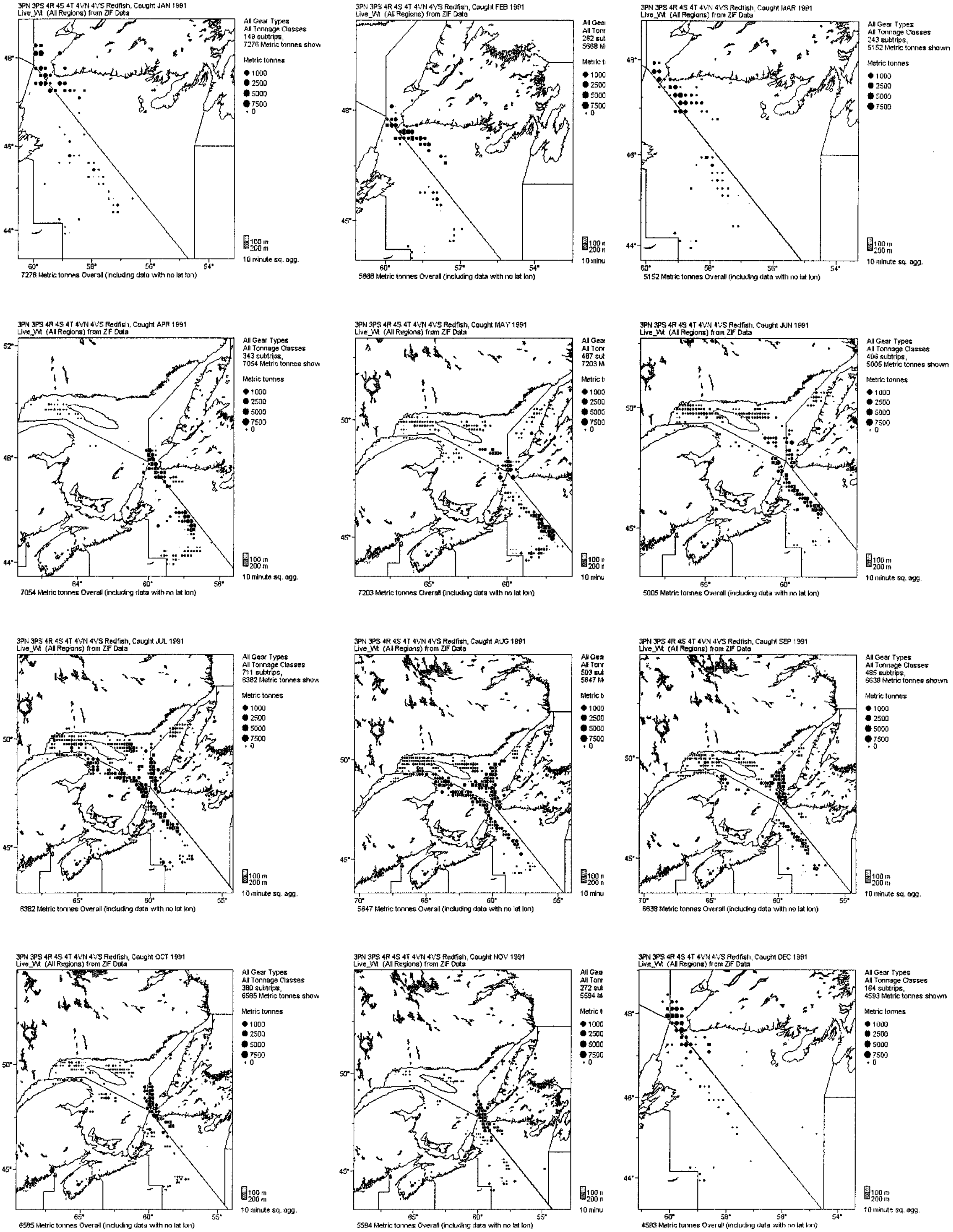


Fig. 22. Monthly plots of 1991 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

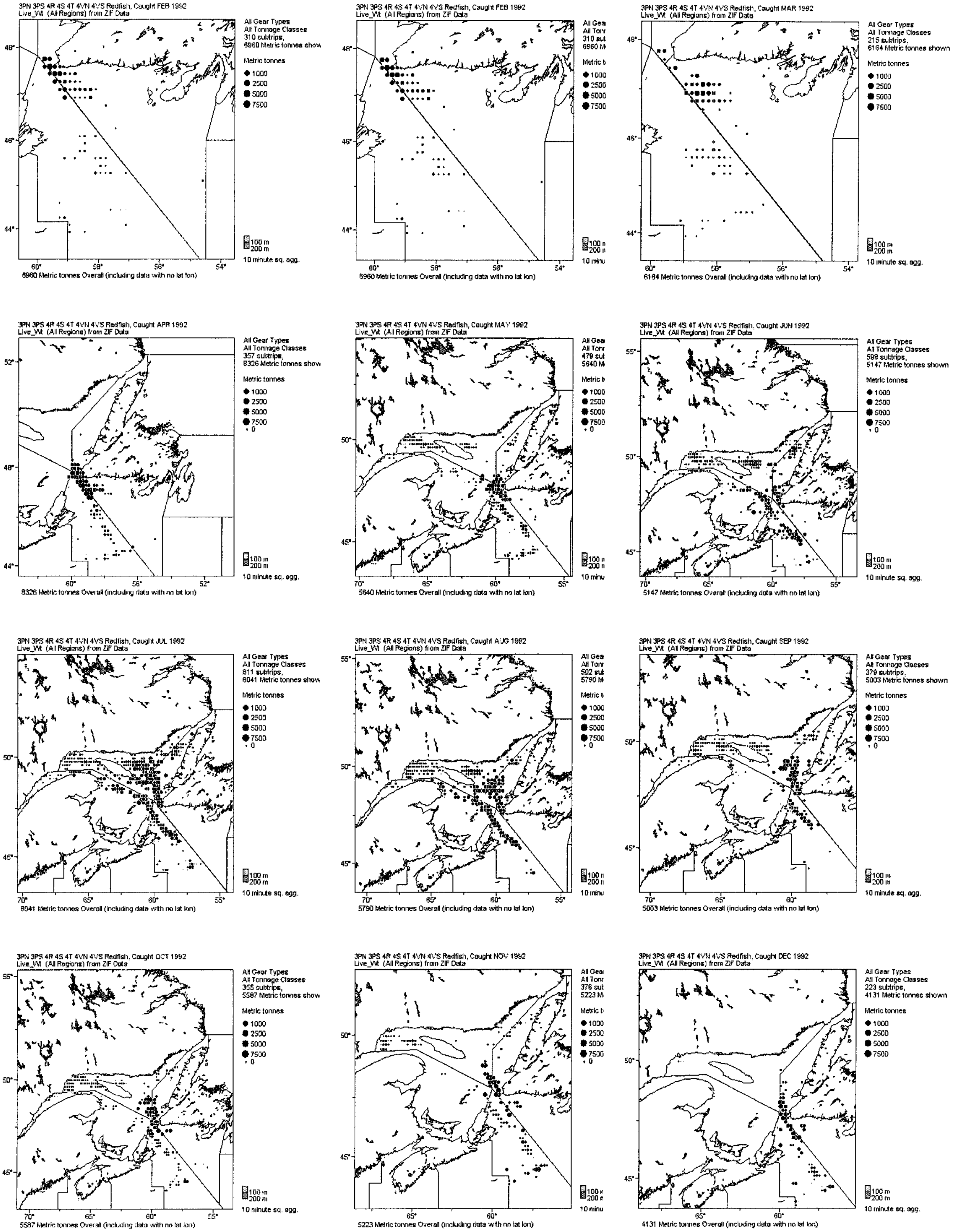


Fig. 23. Monthly plots of 1992 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

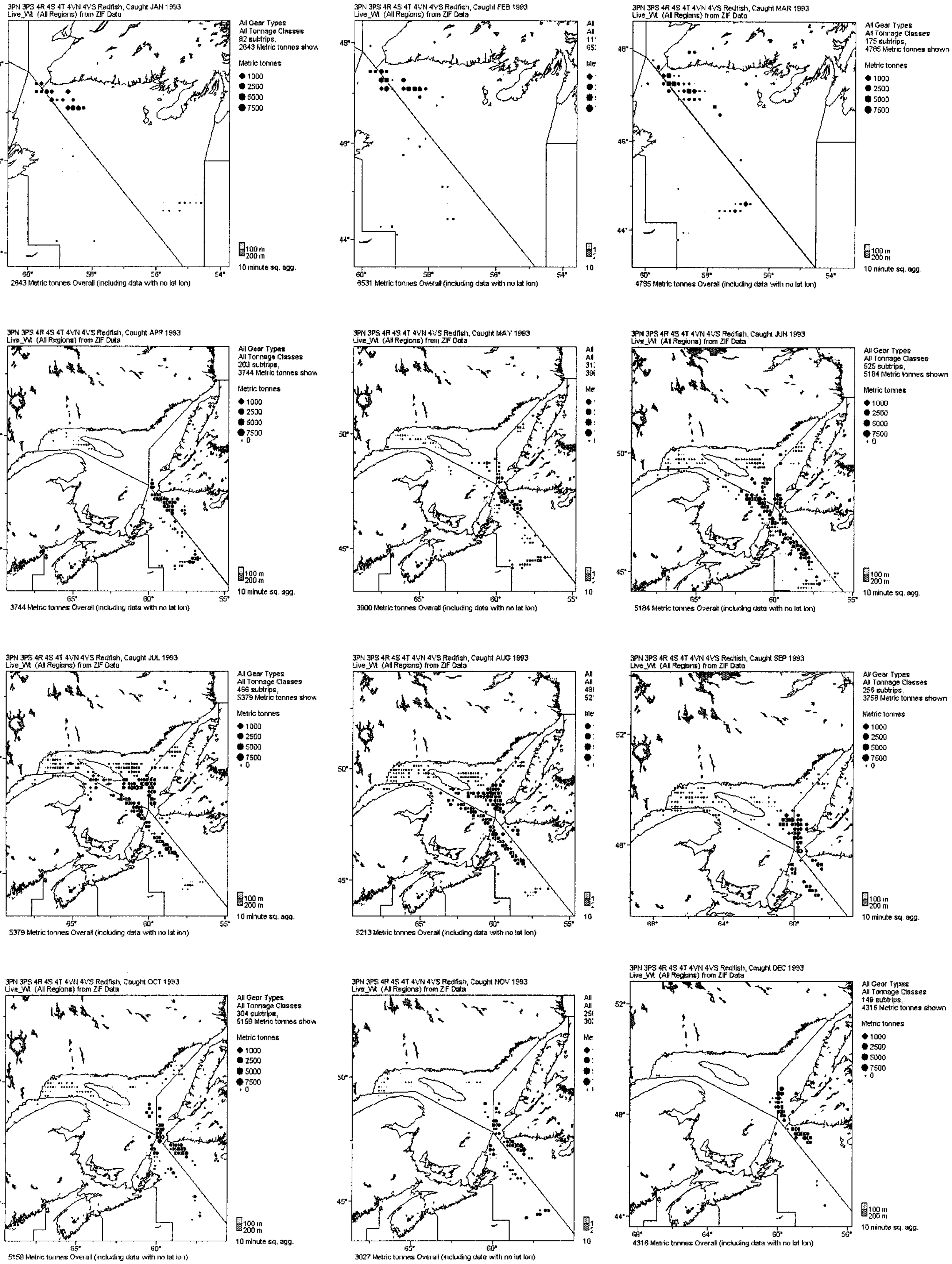


Fig. 24. Monthly plots of 1993 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

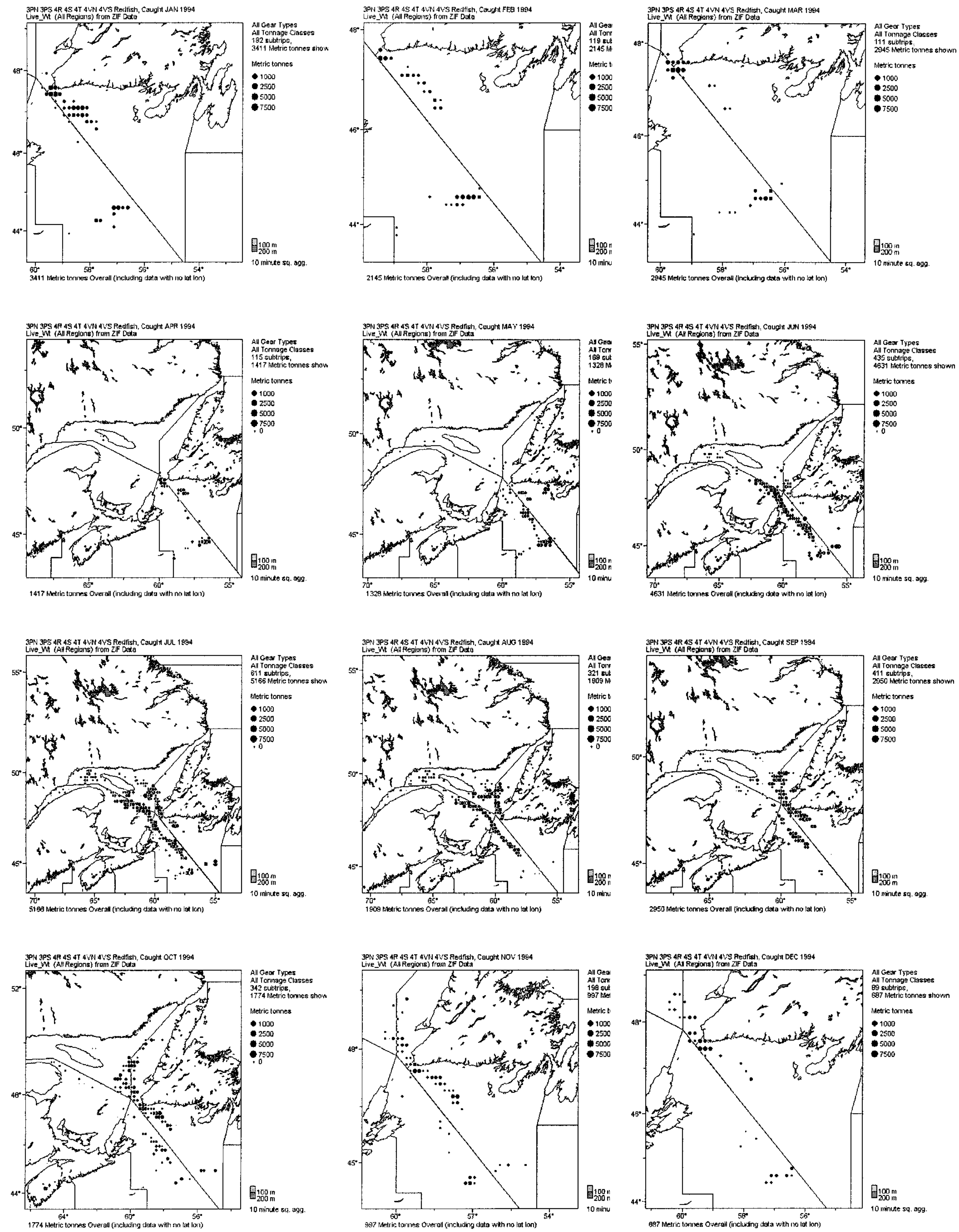


Fig. 25. Monthly plots of 1994 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

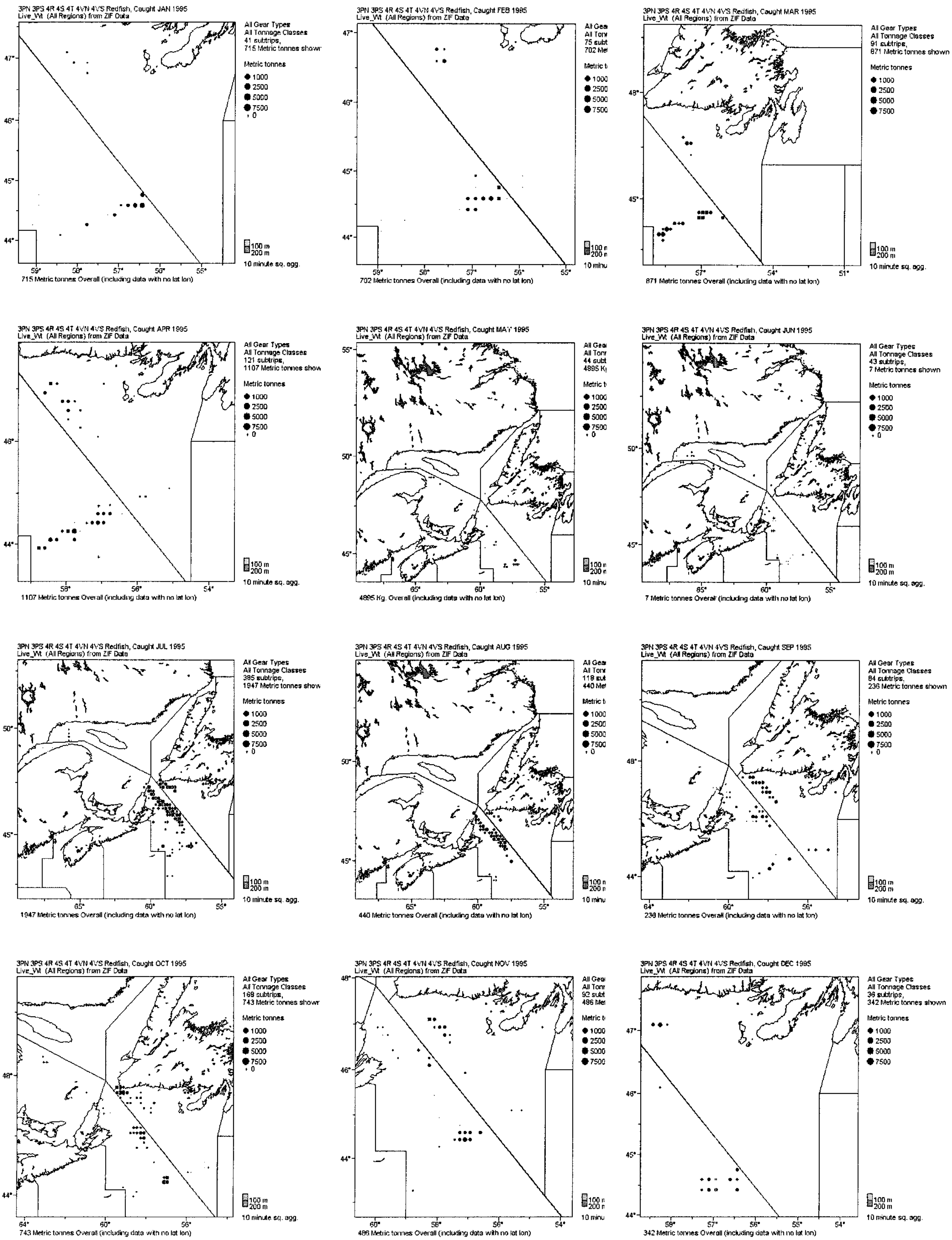


Fig. 26. Monthly plots of 1995 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

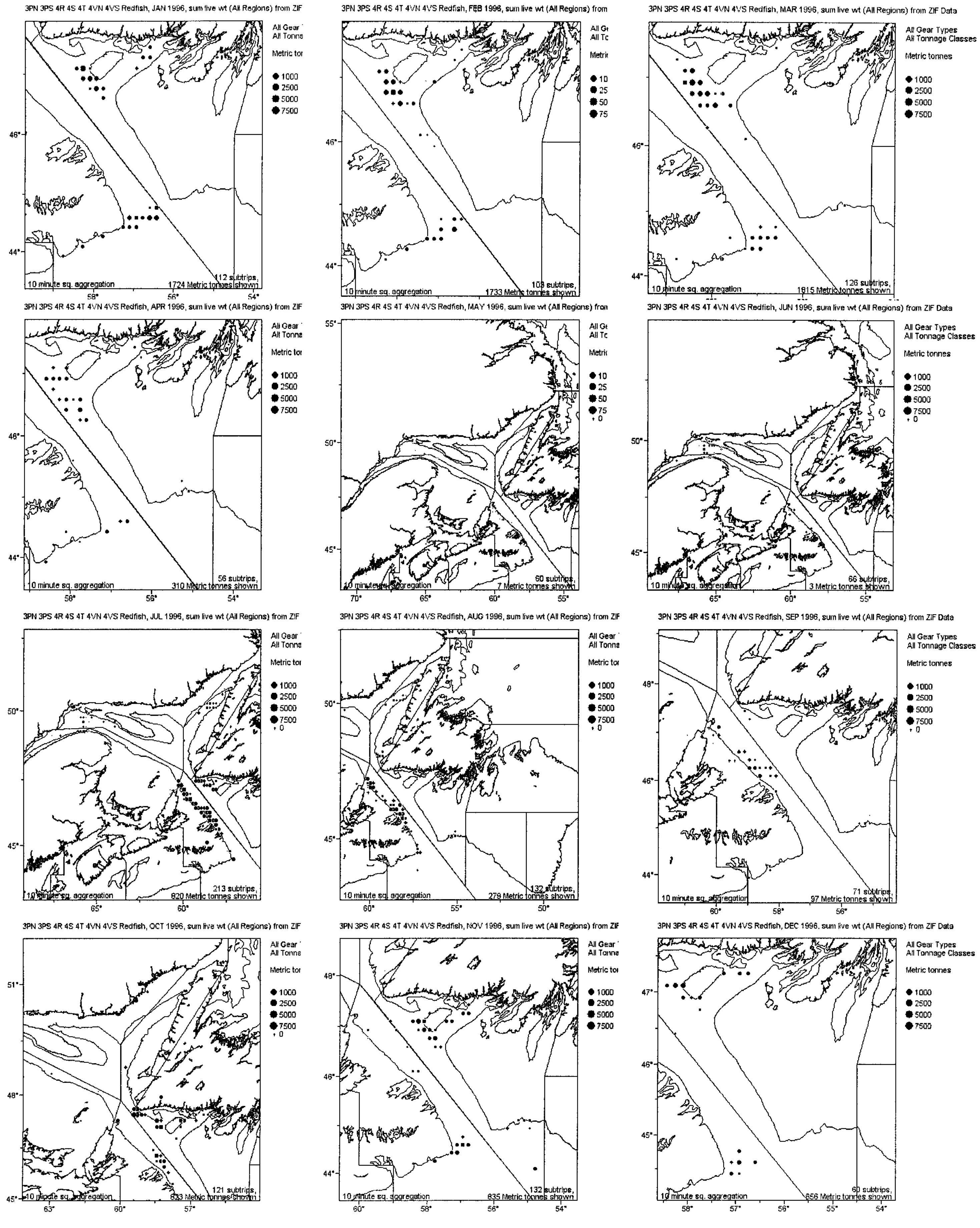


Fig. 27. Monthly plots of 1996 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

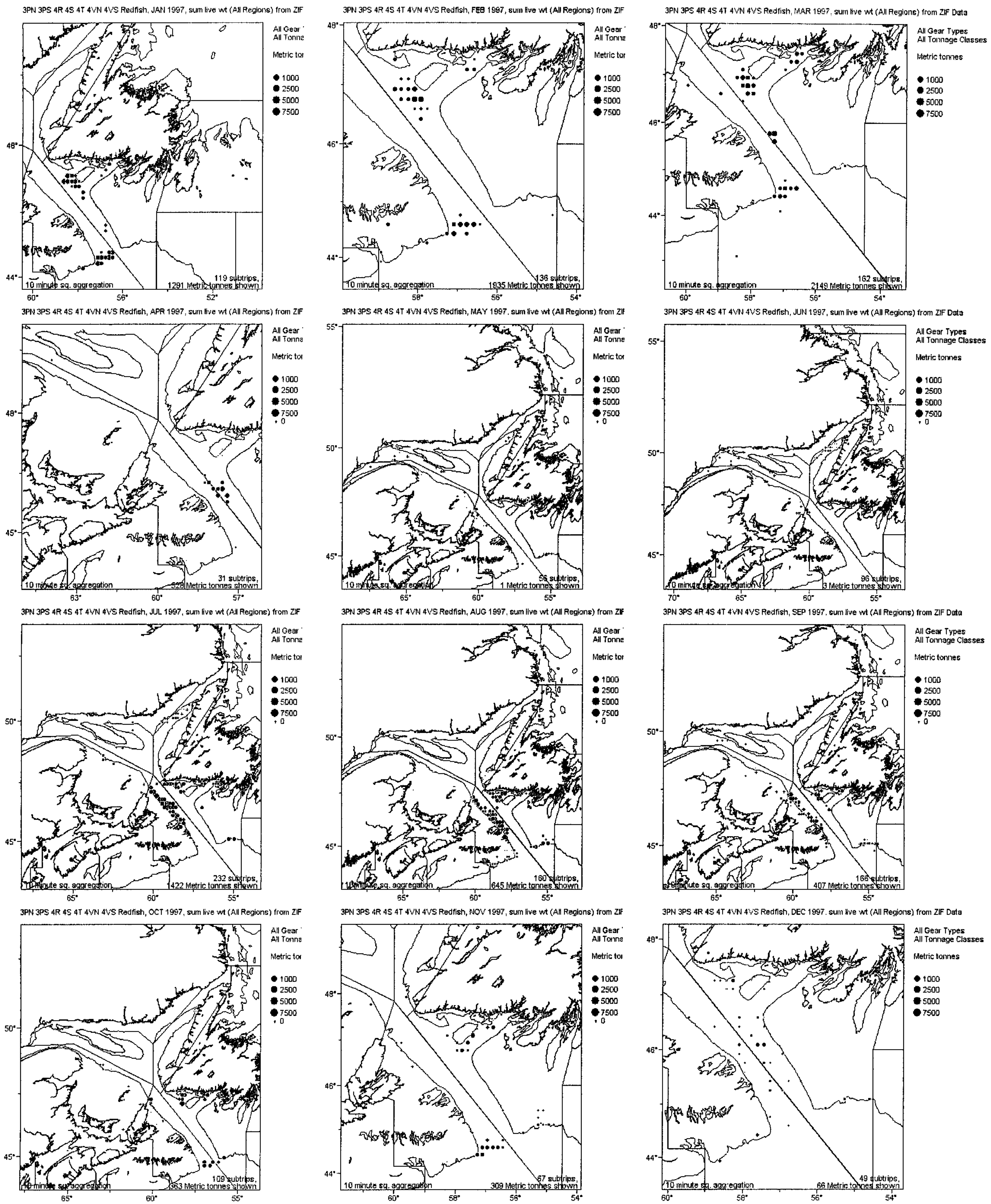


Fig. 28. Monthly plots of 1997 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

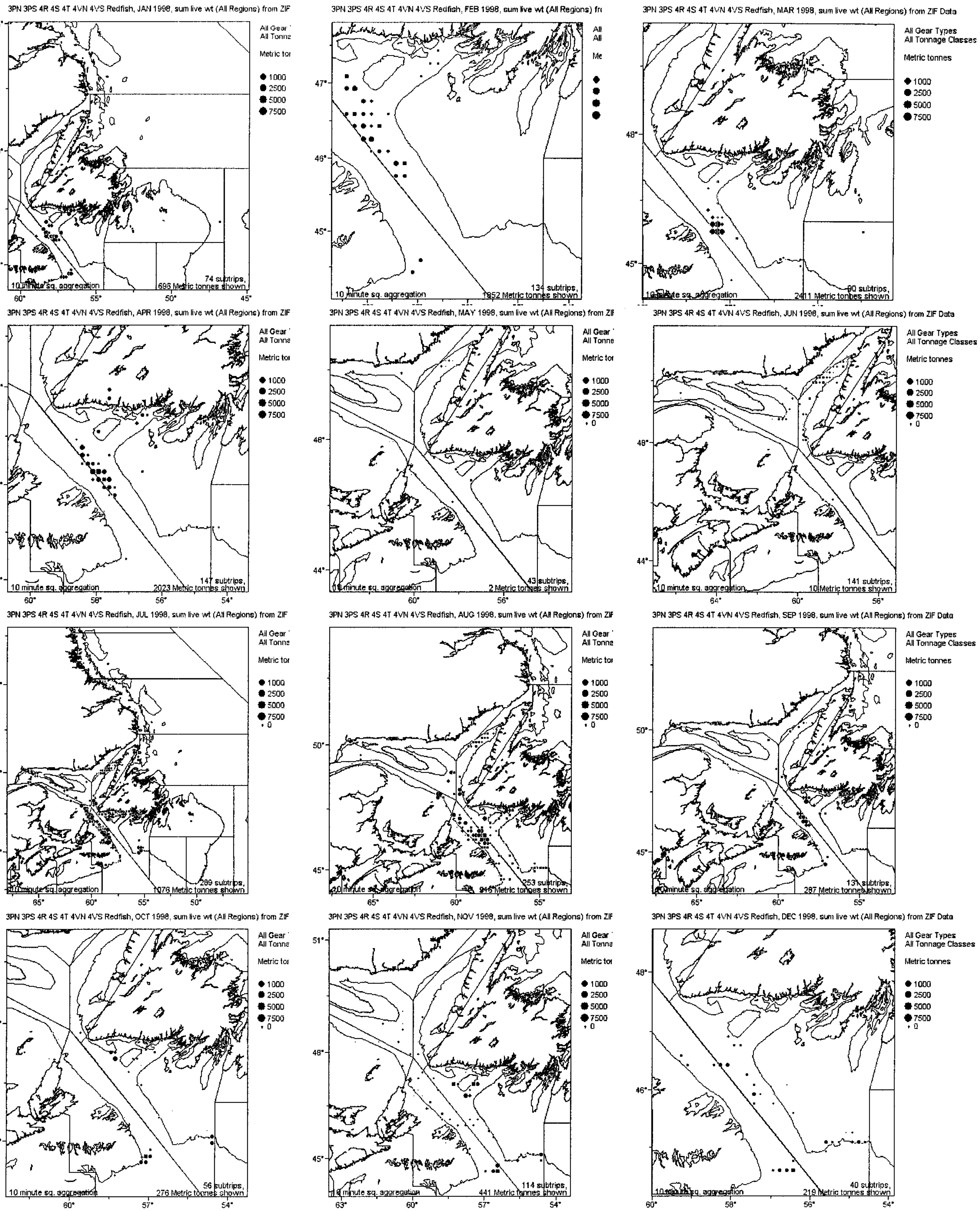


Fig. 29. Monthly plots of 1998 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

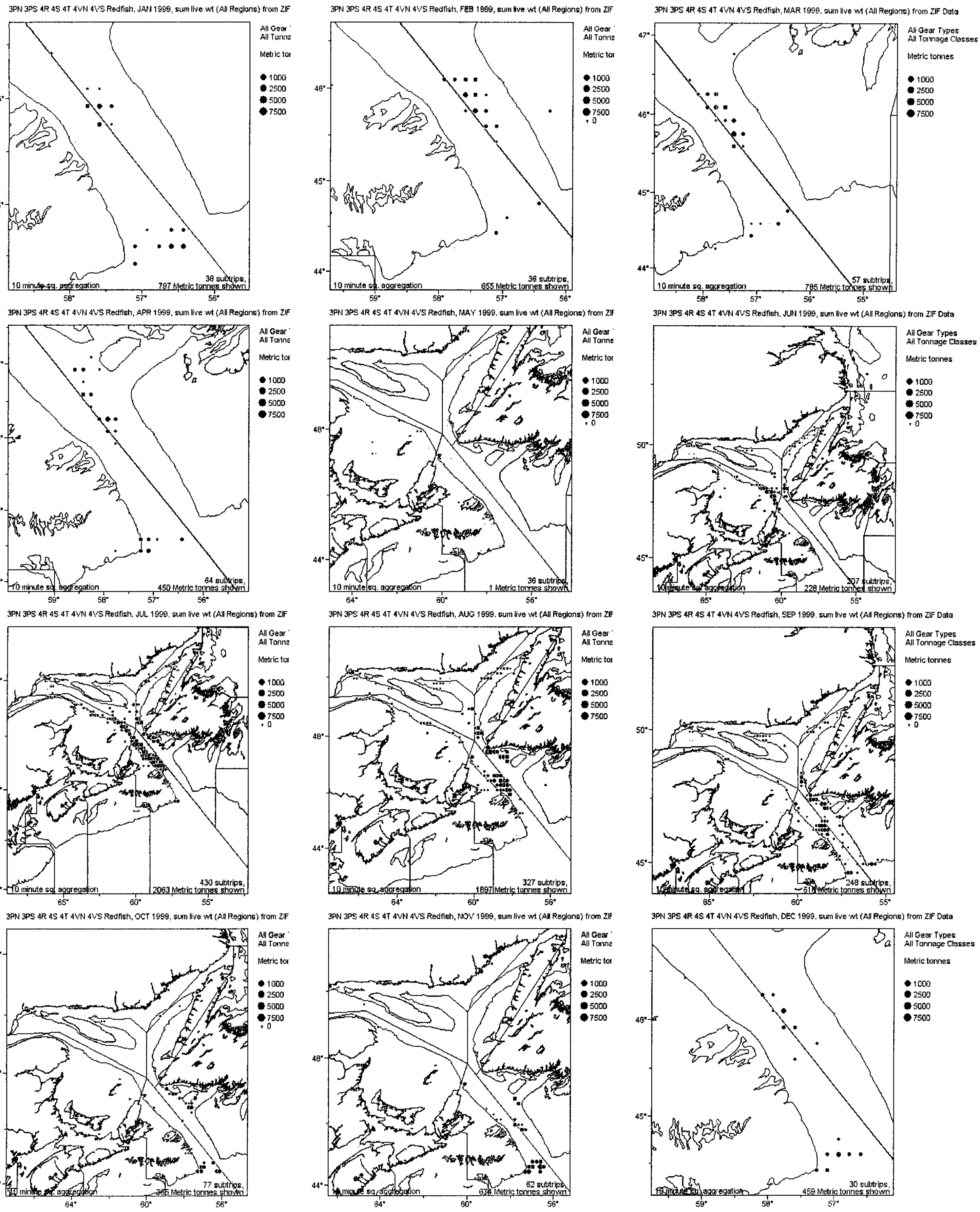


Fig. 30. Monthly plots of 1999 commercial fishery logbook data (all Regions, Gears and Tonnage classes).

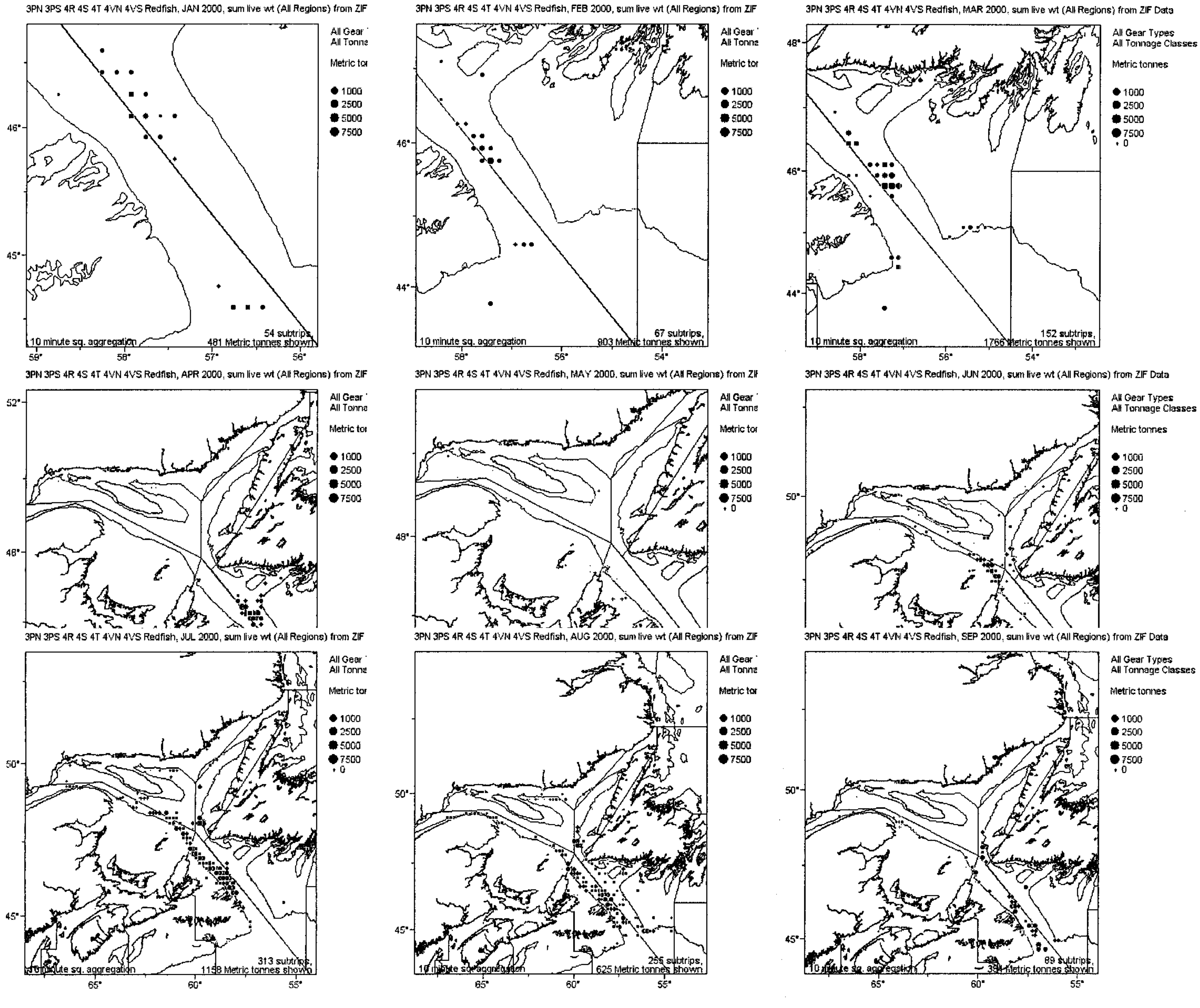


Fig. 31. Monthly plots of 2000 commercial fishery logbook data (all Regions, Gears and Tonnage classes).