The 1983 stock status and 1984-85 yield projections for Division 4RST Redfish

by

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Abstract

Nominal catches of 4RST redfish have declined from a high of 130,000 t in 1973 to 15,000 t in 1980, followed by an increase to about 25,000 t in 1982-83. The commercial catch rates were standardized to Maritimes and Quebec tonnage class 4 otter trawlers fishing in Division 4R. The catch rate standardized by the multiplicative model shows an increase from 0.65 t/h in 1977 to 1.74 t/h in 1983. The catch rate increased in recent years as the result of the entry to the fishery of the abundant year classes of the early 1970's. The fishing pattern of the Magdalen Islands otter trawlers in 1983 shows a concentration of fishing effort in Divisions 4R and 4S between Anticosti Island and the Port au Port Peninsula similar to the 1982 pattern, but more dispersed than in 1981.

The age reading of commercial redfish samples was noted to be inconsistent with that of the previous year. CAFSAC could not accept the present analytical assessment incorporating the 1983 catch at age and recommended that projections be made from the 1982 data presented in the 1983 redfish assessment. The 1983 catch in weight and a 1984 catch set equal to the announced TAC of 50,600 t were used for final projections of catches and mortality rates to 1990. These data were compared to projections at $F_{0.1}$ for all years and to the announced TAC's from 1984 to 1988 with $F_{0.1}$ thereafter. If 50,600t is taken in 1984, projections at $F_{0.1}$ = 0.15 for 1985 and 1986 result in catches of 71,000 t and 63,000 t respectively. The announced TAC for 1985 is 50,000 t and 55,000 t in 1986. By fishing below $F_{0.1}$ until 1987, more redfish will be available for exploitation in the late 1980's.

## Résumé

Les prises totales de sébaste dans les divisions 4R, 4S et 4T ont diminué pendant une bonne période, passant de 130,000 T en 1973 à 15,000 T en 1980, puis ont connu une hausse, pour atteindre environ 25,000 T en 1982-1983. Les taux de prises commerciales ont été standardisés au tonnage des bateaux de pêche au chalut à panneaux de classe 4 des Maritimes et du Québec qui pêchent dans la division 4R. Le taux de prises standardisé par le modèle multiplicatif fait état d'une augmentation de 0,65 T/h en 1977 à 1,74 T/h en 1983. Le taux de prise a augmenté, au cours des dernières années, en raison du recrutement dans cette pêche des classes d'âge abondantes du début des années 1970. Le modèle de pêche des bateaux de pêche au chalut à panneaux des îles de la Madeleine en 1983 indique une concentration de l'effort dans les divisions 4R et 4S, entre l'île d'Anticosti et la presqu'île de Port au Port, un peu comme ce qui s'est fait en 1982, mais sur un territoire plus grand qu'en 1981.

On a noté que le relevé de l'âge des échantillons commerciaux de sébaste ne correspondait pas à celui des années précédentes. Le CSCPCA n'a pu accepter l'évaluation analytique actuelle comprenant la répartition par âge des prises de 1983, et a recommandé que des projections soient faites avec les données de 1982 qui ont été présentées dans l'évaluation sur le sébaste de 1983. Les prises de 1983, en poids, et les prises pour 1984 fixées au TPA annoncé de 50,600 T on été utilisées pour faire les projections finales des prises et des taux de mortalité jusqu'en 1990. On a comparé ces données aux projections à un taux d'exploitation FO.1 pour toutes les années, puis avec les TPA annoncés, de 1984 à 1988, et avec le taux d'exploitation FO.1 par la suite. Si l'on prend le chiffre de 50,600 T en 1984, les projections à FO.1 = 0,15 pour 1985 et 1986 donnent des prises de 71,000 et de 63,000 T respectivement. Le TPA annoncé est de 50,000 T pour 1985 et de 55,000 T pour 1986. Si l'on fait la pêche en-dessous du taux d'exploitation FO.1 jusqu'en 1987, il restera plus de sébaste à pêcher pour la fin des années 1980.

## Introduction

The redfish fishery in the Gulf of St. Lawrence dates back to 1952. The
historical landings and fishing pattern have been summarized previously
(Maguire, Lussiaà-Berdou and Rubec 1983). The peak fishing months are from
June to September, but redfish are taken year around, ice conditions
permitting. Gulf-based fishermen land redfish in Souris PEI, Caraquet NB,
Cap-aux-Meules on the Magdalen Islands, Que., and to less extent at Matane
and Rivière-au-Renard, Que. Non-Gulf based vessels come from Lunenburg and
Petit de Grat, NS and Port aux Basques, Nfld. The fishery is primarily
situated in the northern Gulf of St. Lawrence in the Esquiman Channel at
depths from 240-300 meters. Historical landings are summarized in Figure 1.

## Nominal Catches

Provisional catch statistics indicate that 23,434 t of redfish were taken
from the Gulf of St. Lawrence in 1983 (Table 1). NAFO Division 4S had the
largest share of the redfish catch with 11,614 t being reported. Division 4R
followed with 9,213 t, while 2,607 t were caught in Division 4T. More
redfish were taken by Maritimes vessels (5,047 t in 4R and 6,961 t in 4S)
than by Quebec vessels (3,527 t in 4R and 4,617 in 4S). Quebec vessels based
on the Magdalen Islands commenced fishing in 4R later than Maritimes vessels
due to licensing problems (Table 2). In Division 4T, Quebec vessels landed
1,928 t in comparison to 656 t by Maritimes vessels. Newfoundland vessels
fished primarily in 4R (639 t) with smaller catches reported from 4S (36 t)
and 4T (23 t). The highest catches were taken in August and September for
all divisions combined (Table 2). In Division 4R, the highest catches were
taken in August. Division 4S had the highest catches in September and
October. Catches peaked in July and August in 4T. This may reflect the
seasonal migration of redfish into the Gulf (Atkinson 1984).

The redfish fishery in Divisions 4RST is predominantly an otter trawl
fishery (Table 3). Tonnage class 4 otter trawlers caught 75.3% of the total
catch (17,653 t) and fished in all three divisions. Tonnage class 5 otter
trawlers from Maritimes and Newfoundland took 2,987 t. Shrimp trawlers
operated mainly in 4S where they landed 715 t.

## Catch Composition

Table 4 shows the number of commercial length measurements (25,016) used
to calculate the numbers at age for males (11,902) and females (13,114).
Length measurements from redfish were supplied by Gulf Region (6,823 from PEI
and NB and 4,032 from Que.), Scotia Fundy Region (935) and Newfoundland
Region (7,561) port samplers. In addition the Quebec Observer Program
supplied 2,398 measurements and the Quebec Provincial Government 8,977 length
measurements. Measurements from redfish landed by otter trawlers (6,353) and
shrimp trawlers (5,232) in Division 4S provided the most samples. A total of
8,268 measurements were obtained from otter trawlers in 4R and 5,163 samples
from otter trawlers in 4S. Sampling was adequate in all divisions for most
months (Table 4). High catches of redfish in 4S and 4R in December are
reflected by large samples taken when the fish were landed at ports in 4T and
4R.

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Monthly length frequencies were combined for each sex separately using computer software described by Gavaris and Gavaris (1983). This software allows weighting each monthly length frequency by the appropriate catch weight to obtain composite length frequencies for a chosen time period. Length frequencies were first combined within each division for otter trawlers (and also for shrimp trawler samples in Div. 4S). A flow chart describing how the samples were combined is given (Figure 2). The combinations were made separately for males and for females to obtain yearly length frequencies for each division. The frequencies were further combined and weighted by the total catch weights to obtain frequencies for Divisions 4RST combined for each sex of redfish (Figure 3). An overall frequency for the sexes combined for 1983 was also obtained.

Other combinations of length frequencies weighted by catch weights between divisions were also calculated. The time periods Jan.-Feb., March-June and July-Dec. were combined between Divisions 4R, 4S and 4T. The overall length frequencies for each sex and for sexes combined are very similar to those obtained within divisions. This reflects the fact that the fishery is very homogeneous and has been concentrated on redfish from the early 1970's year classes in the area between the east end of Anticosti Island and the Port aux Port Peninsula (Lussiaà-Berdou and Maguire 1983). A similar fishing pattern for Quebec vessels was exhibited during 1983 (Figure 4). The convergence of Divisions 4R, 4S and 4T in this area means that the same cohorts of redfish are being taken in all divisions.

Recent advice to CAFSAC indicates that the species of redfish being taken by the commercial fishery is the Deepwater Redfish (Sebastes mentella). This species appears to have produced the strong year classes which are presently sustaining the commercial fishery (CAFSAC 1984). The Acadian Redfish (Sebastes fasciatus) predominates only in depths less than 200 m where there is little fishing due to low catch rates and rough bottom.

The combined frequencies for Divisions 4RST were merged with age-length keys for each sex and for the sexes combined to obtain catches at age. The sum of the total variances from ages 8-30 within divisions is 4,182,726 compared to 4,182,584 between divisions. The closeness of the values reflects the homogeneous nature of the catches within and between divisions concentrated on the early 1970's year classes. Within divisions catches at age were used in subsequent calculations to maintain methods comparable to the previous assessment (Maguire, Lussiaà-Berdou and Rubec 1983).

Weights at Age

Weights at age for 1983 were calculated from average lengths at age and the following weight-length relationships (McKone, Atkinson and Legge 1980).

$$Male_{wt} = 0.01659 \ FL^{2.9548}$$

$$Female_{wt} = 0.01372 \ FL^{3.0210}$$

Where FL signifies fork length in centimeters and weights are in grams.

The 1972 to 1980 catch at age and the 1972 to 1981 weights at age were taken from Gavaris and Atkinson (1982). The 1972 to 1982 catch at age matrix is shown in Table 5.

When 1983 weights at age were compared with 1982 weights at age (Table 6), it was noted that the 1983 data were higher on the average than those calculated for 1982. Investigation of this indicated that the bias was due to too much spread of the numbers for each age in the age-length keys. Since weights are approximately proportional to the cube of the length, higher lengths for each age contribute disproportionately to the mean weights at age. The CAFSAC subcommittee noted that the calculated 1983 weights at age were biased and recommended that the mean weights at age for 1981 and 1982 be used to estimate 1983 weights at age. These values are given for 1983 in the weights at age matrix in Table 7.

## Commercial Catch Rates

Commercial catch rates have been used as an abundance index because research vessel indices have too short a time series (Maguire, Lussià-Berdou and Rubec 1983). Commercial catch rates from 1959 to 1982 for the directed redfish fishery (50% or more redfish catches) for vessels tonnage class 4 and larger were standardized to Maritimes and Quebec otter trawlers fishing in Division 4R during January using a multiplicative model (Gavaris 1980). Catch and effort data for 1982 and 1983 were updated.

An unweighted regression was first calculated. The resulting regression coefficients showed the following variables had similar power. They were then combined to increase the explanatory power of the model:

Midwater trawlers TC5 Maritimes and Quebec ⌐
Midwater trawlers TC5 Newfoundland          ⌐

February ⌐
March    ⌐

June ⌐
July ⌐

August    ⌐
September ⌐

Regressions were conducted using the following weighing factors, unweighted, EGLS, Effort, and the fourth root of Catch X Effort. The data set used was the same up to 1981 as that used last year (Maguire, Lussià-Berdou and Rubec 1983).

All regressions showed essentially the same pattern, although the estimated coefficients for the last year (1983) covered a wider range. The fourth root of catch times effort gave the smoothest pattern, and the highest correlation coefficient r and multiple $R^2$ values, of the various regressions tried. The fourth root regression was thus chosen and the resulting Analysis of Variance is shown in Table 8. The catch rates are shown in Table 9 and Figure 5. Catch rates increased from 1962 to 1967 (1.73 t/h) and then declined until 1977 (0.65 t/h). The catch rates have increased since then to reach 1.75 t/h in 1982 and 1.74 t/h in 1983.

Concerns have been expressed that the catch rate in recent years may be somewhat overestimated due to the concentration of fishing effort (Lussiaà-Berdou and Maguire 1983; Maguire, Lussiaà-Berdou and Rubec 1983). There was a shift to the use of Engel 145 high lift trawls by Tonnage Class 4 and 5 vessels commencing in 1981. Several processors have noted that this caused about a 20% increase in the catch rates. Further data are needed before any adjustment can be made in the standardized catch rates derived from the multiplicative model.

## Partial Recruitment

Various methods exist for the calculation of partial recruitment (PR) vectors (O'Boyle 1981). Last year's assessment derived a PR vector for 1982 by taking the percent commercial catch at age divided by the percent research vessel catch at age (Maguire, Lussiaà-Berdou and Rubec 1983). Calculations by this method for the present assessment resulted in an unrealistic fully recruited age of nine. Historical averaging was another method tried. By inputting the 1982 PR vector (Table 10), the catch at age matrix fom 1972 to 1983 and last year's terminal fishing mortality ($F_T$=0.05), a cohort run was made to derive a mortality matrix including data for 1983. Mortality values (F) were averaged over a range of fully recruited ages (14-18) for the years 1972 to 1983, after these F values had been weighted by the population numbers for ages 14-18. For each year, the mean F values were divided into the F values of the mortality matrix for ages 5-29. This derived a partial recruitment matrix. By averaging across the PR matrix a new PR vector was derived. Several PR vectors were calculated (Table 10). The first was unsmoothed and has the age of full recruitment at age 14. The second was smoothed and has the age of full recruitment at age 17.

The PR vectors calculated from the 1983 data were not satisfactory to CAFSAC. The PR vector at age 17 was different from previous assessments which placed the age of full recruitment near age 14. The PR vector at age 14 for 1983 was thought to increase too abruptly. It was decided that the PR vector of 1982 (Table 10) should be used in the present assessment calculations.

## Sequential Population Analysis

Cohort (SPA) runs were conducted with various terminal fishing mortalities ($F_T$). The 1982 PR vector was used for the runs and the natural mortality rate was assumed to be M = 0.10 for all years and all ages. The results of these analyses incorporating 1983 data were not accepted by CAFSAC due to concerns about the 1983 catch at age. CAFSAC decided that it would be best to project from the catch at age matrix from 1972 to 1982 (Maguire, Lussiaà-Berdou and Rubec 1983).

Catch Projections

The abundance of the youngest age classes could not be adequately estimated from the research vessel survey because the survey in 1983 used a Western IIA trawl with 40 mm mesh in the cod-end. Previous research vessel estimates of juvenile abundance were obtained with a Yankee 36 trawl with 19 mm mesh in the cod-end. Consequently, juvenile recruitment was set at 287 million for age 5, which is equal to the geometric mean for the period from 1972 to 1979.

For projections from the catch at age matrix (Table 5), $F_{0.1} = 0.15$ was used as an appropriate average value for redfish (Gavaris and Atkinson 1982). Projections were based on the 1982 assessment (Maguire, Lussiaà-Berdou and Rubec 1983). In Table 11, the first projection at $F_{0.1}$ for all years from 1984 to 1990 assumes that 75,000 t was taken in 1983, when only 23,434 t was estimated to have been taken (Table 2). The second projection assumes that 50,600 t will be taken in 1984 with catches at $F_{0.1}$ thereafter. If 50,600 t is taken in 1984, the projection indicates a TAC of 71,000 t in 1985 and a decline to about 44,300 t by 1990. The third projection incorporates announced TAC's from 1983 to 1988 with catches at $F_{0.1}$ in 1989 and 1990. There is a less precipitous decline in the stock with the exploitable biomass estimated to be 48,100 t by 1990. Catch projections at age for 1984 and 1985 are calculated at $F_{0.1}$ for both years (Table 12), at 50,600 t in 1984 and $F_{0.1}$ in 1985 (Table 13), and at the announced quotas of 50,600 t in 1984 and 50,000 t in 1985 (Table 14).

Acknowledgements

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**Table 1** Nominal catches of redfish by division, country, region and year in the Gulf of St. Lawrence in metric tons.

| YEAR | 4R | | | | | 4S | | | | | 4T | | | | | 4RST TOTAL | TAC |
|------|------|------|------|------|-------|------|------|------|------|-------|------|------|------|------|-------|-------|-------|
| | CAN-N | CAN-M | CAN-Q | FRAN | TOTAL | CAN-N | CAN-M | CAN-Q | FRAN | TOTAL | CAN-N | CAN-M | CAN-Q | FRAN | TOTAL | | |
| 1979 | 717 | 1722 | 1197 | 127 | 3763 | 32 | 2408 | 5189 | 0 | 7629 | 74 | 1773 | 1795 | 0 | 3642 | 15034 | 16000 |
| 1980 | 709 | 2476 | 1567 | 57 | 4809 | 184 | 2444 | 5497 | 0 | 8125 | 0 | 668 | 1230 | 0 | 1898 | 14832 | 16000 |
| 1981 | 1207 | 3802 | 2660 | 16 | 7685 | 411 | 3618 | 6144 | 0 | 10173 | 270 | 1100 | 1321 | 0 | 2691 | 20549 | 20000 |
| 1982 | 1880 | 4028 | 3492 | 10 | 9410 | 358 | 6792 | 6647 | 0 | 13797 | 117 | 498 | 2607 | 0 | 3222 | 26429 | 31000 |
| 1983 | 639 | 5047 | 3527 | 0 | 9213 | 36 | 6961 | 4617 | 0 | 11614 | 23 | 656 | 1928 | 0 | 2607 | 23434 | 33000 |

Table 2   4 RST redfish nominal catches by division, region and month in 1983.

| MONTH | 4R | | | | 4S | | | | 4T | | | | 4RST TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CAN-N | CAN-M | CAN-Q | TOTAL | CAN-N | CAN-M | CAN-Q | TOTAL | CAN-N | CAN-M | CAN-Q | TOTAL | |
| Jan | 66 | 27 | 0 | 93 | 6 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 99 |
| Feb | 3 | 10 | 0 | 13 | 0 | 6 | 0 | 6 | 0 | 0 | 0 | 0 | 19 |
| Mar | 56 | 0 | 0 | 56 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 57 |
| Apr | 38 | 1 | 0 | 39 | 0 | 0 | 2 | 2 | 0 | 1 | 0 | 1 | 42 |
| May | 33 | 135 | 0 | 168 | 1 | 14 | 135 | 150 | 0 | 1 | 4 | 5 | 323 |
| Jun | 9 | 1277 | 0 | 1286 | 0 | 1047 | 252 | 1299 | 0 | 17 | 344 | 361 | 2946 |
| Jul | 105 | 606 | 307 | 1018 | 0 | 802 | 412 | 1214 | 0 | 224 | 756 | 980 | 3212 |
| Aug | 181 | 784 | 912 | 1877 | 0 | 1190 | 603 | 1793 | 21 | 316 | 617 | 954 | 4624 |
| Sep | 105 | 501 | 1002 | 1608 | 29 | 1837 | 965 | 2831 | 0 | 65 | 196 | 261 | 4700 |
| Oct | 7 | 390 | 854 | 1251 | 0 | 1139 | 927 | 2066 | 0 | 9 | 11 | 20 | 3337 |
| Nov | 0 | 237 | 117 | 354 | 0 | 366 | 846 | 1212 | 2 | 21 | 0 | 23 | 1589 |
| Dec | 36 | 1079 | 335 | 1450 | 0 | 559 | 475 | 1034 | 0 | 2 | 0 | 2 | 2486 |
| TOTAL | 639 | 5047 | 3527 | 9213 | 36 | 6961 | 4617 | 11614 | 23 | 656 | 1928 | 2607 | 23434 |

Table 3  4 RST Redfish Nominal Catches by year, tonnage class and division in 1983.

| | | 4R | | | | 4S | | | | 4T | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CAN-N | CAN-M | CAN-Q | TOTAL | CAN-N | CAN-M | CAN-Q | TOTAL | CAN-N | CAN-M | CAN-Q | TOTAL | |
| OTB | 0 | | | | | | | | | | | | | |
| OTB | 1 | | | | | | | | | | 1 | | 1 | 1 |
| OTB | 2 | | | | | | | 89 | 89 | 2 | | 14 | 16 | 105 |
| OTB | 3 | 277 | 5 | | 282 | | 662 | 162 | 824 | 5 | 496 | 123 | 624 | 1730 |
| OTB | 4 | 36 | 3160 | 3526 | 6722 | 29 | 5131 | 3845 | 9005 | | 156 | 1770 | 1926 | 17653 |
| OTB | 5 | 152 | 1867 | | 2019 | 7 | 959 | | 966 | | 2 | | 2 | 2987 |
| ST | 2 | | | | | | | 169 | 169 | | 2 | | 2 | 171 |
| ST | 3 | | 15 | 1 | 16 | | 207 | 337 | 544 | | 1 | 15 | 16 | 576 |
| ST | 4 | | | | | | 2 | | 2 | | | | | 2 |
| SDN | 2 | 8 | | | 8 | | | | | | | | | 8 |
| SDN | 3 | 127 | | | 127 | | | | | | | | | 127 |
| SDN | 4 | | | | | | | | | | | | | |
| GNS | 0 | 35 | | | 35 | | | | | | | | | 35 |
| GNS | 2 | 4 | | | 4 | | | | | | | | | 4 |
| GNS | 3 | | | | | | | | | 16 | | | 16 | 16 |
| LLS | 2 | | | | | | 15 | | 15 | | | 4 | 4 | 19 |
| TOTAL | | 639 | 5047 | 3527 | 9214 | 36 | 6961 | 4617 | 11614 | 23 | 656 | 1928 | 2607 | 23434 |

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**Table 4** Redfish 4RST commercial sampling & nominal catches for 1983. Number of fish measured (male-female)/ nominal catches.

| MONTH | 4R | | | 4S | | | 4T | | |
|---|---|---|---|---|---|---|---|---|---|
| | OTB | ST | OTHER | OTB | ST | OTHER | OTB | ST | OTHER |
| Jan | 481-737/93 | | | 151-147/6 | | | | | |
| Feb | 0-0/13 | | | 0-0/6 | | | | | |
| Mar | 152-259/56 | | | 0-0/1 | | | | | |
| Apr | 495-203/39 | | | | 0-0/2 | | | 0-0/1 | |
| May | 497-389/158 | 0-0/5 | 0-0/5 | 0-0/117 | 107-69/32 | 0-0/1 | 0-0/5 | | |
| Jun | 341-288/1279 | 0-0/1 | 0-0/6 | 230-179/1209 | 753-246/89 | 0-0/1 | 232-170/352 | 0-0/1 | 0-0/8 |
| Jul | 239-206/1005 | 0-0/1 | 0-0/12 | 622-483/1044 | 542-551/158 | 0-0/12 | 97-77/970 | 0-0/10 | |
| Aug | 400-485/1730 | 0-0/8 | 0-0/139 | 628-731/1646 | 614-815/146 | 0-0/1 | 113-69/932 | 0-0/4 | 0-0/18 |
| Sep | 603-1017/1598 | | 0-0/10 | 800-1075/2637 | 463-883/193 | 0-0/1 | 0-0/241 | 0-0/3 | 0-0/17 |
| Oct | 306-402/1249 | | 0-0/2 | 486-571/1984 | 68-121/82 | | 0-0/19 | 0-0/1 | |
| Nov | 0-0/354 | | | 87-163/1200 | 0-0/12 | | 681-743/23 | | |
| Dec | 322-446/1450 | | | 0-0/1034 | | | 1392-1589/2 | | |

Table 5   4RST redfish catch at age for 1972 to 1982.

| Age | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 142 | 273 | 170 | 355 | 7359 | 3801 | 3368 | 2266 | 125 | 1 | 1 |
| 6 | 1272 | 639 | 698 | 620 | 1482 | 2119 | 2656 | 2378 | 285 | 4 | 1 |
| 7 | 784 | 3112 | 292 | 290 | 1073 | 824 | 511 | 2233 | 2728 | 308 | 72 |
| 8 | 944 | 2380 | 444 | 401 | 372 | 669 | 280 | 2899 | 7800 | 2586 | 767 |
| 9 | 1887 | 803 | 510 | 448 | 188 | 620 | 800 | 2373 | 7928 | 10810 | 3642 |
| 10 | 4297 | 3434 | 210 | 286 | 44 | 416 | 708 | 2753 | 5723 | 11974 | 4395 |
| 11 | 2938 | 8043 | 403 | 161 | 146 | 409 | 491 | 1902 | 2141 | 7276 | 9634 |
| 12 | 6366 | 2497 | 463 | 329 | 125 | 236 | 372 | 1838 | 1516 | 5222 | 9421 |
| 13 | 2588 | 12850 | 2240 | 974 | 383 | 171 | 131 | 931 | 853 | 3419 | 8467 |
| 14 | 14034 | 7060 | 5381 | 1654 | 716 | 177 | 131 | 510 | 532 | 2085 | 6701 |
| 15 | 7971 | 76633 | 6364 | 2956 | 1836 | 79 | 153 | 326 | 531 | 1219 | 5098 |
| 16 | 66593 | 8222 | 28739 | 4572 | 3913 | 123 | 86 | 346 | 265 | 940 | 2254 |
| 17 | 5102 | 88382 | 7953 | 25149 | 4025 | 509 | 247 | 887 | 306 | 328 | 1727 |
| 18 | 7659 | 5583 | 37269 | 5771 | 15842 | 379 | 1003 | 1131 | 300 | 401 | 668 |
| 19 | 4299 | 9916 | 2989 | 41020 | 3380 | 2959 | 1399 | 2392 | 500 | 973 | 906 |
| 20 | 3697 | 7166 | 3387 | 4156 | 16519 | 1273 | 3621 | 1943 | 1601 | 858 | 995 |
| 21 | 2471 | 4548 | 1371 | 3453 | 1533 | 5259 | 1294 | 3376 | 921 | 1133 | 792 |
| 22 | 2598 | 4333 | 1233 | 3489 | 2131 | 2519 | 3468 | 1542 | 2446 | 1192 | 997 |
| 23 | 2366 | 4934 | 471 | 2634 | 1431 | 2314 | 4425 | 3048 | 1348 | 2120 | 1344 |
| 24 | 1168 | 1306 | 1168 | 1632 | 1317 | 1814 | 1027 | 1013 | 2219 | 1235 | 2020 |
| 25 | 5840 | 2277 | 825 | 1356 | 543 | 1160 | 725 | 869 | 822 | 1555 | 1001 |
| 26 | 1 | 7963 | 1815 | 1186 | 430 | 1027 | 222 | 905 | 505 | 826 | 1336 |
| 27 | 1 | 1 | 5844 | 2080 | 408 | 229 | 222 | 506 | 298 | 458 | 673 |
| 28 | 1 | 1 | 1 | 7259 | 659 | 515 | 315 | 522 | 234 | 262 | 539 |
| 29 | 1 | 1 | 1 | 1 | 2370 | 196 | 103 | 102 | 78 | 136 | 245 |

**Table 6** Comparison of mean weights and mean lengths of Division 4RST redfish between 1982 and 1983 for sexes combined (commercial data), which shows error in 1983 values due to ageing problem.

| Age | Mean Weight (kg) | | Mean Fork Length (cm) | |
|---|---|---|---|---|
| | 1982 | 1983 | 1982 | 1983 |
| 7 | 0.118 | 0.085 | 20.4 | 18.0 |
| 8 | 0.197 | 0.209 | 23.1 | 24.3 |
| 9 | 0.245 | 0.271 | 24.4 | 26.3 |
| 10 | 0.287 | 0.337 | 26.0 | 28.3 |
| 11 | 0.317 | 0.355 | 27.3 | 28.9 |
| 12 | 0.345 | 0.388 | 28.2 | 29.7 |
| 13 | 0.377 | 0.395 | 29.8 | 29.9 |
| 14 | 0.387 | 0.412 | 30.5 | 30.4 |
| 15 | 0.420 | 0.432 | 31.1 | 30.9 |
| 16 | 0.483 | 0.517 | 32.3 | 32.7 |
| 17 | 0.478 | 0.551 | 32.2 | 33.4 |
| 18 | 0.529 | 0.602 | 33.9 | 34.5 |
| 19 | 0.479 | 0.601 | 33.2 | 34.4 |
| 20 | 0.492 | 0.711 | 33.5 | 36.3 |
| 21 | 0.510 | 0.693 | 34.1 | 35.9 |
| 22 | 0.527 | 0.830 | 34.3 | 38.2 |
| 23 | 0.567 | 0.836 | 35.1 | 38.2 |
| 24 | 0.602 | 0.884 | 35.1 | 39.0 |
| 25 | 0.652 | 0.912 | 36.0 | 39.3 |
| 26 | 0.666 | 0.809 | 36.3 | 37.8 |
| 27 | 0.753 | 1.020 | 38.2 | 40.9 |
| 28 | 0.771 | 0.923 | 38.4 | 39.4 |
| 29 | 0.835 | 0.812 | 39.0 | 38.0 |
| 30 | 0.970 | 1.144 | 40.5 | 39.2 |

Table 7   4RST redfish average weights at age for 1972 to 1983.

| Age | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 0.090 | 0.090 | 0.090 | 0.090 | 0.090 | 0.090 | 0.090 | 0.090 | 0.090 | 0.090 | 0.090 | 0.090 |
| 6 | 0.103 | 0.103 | 0.103 | 0.103 | 0.103 | 0.103 | 0.103 | 0.103 | 0.103 | 0.085 | 0.085 | 0.085 |
| 7 | 0.135 | 0.135 | 0.135 | 0.135 | 0.135 | 0.135 | 0.135 | 0.135 | 0.135 | 0.165 | 0.118 | 0.142 |
| 8 | 0.169 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.219 | 0.197 | 0.208 |
| 9 | 0.205 | 0.205 | 0.205 | 0.205 | 0.205 | 0.205 | 0.205 | 0.205 | 0.205 | 0.263 | 0.245 | 0.254 |
| 10 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.293 | 0.287 | 0.290 |
| 11 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 | 0.320 | 0.317 | 0.319 |
| 12 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.346 | 0.345 | 0.346 |
| 13 | 0.362 | 0.362 | 0.362 | 0.362 | 0.362 | 0.362 | 0.362 | 0.362 | 0.362 | 0.388 | 0.377 | 0.383 |
| 14 | 0.403 | 0.403 | 0.403 | 0.403 | 0.403 | 0.403 | 0.403 | 0.403 | 0.403 | 0.406 | 0.387 | 0.397 |
| 15 | 0.443 | 0.443 | 0.443 | 0.443 | 0.443 | 0.443 | 0.443 | 0.443 | 0.443 | 0.454 | 0.420 | 0.437 |
| 16 | 0.482 | 0.482 | 0.482 | 0.482 | 0.482 | 0.482 | 0.482 | 0.482 | 0.482 | 0.465 | 0.483 | 0.474 |
| 17 | 0.521 | 0.521 | 0.521 | 0.521 | 0.521 | 0.521 | 0.521 | 0.521 | 0.521 | 0.502 | 0.478 | 0.490 |
| 18 | 0.559 | 0.559 | 0.559 | 0.559 | 0.559 | 0.559 | 0.559 | 0.559 | 0.559 | 0.535 | 0.529 | 0.532 |
| 19 | 0.596 | 0.596 | 0.596 | 0.596 | 0.596 | 0.596 | 0.596 | 0.596 | 0.596 | 0.522 | 0.479 | 0.501 |
| 20 | 0.631 | 0.631 | 0.631 | 0.631 | 0.631 | 0.631 | 0.631 | 0.631 | 0.631 | 0.569 | 0.492 | 0.531 |
| 21 | 0.665 | 0.665 | 0.665 | 0.665 | 0.665 | 0.665 | 0.665 | 0.665 | 0.665 | 0.552 | 0.518 | 0.535 |
| 22 | 0.698 | 0.698 | 0.698 | 0.698 | 0.698 | 0.698 | 0.698 | 0.698 | 0.698 | 0.621 | 0.527 | 0.574 |
| 23 | 0.730 | 0.730 | 0.730 | 0.730 | 0.730 | 0.730 | 0.730 | 0.730 | 0.730 | 0.613 | 0.567 | 0.590 |
| 24 | 0.759 | 0.759 | 0.759 | 0.759 | 0.759 | 0.759 | 0.759 | 0.759 | 0.759 | 0.626 | 0.602 | 0.614 |
| 25 | 0.788 | 0.788 | 0.788 | 0.788 | 0.788 | 0.788 | 0.788 | 0.788 | 0.788 | 0.682 | 0.652 | 0.667 |
| 26 | 0.815 | 0.815 | 0.815 | 0.815 | 0.815 | 0.815 | 0.815 | 0.815 | 0.815 | 0.757 | 0.666 | 0.712 |
| 27 | 0.841 | 0.841 | 0.841 | 0.841 | 0.841 | 0.841 | 0.841 | 0.841 | 0.841 | 0.782 | 0.753 | 0.768 |
| 28 | 0.866 | 0.866 | 0.866 | 0.866 | 0.866 | 0.866 | 0.866 | 0.866 | 0.866 | 0.869 | 0.771 | 0.820 |
| 29 | 0.889 | 0.889 | 0.889 | 0.889 | 0.889 | 0.889 | 0.889 | 0.889 | 0.889 | 0.879 | 0.835 | 0.857 |

**Table 8:** 4RST redfish ANOVA table from standardization model.

Multiple r = 0.736
Multiple $R^2$ = 0.541

| SOURCE OF VARIATION | DEGREES OF FREEDOM | SUM OF SQUARES | MEAN SQUARES | F VALUE |
|---|---|---|---|---|
| Intercept | 1 | 17.11 | 17.11 | |
| Regression | 3 | 277.90 | 7.13 | 44.48 |
| Gear type-tonnage class | 5 | 61.88 | 12.38 | 77.25 |
| Months | 8 | 162.20 | 20.27 | 126.52 |
| Divisions | 2 | 4.48 | 2.24 | 13.97 |
| Years | 24 | 123.50 | 5.14 | 32.11 |
| Residuals | 1470 | 235.50 | 0.16 | |
| TOTAL | 1510 | 530.50 | | |

Table 9: 4RST redfish catch rate standardized to Maritimes and Quebec tonnage class 4 otter trawlers in Division 4R during the month of January.

| YEAR | TOTAL CATCH | PROPORTION OF TOTAL CATCH ACCOUNTED FOR IN STANDARD CPUE | CATCH RATE | | EFFORT |
|------|------|------|------|------|------|
| | | | MEAN | STANDARD ERROR | |
| 1959 | 16,978 | 0.392 | 0.798 | 0.083 | 21,282 |
| 1960 | 12,218 | 0.389 | 0.790 | 0.082 | 15,462 |
| 1961 | 10,391 | 0.393 | 0.730 | 0.086 | 14,241 |
| 1962 | 6,585 | 0.208 | 0.575 | 0.079 | 11,448 |
| 1963 | 19,794 | 0.361 | 1.091 | 0.110 | 18,146 |
| 1964 | 29,700 | 0.162 | 1.220 | 0.135 | 24,341 |
| 1965 | 48,827 | 0.242 | 1.271 | 0.126 | 38,420 |
| 1966 | 65,215 | 0.331 | 1.402 | 0.118 | 46,511 |
| 1967 | 70,036 | 0.260 | 1.725 | 0.150 | 40,589 |
| 1968 | 90,963 | 0.395 | 1.646 | 0.129 | 55,248 |
| 1969 | 88,875 | 0.494 | 1.139 | 0.084 | 78,006 |
| 1970 | 87,588 | 0.555 | 0.944 | 0.066 | 92,790 |
| 1971 | 79,406 | 0.531 | 0.928 | 0.066 | 85,592 |
| 1972 | 80,329 | 0.741 | 1.128 | 0.082 | 71,187 |
| 1973 | 130,164 | 0.833 | 0.888 | 0.064 | 146,567 |
| 1974 | 63,489 | 0.792 | 0.637 | 0.045 | 99,655 |
| 1975 | 65,401 | 0.818 | 0.645 | 0.046 | 101,437 |
| 1976 | 37,983 | 0.704 | 0.730 | 0.055 | 52,044 |
| 1977 | 15,840 | 0.494 | 0.645 | 0.059 | 24,558 |
| 1978 | 13,591 | 0.578 | 0.832 | 0.080 | 16,340 |
| 1979 | 15,034 | 0.495 | 0.875 | 0.095 | 17,182 |
| 1980 | 14,832 | 0.688 | 1.263 | 0.128 | 11,747 |
| 1981 | 20,549 | 0.557 | 1.421 | 0.141 | 14,458 |
| 1982 | 26,429 | 0.784 | 1.746 | 0.140 | 15,139 |
| 1983 | 23,434 | 0.837 | 1.735 | 0.140 | 13,504 |

Table 10: 4RST redfish partial recruitment vectors used in tuning of cohort.

| Age | 1982 Full recruitment at 14 | 1983 Full recruitment at 14 | 1983 Full recruitment at 17 |
|---|---|---|---|
| 5 | 0.003 | 0.018 | 0.013 |
| 6 | 0.003 | 0.026 | 0.019 |
| 7 | 0.060 | 0.050 | 0.036 |
| 8 | 0.170 | 0.074 | 0.053 |
| 9 | 0.300 | 0.100 | 0.071 |
| 10 | 0.450 | 0.198 | 0.107 |
| 11 | 0.600 | 0.303 | 0.161 |
| 12 | 0.750 | 0.227 | 0.207 |
| 13 | 0.900 | 0.409 | 0.268 |
| 14 | 1.000 | 1.000 | 0.386 |
| 15 | 1.000 | 1.000 | 0.571 |
| 16 | 1.000 | 1.000 | 0.821 |
| 17 | 1.000 | 1.000 | 1.000 |
| 18 | 1.000 | 1.000 | 1.000 |
| 19 | 1.000 | 1.000 | 1.000 |
| 20 | 1.000 | 1.000 | 1.000 |
| 21 | 1.000 | 1.000 | 1.000 |
| 22 | 1.000 | 1.000 | 1.000 |
| 23 | 1.000 | 1.000 | 1.000 |
| 24 | 1.000 | 1.000 | 1.000 |
| 25 | 1.000 | 1.000 | 1.000 |
| 26 | 1.000 | 1.000 | 1.000 |
| 27 | 1.000 | 1.000 | 1.000 |
| 28 | 1.000 | 1.000 | 1.000 |
| 29 | 1.000 | 1.000 | 1.000 |

Table 11: Biomass projections in metric tonnes for 4RST redfish based on 1^83 assessment. The partial recruitment is that used in the 1983 assessment and recruitment at age 5 was set at 287 million.

| 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|

1. Projection from 1983 assessment with all years at $F_{0.1}$

| 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|
| 69,200 | 62,800 | 56,100 | 50,900 | 46,200 | 43,600 | 41,600 |

2. Projection from 1983 assessment with 1984 being 50,600 t and $F_{0.1}$ thereafter.

| 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|
| 50,600 | 71,500 | 63,200 | 56,700 | 50,600 | 47,100 | 44,300 |

3. Projection from 1983 assessment with approved TAC's to 1988 and $F_{0.1}$ thereafter.

| 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|
| 50,600 | 50,000 | 55,000 | 55,000 | 60,000 | 51,300 | 48,100 |

**Table 12:** 4RST redfish projections from 1983 assessment at $F_{0.1}$ for 1984 and 1985. (Assumes 75,000t taken in 1983). G.M. recruitment = 287 million, partial recruitment as used in 1983 assessment

| Age | Population Numbers in thousands 1984 | 1985 | Population Biomass (mean) in metric tonnes 1984 | 1985 | Catch Biomass 1984 | 1985 | Fishing Mortality 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|
| 5 | 287,000 | 287,000 | 24,575 | 24,575 | 11 | 11 | 0.000 | 0.000 |
| 6 | 259,572 | 259,572 | 20,992 | 20,992 | 9 | 9 | 0.000 | 0.000 |
| 7 | 234,869 | 234,764 | 26,258 | 26,246 | 236 | 236 | 0.009 | 0.009 |
| 8 | 210,962 | 210,614 | 39,057 | 38,993 | 996 | 994 | 0.026 | 0.026 |
| 9 | 20,098 | 186,080 | 4,584 | 42,439 | 206 | 1,910 | 0.045 | 0.045 |
| 10 | 73,898 | 17,385 | 19,528 | 4,594 | 1,318 | 310 | 0.068 | 0.068 |
| 11 | 193,773 | 62,501 | 55,943 | 18,044 | 5,035 | 1,624 | 0.090 | 0.090 |
| 12 | 151,841 | 160,243 | 47,193 | 49,805 | 5,309 | 5,603 | 0.113 | 0.113 |
| 13 | 243,144 | 122,773 | 81,691 | 41,249 | 11,028 | 5,569 | 0.135 | 0.135 |
| 14 | 185,271 | 192,222 | 63,440 | 65,820 | 9,516 | 9,875 | 0.150 | 0.150 |
| 15 | 136,168 | 144,289 | 50,602 | 53,620 | 7,590 | 8,043 | 0.150 | 0.150 |
| 16 | 96,743 | 106,048 | 41,344 | 45,320 | 6,202 | 6,798 | 0.150 | 0.150 |
| 17 | 73,600 | 75,343 | 31,128 | 31,865 | 4,669 | 4,780 | 0.150 | 0.150 |
| 18 | 32,541 | 57,320 | 15,231 | 26,829 | 2,285 | 4,024 | 0.150 | 0.150 |
| 19 | 24,933 | 25,343 | 10,567 | 10,741 | 1,585 | 1,611 | 0.150 | 0.150 |
| 20 | 9,644 | 19,417 | 4,198 | 8,453 | 630 | 1,268 | 0.150 | 0.150 |
| 21 | 13,080 | 7,511 | 5,902 | 3,389 | 885 | 508 | 0.150 | 0.150 |
| 22 | 14,365 | 10,187 | 6,698 | 4,750 | 1,005 | 712 | 0.150 | 0.150 |
| 23 | 11,434 | 11,187 | 5,433 | 5,316 | 815 | 797 | 0.150 | 0.150 |
| 24 | 14,394 | 8,905 | 7,667 | 4,743 | 1,150 | 711 | 0.150 | 0.150 |
| 25 | 19,403 | 11,210 | 11,193 | 6,467 | 1,679 | 970 | 0.150 | 0.150 |
| 26 | 29,163 | 15,111 | 17,185 | 8,905 | 2,578 | 1,336 | 0.150 | 0.150 |
| 27 | 14,451 | 22,712 | 9,629 | 15,132 | 1,444 | 2,270 | 0.150 | 0.150 |
| 28 | 19,288 | 11,255 | 13,158 | 7,678 | 1,974 | 1,152 | 0.150 | 0.150 |
| 29 | 9,716 | 15,021 | 7,178 | 11,098 | 1,077 | 1,665 | 0.150 | 0.150 |
| 5+ | 2,379,348 | 2,274,012 | 620,372 | 577,061 | 69,232 | 62,785 | | |
| 14+ | 704,194 | 733,081 | 300,553 | 310,126 | 45,084 | 46,520 | | |

**Table 13:** 4RST redfish projections from 1983 assessment taking 50,600t in 1984 and $F_{0.1}$ in 1985. G.M. recruitment = 287 million, partial recruitment as used in 1983 assessment.

| Age | Population Numbers in thousands 1984 | 1985 | Population Biomass (mean) in metric tonnes 1984 | 1985 | Catch Biomass 1984 | 1985 | Fishing Mortality 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|
| 5 | 287,000 | 287,000 | 24,577 | 24,575 | 7 | 11 | 0.000 | 0.000 |
| 6 | 259,654 | 259,612 | 21,000 | 20,995 | 6 | 9 | 0.000 | 0.000 |
| 7 | 234,943 | 234,875 | 26,306 | 26,258 | 155 | 236 | 0.006 | 0.009 |
| 8 | 212,300 | 211,339 | 39,476 | 39,127 | 658 | 998 | 0.017 | 0.026 |
| 9 | 20,461 | 188,922 | 4,702 | 43,087 | 138 | 1,939 | 0.029 | 0.045 |
| 10 | 76,271 | 17,977 | 20,386 | 4,751 | 899 | 321 | 0.044 | 0.068 |
| 11 | 203,184 | 66,035 | 59,555 | 19,065 | 3,503 | 1,716 | 0.059 | 0.090 |
| 12 | 161,752 | 173,348 | 51,231 | 53,876 | 3,766 | 6,061 | 0.074 | 0.113 |
| 13 | 263,141 | 135,985 | 90,427 | 45,688 | 7,978 | 6,168 | 0.088 | 0.135 |
| 14 | 203,703 | 217,995 | 71,518 | 74,645 | 7,010 | 11,197 | 0.098 | 0.150 |
| 15 | 151,302 | 167,108 | 57,650 | 62,100 | 5,651 | 9,315 | 0.098 | 0.150 |
| 16 | 107,494 | 124,121 | 47,102 | 53,044 | 4,617 | 7,957 | 0.098 | 0.150 |
| 17 | 81,779 | 88,183 | 35,464 | 37,296 | 3,476 | 5,594 | 0.098 | 0.150 |
| 18 | 36,157 | 67,088 | 17,352 | 31,401 | 1,701 | 4,710 | 0.098 | 0.150 |
| 19 | 27,703 | 29,662 | 12,039 | 12,571 | 1,180 | 1,886 | 0.098 | 0.150 |
| 20 | 10,716 | 22,727 | 4,783 | 9,893 | 469 | 1,484 | 0.098 | 0.150 |
| 21 | 14,534 | 8,791 | 6,724 | 3,967 | 659 | 595 | 0.098 | 0.150 |
| 22 | 15,961 | 11,923 | 7,631 | 5,559 | 748 | 834 | 0.098 | 0.150 |
| 23 | 12,705 | 13,094 | 6,190 | 6,221 | 607 | 933 | 0.098 | 0.150 |
| 24 | 15,993 | 10,423 | 8,735 | 5,552 | 856 | 833 | 0.098 | 0.150 |
| 25 | 21,559 | 13,120 | 12,753 | 7,569 | 1,250 | 1,135 | 0.098 | 0.150 |
| 26 | 32,404 | 17,686 | 19,579 | 10,422 | 1,919 | 1,563 | 0.098 | 0.150 |
| 27 | 16,058 | 26,583 | 10,969 | 17,711 | 1,075 | 2,657 | 0.098 | 0.150 |
| 28 | 21,431 | 13,173 | 14,990 | 8,986 | 1,469 | 1,348 | 0.098 | 0.150 |
| 29 | 10,796 | 17,581 | 8,178 | 12,989 | 802 | 1,948 | 0.098 | 0.150 |
| 5+ | 2,449,003 | 2,424,350 | 679,318 | 637,349 | 50,600 | 71,448 | | |
| 14+ | 780,295 | 849,258 | 341,657 | 359,927 | 33,489 | 53,989 | | |

Table 14: 4RST projections from 1983 assessment with approved TAC's for 1984 and 1985.
G.M. recruitment set at 287 million, partial recruitment as used in 1983 assessment.

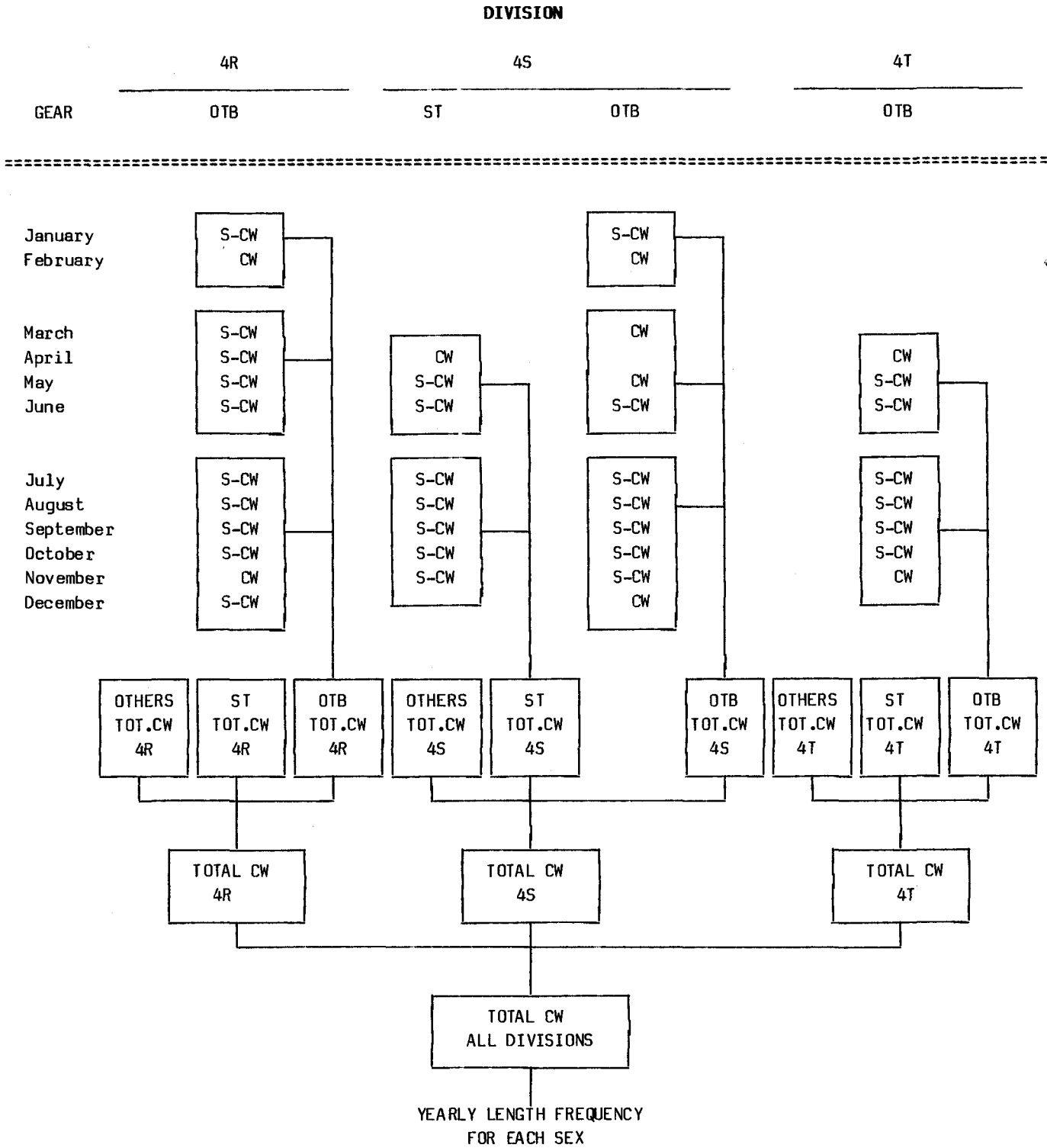| Age | Population Numbers in thousands 1984 | 1985 | Population Biomass (mean) in metric tonnes 1984 | 1985 | Catch Biomass 1984 | 1985 | Fishing Mortality 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|
| 5 | 287,000 | 287,000 | 24,577 | 24,577 | 7 | 7 | 0.000 | 0.000 |
| 6 | 259,654 | 259,614 | 21,000 | 20,997 | 6 | 6 | 0.000 | 0.000 |
| 7 | 234,944 | 234,878 | 31,547 | 31,535 | 181 | 189 | 0.006 | 0,006 |
| 8 | 212,313 | 211,372 | 41,691 | 41,491 | 677 | 704 | 0.016 | 0.017 |
| 9 | 20,467 | 189,016 | 4,878 | 45,021 | 140 | 1,349 | 0.029 | 0.030 |
| 10 | 76,321 | 17,996 | 20,624 | 4,858 | 886 | 218 | 0.043 | 0.045 |
| 11 | 203,401 | 66,154 | 59,946 | 19,472 | 3,434 | 1,167 | 0.057 | 0.060 |
| 12 | 162,000 | 173,800 | 51,432 | 55,090 | 3,682 | 4,126 | 0.072 | 0.070 |
| 13 | 263,668 | 136,456 | 92,033 | 47,538 | 7,907 | 4,273 | 0.086 | 0.090 |
| 14 | 204,206 | 218,935 | 73,546 | 78,683 | 7,021 | 7,858 | 0.095 | 0.100 |
| 15 | 151,739 | 167,950 | 60,232 | 66,525 | 5,750 | 6,644 | 0.095 | 0.100 |
| 16 | 107,829 | 124,799 | 46,426 | 53,618 | 4,432 | 5,355 | 0.095 | 0.100 |
| 17 | 82,034 | 88,684 | 36,512 | 39,388 | 3,486 | 3,934 | 0.095 | 0.100 |
| 18 | 36,270 | 67,469 | 17,527 | 32,534 | 1,673 | 3,249 | 0.095 | 0.100 |
| 19 | 27,790 | 29,830 | 12,634 | 13,532 | 1,206 | 1,352 | 0.095 | 0.100 |
| 20 | 10,749 | 22,856 | 5,180 | 10,990 | 494 | 1,098 | 0.095 | 0.100 |
| 21 | 14,579 | 8,841 | 7,032 | 4,255 | 671 | 425 | 0.095 | 0.100 |
| 22 | 16,011 | 11,990 | 8,348 | 6,238 | 797 | 623 | 0.095 | 0.100 |
| 23 | 12,745 | 13,168 | 6,656 | 6,863 | 635 | 685 | 0.095 | 0.100 |
| 24 | 16,043 | 10,482 | 8,948 | 5,833 | 854 | 583 | 0.095 | 0.100 |
| 25 | 21,627 | 13,195 | 13,103 | 7,977 | 1,251 | 797 | 0.095 | 0.100 |
| 26 | 32,505 | 17,787 | 21,007 | 11,471 | 2,005 | 1,146 | 0.095 | 0.100 |
| 27 | 16,107 | 26,734 | 11,229 | 18,598 | 1,072 | 1,857 | 0.095 | 0.100 |
| 28 | 21,498 | 13,248 | 16,013 | 9,846 | 1,529 | 983 | 0.095 | 0.100 |
| 29 | 10,830 | 17,681 | 8,430 | 13,735 | 805 | 1,372 | 0.095 | 0.100 |
| 5+ | 2,502,330 | 2,429,934 | 700,550 | 670,665 | 50,600 | 50,000 | | |
| 14+ | 782,562 | 853,649 | 352,823 | 380,086 | 33,681 | 37,961 | | |
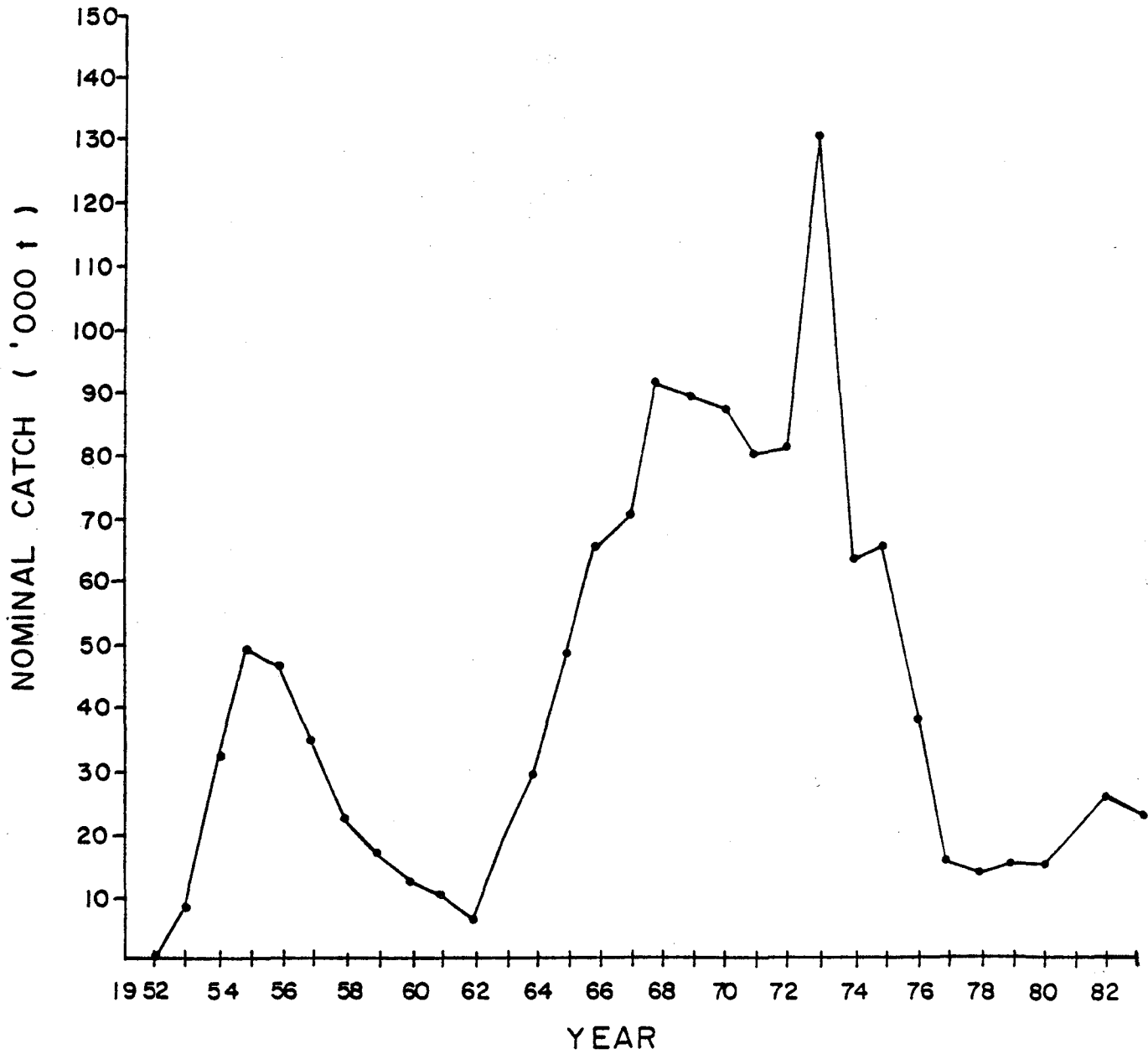
Figure 1.   4RST redfish total nominal catches for 1952-1983

**Figure 2:** 4RST redfish sample combination used to calculate the 1983 catch at age for each sex. "S" represents length frequency samples which were combined and "CW" represents monthly weights to which length frequencies were applied.
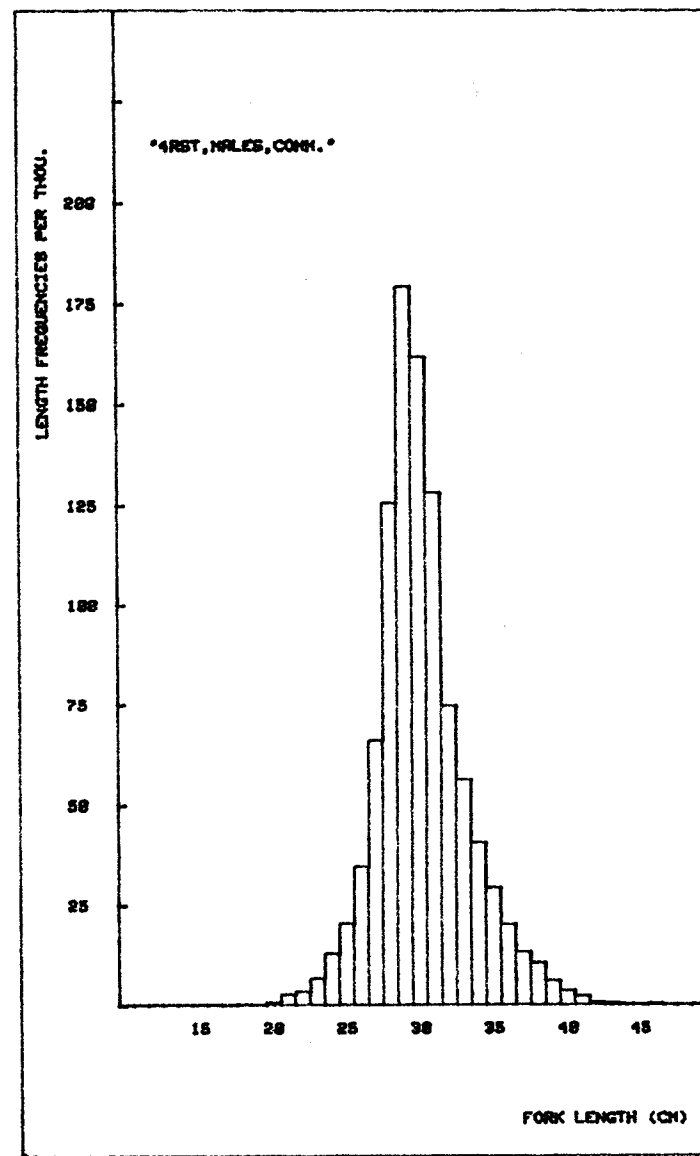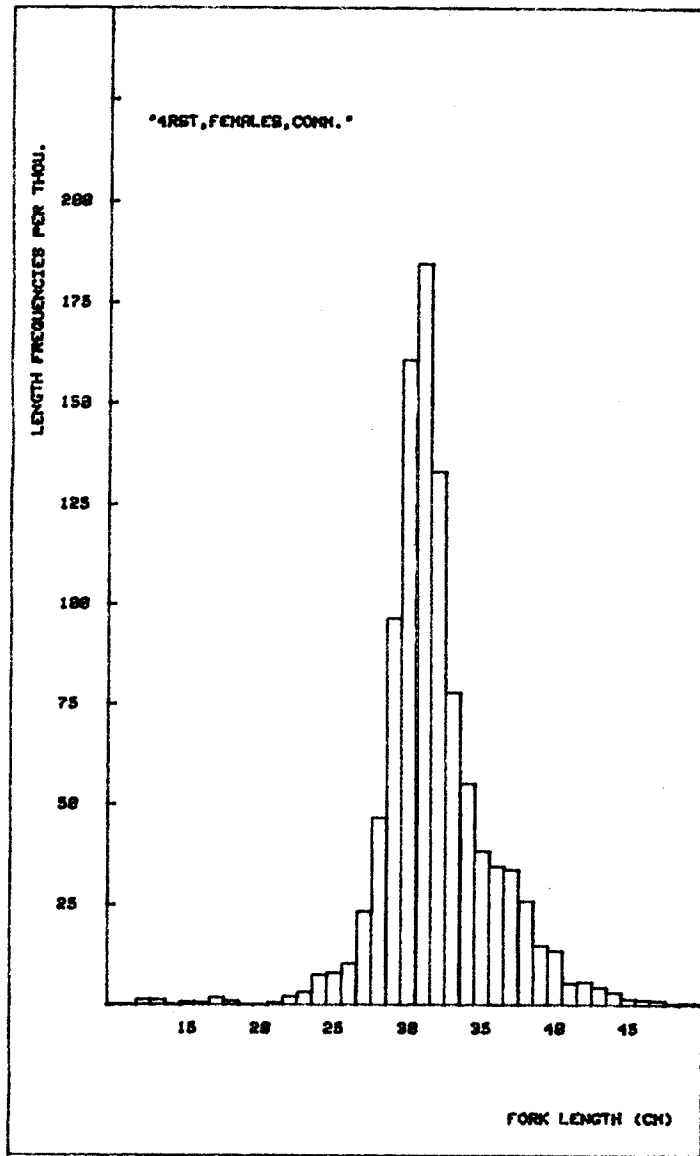
**DIVISION**

|  | 4R | 4S | | 4T |
|---|---|---|---|---|
| GEAR | OTB | ST | OTB | OTB |

| | 4R OTB | 4S ST | 4S OTB | 4T OTB |
|---|---|---|---|---|
| January | S-CW | | S-CW | |
| February | CW | | CW | |
| March | S-CW | | CW | CW |
| April | S-CW | CW | | S-CW |
| May | S-CW | S-CW | CW | S-CW |
| June | S-CW | S-CW | S-CW | |
| July | S-CW | S-CW | S-CW | S-CW |
| August | S-CW | S-CW | S-CW | S-CW |
| September | S-CW | S-CW | S-CW | S-CW |
| October | S-CW | S-CW | S-CW | S-CW |
| November | CW | S-CW | S-CW | CW |
| December | S-CW | | CW | |

| OTHERS TOT.CW 4R | ST TOT.CW 4R | OTB TOT.CW 4R | OTHERS TOT.CW 4S | ST TOT.CW 4S | OTB TOT.CW 4S | OTHERS TOT.CW 4T | ST TOT.CW 4T | OTB TOT.CW 4T |
|---|---|---|---|---|---|---|---|---|

| TOTAL CW 4R | TOTAL CW 4S | TOTAL CW 4T |
|---|---|---|

**TOTAL CW ALL DIVISIONS**

YEARLY LENGTH FREQUENCY FOR EACH SEX

/...26

"4RST,FEMALES,COMM."

LENGTH FREQUENCIES PER THOU.

"4RST,MALES,COMM."

LENGTH FREQUENCIES PER THOU.

FORK LENGTH (CM)

FORK LENGTH (CM)

Figure 3.   4RST redfish yearly length frequencies from commercial sampling for 1983.

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DIRECTION GENERALE DES PECHES MARITIMES DU QUEBEC

FICHE DE PECHE - CHALUTIERS DE   30 A 40 M .

CES RESULTATS NE PEUVENT LIRE UTILISES
POUR D'AUTRES FINS QUE LA PECHE SANS
L'AUTORISATION DE LA D.G.P.M. DU QUEBEC

Figure 4.  Percent distribution of Quebec redfish fishery during 1983, based on
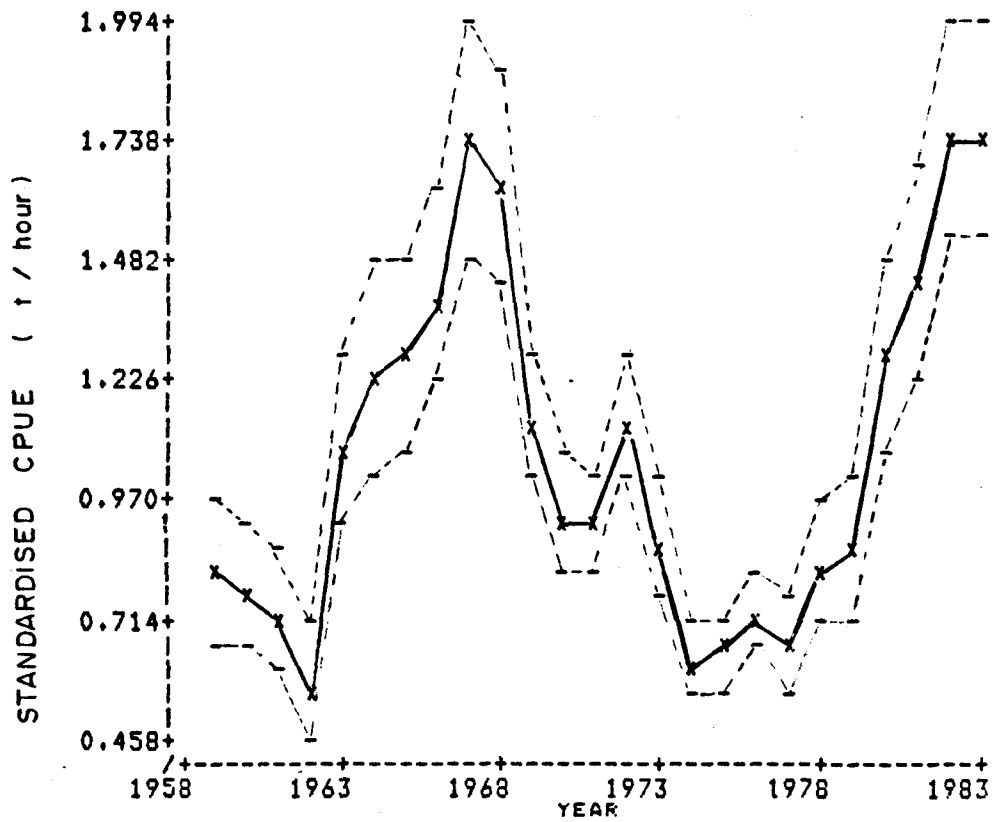4,759 fishing hours from June-October
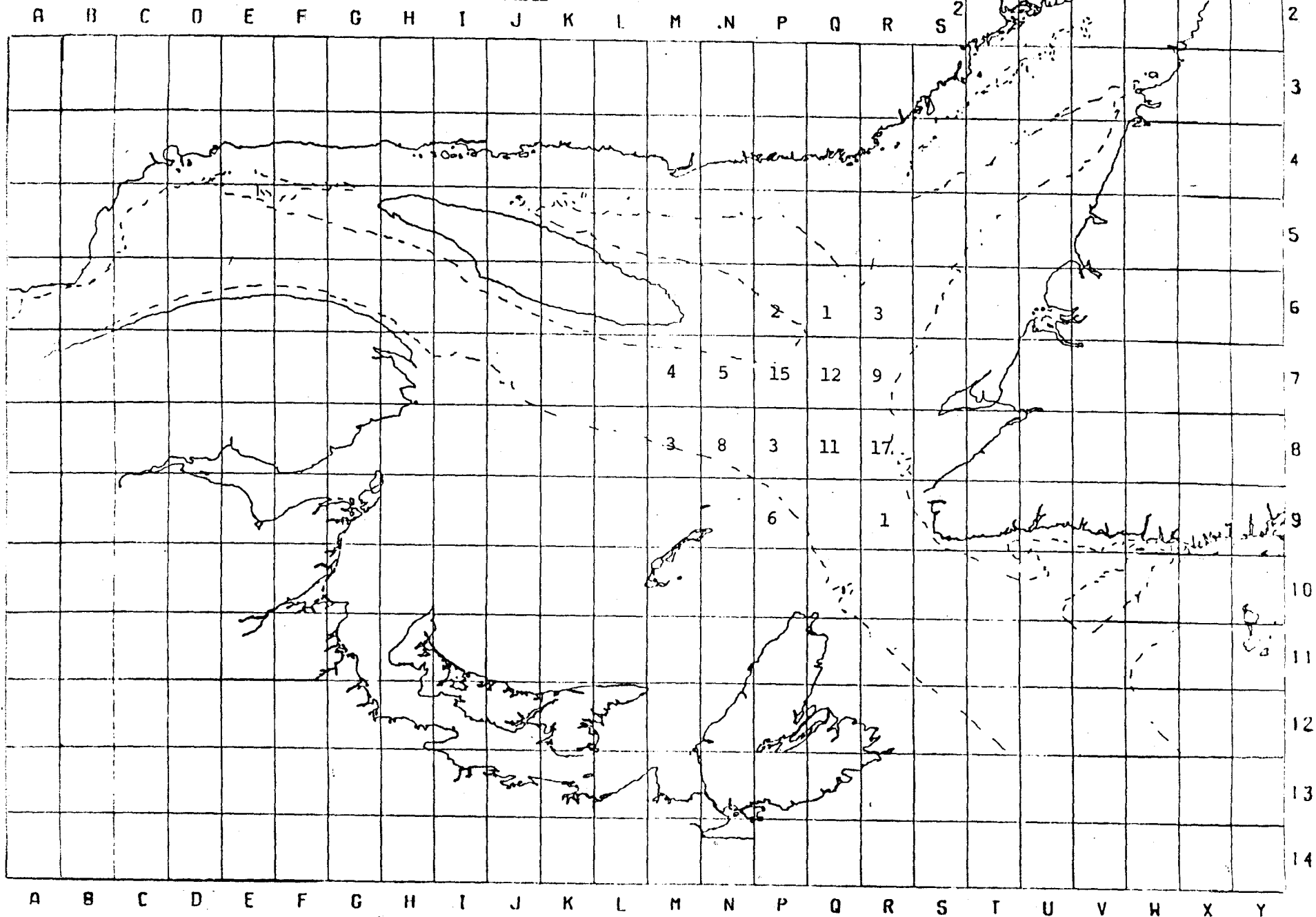
Figure 5.  4RST redfish standardized CPUE for 1959-1983
with approximate 90% confidence intervals.